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**Research Vessel Survey
Data Collection and Management
for Northern Shrimp**

by

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INTRODUCTION

Research vessel surveys by the Northeast Fisheries Science Center (NEFSC) and cooperating state agencies and academic institutions have provided an important database for northern shrimp (*Pandalus borealis*) in the Gulf of Maine. Resulting data have been used for studies of the biology and distribution of northern shrimp and for monitoring trends in abundance, recruitment and total mortality. Together, these data provide an important cornerstone for assessments and related research on the Gulf of Maine northern shrimp stock.

Fishery-independent data for this species have been collected from the Gulf of Maine northern shrimp survey (conducted during summer), multispecies bottom trawl surveys (conducted primarily in spring and autumn) and during exploratory or special purpose surveys dating back to the late 1930s. The summer survey, which was initially developed and implemented with support from the Atlantic States Marine Fisheries Commission (ASMFC), provides the primary fishery-independent data source for the assessment and management of the Gulf of Maine northern shrimp stock. The NEFSC has held lead responsibility for conducting this survey and for processing and archiving the resulting data. The Northern Shrimp Technical Committee (NSTC) of the ASMFC plays an important role in staffing this survey.

Data collected during the northern shrimp and multispecies bottom trawl surveys include "station data" (location, depth, environmental conditions, tow quality indicators, etc.) and "biological data", or catch per tow and relevant biological information of finfish, shellfish and invertebrate species. Procedures for the collection of station data are similar for both types of surveys and require no further discussion. However, procedural aspects in the collection and processing of biological data for northern shrimp require documentation, both to insure correct interpretation of the data and to insure consistency in data collection and processing in future surveys.

The purposes of this report are (1) to document past and current procedures for the collection, processing and archiving of northern shrimp survey biological data from summer shrimp surveys and NEFSC multispecies bottom trawl surveys, and (2) to describe northern shrimp data sets in NEFSC master data files and other archives to provide a basis for their correct use in future assessments and related research. The reader should note that work on these data sets is ongoing and the status of these data files is subject to change. Users should check with the Chief, Ecosystems Surveys Branch at NEFSC to verify current status of these files.

DIRECTED SHRIMP SURVEY

The Gulf of Maine northern shrimp survey was initiated in 1983 and has since been conducted annually aboard the R/V GLORIA MICHELLE, a 65 foot, 96 GT stern trawler. This is a standardized (summer) survey employing a stratified random design¹ and standard field data collection procedures similar to those used in NEFSC multispecies bottom trawl surveys. A complete description of shipboard procedures used is included in the document entitled "Duties of Chief Scientist on the Northern Shrimp Survey", attached as Appendix I. Both shrimp and finfish data are collected but shrimp sampling is the highest priority.

Biological samples for shrimp are processed aboard ship. A 2 kilogram (kg) sample is taken, except for total catches <2 kg, which are processed in their entirety. Shrimp are separated by species (nomenclature as per Williams et.al. 1988) and for northern shrimp, individuals are further separated by sex and female spawning stage. Species, sex and female spawning stage codes used are given in Appendix II. All components are weighed (nearest 0.01 kg) and total counts made for species other than northern shrimp. Northern shrimp are then measured, from the posterior margin of the eye socket to the posterodorsal margin of the carapace (mid-dorsal carapace length [CL]; Rasmussen 1953). Measurements are recorded to the nearest 0.5mm below² (Frechette and Parsons 1983). Sex is determined according to characteristics of the endopodite on the first pleopod (Rasmussen 1953), and females are further characterized as primiparous (not having spawned) or multiparous (having spawned at least once) according to presence or absence of sternal spines (McCrary 1971). In some cases a random subsample has been taken for sex and female spawning stage determinations, leaving a "measured but not sexed" category [catchsex 0]. **However, all individuals in the sample are weighed and measured**, to facilitate retrieval of total numbers, weights and length compositions (survey species [svspp] 306) by station. Data are recorded on standard forms (Station Summary Form, Figure 1) which together with the corresponding trawl logs are "worked up" (svspp codes, expansion factors, etc.) before completion of the cruise.

Processing of data from this survey has been a high-priority activity because of annual stock assessment requirements, and data sets for all of these cruises (except for the 1983 cruise, which was basically a prototype) are available in master data files (data for 1983 will be included at a later date). In each case total numbers, weights, length compositions and sex and female spawning stage data for northern shrimp are available, by station. Also, total numbers and weights for other Pandalids and other shrimps are entered and available. These data may be accessed from the XX70 computer code series, e.g., 8670 for 1986, 9070 for 1990 data, etc.

It should be emphasized that for stations at which a portion of the northern shrimp sample has not been sexed, expanded numbers and weights by sex or female spawning stage would not be complete, because they would not include individuals in the catchsex 0 category. However, total numbers and length compositions can be retrieved using the svspp 306 code, in effect summing over sex (catchsex) categories. If totals by sex or spawning stage are needed it will be necessary to apply sample length and weight data by sex and/or spawning stage (catchsex) to the unsexed numbers, length compositions and weights.

¹Since 1993, fixed station locations (2 per stratum) have been incorporated into the survey to provide options for enhancing sampling precision.

²For example, a shrimp measured at 24.9 mm mid-dorsal CL would be recorded as 24.5 mm.

SEASONAL MULTISPECIES BOTTOM TRAWL SURVEYS

The present time series originated in 1963 and includes autumn (1963+) and spring (1968+) surveys as well as intermittent summer and winter surveys. These surveys have been carefully standardized over time with respect to design (stratified random), gear and data collection and archiving procedures, which are described elsewhere (Azarovitz 1981, 1994; Azarovitz et al., 1997, and other papers).

Haynes and Wigley (1969) utilized bottom trawl survey data from several cruises in 1963, 1964 and 1965 to conduct a detailed study of the biology and distribution of northern shrimp in the Gulf of Maine. However, these data were never archived in the master database. In subsequent years, data for (unclassified) shrimps and shrimplike crustaceans (svspp 305) were not recorded consistently prior to 1968. Sampling for northern shrimp (svspp 306) and other shrimps included in the svspp 305 category did not begin until 1974. From 1974-76, however, shrimp catches were not consistently sampled aboard ship and data for these years have also not been archived in the master database.

