Atlantic States Marine Fisheries Commission

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
2001	723.3	6.5	5.8	2.9
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**
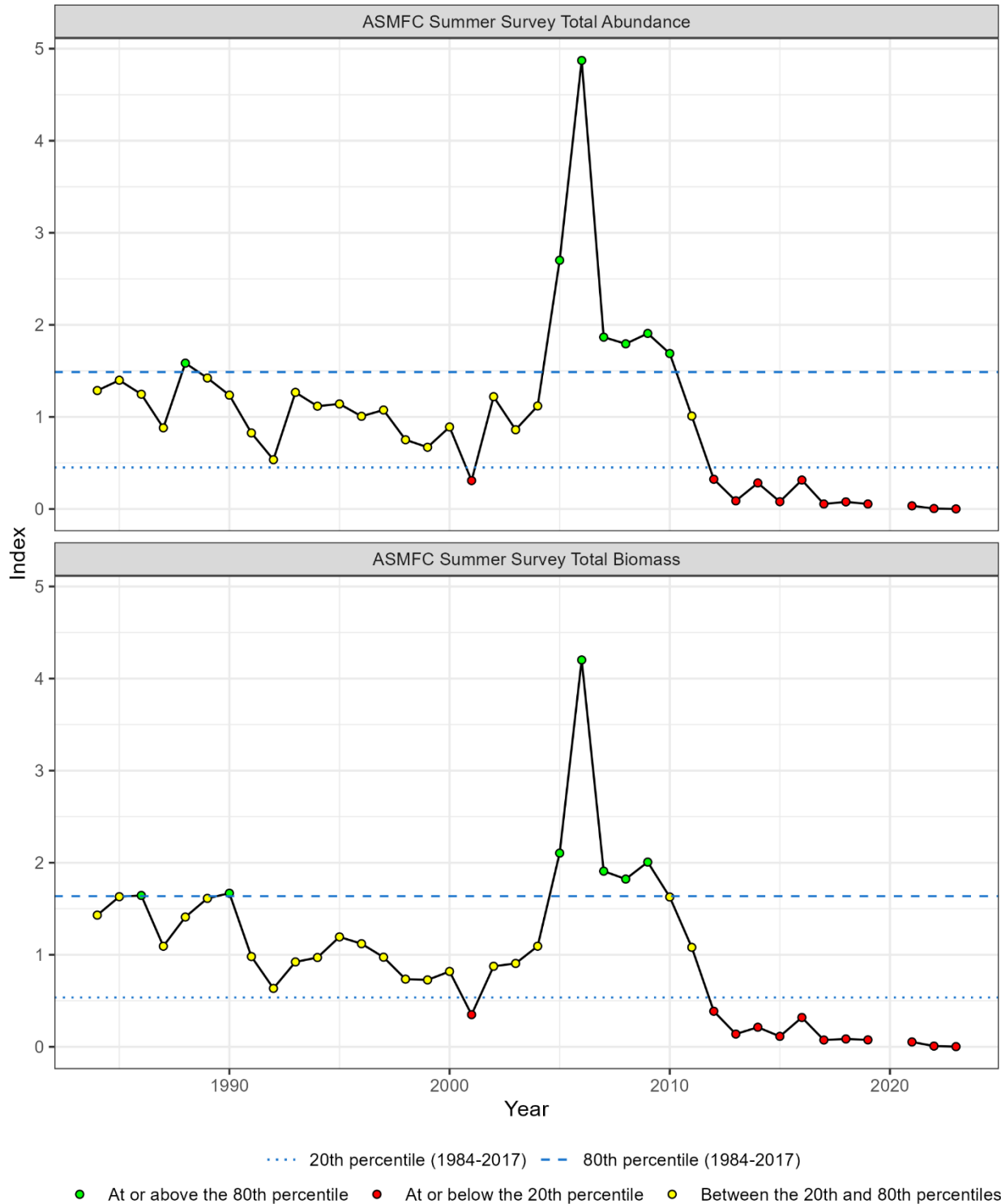
Figure 1. Traffic light analysis for the model-based index of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022 for total abundance (top) and total biomass (bottom). The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a favorable state.
