CRUISE RESULTS
NOAA FRV Gloria Michelle
Gulf of Maine Northern Shrimp Survey
GM 21-04 Parts I-III
14 July – 1 August 2021

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INTRODUCTION

This report summarizes results of the 2021 survey cruise for northern shrimp, *Pandalus borealis,* in the western Gulf of Maine. This was the 38th survey conducted by the Northeast Fisheries Science Center (NEFSC) in cooperation with the Northern Shrimp Technical Committee of the Atlantic States Marine Fisheries Commission. The survey is designed to provide data required for annual stock assessments and related tasks.

The 2021 Gulf of Maine Northern Shrimp Survey was conducted using best practices to keep crew and science staff safe during the COVID-19 Pandemic. Science staff sailed with four staff on each leg (typically six) and limited the total number of stations allocated for the survey.

METHODS

The survey cruise was conducted from 14 July to 1 August 2021 aboard FRV *Gloria Michelle*, a 72-foot, 96 gross registered ton (GRT) stern trawler powered by a 365 horsepower Caterpillar diesel engine. Fieldwork was overseen by NEFSC staff. Participants included personnel from the NEFSC.

The 2021 Northern Shrimp Survey was completed over the course of 3 survey legs. A stratified random sampling design was used to select stations sampled during the 2021 Northern shrimp survey (Figure 1). The number of stations allocated to each stratum was based on the importance of the stratum to the assessment and on the total area of the stratum. Additional non-random stations were also occupied. Field work was conducted during daylight hours in recognition of diel changes in northern shrimp availability. The survey was scheduled to be completed in three parts: Leg 1 during 14 – 19 July; Leg 2 during 21 - 25 July; Leg 3 during 28 - 2 August 2021.

The vessel departed Woods Hole, MA and made intermediate port calls in Portland, ME before ending the survey in Woods Hole, MA.

At each station, a 15 minute tow was made at a vessel speed of two knots. Gear consisted of Bison size 7+ trawl doors and a four-seam modified commercial shrimp trawl fished at a scope of 3:1 in depths up to and including 85 fathoms; 250 fathoms of wire in depths between 86 and 100 fathoms; and a scope of 2.5:1 in depths greater than 100 fathoms.

Reference/hull surface temperatures and meteorological observations were recorded at each station. A NOTUS Trawl Monitoring System was deployed to monitor trawl gear performance on all survey tows, however, sensors did not respond for tows during leg 1 and part of leg 2. Doorspread, wingspread, vertical opening, and bottom contact of the trawl were transmitted and logged electronically. A Seabird long-endurance CTD was attached to the headrope of the net for each survey tow to collect temperature, depth, and conductivity data.

A 2 kilogram (kg) subsample of Pandalid shrimp was sorted at stations where greater than 2 kg of shrimp were caught to determine species composition. Length frequency measurements were collected for northern shrimp (mid-dorsal carapace length, rounded down to the nearest tenth of a millimeter) in addition to sex and female spawning condition (Rasmussen 1953; McCrary 1971). When less than 2 kg of shrimp were caught at a station, the entire catch was processed as described above.

For other species of invertebrates and finfish, standard NEFSC bottom trawl survey techniques (Azarovitz 1981, Grosslein 1969) were used to process the catch. Bony fish were measured to the nearest centimeter (cm) to the end of the central caudal ray; American lobsters were measured in millimeters (mm) from eye socket to end of carapace; and carapace width (cm) was recorded for crabs. Bivalves were measured by shell height (cm) and cephalopods were measured by mantle length (cm). All species weights were recorded to the nearest 0.001 kg. The remainder of the catch (miscellaneous invertebrates, trash, etc.) was recorded by weight. Total and individual weights and lengths for shrimp and all other measured species were recorded directly into the Fisheries Scientific Computer System (FSCS), version 2.0.

RESULTS

During legs 1 – 3 of the shrimp survey, a total of 60 representative stations and 1 non-representative station were completed. Northern shrimp were collected at 47 stations (Table 1). There were 20 non-random fixed stations. Stratum 3, tow 1 had the highest total catch weight of northern shrimp (16.354 kg).

