Deepwater Horizon Oil Spill (DWHOS)

NRDA SEAMAP Plankton Sampling Plan

Attachment 1. Summary of Historical Shelf and Offshore Plankton Data

August 25, 2010

The NMFS/NOAA SEAMAP program is a long-standing plankton survey that covers nearly all of the Gulf of Mexico. With 25 years of data, this program offers a significant resource for understanding the characteristics of the natural state of this community. This is augmented by several state-based surveys that sample in waters closer to shore. In 2009, the SEAMAP program completed a winter, spring, and fall plankton survey. Each of these surveys took over a month to complete. The spring and fall surveys sample using the bongo and neuston net procedures; the strength of this data set is the longevity, 2009 was the 28th year[1]. The winter survey targets fishes that are underrepresented by the spring/fall sampling procedures and attempts to capture the presence of winter-spawning species. The major drawback to the historical SEAMAP plankton surveys is that only the spring survey covers the offshore area. Plankton in the nearshore waters are well covered over all the seasons as plankton samples are collected in conjunction with the shrimp/groundfish surveys. Figures 1-12 of Attachment 1 summarize the historical and current datasets for plankton fish and crustaceans.

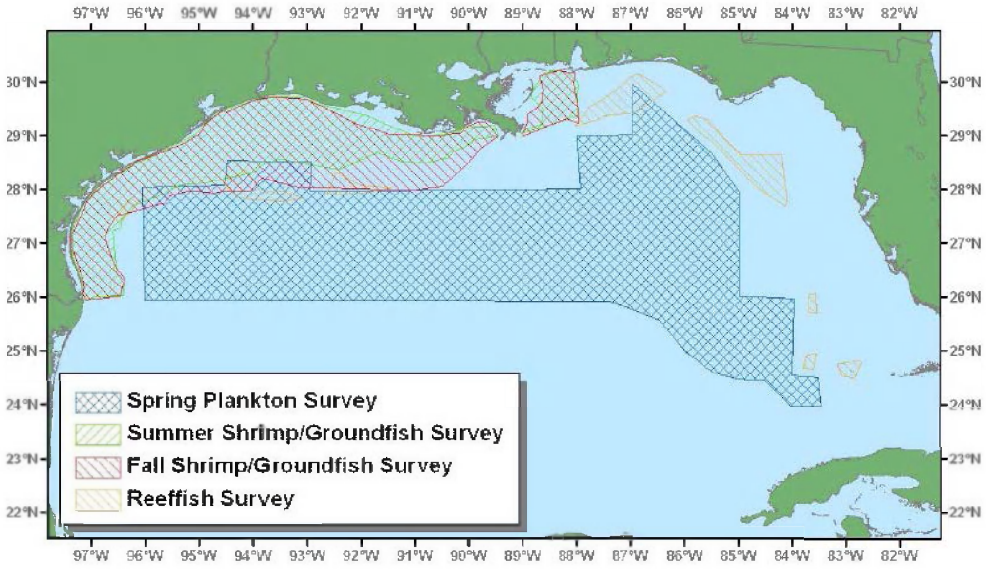

Figure 1. Summary of various SEAMAP surveys.

[1] NOAA, 2010. Annual Report of the Southeast Area Monitoring and Assessment Program (SEAMAP). Number 177.

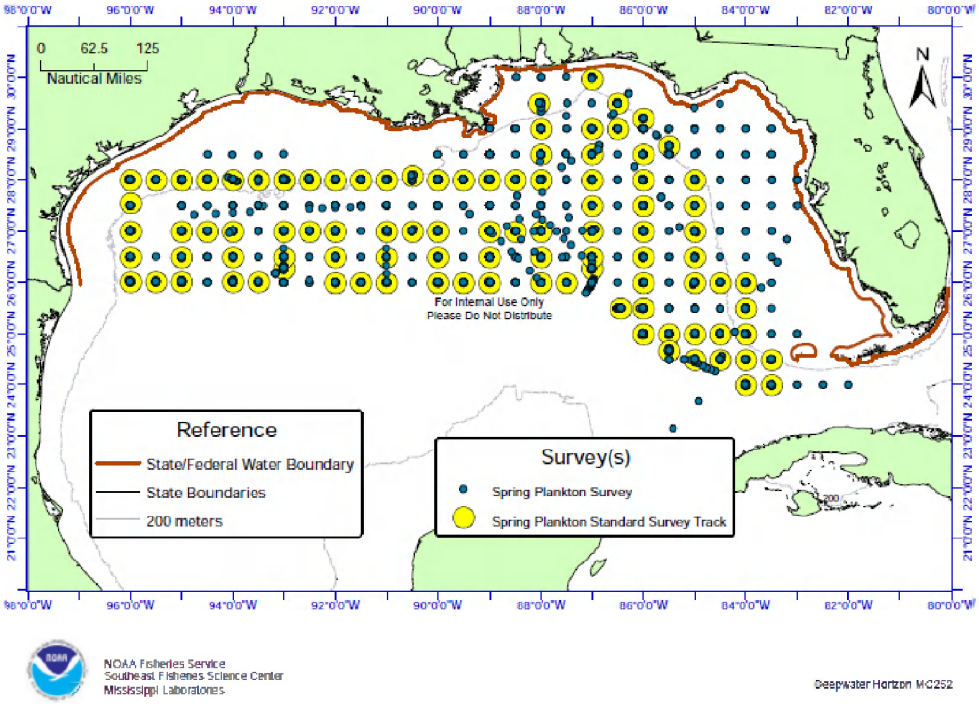

Figure 2. Locations of SEAMAP Spring Plankton Survey effort from 1982-2008 (bottom).

