Atlantic States Marine Fisheries Commission

Northern Shrimp Advisory Panel Meeting

November 30, 2023
1:00 p.m. - 4:00 p.m.
Portland, Maine

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added a necessary.

1. Welcome/Review Agenda *(G. Libby & C. Tuohy)* 1:00 p.m.
2. Review 2023 Traffic Light Analysis and Technical Committee Report (*K. Drew)* 1:05 p.m.
3. Review Northern Shrimp Management Strategy Evaluation Work Group Discussions *(C. Tuohy)* 2:00 p.m.
4. Formulate Advisory Panel Recommendations on Future Management (*G. Libby)* 3:00 p.m.
5. Other Business/Adjourn 4:00 p.m.

This meeting will be held at the Westin Portland Harborview 157 High Street, Portland, ME 04101

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Northern Shrimp Section**

FROM: **Northern Shrimp Technical Committee**

DATE: **January 13, 2023**

SUBJECT: **Northern Shrimp 2022 Data Update**

Background

In 2021, the Northern Shrimp Section extended the existing moratorium on commercial fishing through 2024. The three-year moratorium was set in response to the continued low levels of biomass and recruitment from the 2021 stock assessment update. This memo presents updated data from the most recent years of fishery independent surveys and environmental indices to keep managers and stakeholders informed about current stock trends.

The Northern Shrimp Technical Committee (NSTC) applied the Strict Traffic Light Approach to a suite of survey and environmental indicators. Fishery-independent survey indices included:

- Atlantic States Marine Fisheries Commission (ASMFC) Summer Survey (total abundance, total biomass, spawning stock biomass, and recruitment)
- Northeast Fisheries Science Center (NEFSC) Fall Survey
- Maine-New Hampshire Spring Inshore Survey

None of these surveys occurred in 2020, due to COVID-19, but all have resumed since then.

Environmental condition indicators included:

- A predation pressure index (PPI) calculated from the NEFSC Fall Survey data
- Spring bottom temperature from the NEFSC survey
- Summer bottom temperature from the ASMFC Summer Survey
- Winter surface temperature from Boothbay Harbor, ME

Two qualitative stock status reference levels were developed for the traffic light approach. For the abundance and biomass indices, being below the 20th percentile of the time series from 1984-2017 indicated an adverse state, and being above the 80th percentile of the time series from 1984-2017 indicated a favorable state. For the environmental indicators, the opposite was true: being below the 20th percentile of the time series from 1984-2017 indicated a favorable state while being above the 80th percentile of the time series indicated an adverse state, as higher temperatures and higher predation pressure have negative consequences for northern shrimp.

Results

The traffic light analysis of 2022 data indicated no improvement in status, with indices of abundance, spawning stock biomass, and recruitment at new time-series lows. Recruitment has been below the 20th percentile of the 1984-2017 reference period in 8 of the last 10 years.

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Recent environmental conditions continue to be unfavorable for Gulf of Maine northern shrimp.

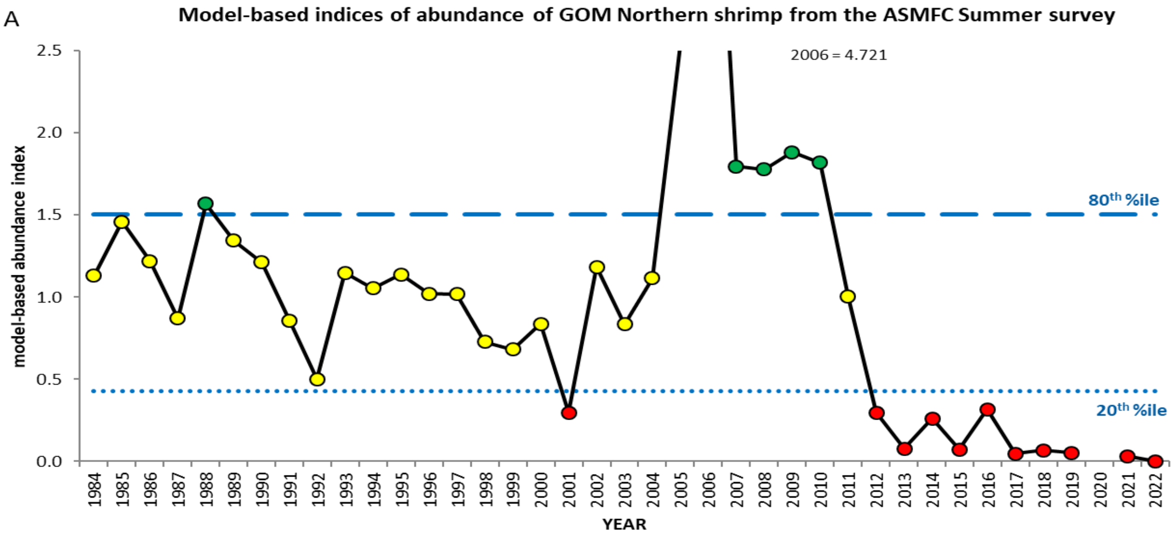
Table 1. Fishery independent indicators (model-based survey indices) for Gulf of Maine northern shrimp traffic light analysis. Colors indicate status relative to reference levels, where: RED = at or below the 20th percentile; YELLOW = between the 20th and 80th percentiles; and GREEN = at or above the 80th percentile of the time series from 1984-2017. White indicates no data.

Survey	**ASMFC Summer**	**NEFSC Fall Albatross**	**NEFSC Fall Bigelow**	**ME-NH Spring**	**ASMFC Summer**			
Indicator	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Biomass	Harvestable Biomass (>22 mm CL)	Spawner Biomass	Recruitment (age ~1.5)
1984	1.130				1.25	0.64	0.63	0.126
1985	1.460				1.70	1.46	0.74	0.250
1986	1.220	0.68			1.59	1.24	0.93	0.233
1987	0.871	0.40			1.08	0.86	0.57	0.197
1988	1.569	0.34			1.40	0.82	0.61	1.008
1989	1.344	0.78			1.53	0.88	0.69	0.255
1990	1.212	0.59			1.63	1.40	0.79	0.102
1991	0.856	0.32			1.01	0.82	0.69	0.350
1992	0.502	0.19			0.59	0.43	0.38	0.140
1993	1.149	1.04			0.84	0.46	0.36	0.750
1994	1.054	1.09			0.92	0.45	0.38	0.354
1995	1.138	0.59			1.18	0.82	0.76	0.253
1996	1.022	0.40			1.13	0.83	0.66	0.321
1997	1.019	0.53			0.92	0.60	0.52	0.515
1998	0.727	0.97			0.71	0.38	0.37	0.200
1999	0.681	1.21			0.73	0.52	0.44	0.200
2000	0.837	0.96			0.77	0.53	0.49	0.462
2001	0.300	0.50			0.34	0.18	0.20	0.036
2002	1.185	0.69			0.86	0.38	0.40	0.910
2003	0.835	0.40		0.51	0.88	0.45	0.52	0.126
2004	1.116	0.88		0.56	1.08	0.89	0.59	0.381
2005	2.540	2.85		1.70	1.97	1.04	0.95	1.236
2006	4.721	3.69		1.94	4.04	1.90	1.94	1.022
2007	1.795	2.41		1.82	1.84	1.21	1.05	0.226
2008	1.778	1.51		2.04	1.83	1.48	0.86	0.524
2009	1.882		4.15	2.18	2.00	1.47	1.16	0.690
2010	1.819		2.87	3.19	1.76	1.01	0.84	0.693
2011	1.004		2.57	2.88	1.07	0.63	0.64	0.280
2012	0.297		0.77	0.84	0.36	0.27	0.25	0.032
2013	0.078		0.20	0.12	0.12	0.12	0.10	0.004
2014	0.260		0.51	0.34	0.20	0.07	0.08	0.186
2015	0.074		0.19	0.14	0.10	0.08	0.08	0.005
2016	0.318		0.14	0.30	0.32	0.19	0.19	0.177
2017	0.048		0.14	0.16	0.07	0.05	0.04	0.001
2018	0.069		0.27	0.09	0.08	0.05	0.05	0.040
2019	0.052		0.17	0.06	0.07	0.05	0.05	0.002
2020								
2021	0.033		0.03	0.11	0.05	0.04	0.04	0.001
2022	0.004			0.02	0.01	0.01	0.01	0.00004
1984-2013 mean	**1.24**	**1.00**	**2.11**	**1.62**	**1.24**	**0.81**	**0.65**	**0.40**
2014-2022 mean	**0.11**	**NA**	**0.21**	**0.15**	**0.11**	**0.07**	**0.07**	**0.05**
80th percentile	**1.50**	**1.16**	**2.69**	**2.07**	**1.66**	**1.10**	**0.81**	**0.59**
20th percentile	**0.43**	**0.40**	**0.17**	**0.27**	**0.50**	**0.34**	**0.31**	**0.13**

Table 2. Environmental condition indicators for Gulf of Maine northern shrimp traffic light analysis. Colors indicate status relative to reference levels, where: RED = at or above the 80th percentile; YELLOW = between the 80th and 20th percentiles; and GREEN = at or below the 20th percentile of the time series from 1984-2017. White indicates no data.

Survey	NEFSC	ASMFC	NEFSC	NEFSC	NEFSC	Boothbay Harbor, ME
Indicator	Predation Pressure Index	Summer Bottom Temp.	Spring Bottom temp. anomaly	Fall Bottom temp. anomaly	Spring Surface temp. anomaly	Feb-Mar Surface temp.
1984	434.3	4.1	0.6	0.8	-0.1	2.9
1985	597.8	4.0	0.1	0.6	0.1	2.8
1986	608.1	6.3	1.2	0.7	0.8	2.6
1987	387.8	6.0	0.0	0.0	-0.6	1.8
1988	503.1	6.5	1.3	-0.1	-0.2	2.7
1989	520.4	5.6	-0.1	-0.3	-0.6	1.9
1990	631.3	3.6	0.2	0.1	0.0	2.6
1991	501.8	6.1	0.5	0.1	0.6	3.4
1992	486.7	6.3	0.6	-0.2	-0.9	3.2
1993	470.1	5.8	-0.8	-0.3	-0.7	1.2
1994	351.9	6.8	0.6	1.3	0.2	1.8
1995	638.5	6.6	0.8	0.5	0.1	3.3
1996	564.8	7.1	1.0	1.1	-0.2	3.3
1997	378.1	6.8	1.4	0.5	0.0	3.7
1998	466.6	6.3	1.3	-0.4	0.5	2.9
1999	738.7	6.1	0.3	0.6	0.9	2.9
2000	813.7	6.7	1.1	0.7	0.9	3.1
2001	723.3	6.5	0.7	0.1	0.4	2.9
2002	1,305.8	7.1	1.3	1.3	1.2	4.1
2003	1,040.8	5.6	-0.2	-0.1	-0.6	2.4
2004	487.8	4.7	-0.8	-1.1	-0.9	3.0
2005	471.3	4.9	0.1	0.5	0.2	3.0
2006	663.5	7.1	1.3	1.2	0.9	5.5
2007	704.7	5.9	0.5	-0.3	0.0	2.0
2008	846.3	5.9	0.5	0.4	1.2	2.3
2009	740.6	6.0	0.4	0.7	0.4	2.6
2010	1,126.5	7.4	0.9	1.7	1.7	4.1
2011	1,150.4	7.7	2.3	1.4	0.9	2.9
2012	1,156.6	7.9	2.0	2.0	1.9	5.5
2013	769.3	7.1	1.3	1.2	1.8	3.9
2014	955.1	6.2	0.5	1.4	0.5	2.2
2015	832.2	5.8	0.1	0.3	0.1	1.4
2016	1,518.4	7.2	1.4	2.0	1.7	4.2
2017	948.2	6.9	1.0	1.3	0.9	3.8
2018	927.2	6.7	1.1	1.3	1.5	4.5
2019	674.4	7.1	1.4	1.4	0.7	3.5
2020						4.6
2021	1255.8	7.6	2.1	3.6	1.9	4.0
2022		7.6	2.5		1.0	3.7
1984-2013 mean	**676.0**	**6.1**	**0.7**	**0.5**	**0.3**	**3.0**
2014-2022 mean	**1,015.9**	**6.9**	**1.3**	**1.6**	**1.0**	**3.6**
20th percentile	**480.5**	**5.7**	**0.1**	**-0.1**	**-0.2**	**2.3**
80th percentile	**950.9**	**7.1**	**1.3**	**1.3**	**0.9**	**3.8**

A



B

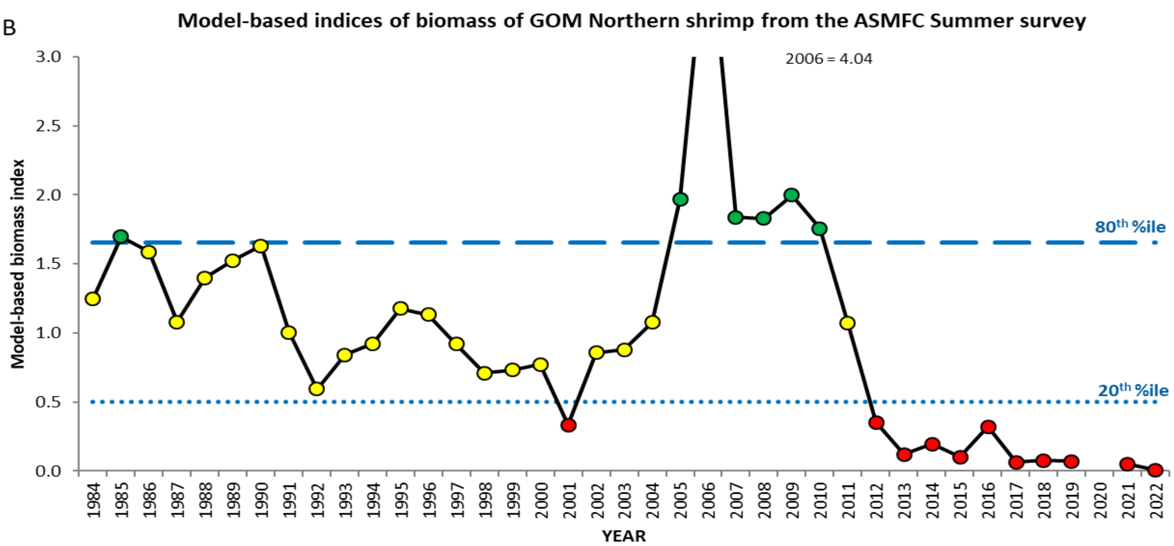


Figure 1. Traffic light analysis for the model-based index of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022 for total abundance (A) and total biomass (B). The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