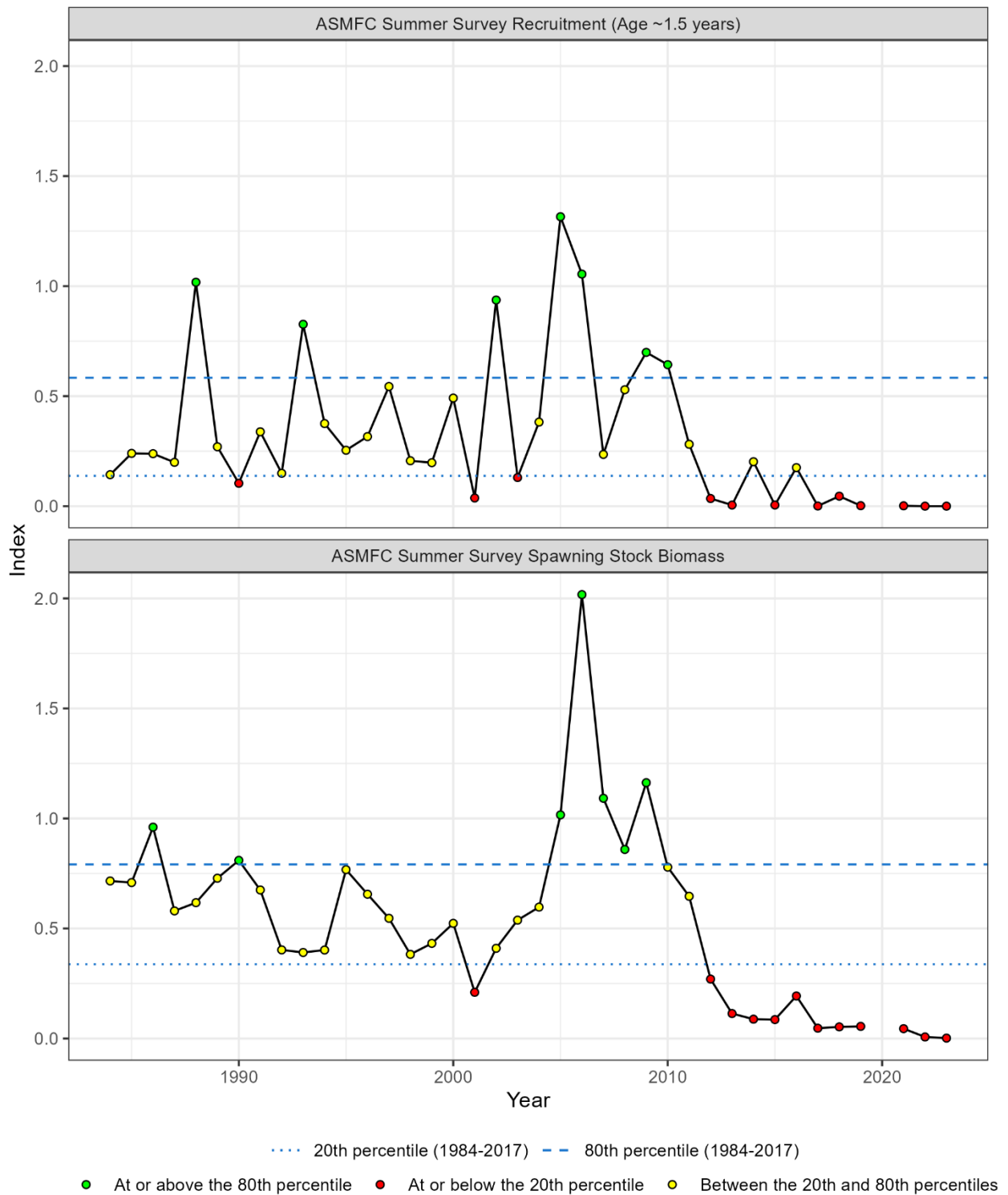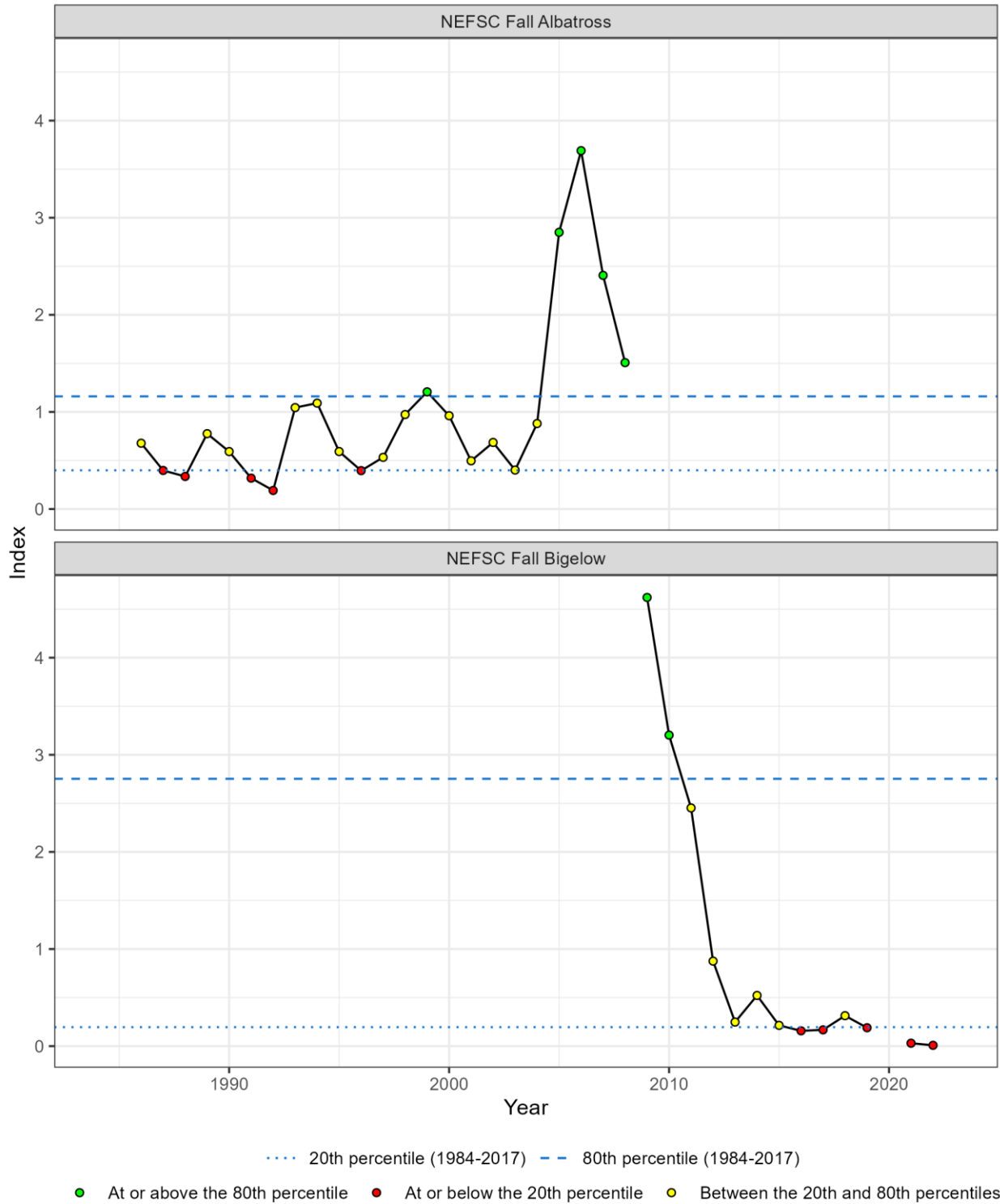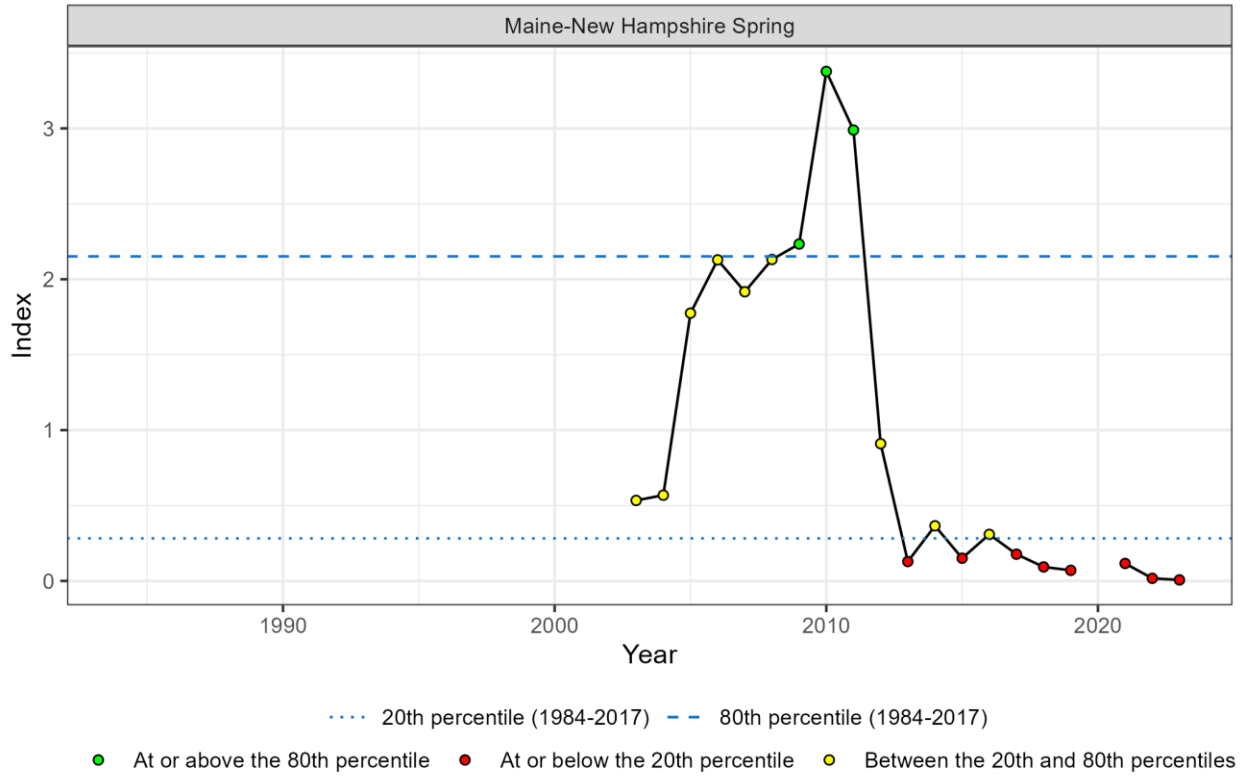
Figure 2. Traffic light analysis of recruitment (top) and spawning biomass (bottom) of Gulf of Maine northern shrimp from the ASMFC Summer survey 1984-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated 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.
