



10 October 2014

CRUISE RESULTS

NOAA FRV *Gloria Michelle*
Gulf of Maine Northern Shrimp Survey
GM 14-04, Parts I-IV
20 July – 15 August 2014

INTRODUCTION

This report summarizes results of the 2014 survey cruise for northern shrimp, *Pandalus borealis*, in the western Gulf of Maine. This was the 31st 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 20 July – 15 August 2014 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 Gulf of Maine Research Institute (GMRI), the state agencies of Maine and Massachusetts, and several volunteers (see Appendix I).

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 roughly proportional to the area of that 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 conducted in four parts: Part I was during 20 – 25 July; Part II, 29 July – August 1; Part III, 4 - 8 August; Part IV, 11 - 15 August 2014. 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 Gloucester, MA before returning to Woods Hole, MA. Part II was delayed 48 hours due to inclement weather. The vessel returned to Gloucester for 2 days in the middle of Part IV due to rough sea conditions. Part IV ended 1 day early due to winch problems.

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 Vemco Minilogger was used to record the bottom temperatures during the survey. A NOTUS Trawl Monitoring System was used to monitor trawl gear performance on most survey tows. Doorspread 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 3rd year we have attempted to collect salinity data using a net-mounted CTD during a shrimp survey and its use was considered experimental.

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 volume. 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 stations were occupied. Northern shrimp were collected at 66 stations (Table 1). There were 14 non-random fixed stations. Stratum 1, tow 2 had the highest total weight of northern shrimp (38.257 kg) while the lowest weights were taken at Stratum 9, tow 1 and Stratum 9, tow 3 (.019 and .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 201470).

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 2014 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 20 July – 15 August 2014.

| STRATUM-TOW | STATION | LATITUDE | LONGITUDE | DEPTH (m) | BOTTOM TEMP (C) | TOTAL No. <= 22mm | TOTAL No. > 22mm | TOTAL NUMBER | TOTAL WEIGHT (kg) |
|-------------|---------|----------|-----------|-----------|-----------------|-------------------|------------------|--------------|-------------------|
| 6-2 | 1 | 42 48 | 69 29 | 173 | NA | 19 | 8 | 27 | 0.182 |
| 6-10 | 2 | 42 56 | 69 22 | 170 | NA | 141 | 25 | 166 | 0.911 |
| 6-9 | 3 | 42 56 | 69 14 | 198 | NA | 29 | 12 | 41 | 0.197 |
| 6-6 | 4 | 42 58 | 69 03 | NA | 5.59 | 4 | 8 | 12 | 0.199 |
| 6-14 | 5 | 43 06 | 69 06 | 176 | 5.53 | 12 | 7 | 19 | 0.17 |
| 6-16 | 6 | 43 08 | 69 07 | 188 | 5.49 | 97 | 119 | 216 | 2.115 |
| 6-7 | 7 | 43 04 | 69 19 | 203 | 5.47 | 6 | 2 | 8 | 0.074 |
| 6-12 | 8 | 43 02 | 69 22 | 188 | 5.46 | 116 | 26 | 142 | 0.82 |
| 6-5 | 9 | 43 02 | 69 25 | 189 | 5.49 | 45 | 10 | 55 | 0.222 |
| 3-3 | 10 | 42 55 | 69 31 | 172 | 5.7 | 251 | 54 | 305 | 1.559 |
| 3-1 | 11 | 42 59 | 69 35 | 166 | 5.63 | 274 | 24 | 298 | 1.282 |
| 1-6 | 12 | 42 50 | 70 24 | 139 | 5.36 | 5543 | 751 | 6294 | 22.62 |
| 1-8 | 13 | 42 52 | 70 28 | 117 | 5.47 | 2660 | 822 | 3482 | 18.008 |
| 1-3 | 14 | 42 57 | 70 24 | 113 | 5.6 | 49 | 8 | 57 | 0.194 |
| 1-5 | 15 | 42 58 | 70 17 | 168 | 5 | 3139 | 1200 | 4339 | 27.292 |
| 1-1 | 16 | 43 03 | 70 20 | 127 | 5.33 | 40 | 0 | 40 | 0.101 |
| 1-4 | 17 | 43 10 | 70 16 | 126 | 5.58 | 45 | 0 | 45 | 0.212 |
| 1-2 | 18 | 43 04 | 70 11 | 174 | 4.97 | 4784 | 1411 | 6195 | 38.257 |
| 3-10 | 19 | 43 04 | 69 58 | 172 | 6.25 | 367 | 94 | 461 | 2.834 |
| 3-8 | 20 | 43 09 | 69 50 | 180 | 5.9 | 2750 | 340 | 3090 | 16.44 |
| 3-6 | 21 | 43 14 | 69 53 | 175 | 5.87 | 3991 | 837 | 4828 | 27.778 |
| 3-5 | 22 | 43 23 | 69 48 | 146 | 5.59 | 631 | 106 | 737 | 3.566 |
| 3-11 | 23 | 43 20 | 69 58 | 165 | 5.61 | 5528 | 505 | 6033 | 27.835 |
| 3-2 | 24 | 43 09 | 69 48 | 178 | 5.97 | 2224 | 355 | 2579 | 14.341 |
| 3-12 | 25 | 43 05 | 69 46 | 162 | 5.57 | 2740 | 465 | 3205 | 17.562 |
| 5-5 | 26 | 42 58 | 69 53 | 229 | 6.48 | 28 | 6 | 34 | 0.291 |
| 5-4 | 27 | 43 00 | 69 50 | 208 | 6.35 | 40 | 9 | 49 | 0.344 |
| 3-7 | 28 | 42 56 | 69 44 | 187 | 6.23 | 16 | 38 | 54 | 0.614 |
| 5-8 | 29 | 42 53 | 69 44 | 208 | 6.5 | 180 | 25 | 205 | 1.269 |
| 5-7 | 30 | 42 46 | 69 37 | 217 | 6.65 | 72 | 24 | 96 | 0.657 |
| 8-3 | 31 | 43 04 | 68 50 | 190 | 6.6 | 352 | 65 | 417 | 2.357 |
| 8-10 | 32 | 42 59 | 68 48 | 184 | 6.74 | 28 | 71 | 99 | 1.174 |