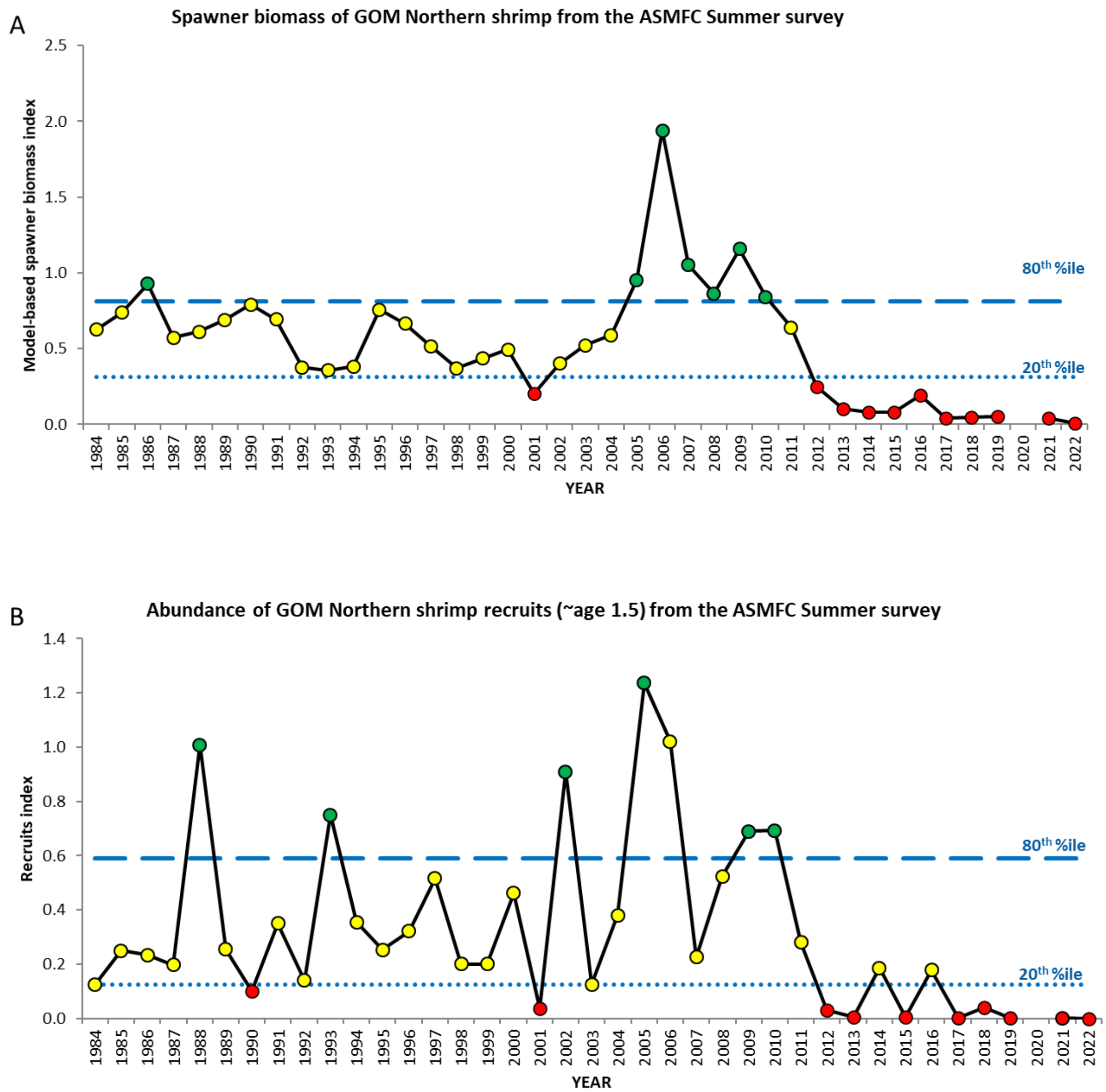
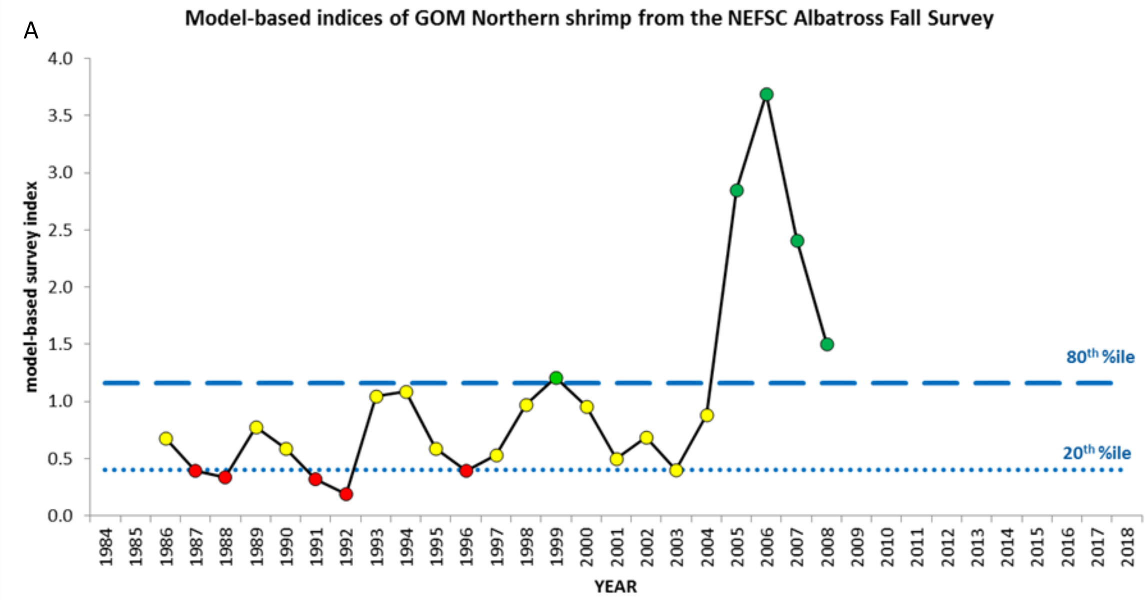


Figure 2. Traffic light analysis of spawning biomass (A) and recruitment (B) of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

A



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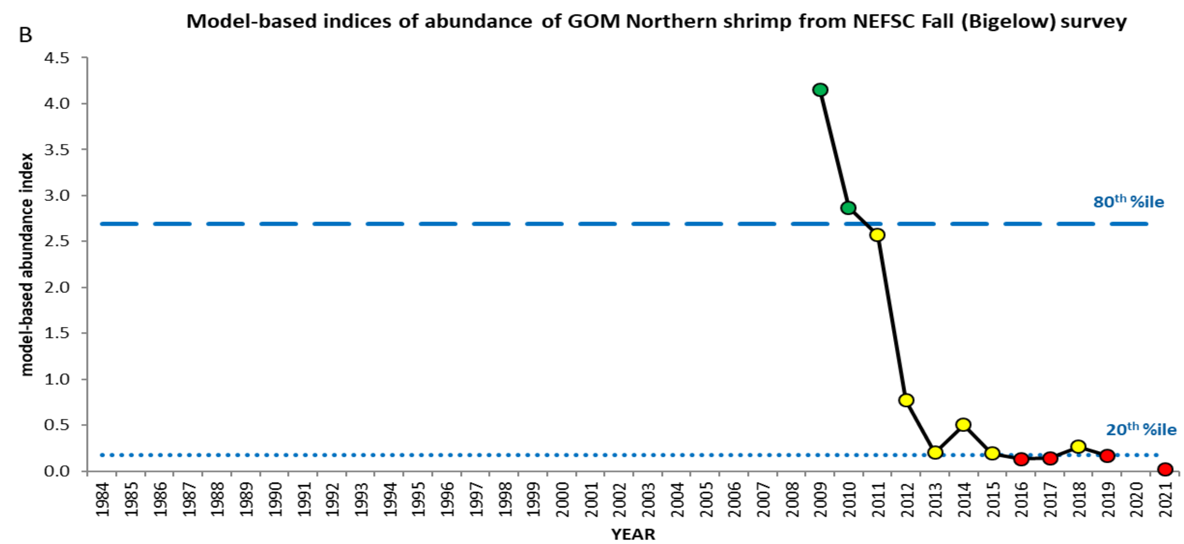

Figure 3. Traffic light analysis of abundance of Gulf of Maine northern shrimp from the NEFSC Fall survey for the Albatross (A) and Bigelow (B) years. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

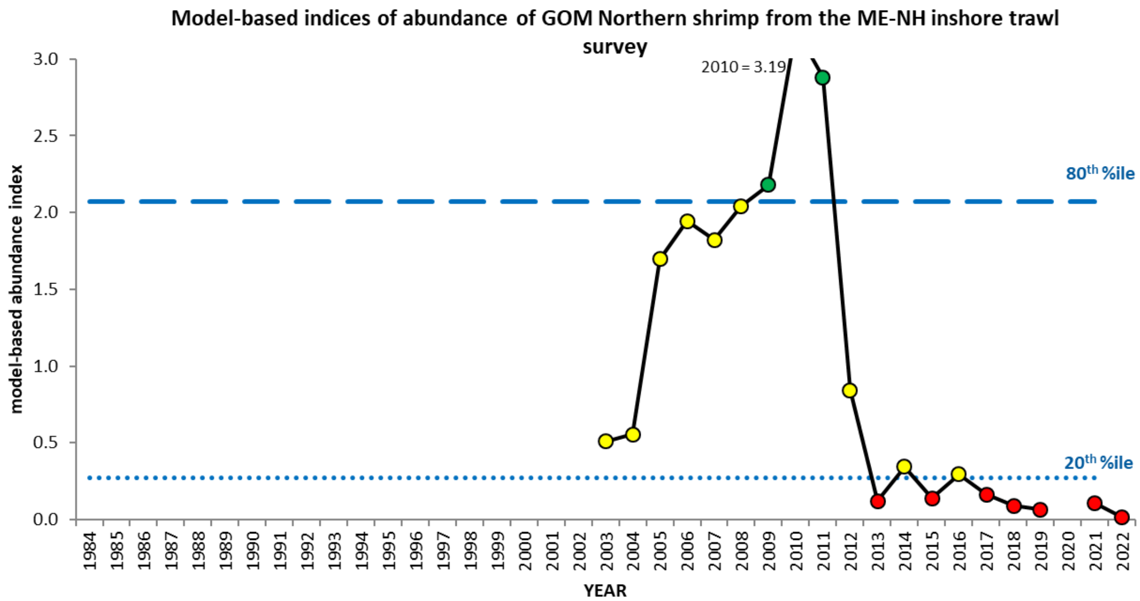

Figure 4. Traffic light analysis of total abundance of Gulf of Maine northern shrimp from the Maine-New Hampshire Inshore Spring survey 2003-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

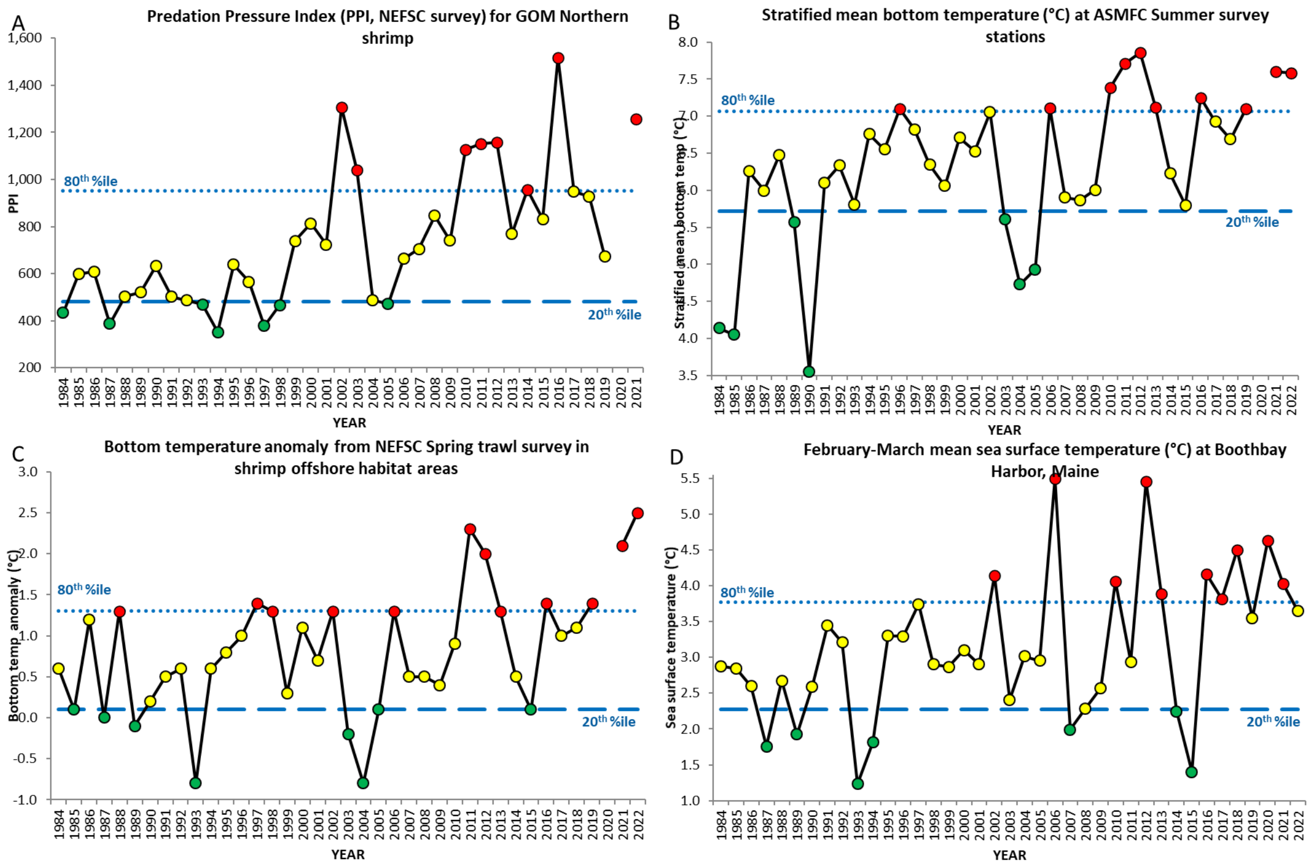

Figure 5. Traffic light analysis of environmental conditions in the Gulf of Maine, including predation pressure (A), summer bottom temperature (B), spring bottom temperature (C), and winter sea surface temperature (D). The 20th percentile of the time series from 1984-2017 delineated a favorable state, and the 80th percentile of the time series from 1984-2017 delineated an adverse state.