Since 1977, NEFSC bottom trawl survey catches have been consistently sampled for northern shrimp. It is not possible to process these samples during the survey because of time constraints. Consequently, for shrimp catches >1 kg, a random 1 kg subsample is taken, labeled appropriately (cruise number, station, stratum-tow and date) and frozen, and brought to the laboratory for processing. (For survey catches <1 kg, the entire catch is saved). A list is kept of all samples collected aboard ship during the cruise (Shrimp Sample Summary Form, Figure 2), which is cross-checked upon return to the laboratory to verify that all svspp 305 catches have been sampled and that no samples are missing. Adjustments for missing samples may be necessary for development of reliable survey indices as described below.

In the laboratory, the sample is thawed, species identifications made, and total numbers and weights recorded by species. Northern shrimp are the only species further processed. They are sexed (according to characteristics of the endopodite of the first pleopod) and non-ovigerous females are further determined to be primiparous or multiparous as described above; and measured (mid-dorsal carapace length to the nearest 0.5mm below)³. Weights are then taken for each sample component. **Again, all individuals are measured and weighed, including those in the "unsexed" category for samples in which subsamples have been taken for sex/spawning stage.** Data are entered on the Station Summary Form (Figure 1). Data on these forms are then entered into raw data files, and audited for final archiving as master data. Sample data are expanded to catch totals by station (see Cruise Summary Form, Figure 3) as follows:

$$\text{Total no. 306} = \frac{\text{Total 305 catch wt.} * \text{Sample no. 306}}{\text{Ship sample wt.}}$$

$$\text{Total wt. 306} = \frac{\text{Total 305 catch wt.} * \text{Sample wt. 306}}{\text{Laboratory sample wt.}}$$

³Measurements were taken to the nearest 0.1mm from 1977-1983.

The latter formula in effect incorporates an adjustment for loss in weight due to thawing in the laboratory (i.e., the ship sample weight/laboratory sample weight ratio).

A summary of the availability and status of data for northern shrimp (svspp code 306) in NEFSC multispecies bottom trawl survey master data is given in Table 1. Major features are as follows:

- | | |
|---------|--|
| 1974-76 | Sampling for pandalid shrimp in NEFSC survey catches incomplete; total numbers and weights available for some stations, no length or sex data available. Data recorded on cruise summary forms only; not entered into master data. |
| 1977-83 | Total numbers, weights and length compositions available by station in master data; sample sex and female spawning stage data available by station for most cruises on station summary forms; unaudited data files also available for 1981-83. |
| 1984-91 | Total numbers and weights available by station in master data; sample length compositions and some sex and female spawning stage data available on station summary forms and in unaudited data files (incomplete for some cruises). |
| 1992-93 | Total numbers, weights, length compositions and sex and female spawning stage data available by station in master data. |
| 1994-97 | Sample numbers and weights available for all cruises on station summary forms; total numbers and weights available for autumn cruises; sample length compositions and sex and female spawning stage data available in unaudited data files. |

It is important to note the following:

1. Again, a portion of the northern shrimp sample is not sexed in many cases, and thus expanded numbers and weights by sex or female spawning stage may not be complete for a given station. **However, all shrimp in the sample are measured and weighed.** Therefore, total numbers and length compositions, and total weights for northern shrimp can be retrieved by using the svspp 306 code, in effect summing over sex (catchsex) categories. If totals by sex or spawning stage are needed it will be necessary to apply sample length and weight data by sex and/or spawning stage (catchsex) to the unsexed length compositions and weights.

2. As noted previously, there may be cases in which samples have not been collected or have been lost, requiring an adjustment for some applications, e.g. calculation of indices of abundance. In such instances it has been common practice to apply the northern shrimp (svspp 306)/unclassified shrimp (svspp 305) ratio for the remaining samples in the stratum to the svspp 305 catch in question. From 1977 to 1989, these adjustments (involving on average one or two stations per cruise) have been made in master data. No such adjustments have been made since 1989. Stations and stratum-tow values for catches so adjusted are listed in Table 2.

3. For NEFSC cruises, data for other shrimps (Appendix II) have been recorded on sample logs but have not been entered into master data. Persons wishing access to this information are referred to sample logs on file with NEFSC. Information for these species is incomplete for many cruises conducted prior to 1993.

OTHER CRUISES

A limited number of other cruises (exploratory or special purpose) have been directed towards northern shrimp. The earliest of these was conducted in 1936 aboard the R/V ATLANTIS by the renown scientist Johan Hjort and others to assess resource potential. Data logs and summaries, and cruise reports since 1954 are archived at NEFSC and are available as indicated in Table 3. Cruises during the 1950s were conducted aboard R/V DELAWARE to locate commercial concentrations of northern shrimp and to determine causes of declining abundance during those years. The 1960s' cruises were exploratory and also involved gear testing and vessel sea trials for the R/V DELAWARE II. The R/V ALBATROSS IV and DELAWARE II cruises in 1980-1981 were conducted to assess differences in catch rates associated with diel changes in vertical distribution.

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Table 1. Availability and status¹ of data for northern shrimp (spp. 306) in Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl survey data files, 1974-1997. Data are available by station unless otherwise indicated.

| Year | Cruise Codes | Data Availability/Status | | | | Remarks |
|------|--------------|--------------------------|-----------|---------------------|--------------------|--|
| | | Total Nos. | Total Wt. | Length Compositions | Sex/Spawning Stage | |
| 1974 | 744 | N | N | NA | NA | Sampling by station incomplete; no length or sex data available. |
| | 748 | N | N | NA | NA | |
| 1975 | 753 | N | N | NA | NA | " " |
| | 758 | N | N | NA | NA | " " |
| 1976 | 762 | N | N | NA | NA | " " |
| | 767 | N | N | NA | NA | " " |
| 1977 | 771 | M | M | M | N | Sex/female spawning stage data available on sample data sheets. |
| | 774 | M | M | M | N | |
| | 778 | M | M | M | N | |
| 1978 | 783 | M | M | M | N | " " |
| | 787 | M | M | M | N | " " |
| | 789 | M | M | M | N | " " |
| 1979 | 793 | M | M | M | N | " " |
| | 794 | M | M | M | N | " " |
| | 799 | M | M | M | N | " " |
| 1980 | 802 | M | M | M | N | " " |
| | 805 | M | M | M | NA | Sex/spawning stage data lost. |
| | 809 | M | M | M | NA | |
| | | | | | | All sample data lost for strata 38,39 |
| 1981 | 811 | M | M | M | U | |
| | 816 | M | M | M | U | |
| 1982 | 8201 | M | M | M | U | |
| | 8202 | M | M | M | U | |
| | 8206 | M | M | M | U | |

¹M, as master data; U, as unaudited sample data files; N, not keypunched, but available as sample logs or summaries; NA, not available, samples lost or not collected.

