



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
Northeast Fisheries Science Center  
166 Water Street  
Woods Hole, MA 02543-1026

29 September 2016

## CRUISE RESULTS

NOAA FRV Gloria Michelle  
Gulf of Maine Northern Shrimp Survey  
GM 16-04, Parts I-IV  
10 July – 5 August 2016

## INTRODUCTION

This report summarizes results of the 2016 survey cruise for northern shrimp, *Pandalus borealis*, in the western Gulf of Maine. This was the 33rd 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.

## METHODS

The survey cruise was conducted from 10 July – 5 August 2016 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 state agencies of Maine and Massachusetts, and the ASMFC.

A stratified random sampling design was used to select stations sampled during the 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 four parts: Part I during 10 – 15 July; Part II, 17 - 22 July; Part III, 24 – 29 July; Part IV, 31 July - 6 August 2016. Locations of stations sampled during each part are given in Figure 2. The vessel departed Woods Hole, MA and made planned intermediate port calls in Portland, ME and New Castle, NH before returning to Woods Hole, MA. The 2016 survey lost 3 days of sampling due to weather.

At each station, a 15 minute tow was made at a vessel speed of two knots. Gear consisted of 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 used to monitor trawl gear performance on all survey tows. 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 tow to collect temperature, depth, and conductivity data. This was

the 5th year we have collected salinity data using a net-mounted CTD during the shrimp survey. A Vemco Minilogger was used as a backup to the CTD for recording bottom temperatures during each tow.

A 2 kilogram (kg) sample of Pandalid shrimp was collected at most stations 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

A total of 68 representative stations were completed. Northern shrimp were collected at each station (Table 1). There were 20 non-random fixed stations. Stratum 1, tow 6 had the highest total weight of northern shrimp (47.256 kg) while the lowest weights were taken at Stratum 10, tow 4 (.021 kg).

All shrimp, finfish, and select invertebrate data have been audited and archived in computer data files (total weight, number, 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 201670).

## REFERENCES

- Azarovitz, T. R. 1981. A brief historical review of the Woods Hole Laboratory trawl survey time series. *Can. Spec. Publ. Fish. Aquat. Sci.*, 58: 62-67.
- 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.

Table 1. Summary of stations and northern shrimp collected on the 2016 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 10 July – 5 August 2016. \*Indicates non-representative tow.

STRATUM-TOW	STATION	LATITUDE	LONGITUDE	DEPTH (m)	BOTTOM TEMP (C)	TOTAL No. <= 22mm	TOTAL No. > 22mm	TOTAL NUMBER	TOTAL WEIGHT (kg)
1-2	28	42 47	70 28	104	5.73	1130	866	1996	13.799
4-2	64	42 26	69 55	181	6.94	293	69	362	1.961
3-13	19	43 26	69 47	137	6.17	498	726	1224	10.189
9-1	51	42 08	68 34	185	7.40	18	2	20	0.109
8-6	11	43 47	68 40	107	8.01	30	20	50	0.394
6-4	5	43 21	69 04	163	6.21	1833	468	2301	13.249
1-7	22	43 04	70 17	146	5.98	864	535	1399	9.368
3-7	32	43 17	69 52	179	6.54	4299	2009	6308	38.955
7-5	60	42 20	69 06	226	7.64	5	3	8	0.069
1-1	25	43 00	70 23	120	5.96	45	2	47	0.13
5-8	69	42 53	69 46	216	7.80	66	237	303	3.212
10-6	8	43 47	68 20	151	8.11	3344	1502	4846	30.978
7-4	61	42 21	69 24	231	7.87	9	4	13	0.098
6-8	14	43 22	69 27	169	6.43	960	642	1602	12.875
3-6	70	43 01	69 33	167	6.51	95	16	111	0.614
2-4	75	42 31	70 26	95	6.63	22	1	23	0.111
6-10	39	43 11	69 06	169	7.30	2661	1036	3697	23.725
4-3	67	42 37	69 57	177	6.86	1415	95	1510	6.313
5-4	72	42 50	69 56	205	7.22	1038	390	1428	9.016
8-3	55	42 39	68 57	188	8.04	14	18	32	0.306
6-11	2	43 12	69 24	161	6.31	634	907	1541	12.107
8-4	48	42 52	68 43	204	9.27	86	107	193	1.824
1-5	21	43 19	70 00	160	6.32	588	749	1337	11.656
7-1	62	42 15	69 29	227	7.20	16	10	26	0.22
3-12	20	43 21	69 56	160	6.31	559	939	1498	14.612
8-2	38	43 10	68 55	173	7.80	234	208	442	3.442
3-5	57	43 09	69 45	158	6.48	2156	653	2809	19.754
8-10	47	43 01	68 50	188	8.78	973	1099	2072	17.916
5-3	71	43 00	69 53	216	7.59	317	168	485	3.238
1-4	26	42 56	70 24	116	5.95	505	128	633	2.94
5-7	68	42 47	69 40	230	8.47	162	469	631	6.544
1-8	27	42 53	70 28	107	5.82	750	616	1366	10.101