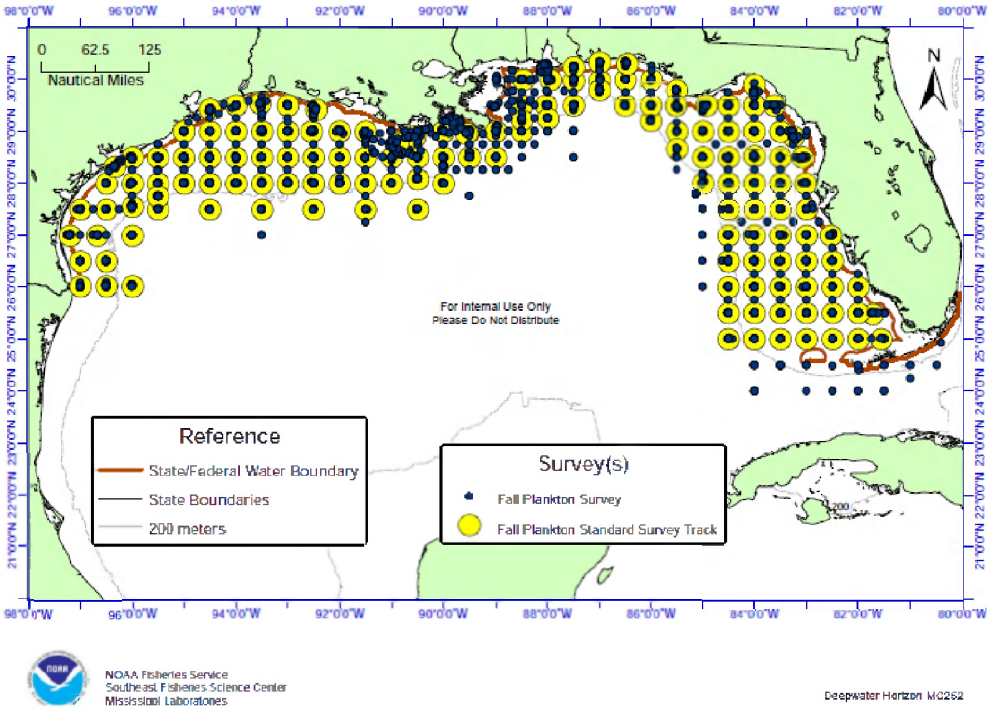

Figure 2. Locations of SEAMAP Fall Plankton Survey effort from 1986-2008.

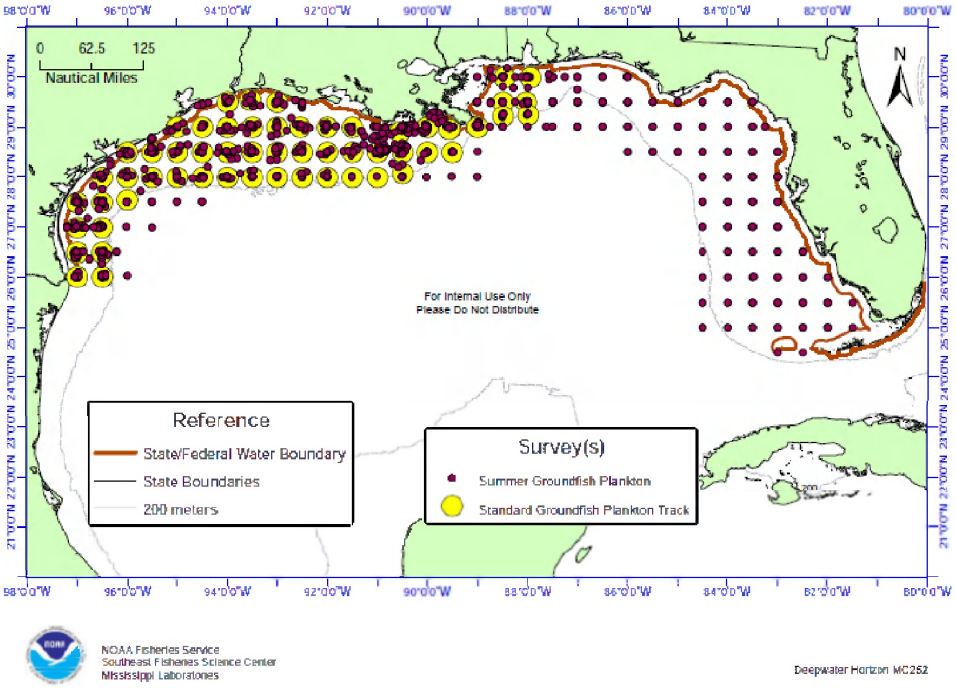

Figure 3. Locations of SEAMAP Summer Groundfish Plankton Survey effort from 1982-2008.