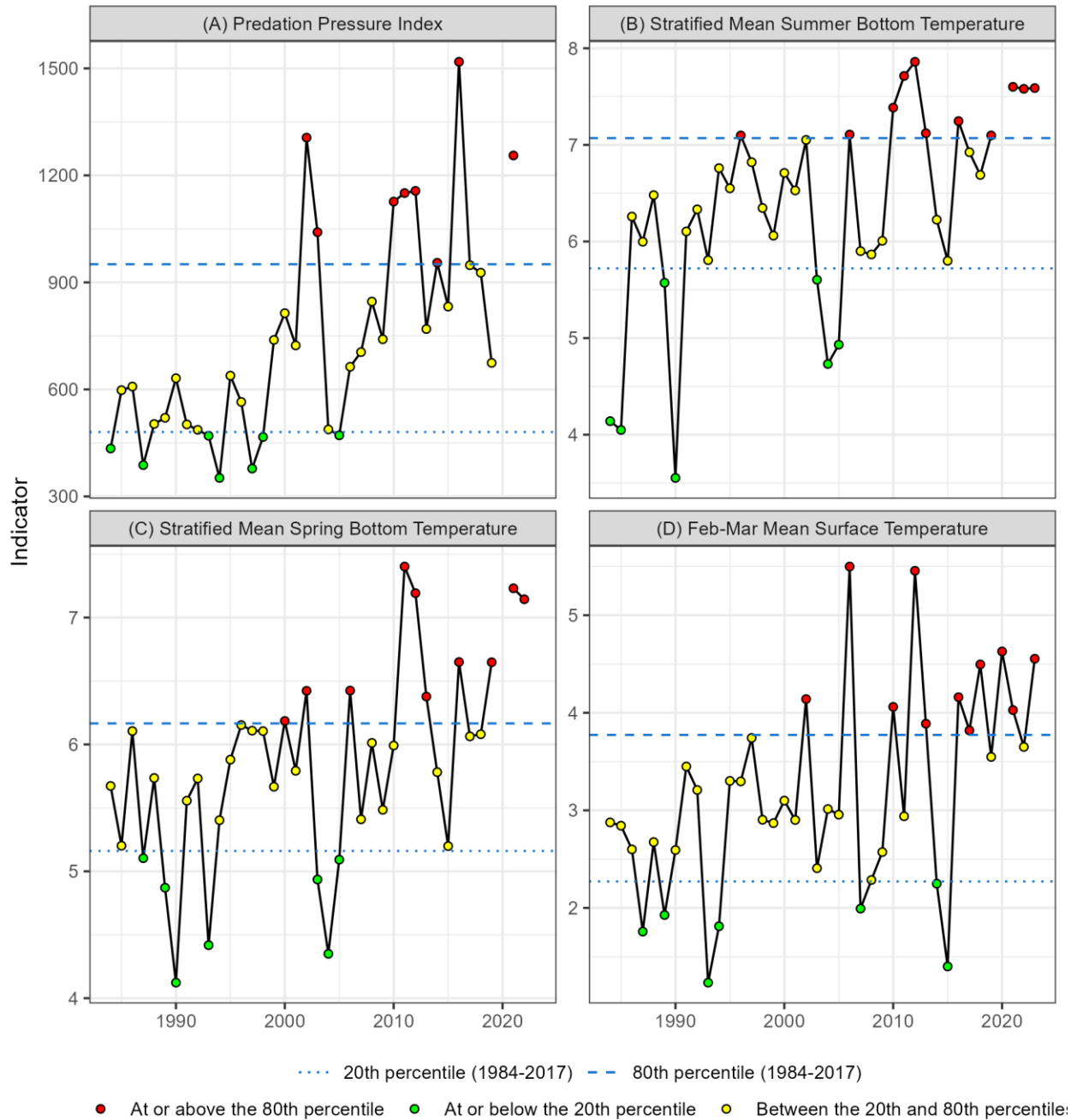
Figure 4. Traffic light analysis of total abundance of Gulf of Maine northern shrimp from the Maine-New Hampshire Inshore Spring survey 2003-2022. The 20th percentile of the time series from 1984-2017 delineated an adverse state, and the 80th percentile of the time series from 1984-2017 delineated a 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.