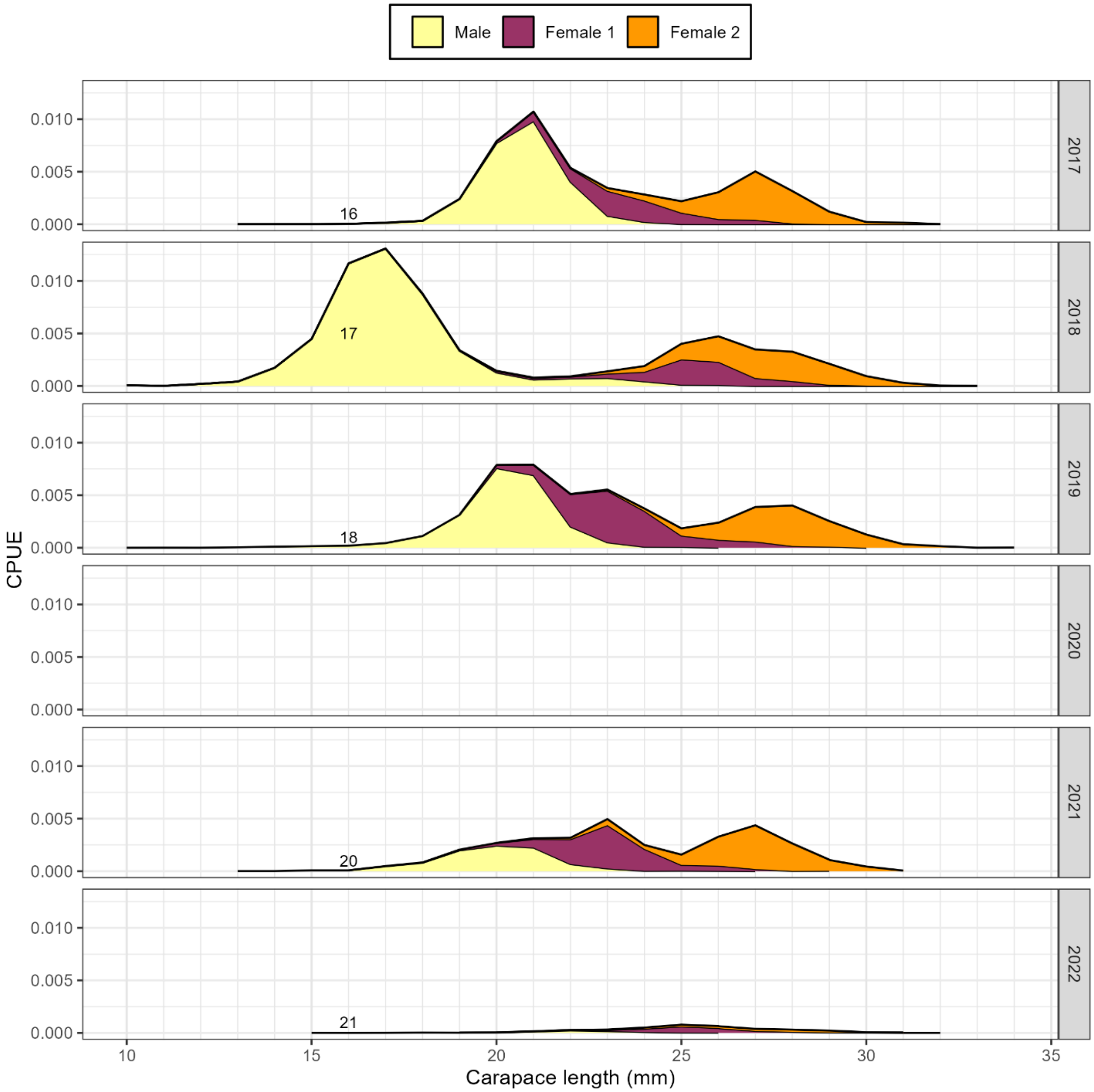

Figure 6. Gulf of Maine northern shrimp abundance from the ASMFC Summer survey by year, length, and development stage for 2017 – 2022 with expanded axes to show detail. Two-digit years are year class at assumed age 1.5.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Northern Shrimp Section**

FROM: **Northern Shrimp Technical Committee**

DATE: **November 17, 2023**

SUBJECT: **Northern Shrimp 2023 Data Update**

Background

In 2021, the Northern Shrimp Section extended the existing moratorium on commercial fishing through 2024. The three-year moratorium was set in response to the continued low levels of biomass and recruitment from the 2021 stock assessment update. This memo presents updated data from the most recent years of fishery independent surveys and environmental indices to keep managers and stakeholders informed about current stock trends.

The Norther Shrimp Technical Committee (NSTC) applied the Strict Traffic Light Approach to a suite of survey and environmental indicators. Fishery-independent survey indices included:

- Atlantic States Marine Fisheries Commission (ASMFC) Summer Survey (total abundance, total biomass, spawning stock biomass, and recruitment)
- Northeast Fisheries Science Center (NEFSC) Fall Survey
- Maine-New Hampshire Spring Inshore Survey

None of these surveys occurred in 2020, due to COVID-19, but all have resumed since then.

Environmental condition indicators included:

- A predation pressure index (PPI) calculated from the NEFSC Fall Survey data
- Spring bottom temperature from the NEFSC survey
- Summer bottom temperature from the ASMFC Summer Survey
- Winter surface temperature from Boothbay Harbor, ME

The PPI and the spring bottom temperature anomaly time series could not be updated in time for this report, as the NSTC does not have access to the NEFSC queries that generate those time series, due to the lack of a NEFSC representative on the NSTC this year. The spring bottom temperature anomaly time series was replaced with the stratified mean spring bottom temperature from the NEFSC survey, which showed a similar historical pattern. The terminal year of the PPI is 2021 for this report.

Two qualitative stock status reference levels were developed for the traffic light approach. For the abundance and biomass indices, being below the 20th percentile of the time series from 1984-2017 indicated an adverse state, and being above the 80th percentile of the time series from 1984-2017 indicated a favorable state. For the environmental indicators, the opposite was true: being below the 20th percentile of the time series from 1984-2017 indicated a favorable

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state while being above the 80th percentile of the time series indicated an adverse state, as higher temperatures and higher predation pressure have negative consequences for northern shrimp.

Results

The traffic light analysis of 2023 data indicated no improvement in status, with indices of abundance, spawning stock biomass, and recruitment at new time-series lows. Recruitment has been below the 20th percentile of the 1984-2017 reference period in 9 of the last 11 years. Recent environmental conditions continue to be unfavorable for Gulf of Maine northern shrimp.

Table 1. Fishery independent indicators (model-based survey indices) for Gulf of Maine northern shrimp traffic light analysis. Colors indicate status relative to reference levels, where: RED = at or below the 20th percentile; YELLOW = between the 20th and 80th percentiles; and GREEN = at or above the 80th percentile of the time series from 1984-2017. White indicates no data.

Survey	ASMFC Summer	NEFSC Fall Albatross	NEFSC Fall Bigelow	ME-NH Spring	ASMFC Summer			
Indicator	Total Abundance	Total Abundance	Total Abundance	Total Abundance	Total Biomass	Harvestable Biomass (>22 mm CL)	Spawner Biomass	Recruitment (age ~1.5)
1984	1.286				1.43	0.73	0.72	0.143
1985	1.398				1.63	1.40	0.71	0.240
1986	1.247	0.68			1.64	1.28	0.96	0.238
1987	0.882	0.40			1.09	0.87	0.58	0.199
1988	1.584	0.34			1.41	0.83	0.62	1.018
1989	1.423	0.78			1.61	0.93	0.73	0.270
1990	1.237	0.59			1.67	1.44	0.81	0.104
1991	0.826	0.32			0.98	0.80	0.68	0.338
1992	0.536	0.19			0.63	0.46	0.40	0.149
1993	1.267	1.04			0.92	0.50	0.39	0.827
1994	1.117	1.09			0.97	0.48	0.40	0.375
1995	1.141	0.59			1.19	0.83	0.77	0.254
1996	1.007	0.40			1.12	0.82	0.66	0.316
1997	1.075	0.53			0.97	0.63	0.55	0.544
1998	0.752	0.97			0.73	0.39	0.38	0.206
1999	0.671	1.21			0.73	0.51	0.43	0.197
2000	0.891	0.96			0.82	0.56	0.52	0.491
2001	0.309	0.50			0.35	0.19	0.21	0.037
2002	1.220	0.69			0.87	0.39	0.41	0.937
2003	0.861	0.40		0.53	0.91	0.47	0.54	0.130
2004	1.119	0.88		0.57	1.09	0.90	0.60	0.382
2005	2.702	2.85		1.78	2.10	1.11	1.02	1.315
2006	4.872	3.69		2.13	4.20	1.98	2.02	1.054
2007	1.867	2.41		1.92	1.91	1.25	1.09	0.235
2008	1.794	1.51		2.13	1.82	1.48	0.86	0.529
2009	1.907		4.62	2.23	2.01	1.47	1.16	0.699
2010	1.689		3.20	3.38	1.63	0.94	0.78	0.643
2011	1.010		2.45	2.99	1.08	0.64	0.65	0.281
2012	0.323		0.88	0.91	0.39	0.30	0.27	0.035
2013	0.089		0.25	0.13	0.14	0.13	0.11	0.005
2014	0.282		0.52	0.37	0.21	0.07	0.09	0.202
2015	0.080		0.21	0.15	0.11	0.09	0.09	0.005
2016	0.314		0.16	0.31	0.32	0.19	0.19	0.175
2017	0.054		0.17	0.18	0.07	0.05	0.05	0.001
2018	0.078		0.31	0.09	0.09	0.06	0.05	0.045
2019	0.054		0.19	0.07	0.08	0.06	0.06	0.002
2020								
2021	0.034		0.03	0.12	0.05	0.04	0.04	0.002
2022	0.005		0.01	0.02	0.01	0.01	0.01	0.00005
2023	0.001			0.01	0.00	0.00	0.00	0.00000
1984-2013 mean	**1.27**	**1.00**	**2.28**	**1.70**	**1.27**	**0.82**	**0.67**	**0.41**
2014-2023 mean	**0.10**	**NA**	**0.20**	**0.15**	**0.10**	**0.06**	**0.06**	**0.05**
80th percentile (1984-2017)	**1.49**	**1.16**	**2.75**	**2.15**	**1.64**	**1.16**	**0.79**	**0.58**
20th percentile (1984-2017)	**0.45**	**0.40**	**0.20**	**0.28**	**0.54**	**0.35**	**0.34**	**0.14**

Table 2. Environmental condition indicators for Gulf of Maine northern shrimp traffic light analysis. Colors indicate status relative to reference levels, where: RED = at or above the 80th percentile; YELLOW = between the 80th and 20th percentiles; and GREEN = at or below the 20th percentile of the time series from 1984-2017. White indicates no data.

Survey	NEFSC	ASMFC	NEFSC	Boothbay Harbor, ME
Indicator	Predation Pressure Index	Summer Bottom Temp.	Spring Bottom Temp.	Feb-Mar Surface temp.
1984	434.3	4.1	5.7	2.9
1985	597.8	4.0	5.2	2.8
1986	608.1	6.3	6.1	2.6
1987	387.8	6.0	5.1	1.8
1988	503.1	6.5	5.7	2.7
1989	520.4	5.6	4.9	1.9
1990	631.3	3.6	4.1	2.6
1991	501.8	6.1	5.6	3.4
1992	486.7	6.3	5.7	3.2
1993	470.1	5.8	4.4	1.2
1994	351.9	6.8	5.4	1.8
1995	638.5	6.6	5.9	3.3
1996	564.8	7.1	6.2	3.3
1997	378.1	6.8	6.1	3.7
1998	466.6	6.3	6.1	2.9
1999	738.7	6.1	5.7	2.9
2000	813.7	6.7	6.2	3.1
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2002	1,305.8	7.1	6.4	4.1
2003	1,040.8	5.6	4.9	2.4
2004	487.8	4.7	4.3	3.0
2005	471.3	4.9	5.1	3.0
2006	663.5	7.1	6.4	5.5
2007	704.7	5.9	5.4	2.0
2008	846.3	5.9	6.0	2.3
2009	740.6	6.0	5.5	2.6
2010	1,126.5	7.4	6.0	4.1
2011	1,150.4	7.7	7.4	2.9
2012	1,156.6	7.9	7.2	5.5
2013	769.3	7.1	6.4	3.9
2014	955.1	6.2	5.8	2.2
2015	832.2	5.8	5.2	1.4
2016	1,518.4	7.2	6.6	4.2
2017	948.2	6.9	6.1	3.8
2018	927.2	6.7	6.1	4.5
2019	674.4	7.1	6.6	3.5
2020				4.6
2021	1255.8	7.6	7.2	4.0
2022		7.6	7.1	3.7
2023		7.6		4.6
1984-2013 mean	**676.0**	**6.1**	**5.7**	**3.0**
2014-2021 mean	**1,015.9**	**6.9**	**6.3**	**3.6**
20th percentile (1984-2017)	**480.5**	**5.7**	**5.2**	**2.3**
80th percentile (1984-2017)	**950.9**	**7.1**	**6.2**	**3.8**

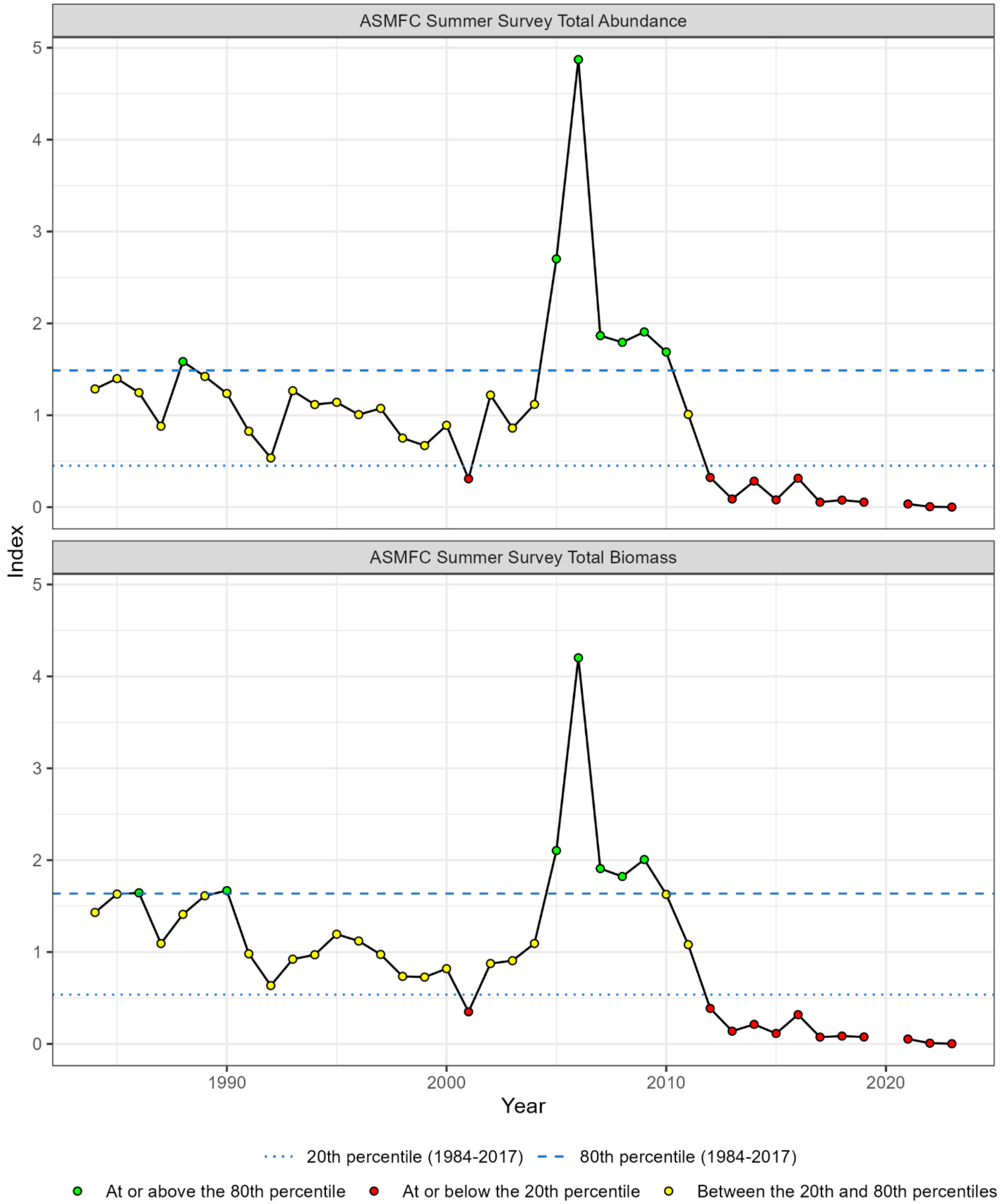

Figure 1. Traffic light analysis for the model-based index of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022 for total abundance (top) and total biomass (bottom). The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