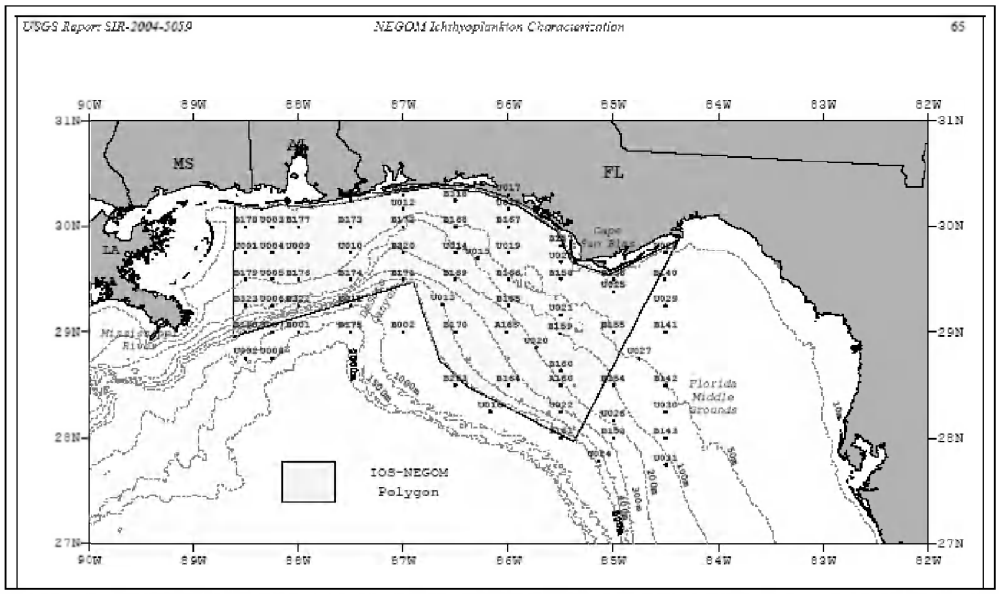

Figure 4. SEAMAP Plankton survey data (1982-1999) collected at 72 sites analyzed in the USGS study. Source : Lyczkowski-Shultz et al. (2004)

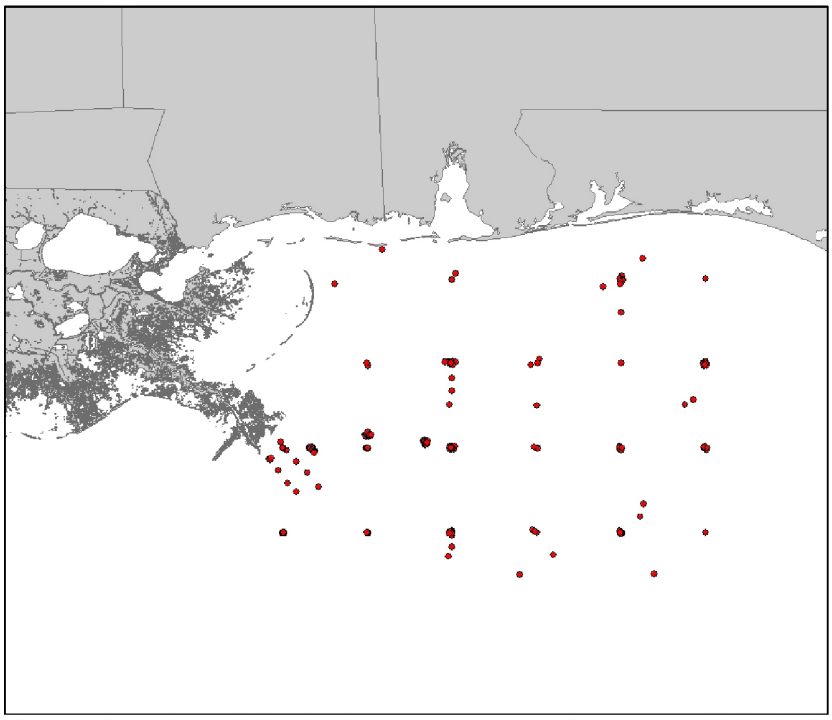

Figure 5. Locations of SEAMAP neuston samples collected from 1982 – 2008.