All shrimp, finfish, and select invertebrate data have been audited and archived in computer data files (total weights, numbers, and length frequencies). Scientific sample collections are summarized in Table 2. This information is available on request (refer to NEFSC Survey Master Data Files Cruise Code 202170).

REFERENCES

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Grosslein, M. D. 1969. Groundfish survey methods. NMFS, Woods Hole, Lab. Ref. Doc. 69-2, 34p.

McCrary, J. A. 1971. Sternal spines as a characteristic for differentiating between females of some Pandalidae. J. Fish. Res. Board Can., 28: 98-100.

Rasmussen, B. 1953. On the geographical variation in growth and sexual development of the deep-sea prawn (Pandalus borealis kr.). Norway Fish. Mar. Invest. Rep., 10 (3); 1-160.

For further information contact Chad Keith, NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, Massachusetts 02543-1097. Charles.Keith@noaa.gov. The cruise results can be viewed at: NEFSC Ecosystems Surveys Branch Northern Shrimp Cruise Results. Choose Cruise Results of interest.

Table 1. Summary of stations where northern shrimp were collected during the 2021 NOAA Northeast Fisheries Science Center Gulf of Maine northern shrimp survey aboard FRV *Gloria Michelle*, 14 July – 1 August 2021.
(* indicates a Non-Representative tow)

STRATUM-TOW	STATION	LATITUDE	LONGITUDE	DEPTH (m)	BOTTOM TEMP (C)	TOTAL No. <= 22mm	TOTAL No. > 22mm	TOTAL NUMBER	TOTAL WEIGHT (kg)
6-14	3*	42 48	69 16	76	6.98	0	0	0	0
6-6	4	42 49	69 19	83	6.97	0	0	0	0
6-10	5	42 51	69 06	188	6.77	15	7	22	0.179
8-6	6	43 00	68 50	187	8.09	20	9	29	0.207
8-7	7	42 59	68 49	181	8.14	14	10	24	0.2
10-1	8	43 03	68 01	197	8.08	4	0	4	0.032
10-2	9	43 13	68 01	211	8.48	3	1	4	0.04
10-3	10	43 17	68 00	233	9.47	0	0	0	0
10-4	11	43 15	68 18	190	7.99	3	2	5	0.05
8-5	12	43 14	68 34	187	7.92	6	7	13	0.106
10-5	13	43 35	68 29	179	7.9	4	4	8	0.078
8-1	14	43 33	68 37	140	7.76	32	45	77	0.678
8-8	15	43 32	68 46	145	7.92	201	256	457	3.484
8-2	16	43 33	68 46	158	7.91	505	863	1368	10.658
8-4	17	43 37	68 54	128	7.93	223	186	409	2.758
6-8	18	43 32	69 10	143		251	189	440	3.167
6-5	20	42 55	69 06	171	6.79	3	1	4	0.038
6-3	21	43 01	69 09	171	6.89	2	1	3	0.046
6-12	22	43 08	69 08	183	7.57	46	50	96	0.726
6-7	23	43 13	68 59	164	7.5	68	93	161	1.338
6-2	24	43 19	69 13	157	6.42	63	40	103	0.725
6-9	25	43 19	69 16	155	6.46	11	8	19	0.152
6-11	26	43 19	69 21	180	6.43	54	55	109	1.081
3-3	27	43 26	69 56	145	6.56	6	18	24	0.25
3-2	28	43 42	69 30	109	7.27	30	72	102	1.222
6-4	29	43 36	69 23	140	6.72	10	35	45	0.563
3-7	30	43 34	69 33	139	6.77	33	127	160	2.01
3-5	31	43 17	69 36	163	6.58	102	178	280	2.904
3-8	32	43 04	69 32	144	6.61	0	0	0	0
5-7	33	42 47	69 37	205	8.19	18	2	20	0.164
8-3	34	42 40	68 36	198	8.94	0	1	1	0.017
9-2	35	42 31	68 45	200	8.07	1	0	1	0.017
9-1	36	42 13	68 40	204	7.26	0	0	0	0
7-6	37	42 26	69 04	224	8.7	0	0	0	0
6-1	38	42 39	69 04	180	7.9	0	0	0	0
7-5	39	42 37	69 14	210	8.43	1	1	2	0.024
7-3	40	42 32	69 21	230	8.55	0	0	0	0
5-3	41	42 43	69 34	233	8.46	0	0	0	0
3-6	42	42 48	69 39	211	8.2	3	4	7	0.076
5-6	43	42 53	69 44	208	8.11	0	1	1	0.016
5-2	44	42 55	69 50	240	8.12	1	0	1	0.019
3-9	45	43 05	69 46	161	6.84	75	375	450	5.473
3-1	46	43 18	69 46	171	6.75	231	1083	1314	16.354