Table 1 (continued).

| Year | Cruise Codes | Data Availability/Status | | | | Remarks |
|------|--------------|--------------------------|-----------|---------------------|--------------------|---|
| | | Total Nos. | Total Wt. | Length Compositions | Sex/Spawning Stage | |
| 1983 | 8302 | M | M | M | U | Summarized sex/spawning stages only. Sample data lost for 25 stations. |
| | 8303 | M | M | M | U | |
| | 8306 | M | M | M | U | |
| 1984 | 8401 | M | M | U | U | |
| | 8402 | M | M | U | U | |
| | 8405 | M | M | U | U | |
| 1985 | 8502 | M | M | U | NA | Length compositions only |
| | 8508 | M | M | U | NA | " " |
| 1986 | 8603 | M | M | U | NA | " " |
| | 8606 | M | M | U | U | |
| 1987 | 8702 | M | M | U | U | Length/sex compositions incomplete. |
| | 8705 | M | M | U | U | " " |
| 1988 | 8801 | M | M | U | NA | Length data incomplete, sex data lost. |
| | 8803 | M | M | U | U | Length/sex compositions incomplete. |
| 1989 | 8901 | M | M | U | U | " " |
| | 8904 | M | M | U | U | " " |
| 1990 | 9002 | M | M | U | U | |
| | 9004 | M | M | U | U | |
| 1991 | 9102 | M | M | U | U | |
| | 9103 | M | M | U | U | |
| | 9105 | M | M | U | U | |
| 1992 | 9202 | M | M | M | M | |
| | 9204 | M | M | M | M | |
| | 9206 | M | M | M | M | |
| 1993 | 9302 | M | M | M | M | |
| | 9303 | M | M | M | M | |
| | 9306 | M | M | M | M | |

¹M, as master data; U, as unaudited sample data files; N, not keypunched, but available as sample logs or summaries; NA, not available, samples lost or not collected.

Table 1 (continued).

| Year | Cruise Codes | Data Availability/Status | | | | Remarks |
|------|--------------|--------------------------|-----------|---------------------|--------------------|---------|
| | | Total Nos. | Total Wt. | Length Compositions | Sex/Spawning Stage | |
| 1994 | 9402 | N | N | U | U | |
| | 9405 | N | N | U | U | |
| | 9406 | N | N | U | U | |
| 1995 | 9503 | N | N | U | U | |
| | 9505 | N | N | U | U | |
| | 9507 | N | N | U | U | |
| 1996 | 9602 | N | N | U | U | |
| | 9604 | N | N | U | U | |
| 1997 | 9702 | N | N | U | U | |
| | 9706 | N | N | N | N | |

¹M, as master data; U, as unaudited sample data files; N, not keypunched, but available as sample logs or summaries; NA, not available, samples lost or not collected.

Table 2. Listing of stations by year and cruise (cruise code) in which catch estimates were developed for northern shrimp to compensate for missing sample data.¹

| Year | Cruise Code | Station/Stratum-Tow |
|------|-------------------|---|
| 1977 | 771 | 442 (26-10), 455 (27-3) |
| | 774 | 377 (37-1), 338 (37-4) |
| | 778 | 351 (26-4), 408(27-6), 428 (28-11) |
| 1978 | 783 | 460 (40-2) |
| | 787 | 322 (40-2), 323 (40-1) |
| | 789 | 355 (24-9), 365 (24-23), 375 (24-3), 379 (24-2) |
| 1979 | 793 | 286 (27-7), 445 (27-6) |
| | 794 | |
| | 799 | 553 (26-9), 556 (28-10), 595 (38-1) |
| 1980 | 802 | |
| | 805 | 408 (39-2), 418 (38-2) |
| | 809 ² | (Samples lost for strata 38,39) |
| 1981 | 811 | |
| | 816 | |
| 1982 | 8201 | |
| | 8202 | |
| | 8206 | 263 (24-4), 356 (24-1) |
| 1983 | 8302 | |
| | 8303 | 373 (28-06), 399 (37-05), 420 (27-02) |
| | 8306 ² | (Samples lost for 25 stations) |
| 1984 | 8401 | |
| | 8402 | |
| | 8405 | |

¹Numbers, weights and length compositions prorated for 1977-83; numbers and weights only for 1984-90. No adjustments made for subsequent years.

²No adjustments possible because of inadequate data (numbers of samples lost).

Table 3. Availability and status of data from non-standard research vessel survey cruises specifically directed towards northern shrimp, 1954-1981.

| Year | Vessel | Cruise | Tot. Sta. | Start | End | Remarks |
|------|--------------|------------------------|-----------|-------|-------|---------------------|
| 1954 | Delaware | 54-32 | 7 | 11/10 | 11/21 | Summaries only |
| 1954 | Delaware | 54-33 | 12 | 12/8 | 12/15 | Summaries only |
| 1955 | Delaware | 55-03 | 19 | 2/4 | 2/13 | Summaries only |
| 1955 | Delaware | 55-04 | 32 | 4/18 | 4/28 | Summaries only |
| 1955 | Delaware | 55-06 | 29 | 5/31 | 6/10 | Summaries only |
| 1959 | Delaware | 59-11 | 71 | 9/8 | 9/17 | Summaries only |
| 1967 | Delaware | 67-09 | 210 | 10/25 | 12/8 | Logs, Cruise Report |
| 1968 | Delaware | 68-01 | 70 | 1/6 | 2/7 | Logs, Cruise Report |
| 1968 | Delaware | 68-04 | 51 | 5/8 | 5/17 | Logs, Cruise Report |
| 1968 | Delaware | 68-08 | 37 | 9/4 | 9/13 | Logs, Cruise Report |
| 1969 | Delaware II | 69-01 | 7 | 1/8 | 1/18 | Logs, Cruise Report |
| 1980 | Albatross IV | 80-08 Part II | 50 | 8/18 | 8/22 | Logs, Cruise Report |
| 1981 | Delaware II | 81-04 Part I, II | 51 | 7/19 | 7/22 | Logs, Cruise Report |