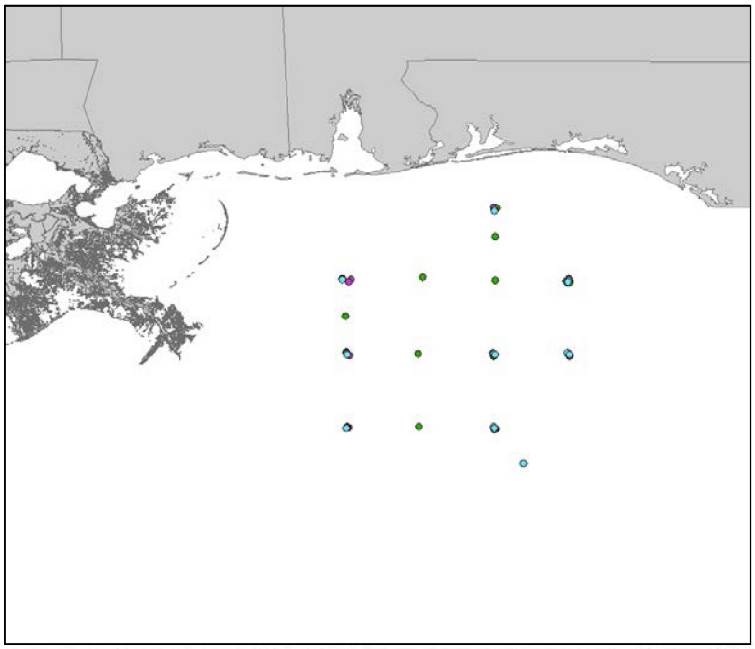

Figure 6. Locations of SEAMAP neuston samples collected from 2006 – 2008, magenta points=2006 (16 samples), green=2007 (21 samples), and blue=2008 (14 samples).

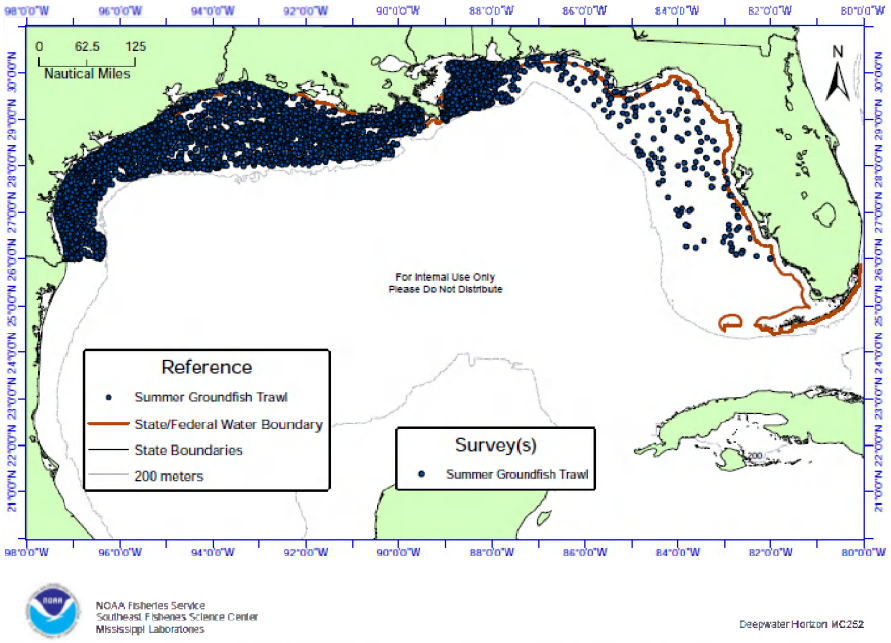

Figure 7. Locations of SEAMAP Summer Groundfish Plankton Survey effort from 1987-2009.

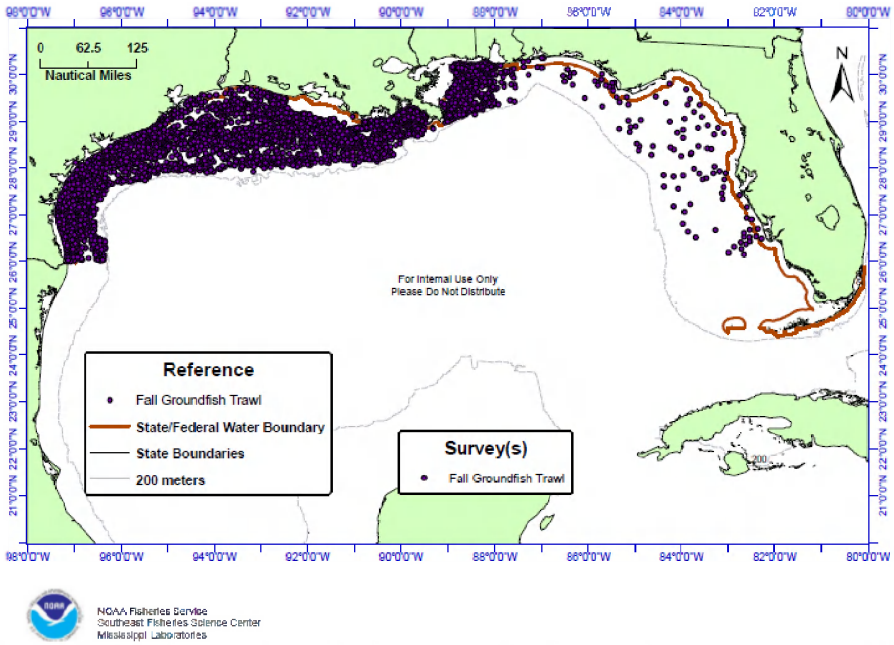

Figure 8. Locations of SEAMAP Fall Groundfish Plankton Survey effort from 1987-2009.