Figure 2. Traffic light analysis of recruitment (top) and spawning biomass (bottom) of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

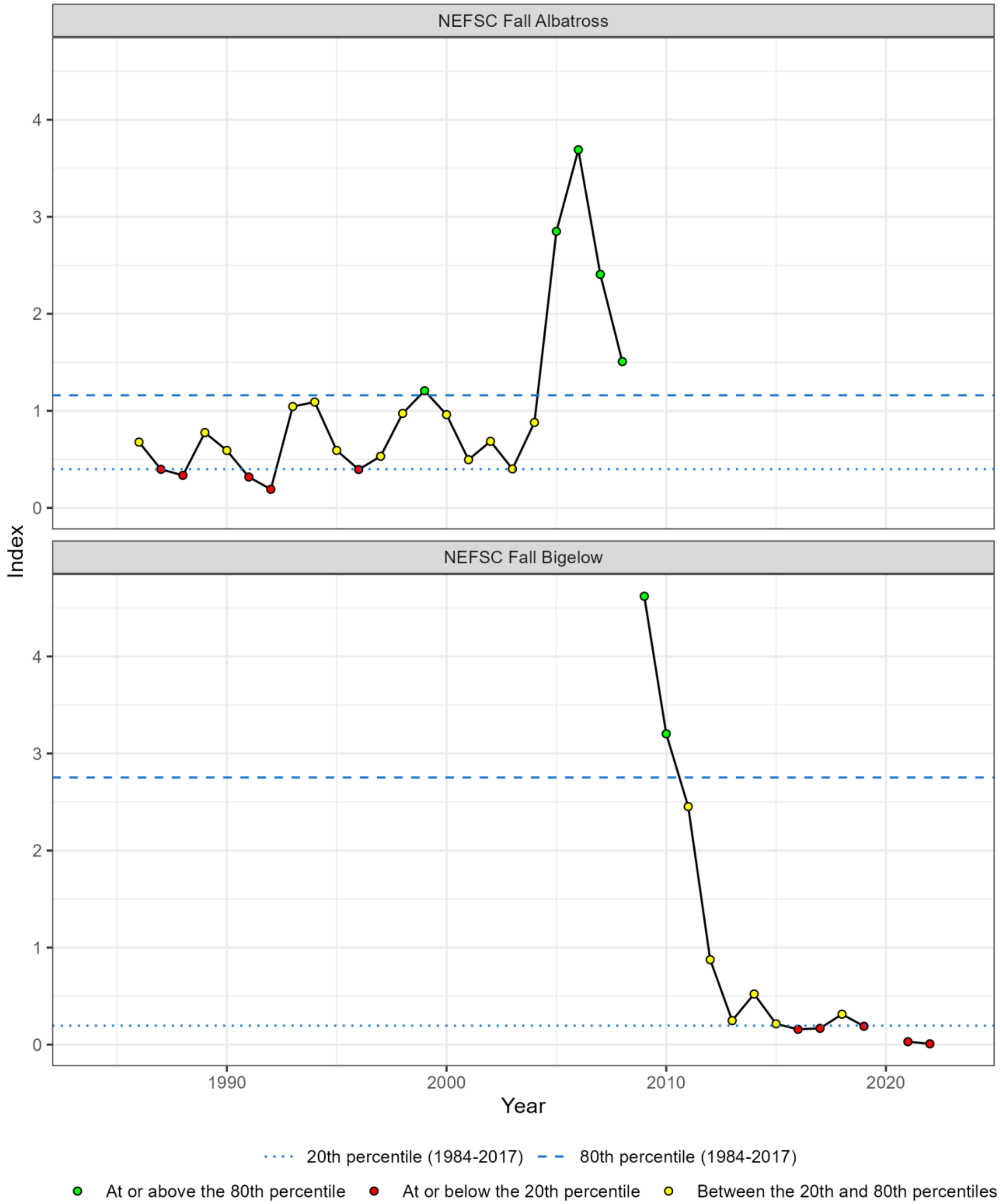

Figure 3. Traffic light analysis of abundance of Gulf of Maine northern shrimp from the NEFSC Fall survey for the Albatross (top) and Bigelow (bottom) years. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

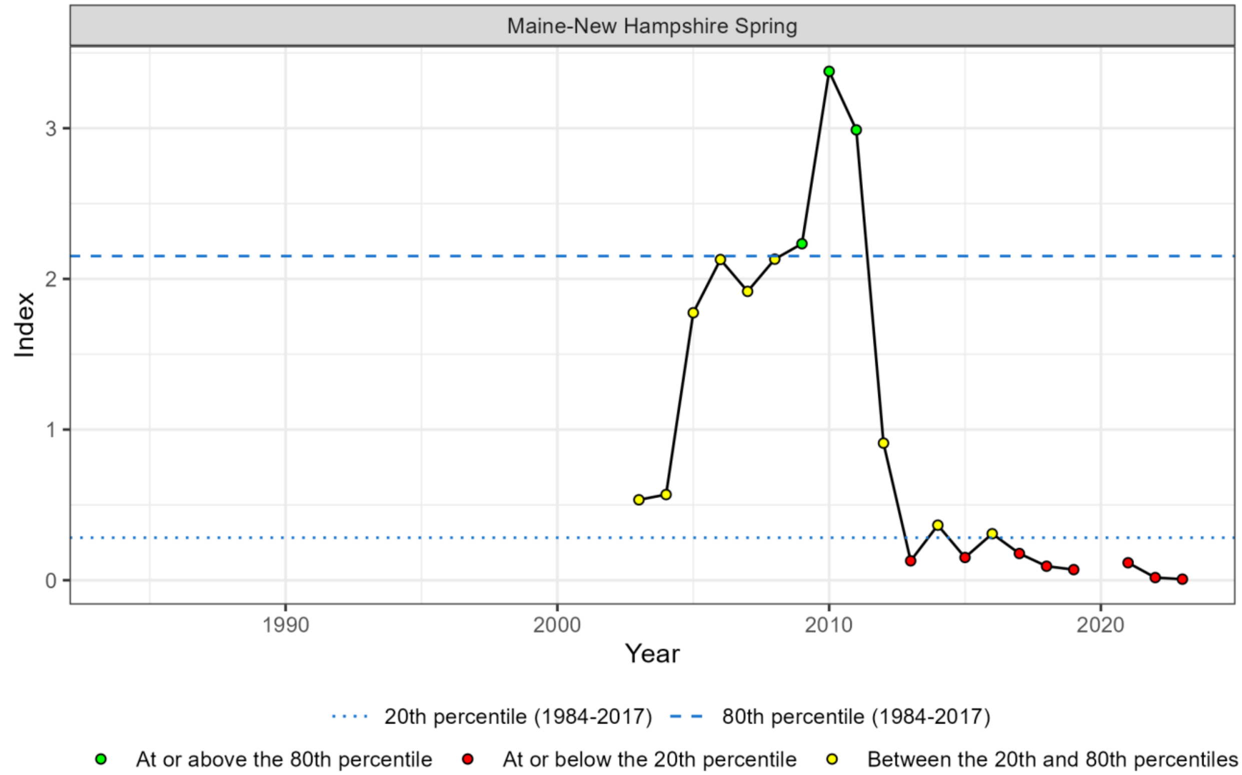

Figure 4. Traffic light analysis of total abundance of Gulf of Maine northern shrimp from the Maine-New Hampshire Inshore Spring survey 2003-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.

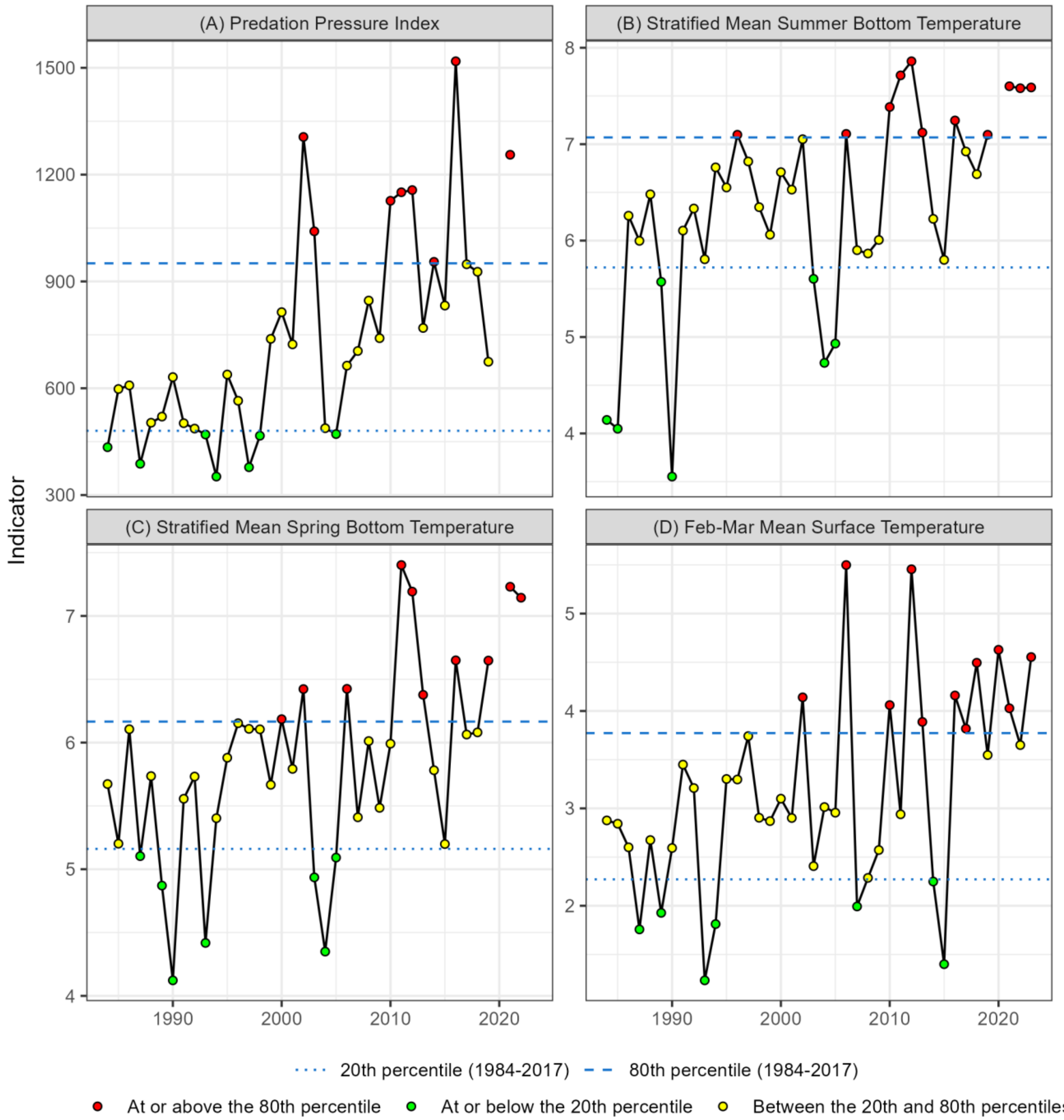

Figure 5. Traffic light analysis of environmental conditions in the Gulf of Maine, including predation pressure (A), summer bottom temperature from the ASMFC Summer survey (B), spring bottom temperature from the NEFSC Spring survey shrimp strata (C), and winter sea surface temperature from Boothbay Harbor (D). The 20th percentile of the time series from 1984-2017 delineated a favorable state, and the 80th percentile of the time series from 1984-2017 delineated an adverse state.