Table 2 (continued).

| Year | Cruise Code | Station/Stratum-Tow |
|------|-------------------|--|
| 1985 | 8502 | 269 (26-1), 348 (39-2), 349 (39-4), 364 (26-2) |
| | 8508 | 215 (24-06), 392 (26-03) |
| 1986 | 8603 | |
| | 8606 | |
| 1987 | 8702 | |
| | 8705 | |
| 1988 | 8801 | 275 (38-5) |
| | 8803 | 297 (37-2), 304 (28-2) |
| 1989 | 8901 | 240 (28-2), 289 (40-1) |
| | 8904 | 322 (27-4) |
| 1990 | 9002 | |
| | 9004 ² | (Samples lost for 17 stations) |

¹Numbers, weights and length compositions prorated for 1977-83; numbers and weights only for 1984-90. No adjustments made for subsequent years.

²No adjustments possible because of inadequate data (numbers of samples lost).

Figure 1. Station Summary Form for pandalid shrimp data.

STATION SUMMARY FORM
"Pandalid Shrimp Data"

Cruise Code: _____ Total Shrimp Catch (kg): _____
 Station: _____ Sub Sample Weight (kg): _____
 Stratum/Tow: _____ Observer(s): _____
 Date: _____ Recorder(s): _____

Sub Sample Data

| Northern Shrimp ¹ | Weight (kg) | Number | Other Species | Weight (kg) | Number |
|-------------------------------|-------------|--------|----------------------|-------------|--------|
| Male [1\306]: | _____ | _____ | _____ | _____ | _____ |
| Female I [2\306]: | _____ | _____ | _____ | _____ | _____ |
| Female II [3\306]: | _____ | _____ | _____ | _____ | _____ |
| Other Borealis: ² | _____ | _____ | _____ | _____ | _____ |
| Unsexed [0\306]: ³ | _____ | _____ | _____ | _____ | _____ |
| Total N. Shrimp: | _____ | _____ | Total Other Sp: | _____ | _____ |
| Remarks: | _____ | | Trash (Debris etc.): | _____ | _____ |

Northern Shrimp Sub-Sampling Length Frequency Data¹

| Mid-dorsal (mm) | Males | | Mid-dorsal (mm) | Female I | | Female II | | Other ² P. borealis | | Mid-dorsal (mm) |
|-----------------|-------|--|-----------------|----------|--|-----------|--|--------------------------------|--|-----------------|
| | Total | | | Total | | Total | | Total | | |
| 7.0 | | | 7.0 | | | | | | | 7.0 |
| 7.5 | | | 7.5 | | | | | | | 7.5 |
| 8.0 | | | 8.0 | | | | | | | 8.0 |
| 8.5 | | | 8.5 | | | | | | | 8.5 |
| 9.0 | | | 9.0 | | | | | | | 9.0 |
| 9.5 | | | 9.5 | | | | | | | 9.5 |
| 10.0 | | | 10.0 | | | | | | | 10.0 |
| 10.5 | | | 10.5 | | | | | | | 10.5 |
| 11.0 | | | 11.0 | | | | | | | 11.0 |
| 11.5 | | | 11.5 | | | | | | | 11.5 |
| 12.0 | | | 12.0 | | | | | | | 12.0 |
| 12.5 | | | 12.5 | | | | | | | 12.5 |
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| 14.0 | | | 14.0 | | | | | | | 14.0 |
| 14.5 | | | 14.5 | | | | | | | 14.5 |
| 15.0 | | | 15.0 | | | | | | | 15.0 |
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| 29.0 | | | 29.0 | | | | | | | 29.0 |
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| 30.5 | | | 30.5 | | | | | | | 30.5 |
| 31.0 | | | 31.0 | | | | | | | 31.0 |
| 31.5 | | | 31.5 | | | | | | | 31.5 |
| 32.0 | | | 32.0 | | | | | | | 32.0 |
| 32.5 | | | 32.5 | | | | | | | 32.5 |
| 33.0 | | | 33.0 | | | | | | | 33.0 |

Total Male: _____ Total Female I: _____ Total Female II: _____ Total Other: _____

1 - Measured to nearest 0.5 mm below, e.g. 9.0 = 9.0 - 9.49
 2 - (Transitional=4, ovigerous=5, non-spawning female=6 for sex codes)
 3 - Unsexed length frequencies entered on back side.

Data on Back:
 Vers 4.0 Vband 4/18/99
 File Name: _meashrimpshrimp_survey_log.xls

Figure 1. (contd.)

| STATION SUMMARY FORM "Pandalid Shrimp Data" | | |
|--|--------------------|-------|
| Sex | Unsexed | Total |
| dorsal (mm) | <i>P. borealis</i> | |
| 7.0 | | |
| 8.0 | | |
| 9.0 | | |
| 10.0 | | |
| 11.0 | | |
| 12.0 | | |
| 13.0 | | |
| 14.0 | | |
| 15.0 | | |
| 16.0 | | |
| 17.0 | | |
| 18.0 | | |
| 19.0 | | |
| 20.0 | | |
| 21.0 | | |
| 22.0 | | |
| 23.0 | | |
| 24.0 | | |
| 25.0 | | |
| 26.0 | | |
| 27.0 | | |
| 28.0 | | |
| 29.0 | | |
| 30.0 | | |
| 31.0 | | |
| 32.0 | | |
| 33.0 | | |
| Total Unsexed | | |