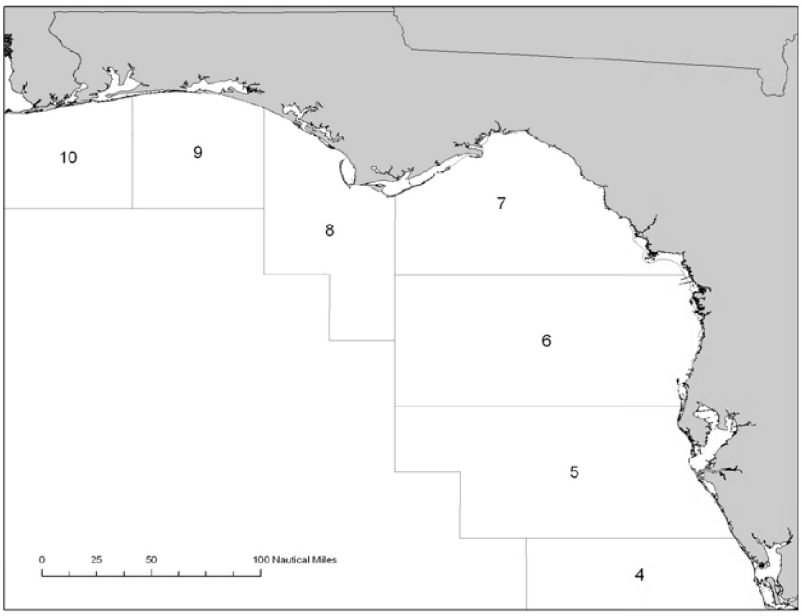

Figure 9: NMFS statistical shrimp zones (4 – 10) within coastal Florida waters.

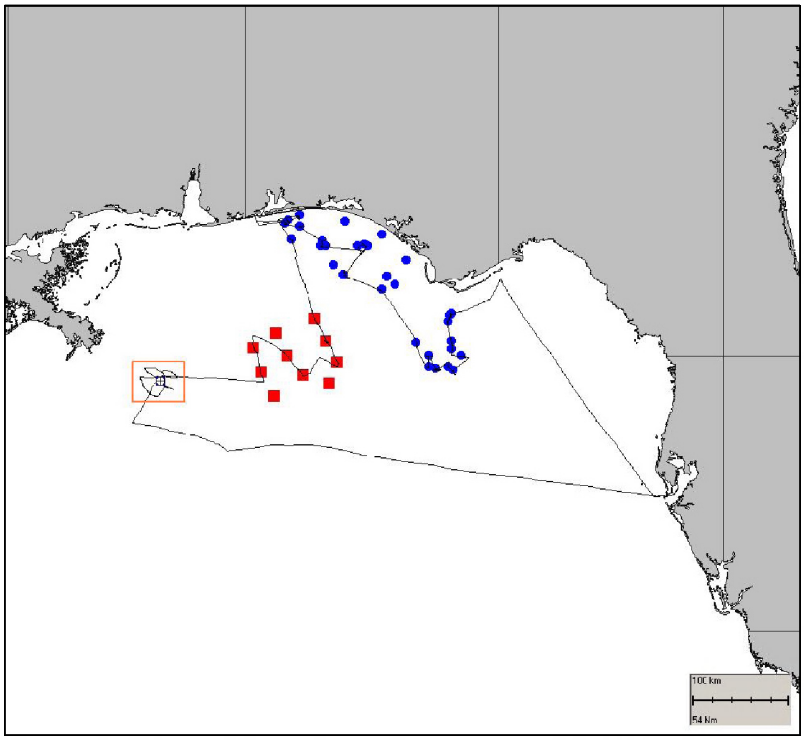

Figure 10. Ship trackline and sampling coverage of the FL Institute of Oceanography, FWC, USF - RV Weatherbird II cruise - SEAMAP/SIPPER May 5-17, 2010.

SEAMAP FIELD OPERATIONS MANUAL

FOR COLLECTION OF DATA

Prepared by:

NATIONAL MARINE FISHERIES SERVICE

and

GULF STATES MARINE FISHERIES COMMISSION

October 2001 (Revision No. 4)

FOREWORD

This manual presents the procedures to be followed by all vessels that participate in the Southeast Area Monitoring and Assessment Program (SEAMAP) surveys. These procedures have been established and agreed to by the Gulf SEAMAP Subcommittee for the purpose of standardizing data collection.

This manual is not meant to be a static document. The document will be updated as new types of surveys and modification of existing surveys are introduced. This is the fourth (4th) revision to this manual.