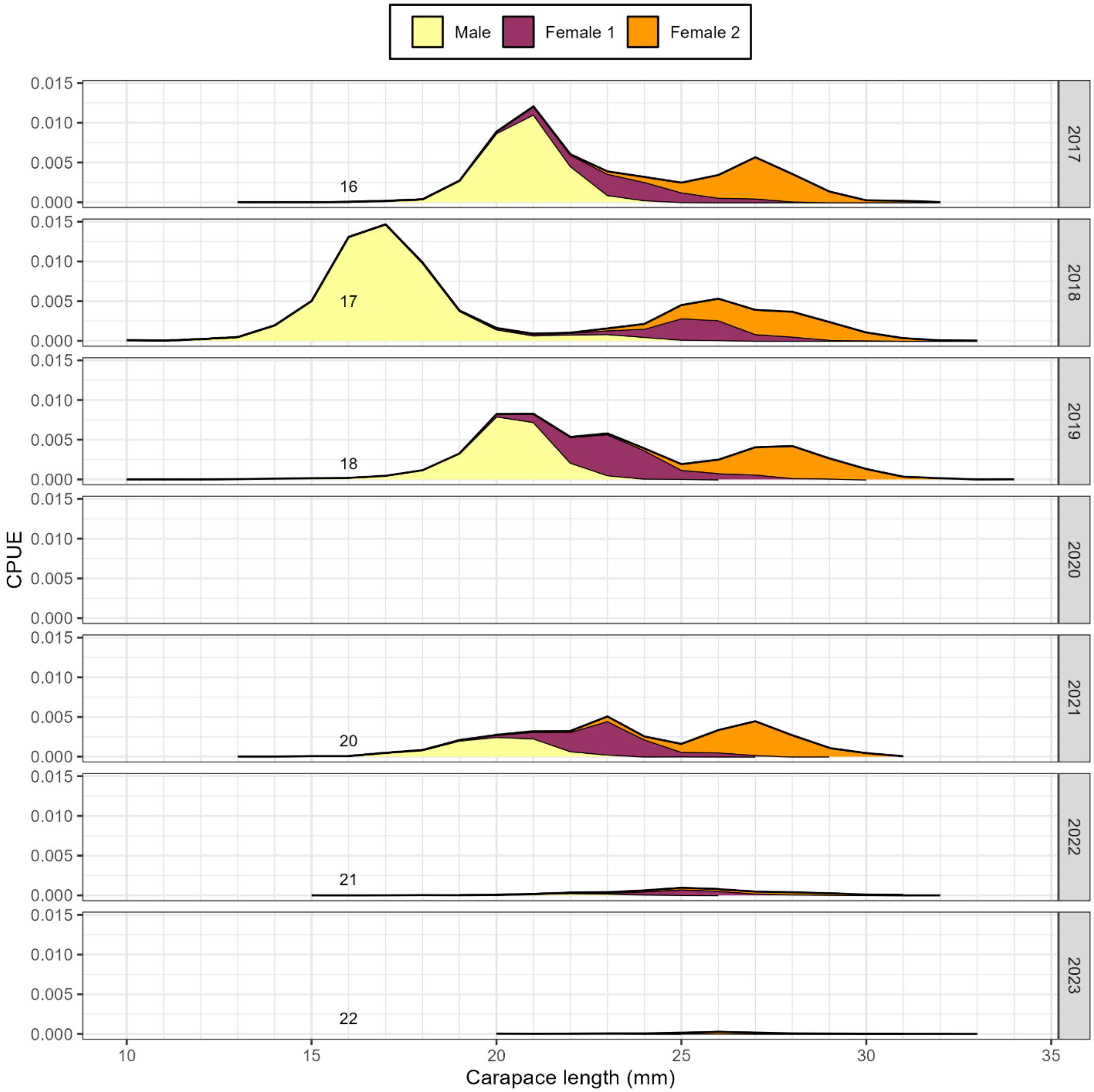

Figure 6. Gulf of Maine northern shrimp abundance from the ASMFC Summer survey by year, length, and development stage for 2017 – 2023. Two-digit years are year class at assumed age 1.5.

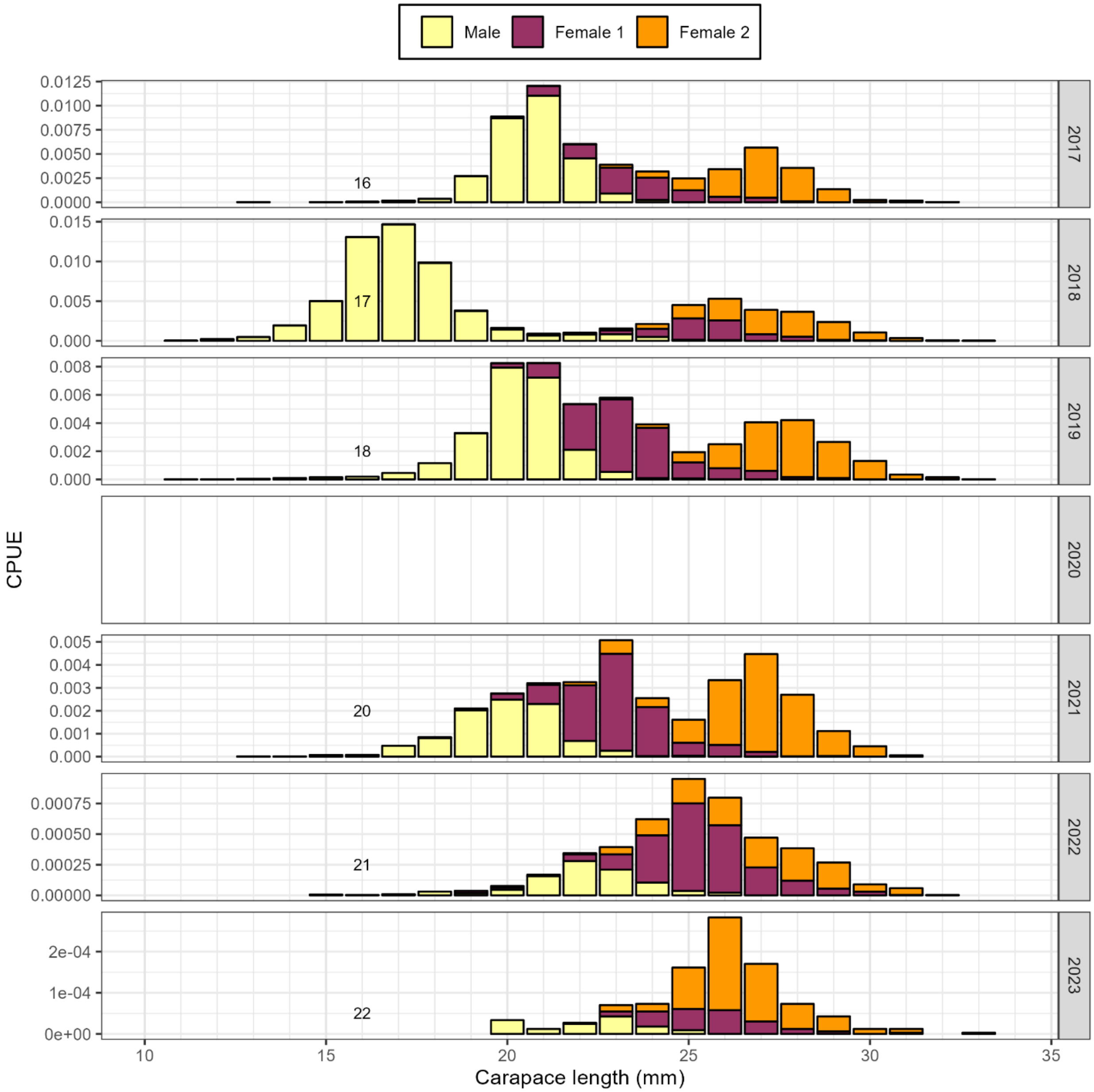

Figure 7. Gulf of Maine northern shrimp abundance from the ASMFC Summer survey by year, length, and development stage for 2017 – 2023 with different y-axes to show detail; note difference in scale from year to year.

Potential Effects of Eliminating the ASMFC Summer Survey on the Northern Shrimp Stock Assessment

April 2022

Introduction

Funding for the ASMFC-NOAA Summer "Shrimp" Survey is in jeopardy, and it is likely that the survey will be eliminated in the next few years. The Summer Survey is the longest time series with the best information on the Gulf of Maine northern shrimp population, but there are other surveys that provide information on northern shrimp, the NEFSC Fall Bottom Trawl Survey and the ME-NH Spring Inshore Trawl Survey, that can support the model in the future. The NEFSC Fall Trawl Survey is currently included in the model, but the data are generally not available for the terminal year of the assessment, as the assessment is run while the survey is taking place. The ME-NH Inshore Survey is not currently included in the assessment, but the spring data would be available for the terminal year of the assessment. All three surveys have shown similar trends over the years, with the exception of a period between 2007-2010 where the Summer Survey and the NEFSC Bottom Trawl Survey were declining and the ME-NH Inshore Trawl Survey was increasing (Figure 1). The ME-NH Trawl Survey peaked in 2010, while the other two surveys peaked in 2006, but after 2010, the ME-NH Trawl Survey declined precipitously and joined the other surveys at time-series lows from 2013-2021.

Note that this report does not address species other than northern shrimp, although several other species assessments use Summer Survey data.

Methods

To look at potential effects of losing information from the Summer Survey in the near term, the Northern Shrimp Technical Committee (NSTC) compared the results from the current northern shrimp stock assessment model that used different configurations of input data that included truncating the Summer Survey from 2018-2021. The scenarios explored were:

1. Base case: all years of Summer Survey (1984-2021) and NEFSC Fall Bottom Trawl (1986-2019)
2. Base case + ME-NH: all years of Summer Survey (1984-2021) and NEFSC Fall Bottom Trawl (1986-2019), plus all years of the ME-NH Spring Inshore Trawl Survey (2003-2021)
3. Shorter Summer Survey: Remove 2018-2021 from the Summer Survey time series, include all years of the NEFSC Fall Bottom Trawl
4. Shorter Summer Survey + ME-NH: Remove 2018-2021 from the Summer Survey time series, include all years of the NEFSC Fall Bottom Trawl and all years of the ME-NH Spring Inshore Trawl Survey
5. No Summer Survey at all + ME-NH: Drop the Summer Survey time series entirely and fit the model with only the NEFSC Fall Bottom Trawl and the ME-NH Spring Inshore Trawl Survey

In addition, the NSTC was interested in looking at the potential impacts of survey changes during a time period of conflicting information in the indices, so a series of runs with a terminal year of 2011 was also conducted. Those scenarios included:

6. Base case, end in 2011: Summer Survey (1984-2011) and NEFSC Fall Bottom Trawl Survey (1986-2010)
7. Base case + ME-NH, end in 2011: Summer Survey (1984-2011), NEFSC Bottom Trawl Survey (1986-2010), and ME-NH Spring Inshore Trawl Survey (2003-2011)
8. Shorter Summer Survey + ME-NH, end in 2011: Remove 2009-2011 from the Summer Survey time series, include all years of the ME-NH Spring and NEFSC Fall surveys

In addition to comparing the model estimates of spawning stock biomass, *F*, and recruitment from the different scenarios, a set of short term projections were run using Scenario 4 (shortened Summer Survey with the ME-NH Spring and NEFSC Fall surveys, terminal year 2021).

Results

Terminal Year 2021 Runs

Overall, losing a few years of the Summer Survey data did not significantly impact the results of the stock assessment. However, without the Summer Survey, the model was more optimistic about the stock trajectory in recent years. The scenario that dropped the Summer Survey entirely was the most optimistic, both historically and in recent years. Without the Summer Survey, population trends were generally similar, but the model estimated a slightly higher SSB and recruitment and lower *F* at the beginning of the time series (although not in all years), and SSB did not decline as significantly as the base model run from 2012-2021 (Figure 2-4). The shortened Summer Survey without the addition of the ME-NH Spring Survey was the most optimistic of the runs that did include the Summer Survey, showing higher recruitment (Figure 2) and a more rapidly increasing trend in SSB (Figure3) from 2018-2021 compared to the base model. Adding the ME-NH Spring Inshore Trawl Survey to the run with the shortened Summer Survey brought those estimates of recruitment and SSB more in line with the estimates of the base run with the full Summer Survey. The 2020 estimate of recruitment for that scenario was still very high compared to the base run and the 2019 and 2021 estimates; however, none of the surveys were conducted in 2020, and that was the second to last year of the time series, so there was very little information to help inform that data point. Estimates of average *F* were very similar across the runs as well (Figure 4).

Terminal Year 2011 Runs

The model struggled to converge somewhat with the terminal year of 2011, but the configurations that did converge showed very similar results across all scenarios, in comparison to the base case with the terminal year of 2011 (Figures 5-7). The base case with the terminal year of 2021 had lower *F* and higher SSB during this time period, the effect of adding more years of data to the model. Although the trend in the ME-NH Spring Inshore Trawl Survey differed from the trend in the other surveys, the additional information from the catch-at-length supported the trend in the other surveys and the model was not strongly influenced by the ME-NH Spring Inshore Trawl Survey trend.

Projections

The scenario with the shortened Summer Survey time series and the ME-NH Spring Inshore Trawl Survey included were more optimistic in the first two years of the projections than the base run (Figures 8-9). This was most likely due to the higher estimates of SSB and recruitment in the most recent few years, especially the high 2020 recruitment value. However, under the recent M and recent recruitment conditions, SSB declined after that and even under zero fishing mortality, the probability of SSB being above SSB in 2021 was very low.

Discussion

While removing the last few years of data from the Summer Survey did not significantly change our perception of stock status in recent years – the stock was still depleted compared to the historical abundance, and SSB in 2021 was still below the 20^{th} percentile of 1984-2017 (Figure 10) – the models were all more optimistic about SSB and recruitment for those years without the Summer Survey data. Including the ME-NH Spring Inshore Trawl Survey with the shortened Summer Survey produced results that were more similar to the base run than to the run with only the shortened Summer Survey and the NEFSC Fall Bottom Trawl Survey. Similarly, projections indicated that under current M and recruitment conditions, even very low or zero fishing pressure will cause the stock to decline in a few years.

The runs with the terminal year of 2011 had more difficulty converging, which may have been due to the difference in trends between the ME-NH Spring Inshore Trawl Survey and the NEFSC Fall Bottom Trawl Survey during this time or may have been due to the pattern in the other indices, which showed a sharp increase followed by a sharp decrease over approximately a single shrimp generation. Adding the 2011 data from the NEFSC Fall Survey was required to get these runs to converge; in a real assessment, those data would not have been available during the usual assessment timeline. This suggests that conflicting data in future years may cause problems with convergence or may require a delay in the assessment timeline to incorporate the NEFSC Fall Bottom Trawl Survey data, but the degree to which that affects the results will depend on how significant the divergence is between the data sources.

The NEFSC Fall Bottom Trawl Survey and the ME-NH Spring Inshore Trawl Survey can still inform the stock assessment model in the absence of the Summer Survey in the near term. However, results should be interpreted cautiously, as they were more optimistic than the results of the model with the Summer Survey. A full simulation study would be necessary to evaluate the degree of this bias and long term consequences of the loss of the Summer Survey.