| Other Species | Code |
|--|------|
| <i>Crangon septempinnatus</i> , Sevenpin bay shrimp | 287 |
| <i>Dichelopandalus leptocerus</i> , Bridled longbeak | 296 |
| <i>Eulus</i> (=Spirontocaris) fabricei, Arctic scallop | 291 |
| <i>Euphausiella</i> , mysids, Harmeria species | 300 |
| <i>Lebbeus greenlandicus</i> , Spiny lebbellid | 293 |
| <i>Lebbeus potaric</i> , Polar lebbellid | 294 |
| <i>Pandalus borealis</i> , Northern shrimp | 306 |
| <i>Pandalus montagui</i> , Striped pink shrimp | 287 |
| <i>Pandalus propinquus</i> | 298 |
| <i>Parapandalus multidentata</i> , Pink glass shrimp | 292 |
| <i>Parapandalus norvegicus</i> , Norwegian shrimp | 299 |
| <i>Spirontocaris iljshbergi</i> , Fritsen's blade shrimp | 295 |
| <i>Spirontocaris phillipi</i> , Punctate blade shrimp | 285 |
| <i>Spirontocaris apicatus</i> , Parrot shrimp | 286 |

| Sex Code Assignments | |
|----------------------|---|
| Unsexed: | 0 |
| Male: | 1 |
| Female I: | 2 |
| Female II: | 3 |
| Transitional: | 4 |
| Oviparous: | 5 |
| non-spawning: | 6 |

| Individual Length/Weight Data | | | |
|-------------------------------|--------|------------|-----|
| ID # | Length | Weight (g) | Sex |
| 011 | | | |
| 012 | | | |
| 013 | | | |
| 014 | | | |
| 015 | | | |
| 016 | | | |
| 017 | | | |
| 018 | | | |
| 019 | | | |
| 110 | | | |
| 111 | | | |
| 112 | | | |
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| 713 | | | |
| 714 | | | |
| 715 | | | |
| 716 | | | |
| 717 | | | |
| 718 | | | |
| 719 | | | |
| 810 | | | |

DUTIES OF CHIEF SCIENTIST ON THE NORTHERN SHRIMP SURVEY

Ecosystems Surveys Branch

Version 3.0

Revised March 1999

There are usually three legs during a Northern Shrimp Survey. The first leg departs from Woods Hole, MA and arrives in Boothbay Harbor, ME. The second leg usually departs from Boothbay Harbor and arrives in Gloucester, MA. The third leg usually departs from Gloucester and returns to Woods Hole. The following summarizes duties of the Chief Scientist before, during, and after the cruise. Contacts and directions to vessel docking locations are given in Attachment 1.

I. Precruise

A. At least Six Weeks Prior to Sailing:

1. Obtain a list of potential cruise participants by contacting the Chief, Ecosystems Surveys Branch, and the chairman of the Northern Shrimp Technical Committee, or other Committee members (See Attachment 1). One NMFS scientist should be assigned to each cruise leg to act as Chief Scientist. Six persons including the Chief Scientist are needed for each leg. There is one four-person cabin and one two-person cabin.
2. Confirm cruise dates with the Officer-In-Charge, James J. Howard Laboratory and with the Captain, R/V GLORIA MICHELLE. Prepare a Sailing Order and submit it to the NEFSC Vessel Program Coordinator. The cruise usually occurs during the first two weeks of August.
3. Participants should have their current medical forms filled out. If not, they may be completed on-board the R/V GLORIA MICHELLE.
4. Contact the Chief, Ecosystems Surveys Branch, to have stations selected and plotted on large nautical charts. Originals and at least four reduced photocopies of charts are needed. Send photocopies to committee members and to the Captain, R/V GLORIA MICHELLE.
5. Contact the Chief, Ecosystems Surveys Branch to arrange for nets and other sampling supplies and gear as per Attachment 2. Acquire two NEFSC four-seam commercial shrimp trawls and one set of 350 kg doors, legs and other gear as needed. All trawl and gear should be in Woods Hole on day before sailing.

6. Contact the Program Leader, Ecosystems Monitoring Program, at the Narragansett Laboratory to arrange for SEAS System delivery and setup. This will be done on the morning of the scheduled sailing data from Woods Hole.

7. A van large enough to transport scientific gear and personnel should be checked out for the Boothbay Harbor and Gloucester port arrival dates. Make sure to obtain a key!

8. Check with Ecosystems Surveys Branch Chief regarding aquarium requests. Arrange for live tank if necessary.

B. One Week Prior to Sailing:

1. Complete the cruise roster and give names of participants and work/home telephone numbers to Chief, Ecosystems Surveys Branch.

2. Contact all scientists to answer questions, address any problems, give approximate estimated time of departure, (ETD) and remind them to bring their Medical History form with them when they board the ship. Travel directions are given in Attachment 1. Discuss what personal items to bring, directions to port of call and who to contact early on the day of sailing. All participants should provide their own foul weather gear or make arrangements for it to be on board. (Obtain sizes for participants who will be arriving at ports of call other than Woods Hole).

3. Confirm date and time of arrival of the R/V GLORIA MICHELLE in Woods Hole.

4. Consult with the Chief, Ecosystems Surveys Branch, regarding overtime protocol.

5. Since State personnel will be meeting and departing the vessel in Boothbay Harbor and Gloucester, it is important that arrangements are made for transportation. This may be facilitated by appropriate scheduling of participants; but it is up to the Chief Scientist to confirm. Final responsibility for travel arrangements, however, does rest with the participants.

C. Day of Sailing:

1. Instruct scientific personnel to be on board one hour prior to sailing if you are leaving Woods Hole. If you are leaving from Boothbay Harbor or Gloucester, you will want to arrive at the dock before the ETA since the crew will need to use the vehicle to get supplies and as soon as they return, the scientists can leave. (see Attachment 1 for directions to Boothbay Harbor and Gloucester).

2. Bring navigational charts on board (first leg only) and meet with officer-in-charge about the cruise track. Remember that the assessment strata (strata codes 04010, 04030, 04050-04080) have priority in determining layout of the cruise track. Other strata are also of interest but are of

secondary importance to the assessment strata.