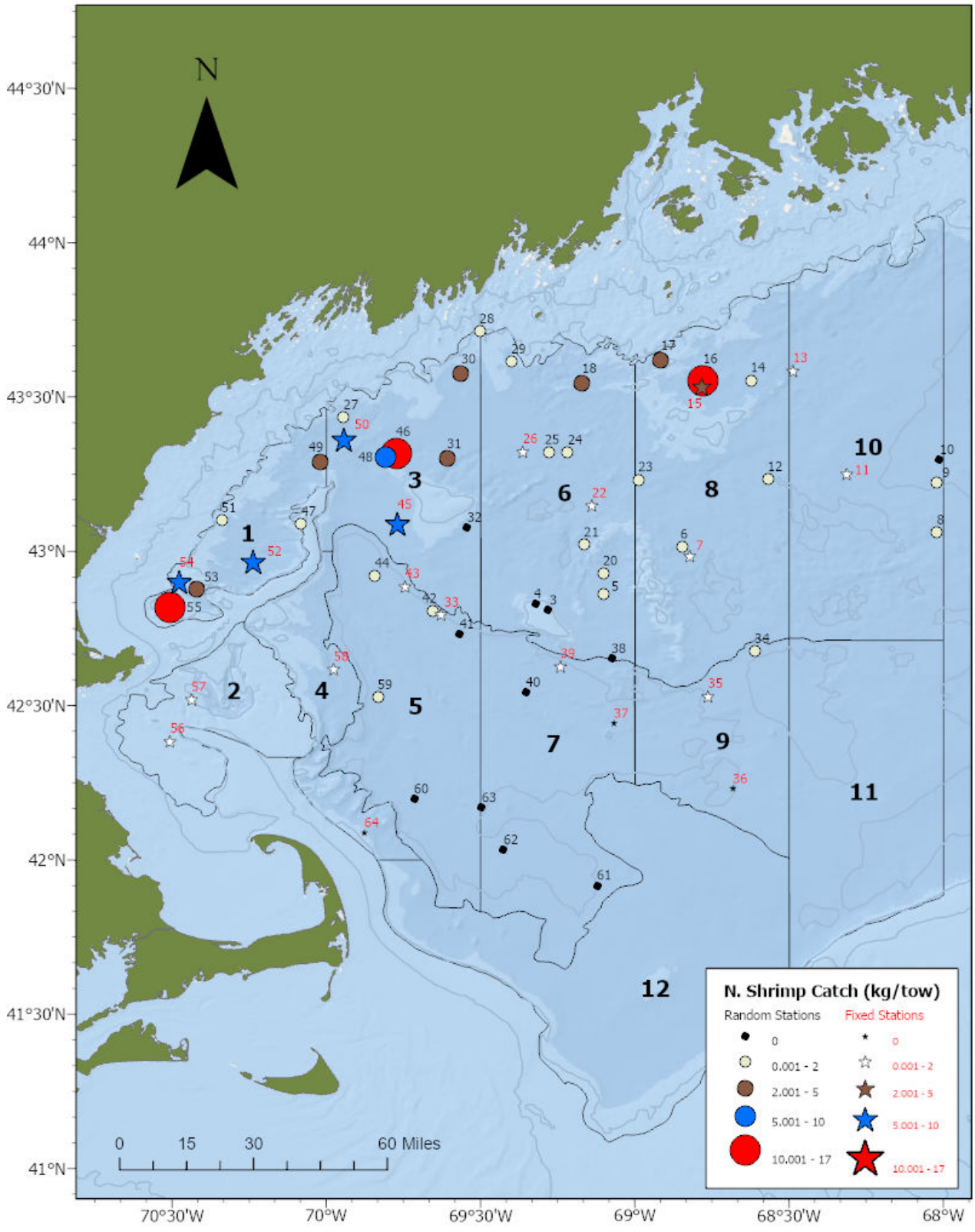
Table 1 (continued). Summary of stations where northern shrimp were collected during the 2021 NOAA Northeast Fisheries Science Center Gulf of Maine northern shrimp survey aboard FRV *Gloria Michelle*, 14 July – 1 August 2021. (* indicates a Non-Representative tow)