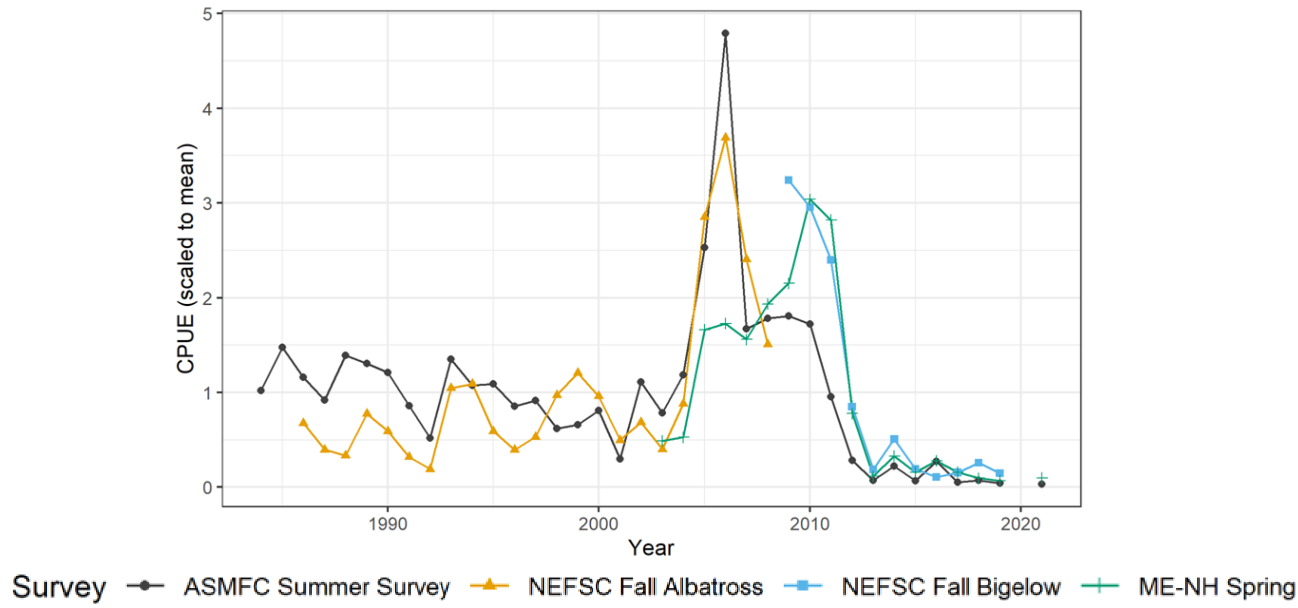

Figure 1. Standardized survey indices of abundance for Gulf of Maine northern shrimp for 1984-2021.

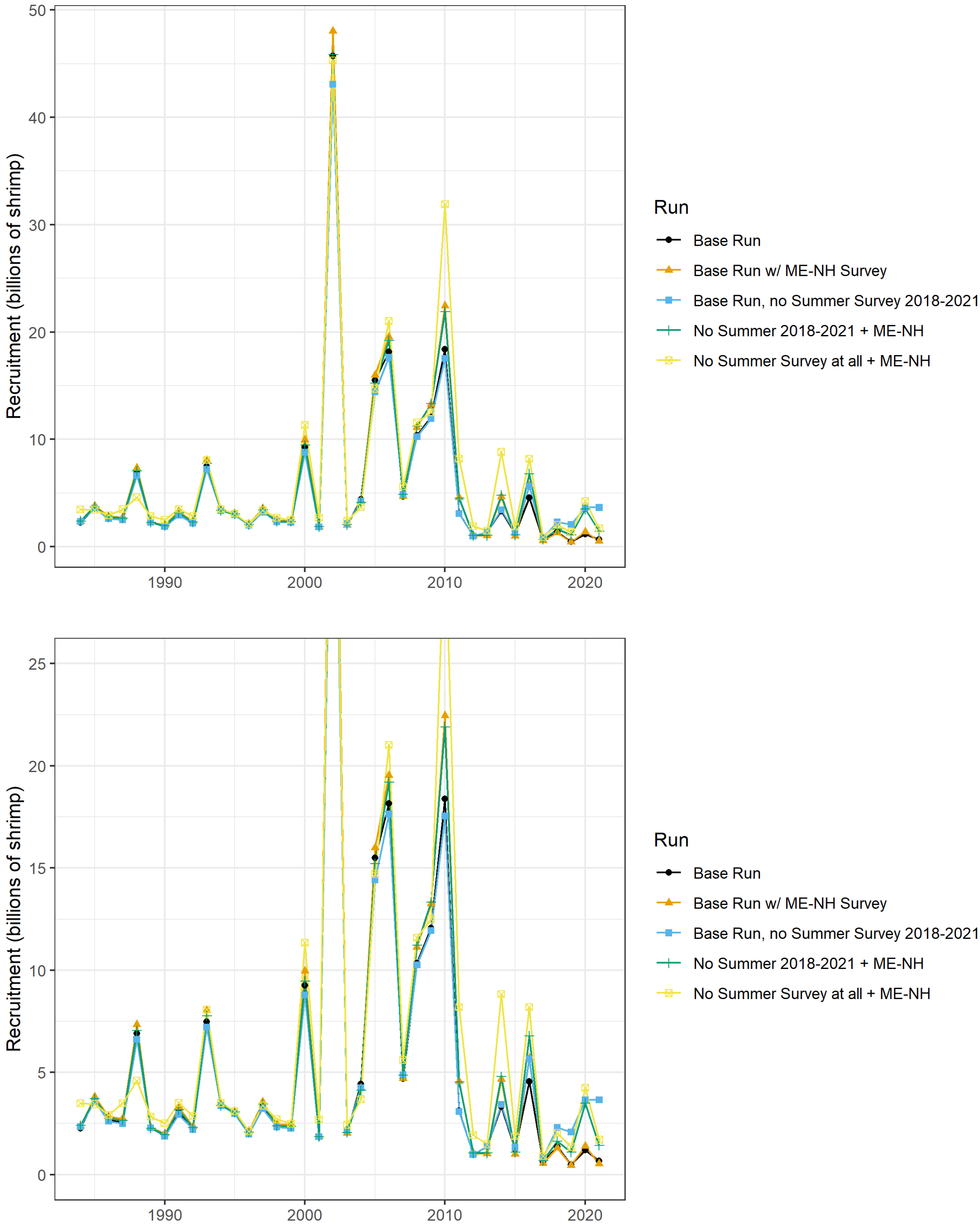

Figure 2. Recruitment estimates under different survey scenarios for the model with a terminal year of 2021. Y-axis has been truncated to show detail in lower figure.

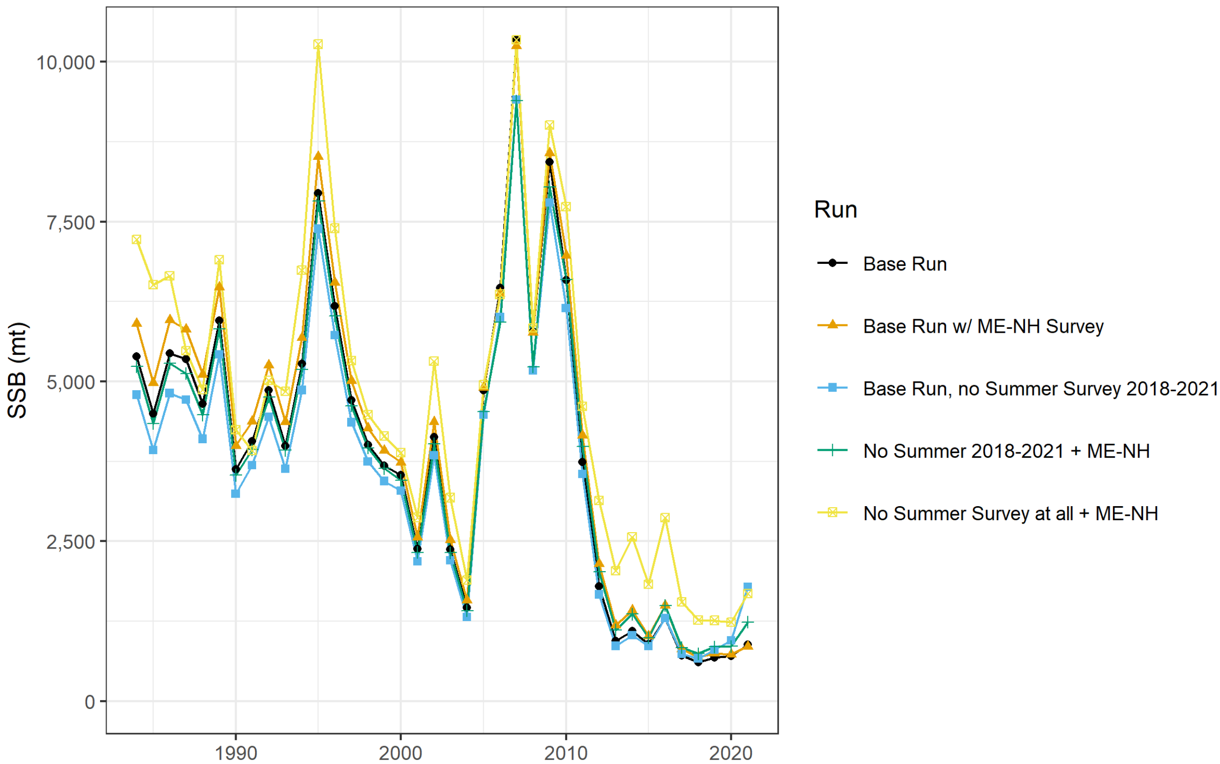

Figure 3. SSB estimates under different survey scenarios for the model with a terminal year of 2021.

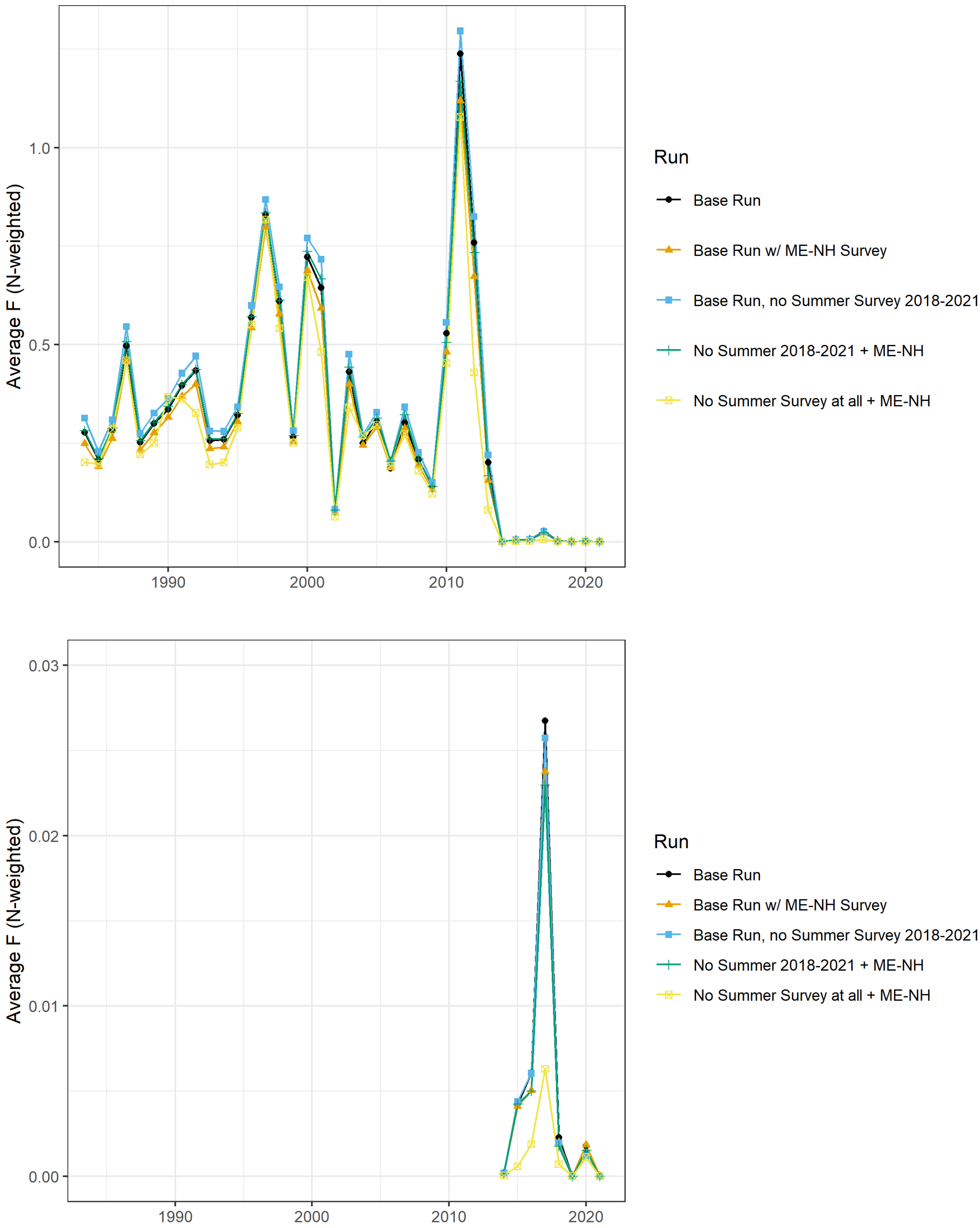

Figure 4. Average *F* estimates under different survey scenarios for the model with a terminal year of 2021. Y-axis has been truncated to show detail in lower figure.

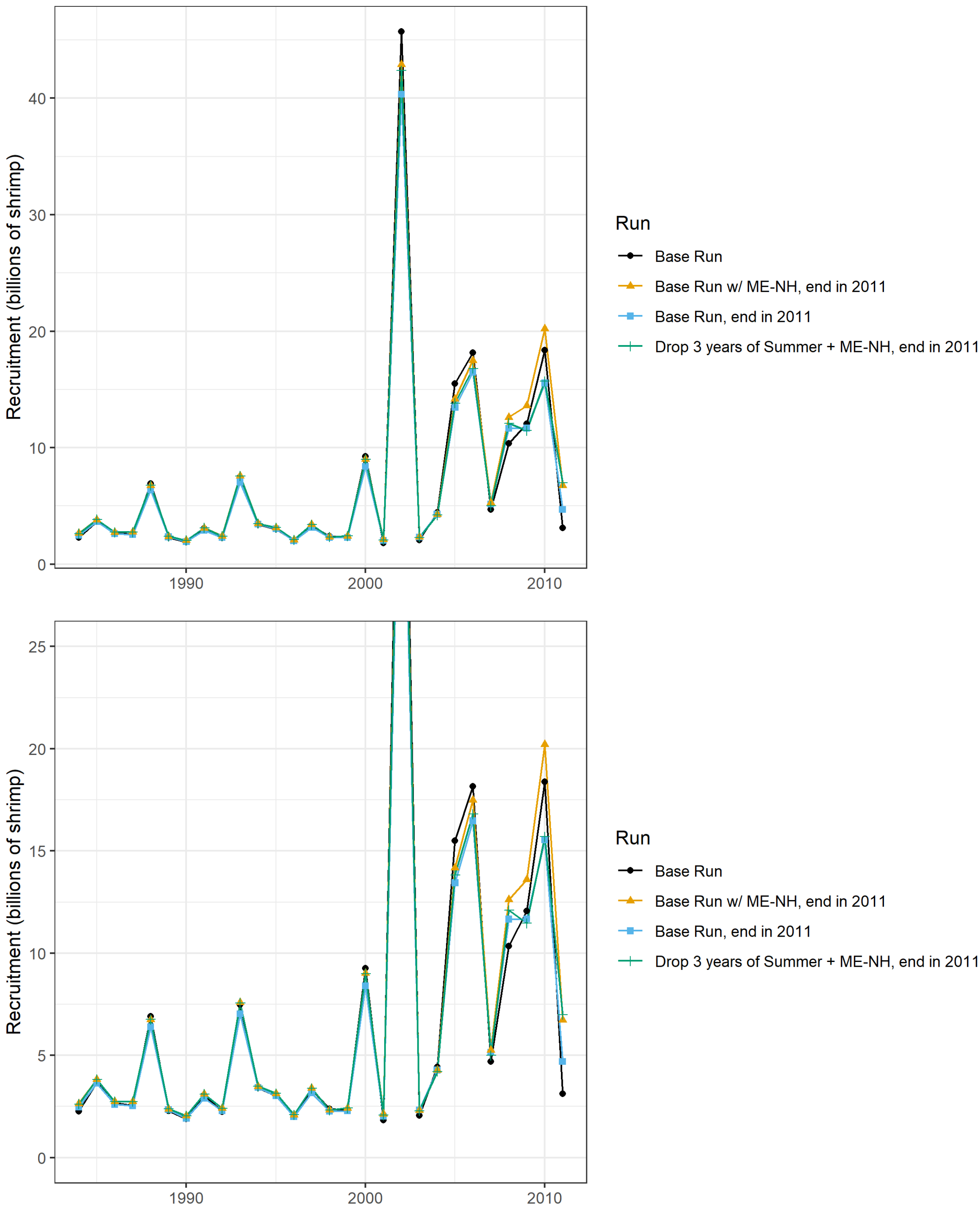

Figure 5. Recruitment estimates under different survey scenarios for the model with a terminal year of 2011. Y-axis has been truncated to show detail in lower figure.