Please report problems or errors in this document to one of the following personnel:

Rob Ford
National Marine Fisheries Service
P O Drawer 1207
Pascagoula, MS 39568-1207
(228) 762-4591 ext. 286

Jeff Rester
SEAMAP-Gulf Coordinator
Gulf States Marine
Fisheries Commission
P O Box 726
Ocean Springs, MS 39564
(228) 875-5912

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INTRODUCTION

The following is a SEAMAP operations manual for use aboard all designated SEAMAP survey vessels. The procedures in this manual have been agreed to by the SEAMAP Subcommittee in order to standardize SEAMAP data collection. These procedures are the sequence of events to be followed on each station for SEAMAP cruises. All vessels may not adhere to this sequence rigidly as they may not all have the same environmental, plankton or biological collecting gears. For those vessels lacking certain types of sampling apparatus, these methods will still apply. If for some reason procedures in this manual are not followed, please take the time to document the procedures used for your particular survey.

This manual is composed of five sections. Three sections address the major types of SEAMAP survey data: biological or trawling data, environmental data, and ichthyoplankton data. One section addresses Real-Time Data. A new section on the trawling gear has been added. New material has been included for using the electronic measuring boards, CTD, and STD.

On all SEAMAP surveys, a Pascagoula Station Sheet Type I-IV must be completed for every station- trawl station, environmental station, or plankton station. The following general instructions apply to all types of data sheets- Biological, Environmental, and Plankton:

> Please use a soft lead pencil and make entries DARK enough and LEGIBLE enough so that the key entry operator can read them. All numeric fields are to be right justified or aligned with the decimal place. A leading zero is not required, but enter any trailing zeros.

I. COLLECTING BIOLOGICAL DATA

I. COLLECTING BIOLOGICAL DATA

A. Introduction

SEAMAP surveys use trawling gear to collect biological data (i.e. finfish, shrimp, and other invertebrates). Prior to 1987 three types of SEAMAP trawling surveys were: offshore butterfish, summer shrimp (Texas Closure), and fall groundfish. The offshore butterfish surveys were discontinued in 1986. The same survey design for the summer shrimp (Texas Closure) and fall groundfish surveys have been used from 1987 to the present.

B. Summer and Fall Trawl Surveys

1. Trawling - sampling will be conducted around the clock with an equal number of day and night stations. Day and night are sampled as independent strata. (Note: Several of the state vessels will not be able to operate around the clock or at night due to size limitations and availability of personnel).

2. Survey strategy - SEAMAP sampling sites are chosen randomly within strata determined by depth and statistical area (two or three areas per stratum). Sampling sites in water depths of 5-20 fathoms, stations occur at 1 fathom strata; 20-22 fathom stations at 2 fathom strata; 22-25 fathom stations at 3 fathom strata; 25-50 fathom stations at 5 fathom strata, and finally a 50-60 fathom stratum. Trawls are towed perpendicular to the depth contours and cover the entire depth stratum for each sample site. Towing time can vary from a **minimum of 10 minutes** to a **maximum of 55 minutes.** For sample sites with depth strata that cannot be covered by a single 55 minute tow, a series of consecutive trawl tows (2, 3, or 4) will be necessary to cover that depth stratum. Each tow receives a separate station number. An extremely narrow stratum may be towed obliquely to ensure at least 10 minutes towing time.

3. Sampling Catch

   a. If the total weight of the catch is less than **22.7 kilos** and is not excessively diverse in species composition, then the entire catch shall be processed. If a catch is especially diverse, then the watch leader may exercise the option of sampling.

   b. If the total weight of the catch is between **22.7** and **45.4 kilos,** obtain a sample equal to 50% of the total weight and process.

   c. If the total weight of the catch is between **45.4** and **90.7 kilos,** obtain a sample equal to 25% of the total weight and process.

   d. If total weight of catch is between **90.7** and **136.0 kilos,** obtain a sample equal to 18% of the total weight and

process.

e. If the total weight of catch is greater than **136.0 kilos**, obtain a sample equal to 12% of the total weight and process.

Note: If time allows, the watch leader should process the entire catch regardless of catch weight.

4. Processing Catch (Sample)

a. Separate entire catch or aliquot sample into its component species, then weigh (a species total weight) and count the number of individuals for each species.

b. Record species, weight, and number on field data sheet, NMFS Pascagoula Station Sheet-Type II.

c. Measure all organisms that are identified to the species level. Do not measure organisms identified to the genus or higher taxon. Record measurements on the General Length Frequency Form.

d. Process shrimp species in the following prescribed manner:

(1) **For the summer survey only, to include: sex, length frequency, and weight.** *Farfantepenaeus aztecus* (brown shrimp), *F. duorarum* (pink shrimp) and *Litopenaeus setiferus* (white shrimp) will be separated from each trawl catch station. Total count and weight by species will be recorded. A random sample of up to 200 of each species from each trawl catch will be sexed, then weighed and measured by sex to obtain length frequency data. On SEAMAP stations where more than one trawl tow is necessary to cover the depth stratum, shrimp from each haul will be worked up separately as described above. Shrimp data will be recorded only on the Shrimp Length Frequency Form or measured on the electronic measuring boards. Do not record on the General Length Frequency Form.

(2) **For the fall survey, shrimp are treated the same as finfish and other invertebrates. Only 20 shrimp length frequencies are recorded per station.**

e. Proceed to the next station.