3. Obtain a 'sea pack' from the Ecosystems Surveys Branch. This includes a list of previous tows (a database query should be made to obtain a listing which includes latitude, longitude, LORAN time delays, and quality indicators), previous years' shrimp cruise report, a fathom-meter conversion chart, and examples of station, bio, and shrimp logs.

4. Review gear and supply list with Ecosystems Surveys Branch.

5. Make arrangements to have large and small electronic scales on board; installed and calibrated. Take calibrated weight on survey and include instructions for calibrating.

6. Review scale and SEAS operations at dock.

7. Inform all NMFS participants that they should complete a Travel Order.

II. Cruise

A. Scientists Meeting:

1. Shortly after departure, assemble the scientific party to meet with officers to discuss ship operations and procedures (abandon ship, fire, man overboard, location of fire extinguisher, use of head, use of freezers, accommodation and conduct aboard the vessel). Meal preparation: all personnel, including crew, officers and scientists are expected to participate in meal preparation and clean-up. Usually a sign-up sheet is provided. You should sign up for one meal preparation and for one clean-up. Breakfast is on your own, but lunch and dinner are scheduled and a menu provided.

2. Trawling operations are conducted during daylight hours. The scientific watch schedule will be from approximately local sunrise to local sunset with personnel on duty for approximately 12-14 hours each day. Processing of tows made at dusk may continue into the night.

3. Review catch & shrimp processing protocols.

4. Review operation of SEAS system.

B. Station Procedures:

1. Someone should be assigned the task to assure that the scales, dial or MAREL, are tared at least once each day. The shrimp personnel will adjust the brass scales, if they are in use.

2. Someone else should be assigned XBT duties. Once on station, an XBT is made at the

beginning of each tow. A surface bucket temperature is also taken.

3. The officers and crew will be very busy preparing for the tow, handling the vessel during the tow and securing gear after the tow. The Chief Scientist should be prepared to enter station data on the log (see example log and coding instructions (included in 'seapack')). A 15 minute tow is completed at 2.0 knots with a 3:1 scope at depths up to and including 85 fathoms. Between 85-100 fathoms, 250 fathoms of wire is used and at depths greater than 100 fathoms, the scope is 2.5:1. Note that depths on the R/V GLORIA MICHELLE are in fathoms and that fathoms are later converted to meters.

4. Standard bottom trawl survey techniques are used to record the catch composition. The shrimp work is done separately from the finfish, but the final results are recorded on the trawl log. Record any shrimp sample weights on the trawl log. The scientific party is divided into two teams; these being (1) the shrimp team, which processes the shrimp catch, and (2) the groundfish or finfish team which processes the finfish and addresses feeding ecology, age and growth, or other sampling requests.

C. Special Shrimp Sampling:

1. All shrimp and shrimp-like animals are sorted into the plastic two bushel baskets. Shrimp and shrimp-like animals are considered to be the decapod shrimp, especially Pandalus borealis, Northern shrimp; other Pandalid species; krill; Crangon species; mantis shrimp, Lebbeids, etc. The only occasions when shrimp are not completely sorted are in situations that preclude an efficient separation of the shrimp from trash such as brittle stars, starfish, sea urchins, mud, and extremely large catches of silver hake. In these cases, the mix will be sub-sampled according to usual groundfish mix sub-sampling techniques.

2. After the shrimp are sorted from the catch, the deck hose is used to wash the shrimp down. The shrimp baskets are then set aside to drain before weighing. The aggregate shrimp weight is recorded on the trawl log.

3. A two kilogram (rarely more or less) sample of shrimp is taken and processed by the shrimp team. (If <2 kg, the entire catch is processed).

The sample amount should be recorded on both the shrimp summary sheet and trawl log. If the sample is processed before the aggregate shrimp weights are taken, then this amount should also be recorded as part of the weighed part of the catch - Other (Net) on the trawl log.

4. The shrimp sample is sorted according to taxa. This means that all Northern shrimp, Bristled Longbeak, etc. are sorted into separate components.

5. All species other than Northern shrimp are identified, counted, and weighed.

6. Northern shrimp are separated by sex and maturity. Be sure everyone knows how to read the electronic calipers. Each group is weighed and measured (**mid-dorsal carapace length to the nearest ½ millimeter below**).

In the event that one sex and maturity stage are too numerous to effectively measure, sub-sampling may be done. When this happens (usually for male Northern shrimp) a volumetric or weight sub-sample is taken. Also, time constraints may preclude sexing/staging the entire sample, in which case a subsample is drawn **at random** for this purpose before working up the sample. Weights and measurements are taken and recorded for the remaining animals in the sample as "unsexed" shrimp (catchsex 0 category). **It is very important that all animals are measured in this category.**

7. The Chief Scientist or the individual who is delegated to work the log sheets, will expand each taxon and Northern shrimp sex group according to the appropriate expansion factors. Therefore, it is very important to note sub-sampling methods on the trawl logs.

D. Other Invertebrate species:

1. Snow crabs, *Chionectes opilio*, are sexed, weighed, and carapace width measured. Do not mistake this species for a *Libinia* type spider crab. Keep different taxonomic orders together. Make liberal use of visual guides supplied in the 'seapack'.

2. Red crabs, *Geryon quinquedens*, Northern stone crabs, *Lithodes maja*, and Jonah and rock crabs are sexed, weighed and carapace width is measured (cm).

3. American lobsters are sexed, weighed, and the eye socket to mid-dorsal carapace length is recorded (mm). Sex codes from 1-5 are used to record v-notch and egg-bearing lobsters. The sex codes are:

- A. Males - 1
- Females - 2 = no eggs, no notch
- FE - 3 = female with eggs, no notch
- FV - 4 = female with notch, no eggs
- FEV - 5 = female with eggs and notch

4. Rossia type squid are weighed, counted and recorded as squid unclassified.

5. Octopus species are determined by species, weighed, counted, and measured (total length).

E. Finfish:

1. The usual groundfish survey protocols are followed. Weigh and measure all. Biological

sampling for age and growth studies is done on request only. Special attention should be directed to the sorting of the white and red hake. These species appear in significant numbers during this survey. Smooth and clearnose skates are often mis-identified during this survey. Clearnose skates are very rare in the Gulf of Maine; do not mistaken for smooth skate! Spiny dogfish are sexed.