STRATUM-TOW	STATION	LATITUDE	LONGITUDE	DEPTH (m)	BOTTOM TEMP (C)	TOTAL No. <= 22mm	TOTAL No. > 22mm	TOTAL NUMBER	TOTAL WEIGHT (kg)
10-2	34	43 33	68 13	176	8.38	24	44	68	0.529
6-14	46	42 45	69 00	175	7.21	45	23	68	0.484
2-3	76	42 23	70 31	87	6.13	321	115	436	2.51
10-5	9	43 40	68 26	180	8.08	458	513	971	7.966
5-2	66*	42 32	69 52	190	7.42	495	137	632	3.656
10-3	49	42 46	68 22	201	9.75	2	1	3	0.039
6-12	4	43 15	69 10	168	6.64	2107	555	2662	15.681
5-1	65	42 30	69 50	228	7.72	440	130	570	3.355
1-6	23	43 00	70 12	155	6.01	5689	2320	8009	47.256
7-8	45	42 37	69 15	218	8.79	5	1	6	0.049
10-4	50	42 44	68 11	187	9.64	3	0	3	0.021
7-7	59	42 27	69 01	224	9.05	11	0	11	0.051
9-2	53	42 20	68 30	186	9.23	5	0	5	0.027
6-15	12	43 19	69 19	169	6.36	1530	1172	2702	21.964
6-1	13	43 20	69 21	179	6.36	2037	872	2909	20.648
3-2	33	43 22	69 45	155	6.40	1978	452	2430	12.484
8-5	37	43 33	68 50	146	7.50	308	130	438	2.914
6-5	42	43 00	69 19	184	6.46	749	651	1400	12.232
7-2	44	42 38	69 15	204	8.51	13	5	18	0.116
8-9	36	43 32	68 47	145	7.34	258	86	344	2.223
8-8	10	43 46	68 38	118	7.94	1418	88	1506	9.276
3-9	17	43 28	69 34	148	6.31	841	748	1589	12.361
9-4	54	42 29	68 47	202	8.73	9	2	11	0.078
1-9	24	42 58	70 16	160	5.98	1193	1177	2370	18.752
5-5	63	42 20	69 53	208	7.56	36	11	47	0.319
6-7	41	43 01	69 12	205	6.45	179	358	537	4.691
10-9	35	43 34	68 29	176	8.06	103	155	258	2.314
3-4	30	43 20	69 46	170	6.47	3437	911	4348	23.86
6-6	3	43 16	69 15	175	6.26	1450	840	2290	16.99
9-3	52	42 13	68 40	200	7.37	15	0	15	0.076
6-16	40	43 09	69 08	186	7.10	2708	1134	3842	25.848
4-1	73	42 46	70 12	109	6.86	5	1	6	0.043
3-11	56	43 10	69 47	172	6.56	1493	543	2036	14.065
3-1	29	43 16	69 41	154	6.37	1581	869	2450	17.759
6-9	1	43 10	69 16	198	6.62	1799	700	2499	15.886
6-13	43	42 57	69 15	179	6.44	638	791	1429	12.984
10-8	7	43 53	68 06	185	8.23	1	1	2	0.031
3-10	31	43 19	69 52	175	6.53	879	733	1612	13.624

Table 2. Miscellaneous scientific collections made on the 2016 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 10 July – 5 August 2016.

<b>Investigator &amp; Affiliation</b>	<b>Samples Saved</b>	<b>Approximate Number</b>
Age Samples, NMFS, NEFSC, Woods Hole, MA	White Hake	262 otoliths
Age Samples, NMFS, NEFSC, Woods Hole, MA	Goosefish	2 illicia
Peter Chase, NMFS, NEFSC, Woods Hole, MA	Misc fish for ID	16 individuals
Rich Langton, NMFS, NEFSC, Orono, ME	Sea Pens	36 bags
John Galbraith, NMFS, NEFSC, Woods Hole, MA	Misc fish for ID	9 individuals
Anne Richards, NMFS, NEFSC, Orono, ME	Goosefish	15 individuals

Figure 1. Northern shrimp survey strata and observed distribution of catch per tow (kg) of northern shrimp collected during the 2016 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 10 July – 5 August 2016.