C. NMFS Pascagoula Station Sheet - Types I-IV Instructions

1. GENERAL COMMENTS- A Pascagoula Station Sheet MUST be completed for every SEAMAP station. The top section (down to the heavy black line across page) MUST be completed for each station occupied, regardless of gear types(s) used. There are four types of NMFS Pascagoula Station Sheets, Types I to IV. Each type of data sheet has the same data entry fields except for the species list. The Type I data sheet species list is blank, and is used primarily for plankton surveys and as a continuation sheet for the other three types. The Type II data sheet lists dominant species encountered at depths of 0-49 fathoms (Figure 1-1, page 1-10), Type III for depths of 50-149 fathoms, and Type IV for depths of 150-300 fathoms.

Please use a lead pencil and make entries DARK enough and LEGIBLE enough so that the key entry operator can read them. All numeric fields are to be right justified or aligned with the decimal place. Leading zeros are not required, but enter trailing zeros.

2. Data Requirements For All Stations:

FIELD BY FIELD INSTRUCTIONS

VESSEL - Enter 2-digit numerical code from Appendix 1, Vessel Codes, page A-2. If your vessel has not been assigned a code, notify NMFS Pascagoula to receive one.

PASCAGOULA STATION NUMBER - This is a unique sequential consecutive 5-digit number within each cruise, preferably starting with "00001". For state vessels enter the 2-digit vessel code followed by a 3-digit station number. Transfer this station number to the environmental or plankton sheet. Do not duplicate this station number for other stations on a cruise.

CRUISE - Enter 3-digit cruise number. Except for the Oregon II and other vessels having historically different cruise numbering conventions, the cruise number for **ALL VESSELS** shall be the calendar year of the survey followed by the cruise number for the year, e.g. "011" first cruise for year 2001, "012"- second cruise for year 2001, etc. The leading zero is required. Use this cruise number on all sheets during a cruise; do not change it.

START TIME - Obtain time zone code from Appendix 2-A, Time Zone Codes, page A-3. Enter military time (0000-2359), HHMM, of start of station. For fishing stations, enter dog-off time or end of gear set. For environmental and plankton stations, enter the time data acquisition started.

START LATITUDE & LONGITUDE - Enter position occupied at start time in degrees, minutes, and hundredths of minutes, observing indicated decimals and entering trailing zeros.

START DEPTH - Enter starting depth in fathoms and tenths.

SEAMAP/OTHER STATION NO. - Use for SEAMAP or other alternate station numbers. For SEAMAP Station numbers, use four alpha/numeric characters and right justify, but be consistent in field length - all numbers should be the same number of characters, T065, W102, **NOT T65 or W0102.**

DATE - Enter station date (based on start time), in the format MMDDYY.

END TIME - Enter as for start time - fishing stations end at start of haulback, others when data acquisition ends.

END LATITUDE & LONGITUDE - Enter position occupied at end time in degrees, minutes, and hundredths of minutes, observing indicated decimals and entering trailing zeros.

END DEPTH - Enter end depth in fathoms and tenths, observing the indicated decimal and entering a trailing zero.

GEAR TYPES USED AT THIS STATION - Enter codes for all gear types used- see Appendix 3, Gear Codes and Examples on Use, page A-3.

SURFACE AND BOTTOM TEMPERATURES - If taken, enter temperatures in degrees Celsius, observing 2 indicated decimals. Add trailing zeros if necessary. If more than one method is used, data entry precedence is 1) CTD, 2) XBT, and 3) bucket.

Wind speed and direction may be measured by either the ship's onboard instruments or handheld anemometers and a compass. Hand held anemometers and compasses are available from wildlife and fishery supply houses. All weather data should be rounded off to nearest hour, i.e. if the time is 13:31 then record weather data collected at 14:00 hours.

AIR TEMPERATURE - Enter in degrees Celsius and tenths (dry bulb), observing 1 indicated decimal.

BAROMETRIC PRESSURE - Enter in millibars of mercury, observing 1 indicated decimal.

WIND SPEED - Enter wind speed in knots, no decimals.

WIND DIRECTION - Enter wind direction in compass degrees, 001-360.

WAVE HEIGHT - Enter wave height in meters, observing 1 indicated decimal.

SEA CONDITION - Enter Beaufort scale- see Appendix 2-B,

Beaufort Sea Condition Table, page A-3.

DATA SOURCE CODE - Enter code identifying data collecting entity- see Appendix 2-C, Data Source Codes, page A-3.

VESSEL SPEED - Enter vessel speed, in knots, during the station, observing 1 indicated decimal.

STATISTICAL ZONE - Enter GCSD statistical zone from Figure 1-2, page 1-11. Leave blank if you are outside a statistical zone.

TOW NO. - Consecutive number of the tow within a SEAMAP station.

NET NO. - 1 = Port, 2 = Starboard and 3 = Stern Trawl.

The data above must be recorded regardless of type of station.

3. Data Requirements For Biological And Trawling stations:

FIELD BY FIELD INSTRUCTIONS

NMFS FAUNAL ZONE - Enter NMFS Faunal Zone from Figure 1-3, page 1-12.