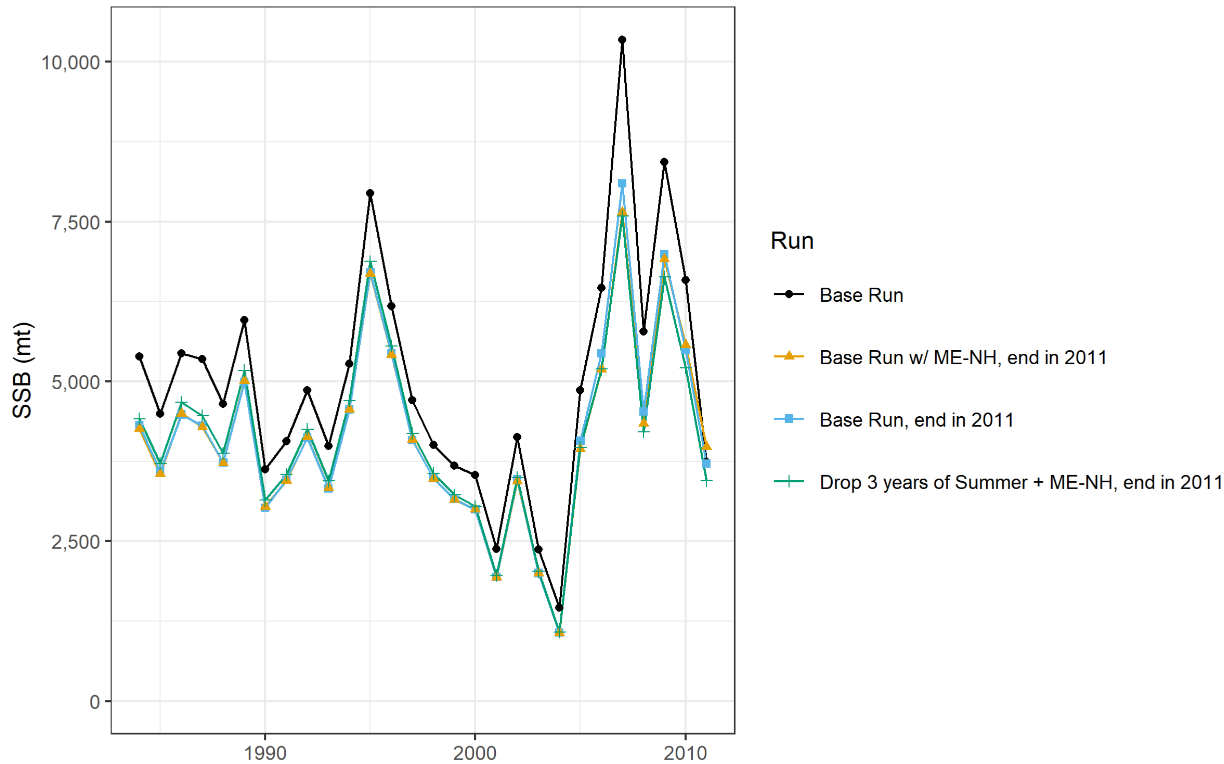

Figure 6. SSB estimates under different survey scenarios for the model with a terminal year of 2011.

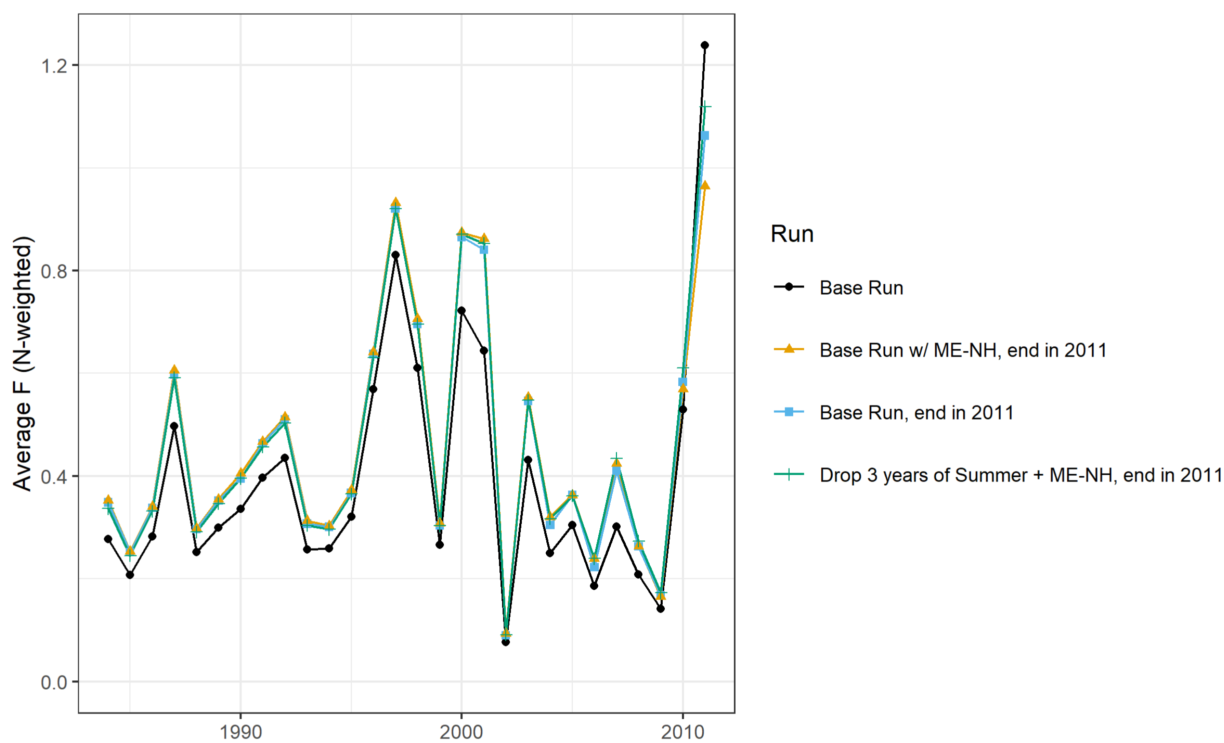

Figure 7. Average *F* estimates under different survey scenarios for the model with a terminal year of 2011.

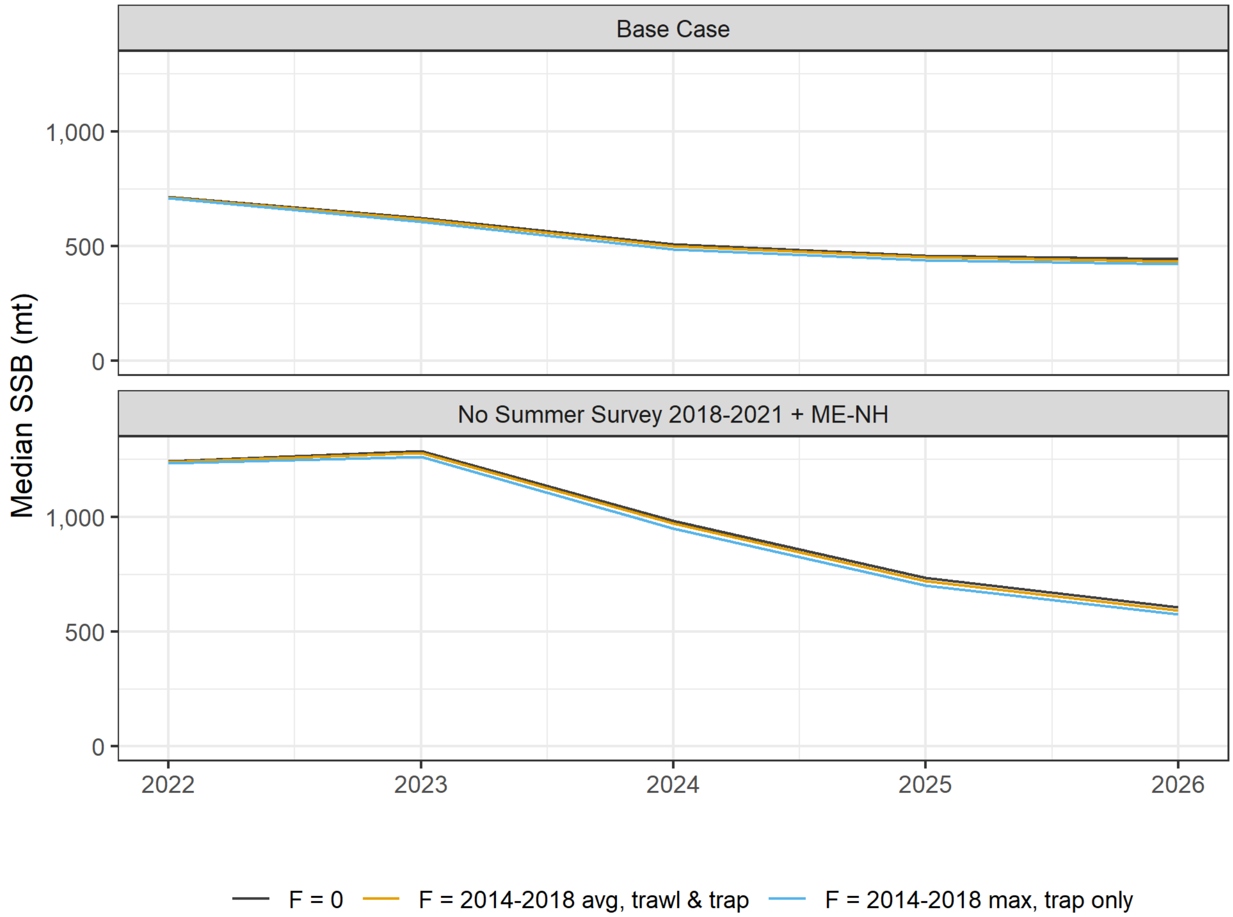

Figure 8. Median projected SSB under recent M and recruitment conditions and varying *F* rates for the base model run (top) and the run with the shortened Summer Survey and the ME-NH Spring and NEFSC Fall surveys (bottom).

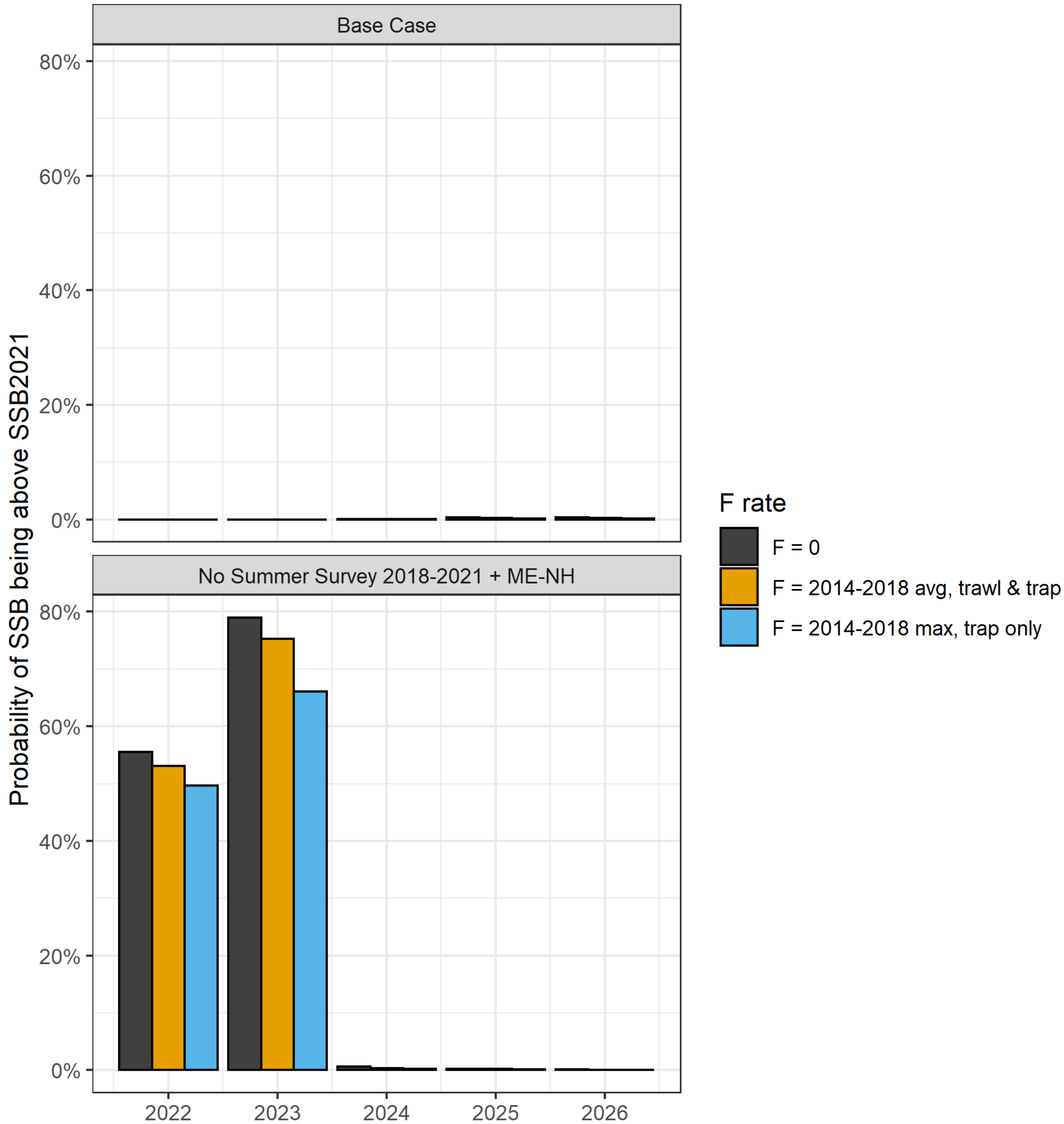

Figure 9. Probability of SSB being above SSB_{2021} under recent M and recruitment conditions and varying *F* rates for the base model run (top) and the run with the shortened Summer Survey and the ME-NH Spring and NEFSC Fall surveys (bottom).