| STRATUM-TOW | STATION | LATITUDE | LONGITUDE | DEPTH (m) | BOTTOM TEMP (C) | TOTAL No. <= 22mm | TOTAL No. > 22mm | TOTAL NUMBER | TOTAL WEIGHT (kg) |
|-------------|---------|----------|-----------|-----------|-----------------|-------------------|------------------|--------------|-------------------|
| 8-2 | 33 | 43 01 | 68 35 | 187 | 6.98 | 160 | 53 | 213 | 1.664 |
| 8-8 | 34 | 43 07 | 68 40 | 185 | 6.7 | 315 | 167 | 482 | 3.877 |
| 10-3 | 35 | 43 00 | 68 23 | 206 | 7.14 | 122 | 63 | 185 | 1.583 |
| 3-4 | 36 | 43 15 | 69 41 | 157 | 5.54 | 2289 | 208 | 2497 | 13.258 |
| 1-7 | 37 | 43 20 | 70 04 | 157 | 5.56 | 1626 | 360 | 1986 | 10.592 |
| 6-1 | 39 | 43 20 | 69 21 | 178 | 5.56 | 2684 | 222 | 2906 | 14.377 |
| 6-13 | 40 | 43 17 | 69 04 | NA | 5.7 | 810 | 48 | 858 | 4.671 |
| 6-3 | 41 | 43 19 | 69 04 | 160 | 5.74 | 565 | 81 | 646 | 3.584 |
| 8-4 | 42 | 43 22 | 68 55 | 134 | 5.82 | 1161 | 18 | 1179 | 5.164 |
| 8-5 | 43 | 43 16 | 68 36 | 184 | 6.37 | 1469 | 54 | 1523 | 7.842 |
| 10-5 | 44 | 43 14 | 68 20 | 185 | 6.94 | 857 | 80 | 937 | 5.266 |
| 10-2 | 45 | 43 24 | 68 27 | 583 | 7.14 | 381 | 81 | 462 | 2.736 |
| 10-1 | 46 | 43 36 | 68 07 | 195 | 7.82 | 58 | 1 | 59 | 0.322 |
| 10-6 | 47 | 43 53 | 68 05 | 184 | 7.38 | 28 | 4 | 32 | 0.222 |
| 10-9 | 50 | 43 39 | 68 28 | 181 | 7.54 | 124 | 8 | 132 | 0.749 |
| 10-8 | 51 | 43 36 | 68 29 | 190 | 7.7 | 111 | 7 | 118 | 0.692 |
| 8-6 | 52 | 43 30 | 68 30 | 169 | 7.39 | 724 | 10 | 734 | 3.312 |
| 8-7 | 53 | 43 27 | 68 45 | 135 | 6.55 | 252 | 12 | 264 | 1.128 |
| 8-1 | 54 | 43 32 | 68 46 | 148 | 7.29 | 128 | 12 | 140 | 0.865 |
| 6-15 | 55 | 43 26 | 69 12 | 171 | 5.78 | 6408 | 272 | 6680 | 29.08 |
| 6-11 | 56 | 43 26 | 69 17 | 167 | 5.67 | 1876 | 105 | 1981 | 8.953 |
| 6-4 | 57 | 43 36 | 69 24 | 143 | 5.73 | 1019 | 44 | 1063 | 4.721 |
| 2-3 | 59 | 42 23 | 70 30 | 94 | 5.57 | 12 | 0 | 12 | 0.056 |
| 9-3 | 61 | 42 32 | 68 47 | 197 | 8.73 | 4 | 0 | 4 | 0.021 |
| 9-2 | 62 | 42 38 | 68 37 | 195 | 9.03 | 5 | 1 | 6 | 0.046 |
| 9-1 | 63 | 42 24 | 68 38 | 194 | 8.43 | 3 | 0 | 3 | 0.019 |
| 9-4 | 64 | 42 13 | 68 40 | 195 | 6.69 | 27 | 0 | 27 | 0.096 |
| 7-8 | 65 | 42 37 | 69 15 | 212 | 7.56 | 15 | 1 | 16 | 0.085 |
| 7-2 | 66 | 42 30 | 69 12 | 227 | 7.96 | 7 | 0 | 7 | 0.036 |
| 7-3 | 67 | 42 23 | 69 12 | 233 | 8.21 | 9 | 0 | 9 | 0.042 |
| 7-1 | 69 | 42 10 | 69 11 | 191 | 5.58 | 136 | 0 | 136 | 0.562 |
| 7-5 | 70 | 42 04 | 69 17 | 207 | 5.45 | 87 | 0 | 87 | 0.381 |
| 5-2 | 73 | 42 16 | 69 51 | 218 | 6.31 | 13 | 0 | 13 | 0.044 |
| 5-6 | 75 | 42 09 | 69 41 | 231 | 6.3 | 4 | 1 | 5 | 0.033 |