STRATUM-TOW	STATION	LATITUDE	LONGITUDE	DEPTH (m)	BOTTOM TEMP (C)	TOTAL No. <= 22mm	TOTAL No. > 22mm	TOTAL NUMBER	TOTAL WEIGHT (kg)
1-4	47	43 05	70 04	98	6.74	0	2	2	0.026
3-4	48	43 18	69 48	166	6.71	112	608	720	9.139
1-5	49	43 17	70 01	153	6.43	95	310	405	4.821
3-10	50	43 21	69 56	165	6.54	95	461	556	6.818
1-2	51	43 06	70 20	115	6.63	2	0	2	0.019
1-7	52	42 57	70 14	167	6.06	88	352	440	5.721
1-1	53	42 52	70 25	138	6.51	165	240	405	4.086
1-6	54	42 54	70 28	106	6.73	92	419	511	5.838
1-3	55	42 49	70 30	116	6.47	143	779	922	10.339
2-2	56	42 23	70 30	89	6.48	10	25	35	0.416
2-1	57	42 31	70 26	101	7.08	0	6	6	0.072
4-2	58	42 37	69 58	180	7.43	1	2	3	0.05
5-4	59	42 31	69 49	235	8.35	10	23	33	0.429
5-1	60	42 11	69 42	239	8.2	0	0	0	0
7-1	61	41 55	69 07	202	7.91	0	0	0	0
7-2	62	42 01	69 25	210	7.34	0	0	0	0
7-4	63	42 10	69 29	215	7.77	0	0	0	0
4-1	64	42 05	69 52	116	7.02	0	0	0	0

Table 2. Miscellaneous scientific collections made during the 2021 NOAA Northeast Fisheries Science Center Gulf of Maine northern shrimp survey aboard FRV *Gloria Michelle*, 14 July – 1 August 2021.

Investigator & Affiliation	Samples Saved	Approximate Number
Age Samples, NMFS, NEFSC, Woods Hole, MA	White Hake	250 otoliths
Age Samples, NMFS, NEFSC, Woods Hole, MA	Atlantic Herring	68 heads

Figure 1. Northern shrimp survey strata and observed distribution of catch per tow (kg) of northern shrimp collected during the 2021 NOAA Northeast Fisheries Science Center Gulf of Maine northern shrimp survey aboard FRV *Gloria Michelle*, 14 July – 1 August 2021.



Appendix I. Participants on the 2021 NOAA Northeast Fisheries Science Center Gulf of Maine northern shrimp survey aboard FRV *Gloria Michelle*, 14 July – 1 August 2021.

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Mike Bergman, Chief Scientist[1,2]
Peter Chase, Chief Scientist[3]
Jonathan Duquette, [1]
Nancy McHugh[1]
Carolina Breakell[1]
Adam Poquette, [2]
Paul Kostovick [2]
SeanMcLaughlin[2,3]
Joe Dunphy[3]
Joe Warren[3]

Gloria Michelle Crew

LT Benjamin VanDine[1,2,3]
LTJG Alex Creed[1,2,3]
George Morton[1,2,3]
Jason McGrath [1,2,3]

[1] 14 - 19 July
[2] 21 - 25 July
[3] 28 - 1 August