F. End of Tow:

1. Clean all buckets, baskets, scales and calipers (calipers should be stored, dried, and oiled daily as they will rust).

2. Shrimp from the last tows in each leg should be saved for fish food for the aquarium. Put shrimp in freezer bags and place in separate freezer. Coolers and bags will be provided by the aquarium. The Chief Scientist will transport the full coolers to Woods Hole and place them in the freezer. The Chief Scientist should contact the aquarium for coolers and bags previous to sailing or going to the port.

G. Other Cruise Duties

1. Communicate daily via sideband radio, PACKRAT, or cellular telephone with Woods Hole reporting on the number of stations completed and other scientific traffic as necessary.

2. Review and code (if time allows) trawl and shrimp logs at sea.

3. Review all shrimp sampling to assure that the correct expansion factors are calculated.

4. Assure that the excess shrimp catch is saved for the Woods Hole Aquarium as fish food. This is usually done on the last day of the leg (coolers will be provided for transport).

H. Postcruise

1. Clean all equipment.

2. The Chief Scientist is responsible for reporting NMFS personnel time and attendance.

3. Bring all logs from the completed leg to Woods Hole laboratory and give to the Chief, Ecosystems Surveys Branch to be reviewed and sent to UNICOR for keypunching.

4. The day before the leg ends, communicate a list for supplies needed for the next leg. The Chief Scientist on the next leg should be in touch with the vessel through the Port Captain. Obtain the estimated time of arrival at the dock so that the vessel can be met and the scientific complement can be exchanged in timely fashion. The crew will need to borrow the motor vehicle to replenish supplies, so plan to meet the vessel with time to spare.

Attachment 1. List of contacts and directions to vessel docking locations in Boothbay Harbor and Gloucester.

Contacts:

| | | |
|---|---------------------------------|--------------|
| Atlantic States Marine Fisheries Commission, Washington, D.C. | | |
| ISFMP Coordinator | Amy Schick | 202-289-6400 |
| Maine Department of Marine Resources, Boothbay Harbor, ME | | |
| NSTC (Chair) | Dan Schick | 207-633-9500 |
| Massachusetts Division of Marine Fisheries, Gloucester, MA | | |
| NSTC | Mike Armstrong Dave McCarron | 978-282-0308 |
| New Hampshire Fish and Game Department, Durham, NH | | |
| NSTC | Claire McBain | 603-868-1095 |
| Northeast Fisheries Science Center | | |
| Woods Hole Laboratory, Woods Hole, MA | | |
| Vessel Program Coordinator | Charles Byrne | 508-495-2224 |
| Ecosystems Surveys Branch Chief | Thomas Azarovitz | 508-495-2283 |
| James J. Howard Laboratory, Highlands, NJ | | |
| Officer-In-Charge | Anne Studholme | 732-872-3001 |
| R/V GLORIA MICHELLE | Lt JG Jeremy Adams | 732-872-3029 |
| Narragansett Laboratory, Narragansett, RI | | |
| Chief, Ecosystems Monitoring Program | Sharon Maclean | 401-782-3258 |

Directions to:

Signal Point Marina, Wotton's Lobster Pound, Boothbay Harbor, ME

- Head N on Rte. 95 to the ME Turnpike
- Continue N on Me Turnpike to Exit 9 (Falmouth, Rt 1, Brunswick)
- Go N on Route 95 to Exit 22 (Brunswick, Bath, Rt 1)
- Go N on Route 1 through Bath and Wiscasset to Route 27
- Go S on Route 27 at Wiscasset toward Boothbay Harbor
- In the center of Boothbay Harbor, take a left at Chevrolet dealer (down hill), Signal Point Marina is 300 yards on left. You can't see the wharf from the road. The entrance to the wharf area is across from Dunton's Hotdog stand. It looks like you are going into a private condo area. The wharf is on the other side of the condos.

Coast Guard Station, Gloucester, MA

- Head N on Route 3 to Route to Route 128
 - Go N on Route 128 to Exit 11 Grant Circle (still Rt 128)
 - At the second right, take Exit 9 Blackburn Circle (still Rt 128)
 - Take right onto Main Street and then a left onto Harbor Loop.
-

SHRIMP SURVEY SUPPLIES

_____ **STATIONARY SUPPLIES**
 _____ BINDER CLIPS LARGE (1 DOZ)
 _____ BINDER CLIPS SMALL (1 DOZ)
 _____ CLEAR CLIPBOARDS (2)
 _____ CLIPBOARDS, LETTER SIZE (2)
 _____ CLIPBOARDS, LEGAL SIZE (1)
 _____ ACCORDION FOLDER, LEGAL SIZE (4)
 _____ ACCORDION FOLDER, LETTER SIZE (4)
 _____ LINED PAPER, YELLOW LEGAL (3)
 _____ LINED PAPER, WHITE LETTER (2)
 _____ PAPER CLIPS (1 BOX)
 _____ BALLPOINT PENS (1 DOZ)
 _____ PERMANENT INK PEN, FINE (4)
 _____ PERMANENT INK PEN, WIDE (2)
 _____ PENCILS, #2 LEAD (6 DOZ)
 _____ PENCILS, RED LEAD (1DOZ)
 _____ RUBBER BANDS, #64 (2 BAGS)
 _____ RUBBER BANDS, #19 (1 BAG)
 _____ SURVEY STAMP (1)
 _____ INK PAD (1)
 _____ INK BOTTLE (1)
 _____ RULERS (3)
 _____ SCISSORS (2)
 _____ STAPLER (1)
 _____ STAPLES (1BOX)
 _____ OAK TAGS (500)
 _____ SCOTCH TAPE (3 ROLLS)
 _____ SCOTCH TAPE DISPENSER (1)
 _____ FIBER TAPE (1)
 _____ MASKING TAPE (1)
 _____ DUCT TAPE (1)
 _____ **LOGS, TAGS, FORMS**
 _____ LENGTH TALLY SHEETS (100)
 _____ LENGTH TALLY SHEETS WATERPROOF(50)
 _____ WATERPROOF PAPER (50)
 _____ SHRIMP LOGS (70)
 _____ INTERNAL LABELS (200)
 _____ TRAWL LOGS (100)
 _____ BIOLOGICAL LOGS (100)
 _____ CD-26 WORKSHEETS (50)
 _____ FORMS TEMPLATE
 _____ **ELECTRONIC EQUIPMENT**
 _____ CALCULATORS (2)
 _____ MAREL SCALES (1-200KG,1-3KG AND 6KG)
 _____ CALIBRATION WEIGHTS 3-20KG
 _____ CALIBRATION WEIGHTS 1-1KG
 _____ MINILOG, TEMP/DEPTH, TEMP
 _____ MINILOG BASE RECEPTACLE
 _____ MINILOG SOFTWARE
 _____ 9 VOLT ADAPTER(1), 9VOLT BATT.(4)
 _____ COMPUTER (CHECK W/SHIP)
 _____ 3.5 INCH DISKS (2)
 _____ XBT SYSTEM (see Bob Benway Narr. Lab)
 _____ XBT T-10,T-6 (3 CASES)
 _____ **CHIEF SCIENTIST SUPPLIES**
 _____ CHARTS
 _____ DISK OF STATION LOCATIONS
 _____ HARD COPY OF STATION LOCATIONS
 _____ 1 SET REDUCED CHARTS FOR CRUISE TRACK
 _____ 1 DOZ SPARE GLOVES
 _____ **CHIEF SCIENTIST SIG.**