Table 2. Miscellaneous scientific collections made on the 2014 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 20 July – 15 August 2014.

| Investigator & Affiliation | Samples Saved | Approximate Number |
|--|----------------------|---------------------------|
| Age Samples, NMFS, NEFSC, Woods Hole, MA | Goosefish | 1 vertebrae |
| | White Hake | 196 otoliths |
| Peter Chase, NMFS, NEFSC, Woods Hole, MA | Misc Inverts for ID | 16 individuals |
| John Galbraith, NMFS, NEFSC, Woods Hole, MA | Misc fish for ID | 5 individuals |
| Richard McBride, NMFS, NEFSC, Woods Hole, MA | N. Sand lance | 1 individual |
| | Pollock | 5 individuals |

Figure 1. Northern shrimp survey strata and observed distribution of catch per tow (kg) of northern shrimp collected during the 2014 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the western Gulf of Maine aboard FRV *Gloria Michelle*, 20 July – 15 August 2014.

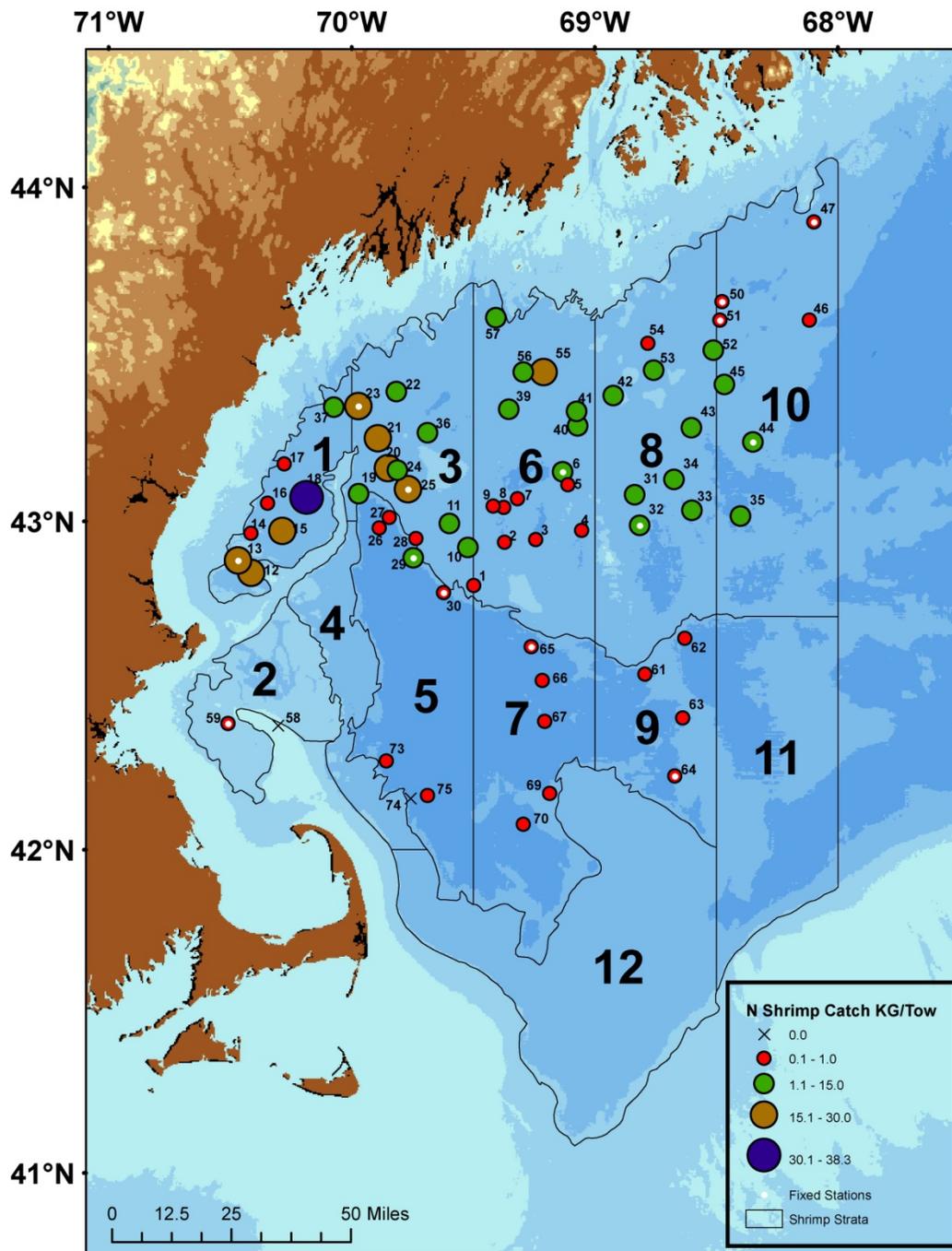
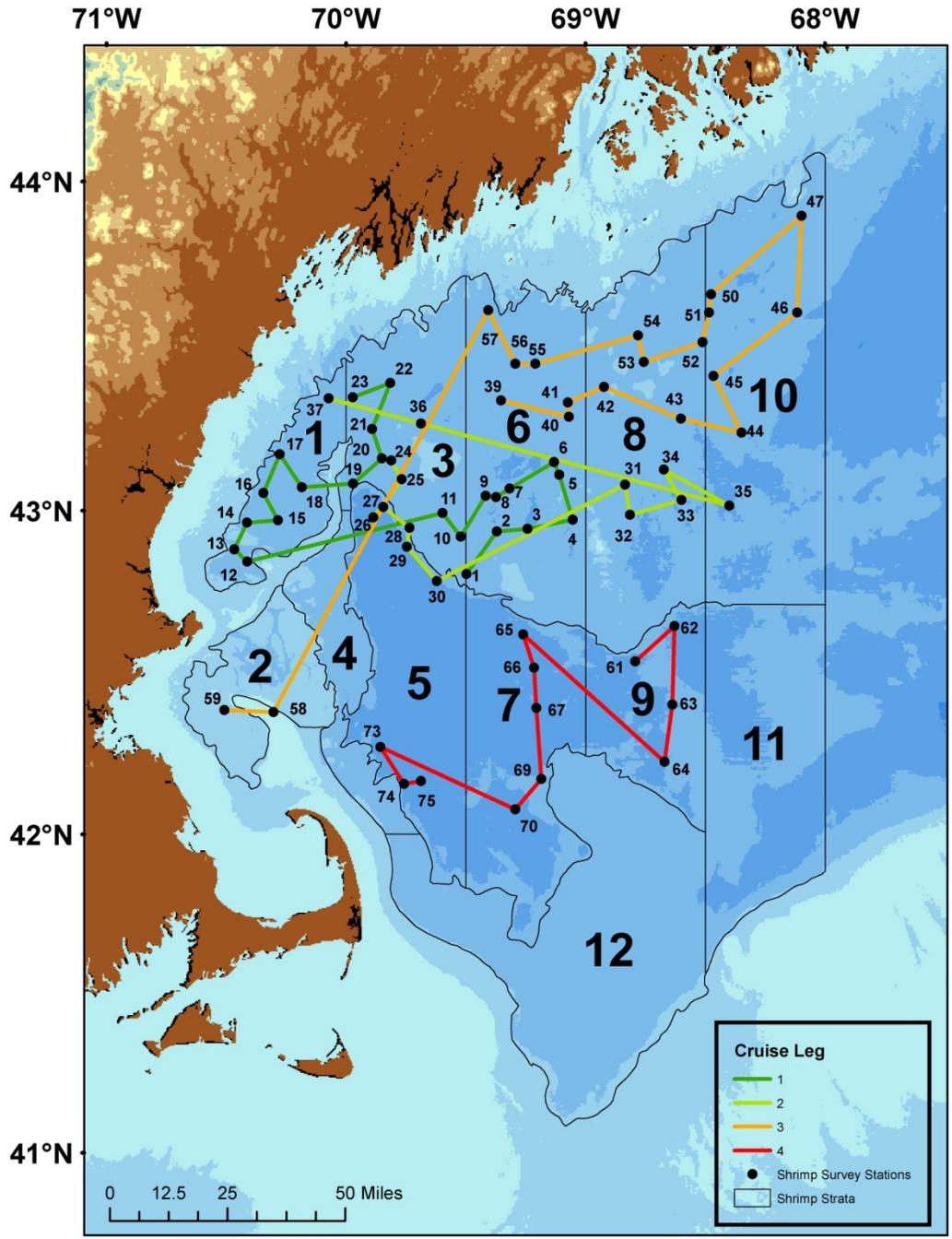