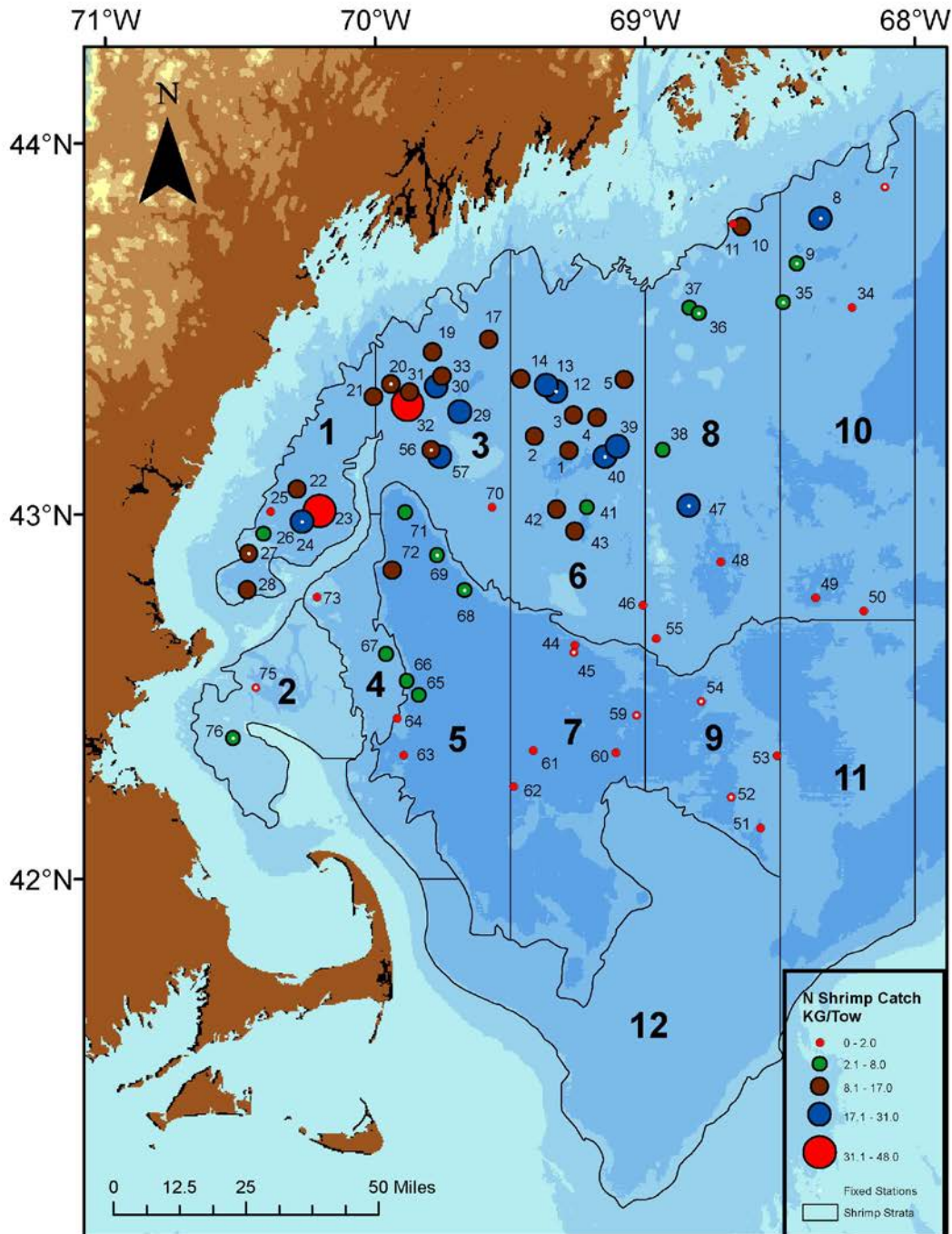
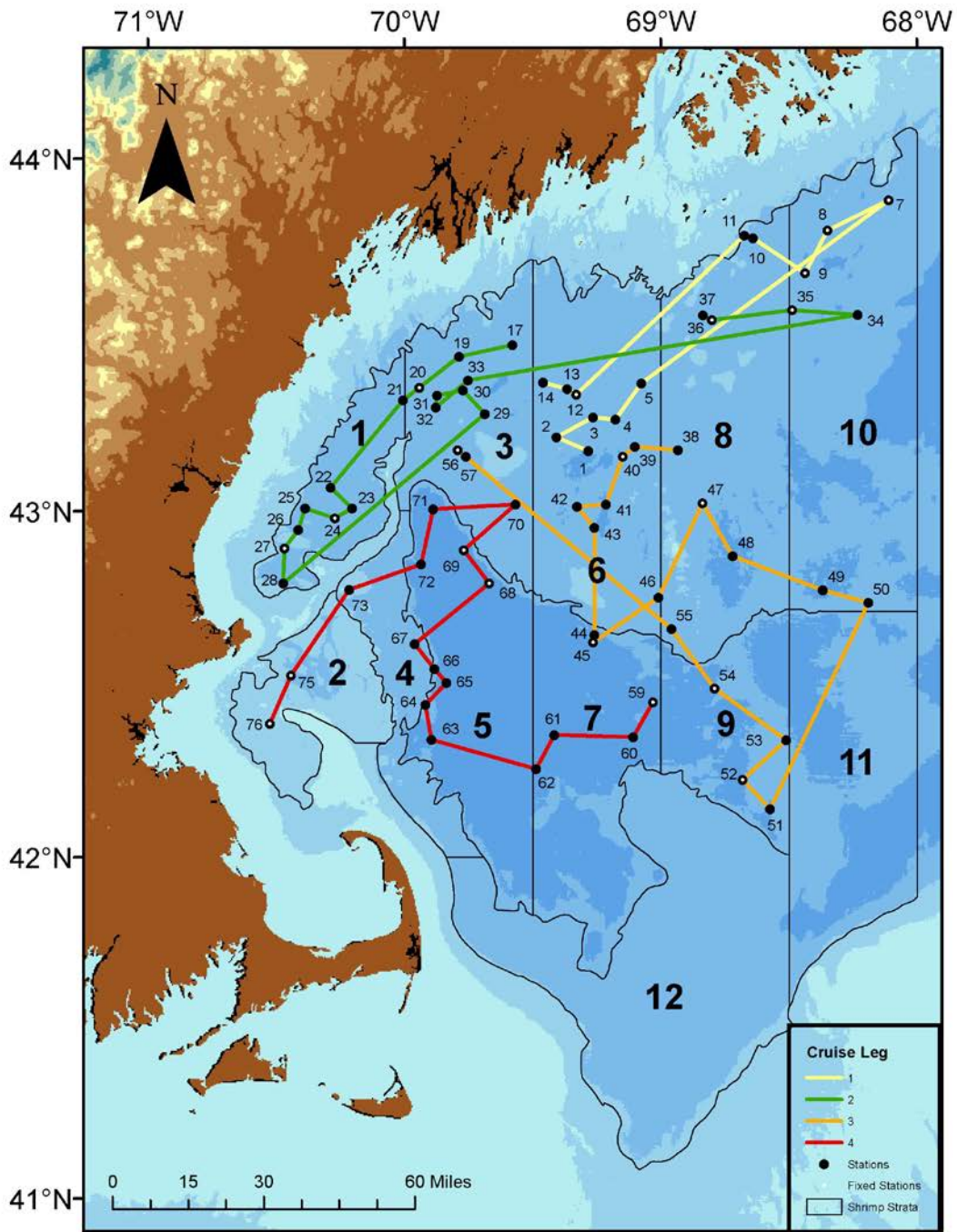