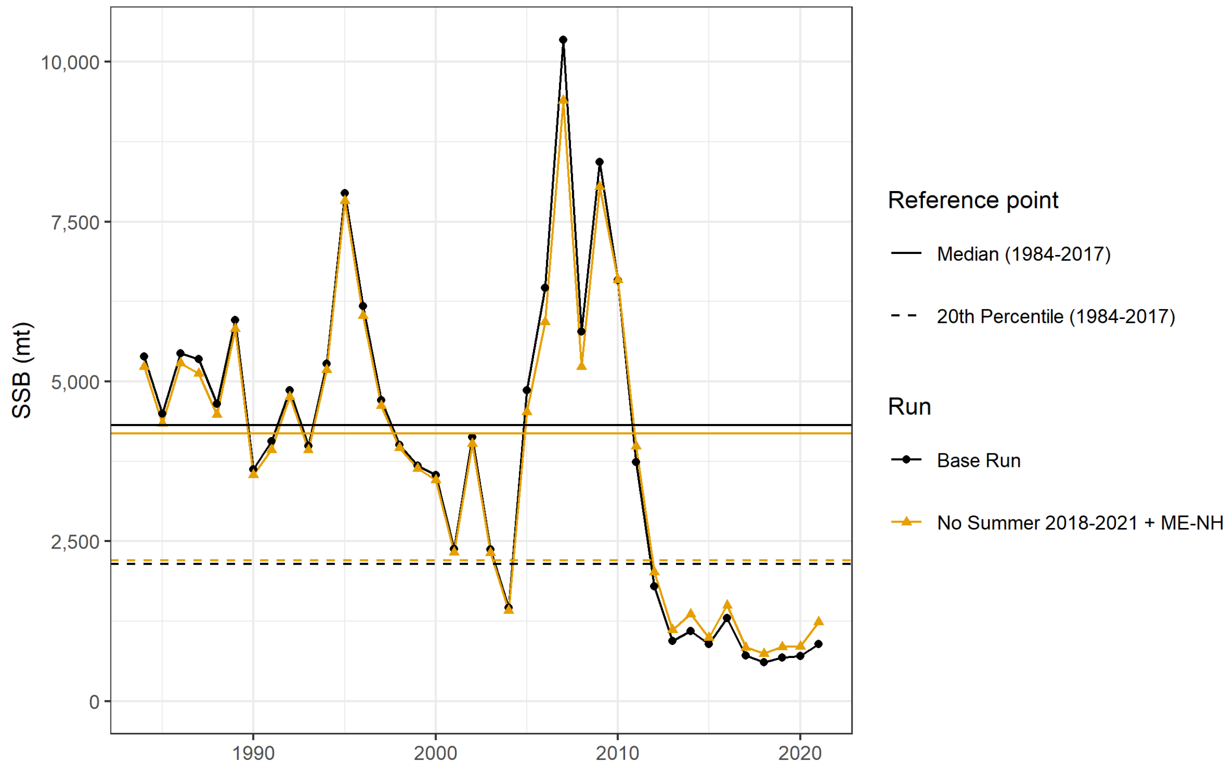

Figure 10. SSB from the base run and the run with the shortened Summer Survey and the ME-NH and NEFSC surveys plotted with the median and 20th percentile of SSB from 1984-2017 for each model.

Northern Shrimp Management Strategy Evaluation Work Group and Technical Committee Meeting Summary

Webinar
April 10, 2023

Work Group Members: Cheri Patterson (Work Group Chair, NH), Melissa Smith (ME), Kelly Whitmore (MA), Jerome Hermsen (NOAA, proxy for Alison Murphy), Toni Kerns (ASMFC Staff), & Chelsea Tuohy (ASMFC Staff)

Technical Committee Members: Alicia Miller (NOAA), Katie Drew (ASMFC Staff), Lulu Bates (ME), Robert Atwood (NH), Tracy Pugh (MA)

Others Present: Adam Lee (ACCSP Staff) & Charles Lynch (NOAA)

The Northern Shrimp Management Strategy Evaluation Work Group (WG) and Northern Shrimp Technical Committee (TC) met on Monday, April 10, 2023 to discuss the TC's 2022 data update and to discuss the potential ramifications of the Atlantic States Marine Fisheries Commission (Commission) relinquishing management control of the Northern Shrimp Fishery Management Plan (FMP).

Stock Assessment Update and Wake-Up Index

Staff began the meeting by presenting a brief overview of the Section's tasks for the WG, previous WG and TC discussions, and a short history of the status of the fishery. Following this presentation, TC members presented the 2022 Traffic Light Analysis results, which found no improvement status for the northern shrimp stock and new time-series lows for abundance, spawning stock biomass, and recruitment indices. Additionally, the TC reported the Northeast Fisheries Science Center (NEFSC) received funding for a 2023 summer survey with a plan to sample 84 stations in 12 strata. However, the group noted that the summer survey's future remains unclear due to a lack of funding moving forward.

Following the stock assessment update, the TC presented work on the Section's task for the WG and TC to "develop a set of biological indicators that could serve as a trigger to indicate when the northern shrimp stock approaches a healthy population level that may be able to support a viable fishery." The TC's response to this task was the development of the wake-up index. This index was created under the idea that the northern shrimp fishery would be placed in a permanent moratorium with annual evaluations of the index. If the index were to indicate stock recovery, it would trigger the TC and Section to take additional steps to evaluate the possibility of opening the fishery.

For the wake-up index, the TC proposed three consecutive years of non-failed recruitment would prompt a reevaluation of stock health. Non-failed recruitment is defined as "a recruitment value above the 20th percentile of the reference period (1984-2017) that also persists through the length frequency in subsequent years". If this index were to be triggered, the TC recommended the next steps be a full assessment update with projections, including the potential for harvest.

One WG member noted the wake-up index was based on data provided by the summer survey and asked the TC how they would proceed in the likely event that the summer survey is discontinued in the future. The TC responded that the wake-up index is currently based on the summer survey because it is the best information available. However, the TC can also develop complimentary triggers that could be used if it is necessary to rely on the Maine-New Hampshire Inshore Spring Survey and the NEFSC Fall Bottom Trawl Survey. While the Maine-New Hampshire Inshore Spring Survey and the NEFSC Fall Bottom Trawl Survey do not provide sex-specific information, they provide length information allowing the TC to track recruitment. That said, the TC would approach the non-failed recruitment above the 20th percentile threshold more cautiously. The TC is seeking guidance from the Section on when these alternative triggers should be developed.

Another WG member agreed with the TC that the wake-up index would be an ideal option moving forward if the Northern Shrimp FMP remains under the Commission's authority, as this index allows for minimal TC and staff time to maintain the FMP until promising signals in the shrimp stock are indicated. The WG recommended the wake-up index be presented to the Section as an option to complete the task of developing triggers to indicate fishery recovery.

Relinquishing Management Control Implications

In previous meetings, the WG discussed what relinquishing management control of the species would look like, and the group was left with questions regarding how the Magnuson–Stevens Fishery Conservation and Management Act (MSA) would apply to the fishery and if the predominant location of the fishery was located in state or federal waters. To help answer the question of the predominant location of the fishery, ACCSP staff presented 2000-2021 landings data. This presentation revealed the predominant location of the fishery is hard to pinpoint due to many contradictory reports between data sources, even with good reporting.

One WG member noted that the years from 2014-2021 should be excluded from an analysis, given the majority of landings from this time were part of a Research Set Aside program and would not be indicative of the true location of the fishery. Other group members supported this statement, and it was decided that ACCSP staff would exclude moratorium years from the analysis and work with state agency staff to clarify as much reporting information as possible. The revised analysis will be provided to the Section before its next meeting. However, the revised analysis will likely still have similar uncertainties. Because the stock has experienced a regime shift since landings stopped occurring it will be difficult to answer the question of where the northern shrimp fishery would primarily occur if the fishery were to rebound.

As the group continued to discuss the ramifications of relinquishing the Northern Shrimp FMP, several members asked if there were any circumstances under which the New England Fishery Management Council (NEFMC) would not assume control of the FMP if the Commission no longer managed the species. This question came up due to the observations that environmental conditions in US waters may no longer be hospitable for the species. Additionally, several members were concerned that if NEFMC were to pick up the FMP, it would be required to implement a rebuilding plan. Members of the WG were skeptical that a rebuilding plan would successfully manage the stock, given the fishery has been in a moratorium for a decade with no improvement. It was noted that this may be unique situation where new reference points and a new normal should be considered for the northern shrimp fishery.

Representatives from NOAA Fisheries noted a case where a rebuilding plan was not implemented when there was low recruitment: the Southern New England/Mid-Atlantic winter flounder fishery. The most recent winter flounder stock assessment set new baselines for the species and categorized them as not overfished and overfishing not occurring under the assumption that low productivity was the new normal. Southern New England lobster represent yet another example that may be helpful in determining how NOAA Fisheries would handle the management of northern shrimp should the

Commission wish to relinquish the FMP. Here, the science advice recognizes the stock is depleted, but overfishing is not happening. Scientists agree that significant management action is required to at least stabilize the stock.

Other comments on the Commission relinquishing management control of the species considered there are many unknowns as to what would happen should NEFMC pick up the FMP. Additional unknowns are added if the Council picked up the FMP and the states open personal use fisheries in state waters. It was noted that, if there was a personal use fishery, preemption might be needed, but this cannot be determined with certainty. What is known, is that if NOAA Fisheries picks up the FMP and there is a moratorium in federal waters but not in state waters, individuals with federal permits would be prohibited from fishing in state waters unless they were to relinquish their federal permits.

Next, the group discussed the merits of keeping management with the Commission. First, the group discussed the Commission's historical knowledge of the fishery, and recognized state staff have been working on this fishery for many years thus are familiar with industry and the resource. Relinquishing the FMP would not initially lighten staff workload but would result in losing Atlantic Coastal Fisheries Cooperative Management Act funding to conduct the work. In a previous meeting, NEFMC staff noted it would take a significant amount of time to have Council staff pick up where the Commission left off. Lastly the group discussed adaptive management. Due to the species' high sensitivity to environmental conditions, the group thought a Commission FMP would allow for states to be more adaptive and responsive to the resource needs in terms of management flexibility. Overall, it was determined, should the Section recommend the Commission to relinquish management control of the FMP, more consultation with NOAA Fisheries is needed to ensure minimal interruptions to management and a smooth transition.

Personal Use Fishery

The WG and TC briefly discussed how the Commission could open a personal-use fishery, a topic that has been explored at previous Section meetings. Current projections indicate the northern shrimp stock will continue to decline under no fishing mortality. The TC would need guidance on how and what the Section considers to be not interfering with the ecosystem services shrimp provide to assess a personal use quota. With this guidance, the TC would perform a management strategy evaluation (MSE) assessment and ecosystem analysis to provide advice on a personal use fishery. A MSE would require a significant level of staff time for Commission, federal, and state staff as well as funding. The wake-up index was developed so the Section and TC could perform basic check-ins with a full assessment needed only when the stock showed promising signs of recovery. The ability of the Commission and states to take a step back from the northern shrimp workload through the wake-up index could likely not be accompanied by the opening of a personal-use fishery.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Northern Shrimp Section**

FROM: **Atlantic Coastal Cooperative Statistics Program, Maine Department of Marine Resources, New Hampshire Fish and Game Department, and Massachusetts Division of Marine Fisheries Data Providers**

DATE: **November 17, 2023**

SUBJECT: **Insights into the Predominant Location of the Northern Shrimp Fishery Pre-Moratorium**

I. Introduction

ACCSP and data representatives from Maine, New Hampshire, and Massachusetts have investigated best available commercial harvest and landings data concerning northern shrimp (*Pandalus borealis*) in order to answer the following question posed by the Northern Shrimp Management Strategy Evaluation Work Group: was the pre-moratorium fishery predominantly located in federal or state waters?

Multiple data sources exist that could potentially answer the question. All data sources represent self-reported data as required by permit-holding entities. Numerous inaccuracies or biases may exist. Additionally, distinct reporting entities, reporting requirements, and data systems mean that discrepancies may exist across datasets.

II. Data Warehouse Landings Profile

Dealer datasets contain the most accurate total poundage of landed product. However, they often do not contain the best available fishing effort information. The ACCSP Data Warehouse was used to profile data, by state, for a census of landings.

From 2003-2013, ~90% of United States harvested northern shrimp were landed in Maine. New Hampshire and Massachusetts accounted for ~8.5% and ~1.5% of landings, respectively. Other states accounted for less than <0.1% and may have recorded landings due to misreporting.

III. State-Specific Area of Capture Profile

III.a Maine

Agency representatives from the Maine Department of Marine Resources (ME DNR) provided their own analysis of shrimp landings by jurisdiction. The analysis was based on harvester reports sourced from ME DMR and National Oceanic and Atmospheric Association, Greater Atlantic Regional Fisheries Office databases. From 2003-2013, 65% of northern shrimp landings in Maine were harvested in Maine state waters, and 35% were harvested in federal waters. In the same time period, 72.5% of trips harvesting northern shrimp fished in state waters while 27.5% of trips fished in federal waters. It should be noted that any erroneous

M23-97

latitude/longitudes (those that fell on land) were removed from the dataset as it could not be accurately determined if these trips occurred in state or federal waters.

III.b New Hampshire and Massachusetts

Agency representatives from the New Hampshire Fish and Game Department (NH FGD) and the Massachusetts Division of Marine Fisheries (MA DMF) supported use of federal vessel trip reporting (VTR) data to characterize area of capture. Federal requirements include latitude and longitude coordinates, area/sub-area code, and Loran. NH FGD performed spatial analysis to create a single standard value from 2004-2013 federal VTR data. Coordinates were converted from degrees, minutes, and seconds to decimal degrees, and when missing, Loran values were converted to decimal degrees. These data were loaded into a geographic information system (GIS), along with a state waters boundary shapefile. Spatial analysis was performed to characterize each effort as occurring in state vs. federal waters. The resulting data set was exported and summarized. The data set did contain misreported coordinates (points on land), and therefore may contain additional instances of misreporting.

From 2003-2013, 7% of trips harvesting northern shrimp occurred in New Hampshire state waters and 10% of trips occurred in Massachusetts state waters.

IV. Determination

Data suggests that the pre-moratorium fishery was predominantly located in state waters. The majority of northern shrimp landings occurred in the state of Maine, and most of the Maine landings were harvested in adjacent state waters. Landings in other states were predominantly from federal waters.