Figure 2. Trawl hauls made during the 2014 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey in the Gulf of Maine aboard FRV *Gloria Michelle*, 20 July – 15 August 2014.



Appendix I. Participants on the 2014 National Marine Fisheries Service, Northeast Fisheries Science Center northern shrimp survey cruise in the western Gulf of Maine aboard FRV *Gloria Michelle*, 20 July to 15 August 2014.

National Marine Fisheries Service, NEFSC, Woods Hole, MA

| | |
|--|-------------------------------|
| Peter Chase, Chief Scientist ^{1,2} | Catherine Fillo ¹ |
| Tasha O'Hara ^{2,3} , Chief Scientist ³ | Anne Richards ² |
| Adam Poquette, Chief Scientist ⁴ | Grace Thornton ⁴ |
| Heidi Marotta ² | Tyler Staples ⁴ |
| Paul Kostovick ¹ | Sandy Sutherland ³ |
| Joe Mello ³ | Kris Tholke ³ |
| TK Arbusto ¹ | |

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Lessie White²

Gulf of Maine Research Institute, Portland, ME

Nancy Martz¹

Volunteers

Robbie Fogarty²

Alexandra Doudera⁴

Andrew Ransom⁴

Kelsey Rose⁴

Gloria Michelle Crew

LT Anna-Liza Villard-Howe^{1,2,3,4}

ENS Doug Pawlishen^{1,2,3,4}

George Morton^{1,2,3,4}

ENS Andrew Reynaga²

Kevin Burt^{1,3,4}

¹ 20 – 25 July

² 29 July – 1 August

³ 4 – 8 August

⁴ 11 – 15 August