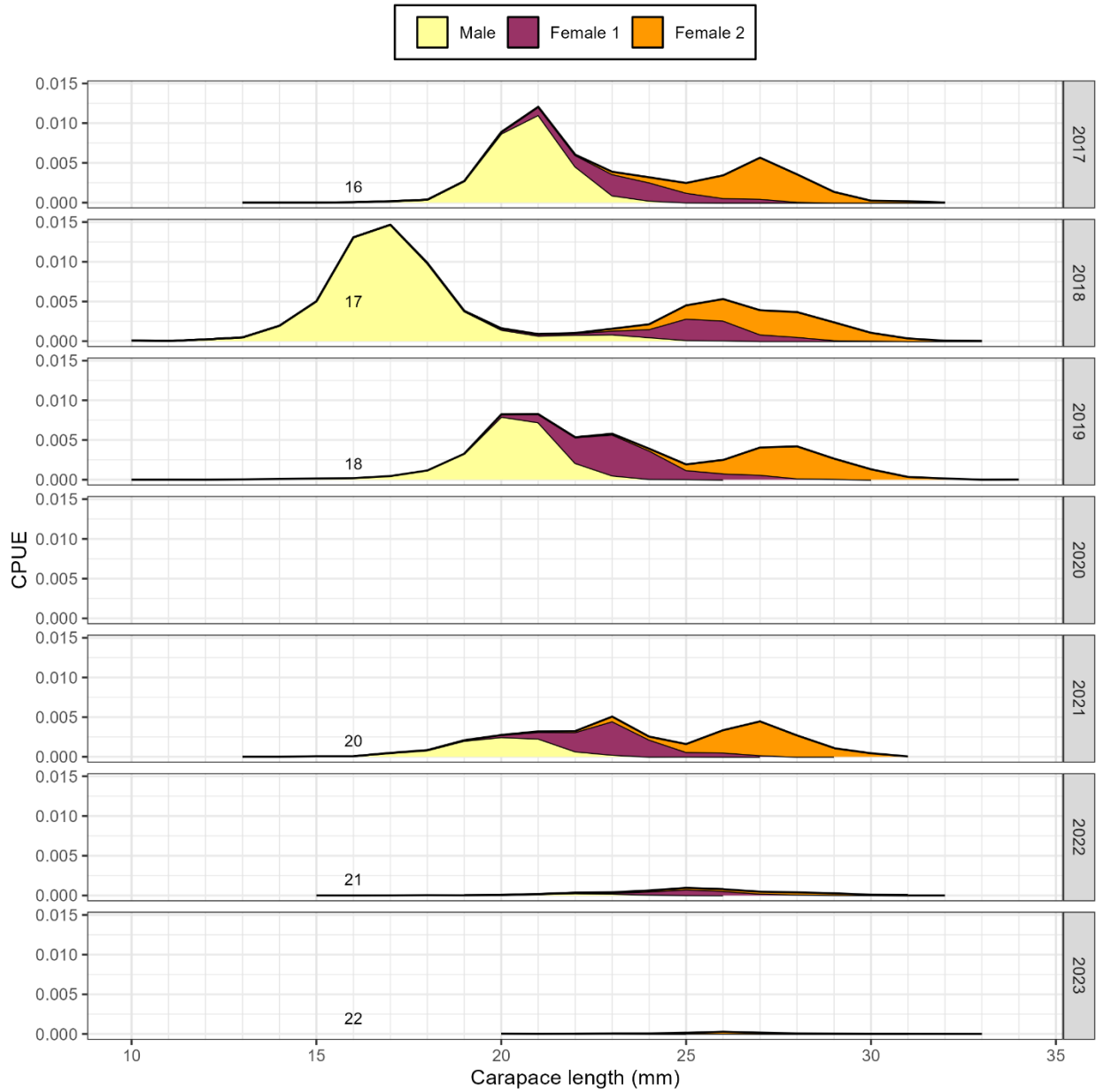
Figure 6. Gulf of Maine northern shrimp abundance from the ASMFC Summer survey by year, length, and development stage for 2017 – 2023. Two-digit years are year class at assumed age 1.5.