CRUISE

_____ **BIOLOGICAL REFERENCE MATERIAL**
 _____ WILLIAMS DECAPOD CRUSTACEANS
 _____ BIGELOW AND SCHROEDER
 _____ SCOTT AND SCOTT
 _____ PETERSON ATLANTIC FISHES
 _____ POTTS AND RAMSEY DEMERSAL FISHES
 _____ FLESCHER TRAWL CAUGHT FISH
 _____ VECCHIONE CEPHALOPOD GUIDE
 _____ GOSNER ATLANTIC SEASHORE
 _____ MORRIS ATLANTIC SHELLS
 _____ MINER SEASHORE LIFE
 _____ **TECHNICAL REFERENCE MATERIAL**
 _____ MAREL SCALE MANUAL
 _____ MAREL SCALE INSTRUCTIONS
 _____ VEMCO MINILOG MANUAL
 _____ MINILOG SURVEY INSTRUCTIONS
 _____ **LAB SUPPLIES**
 _____ CARDBOARD BOXES (25)
 _____ FORMALIN NEUTRALIZER (if necessary)
 _____ FORMALIN RESPIRATOR (1-if nec.)
 _____ PAPER TOWELS (1 CASE)
 _____ PLASTIC BAGS, LARGE 23X24 (1 BOX)
 _____ PLASTIC BAGS, SMALL 5X16 (1 BOX)
 _____ ZIPLOCKS, 8X8 (50)
 _____ ZIPLOCKS, 4X4 (50)
 _____ ZIPLOCKS FROM AQUARIUM
 _____ ELECTRIC PENCIL SHARPENER (1)
 _____ MAGNIFYING VISOR LENS (1)
 _____ FLY SWATTERS (3)
 _____ SPECIAL SAMPLE MATERIALS(VIC-JANET)
 _____ OTHER
 _____ **DECK SUPPLIES**
 _____ SALTER DIAL SCALE 50KG (1)
 _____ HANGING STRAPS (2)
 _____ PLASTIC BUCKET LIDS (3)
 _____ VERNIER CALIPERS, 300mm (1)
 _____ VERNIER CALIPERS 200mm (1)
 _____ DIGITAL SOLAR CALIPERS 150mm (2)
 _____ DIGITAL CALIPERS 200mm (1)
 _____ PLASTIC CALIPERS 130mm (1)
 _____ GLOVES (2 DOZ)
 _____ KNIVES, RIPPING (1 DOZ)
 _____ KNIVES, SCALLOP (2)
 _____ KNIVES, CLAM (1)
 _____ KNIFE SHARPENER, 123 (1)
 _____ WHETSTONES (2)
 _____ LOBSTER BANDS (1 BAG)
 _____ MEASURING BOARDS 100CM (1)
 _____ MEASURING BOARDS 120CM (2)
 _____ PLASTIC BUCKETS 5GAL (15)
 _____ PLASTIC BASKETS (12)
 _____ SMALL PLASTIC BUCKETS (12)
 _____ WD-40 (1)
 _____ BUCKET THERMOMETER (1)
 _____ SPARE THERMOMETERS (3)
 _____ APRONS (6)

Appendix II. Survey species code (svspp) and sex code (catchsex) assignments for shrimp and shrimplike crustaceans.

Species Codes Assignments

| <u>Name</u> | <u>Code</u> |
|---|-------------|
| <i>Crangon septemspinosa</i> , Sevenspine bay shrimp | 287 |
| <i>Dichelopandalus leptocerus</i> , Bristled longbeak | 296 |
| <i>Eaulus fabricii</i> , Arctic eaulid | 291 |
| General (includes Euphausiids, miscellaneous Aristeidae, Penacidae, and others) species | 305 |
| <i>Lebbeus groenlandicus</i> , Spiny lebbeid | 293 |
| <i>Lebbeus polaris</i> , Polar lebbeid | 294 |
| <i>Pandalus borealis</i> , Northern shrimp | 306 |
| <i>Pandalus montagui</i> , Striped pink shrimp or Aesop shrimp | 297 |
| <i>Pandalus propinquus</i> | 298 |
| <i>Pasiphaea multidentata</i> , Pink glass shrimp | 292 |
| <i>Pontophilus norvegicus</i> , Norwegian shrimp | 299 |
| <i>Spirontocaris liljeborgii</i> , Friendly blade shrimp | 295 |
| <i>Spirontocaris phippisii</i> , Punctate blade shrimp | 285 |
| <i>Spirontocaris spinus</i> , Parrot shrimp | 286 |

Sex Codes Assignments

| | |
|---------------|-----------------------------|
| 0 : unsexed | 4 : Transitional |
| 1 : Male | 5 : Ovigerous female |
| 2 : Female I | 6 : Non-spawning female |
| 3 : Female II | 7 : Undifferentiated female |