Figure 2. Trawl hauls made during the 2016 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the Gulf of Maine aboard FRV *Gloria Michelle*, 10 July – 5 August 2016.



Appendix I. Participants on the 2016 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey cruise in the western Gulf of Maine aboard FRV *Gloria Michelle*, 10 July to 5 August 2016.

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Peter Chase, Chief Scientist <sup>1,2</sup>	TK Arbusto <sup>1</sup>
Catherine Fillo <sup>2</sup> , Chief Scientist <sup>3</sup>	Heidi Marotta <sup>2</sup>
Tasha O'Hara <sup>3</sup> , Chief Scientist <sup>4</sup>	Michael Bergman <sup>2</sup>
Adam Poquette <sup>1,2</sup>	Robert Alexander <sup>2</sup>
Paul Kostovick <sup>1</sup>	Jakub Kircun <sup>3,4</sup>
Richard Raynes <sup>1</sup>	Sandy Sutherland <sup>4</sup>

MA Division of Marine Fisheries, Gloucester, MA

Collin Farrell<sup>1</sup>  
Kate Ostrikis<sup>3</sup>  
Liz Morrissey<sup>4</sup>  
Kimberly Trull<sup>4</sup>

Atlantic States Marine Fisheries Commission

Ashton Harp<sup>3</sup>

NH Department of Fish and Game, Durham, NH

Robert Eckert<sup>3</sup>

Volunteers

Alina Basilone<sup>4</sup>

Gloria Michelle Crew

LTJG Douglas Pawlishen<sup>1,2,3,4</sup>  
ENS Andrew Reynaga<sup>1,2</sup>  
CDR Nicholas Chrobak<sup>3</sup>  
ENS Michael Ball<sup>4</sup>  
George Morton<sup>1,2,3,4</sup>  
LTJG Casey Marwine<sup>1</sup>  
Harvey Walsh<sup>2</sup>  
Adam Poquette<sup>3</sup>  
LTJG Rachel Pryor<sup>4</sup>

<sup>1</sup> 10 – 13 July

<sup>2</sup> 17 – 22 July

<sup>3</sup> 24 - 29 July

<sup>4</sup> 31 July – 5 August