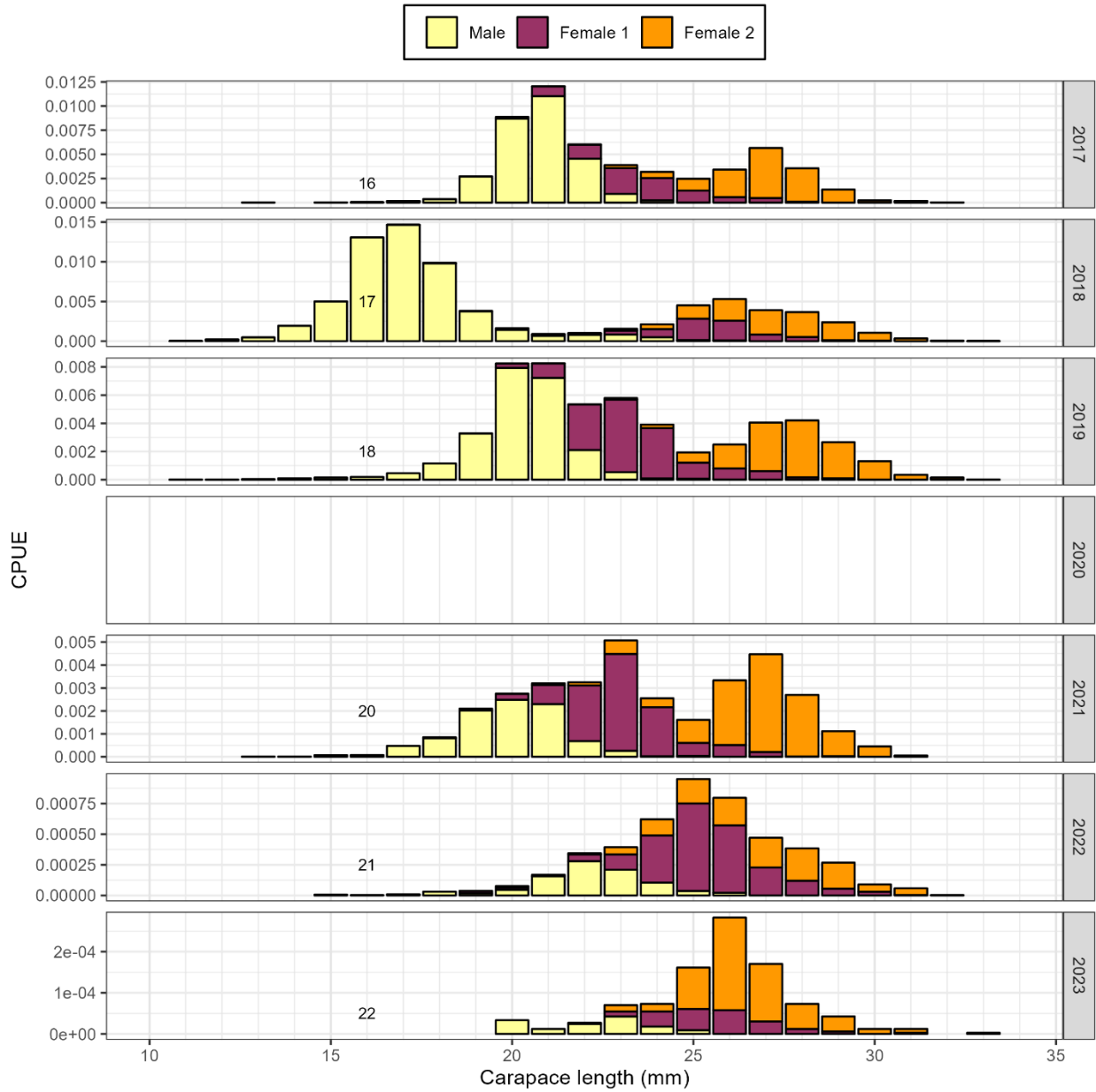
Figure 7. Gulf of Maine northern shrimp abundance from the ASMFC Summer survey by year, length, and development stage for 2017 – 2023 with different y-axes to show detail; note difference in scale from year to year.