GEAR SIZE - Enter gear size as follows:

Trawls - headrope length in feet
Longlines (surface, bottom, and off-bottom) - number of hooks returned
Traps - number returned
Handlines, trolling gear - number of lines fished.
Other - see FPC or contact Pascagoula data management

GEAR TYPE - Enter the code for fishing gear type used from Appendix 3, Gear Codes with Examples On Use, page A-4.

MESH SIZE - Enter stretched mesh size in inches:
a **40-ft trawl** is **1.58 inches**
a **65-ft trawl** is **2.00 inches**

OPERATION - Enter codes only for unsuccessful or abnormal stations from Appendix 4, Operation Codes, page A-6.

MINUTES FISHED - Enter minutes actually fished (end set to start haulback; **55 minutes maximum for SEAMAP trawl stations**).

WATER COLOR - Enter the gross water color, daytime only, from Appendix 5-A, Water Color Codes, page A-7.

BOTTOM TYPE - Enter from Appendix 5-B, Bottom Type, page A-7, if known. Left justify if code is one character.

BOTTOM REGULARITY - Enter from Appendix 5-C, Bottom regularity, page A-7, if known.

TOTAL LIVE CATCH - Enter total **LIVE** catch in kilograms, observing 1 decimal. For extremely small catches, you must enter a minimum weight of 0.1 kg. DO NOT include weight of dead shell, mud, sand, wood, rocks, trash, etc. Such items should be mentioned in the comments section or with an operation code. Use an actual or estimated weight, but do make an entry.

FINFISH, CRUSTACEANS, AND OTHER LIVE CATCH - Record in these sections the totals for each category in kilos and tenths. These should reflect the ENTIRE live catch, not just the sample or select weight. When completed, these figures should add up to the "total live catch" weight above. When working up the entire catch, obtain total weight for each category and record. For catches which were sampled, it is necessary to extrapolate from the sample weights to obtain the total weights. This is done by using the formula:

$$\frac{(A-B)}{C} \times D + E = F$$

where:

A = Total live catch.
B = Select weight (weight of all species removed from the catch in their entirety).
C = Total sample weight.
D = Sample weight of category (finfish, crustaceans, or others).
E = Select weight of category (finfish, crustaceans, or others).
F = Total catch weight of category. Record this figure in the appropriate block. Enter at least 0.001 if a category is represented.

This operation should be performed for each category. The "Other live catch" includes any organisms that are not finfish or crustaceans, such as squid, jellyfish, starfish, horse shoe crabs, sea-turtles, sea grasses, mollusks, etc.

The following two fields should be completed ONLY if the catch was sampled.

SELECT WEIGHT - Enter total weight of all species removed from the catch IN THEIR ENTIRETY. This will normally include commercial shrimp; some food or sport fish; sharks, skates, rays, or other large fish; or other species that are rare or poorly represented in the catch. Observe 3 decimal places. Do not record any weight data in this section if the catch was NOT sampled.

SAMPLE WEIGHT- Total weight of the sample, obtained by summing the various sample components. Be sure not to include any of the 'select' species in the sample. Observe 3 decimal places. DO NOT record data in this section if the catch was NOT sampled.

SPECIES DATA SECTION - Crustacea, other, finfish. The Pascagoula Types II-IV station sheet contains pre-printed lists based on working depth, the Type I does not have a pre- printed species list, use it for a continuation sheet or for a plankton station.

GENUS AND SPECIES - Locate organism in pre-printed species list. If not present, enter first seven characters of genus name and first six of species name, or, if not identified to species level, enter up to thirteen characters of genus, family, class, etc. Refer to Appendix A-6, Alphabetic List of Length Frequency Codes, page A-8, for genus and species names.

YOY - Make an entry from the codes below only if: **T**wo distinct size classes occur for a species; **S**amples were taken; organisms were **C**ounted, but no weight is available; the organism(s) weight was **E**stimated; or if colonial organisms such as sponges, corals, or zoobotryon were **W**eighed, but not counted. Otherwise, leave this field blank.

YOY Entry Codes:
T- denotes young of the year.
S- denotes specimens were retained frozen or preserved.
C- denotes counts were recorded without a weight.
E- denotes an estimated weight was recorded.
W- denotes a recorded weight, but individual numbers are unavailable, for colonial organisms, sponges, corals, etc.

NUMBER - Enter number of individuals in SELECT or SAMPLE. For some colonial organisms, sponges and corals, enter the number of pieces.

SAMPLE WT.(kg) - Enter weight in kilos of organism in the SAMPLE column, observing three decimal places. Enter trailing zeros where needed.

SELECT WT.(kg) - Enter weight in kilos of organism in the SELECT column, observing three decimal places. Enter trailing zeros where needed. IMPORTANT: If the catch was worked up in its entirety (not sampled), ALL weight entries will be in the SELECT column. Do not list a species in both the sample and SELECT column.

Subtotal the sample and select weights columns for each category, then combine for total sample and select weights.

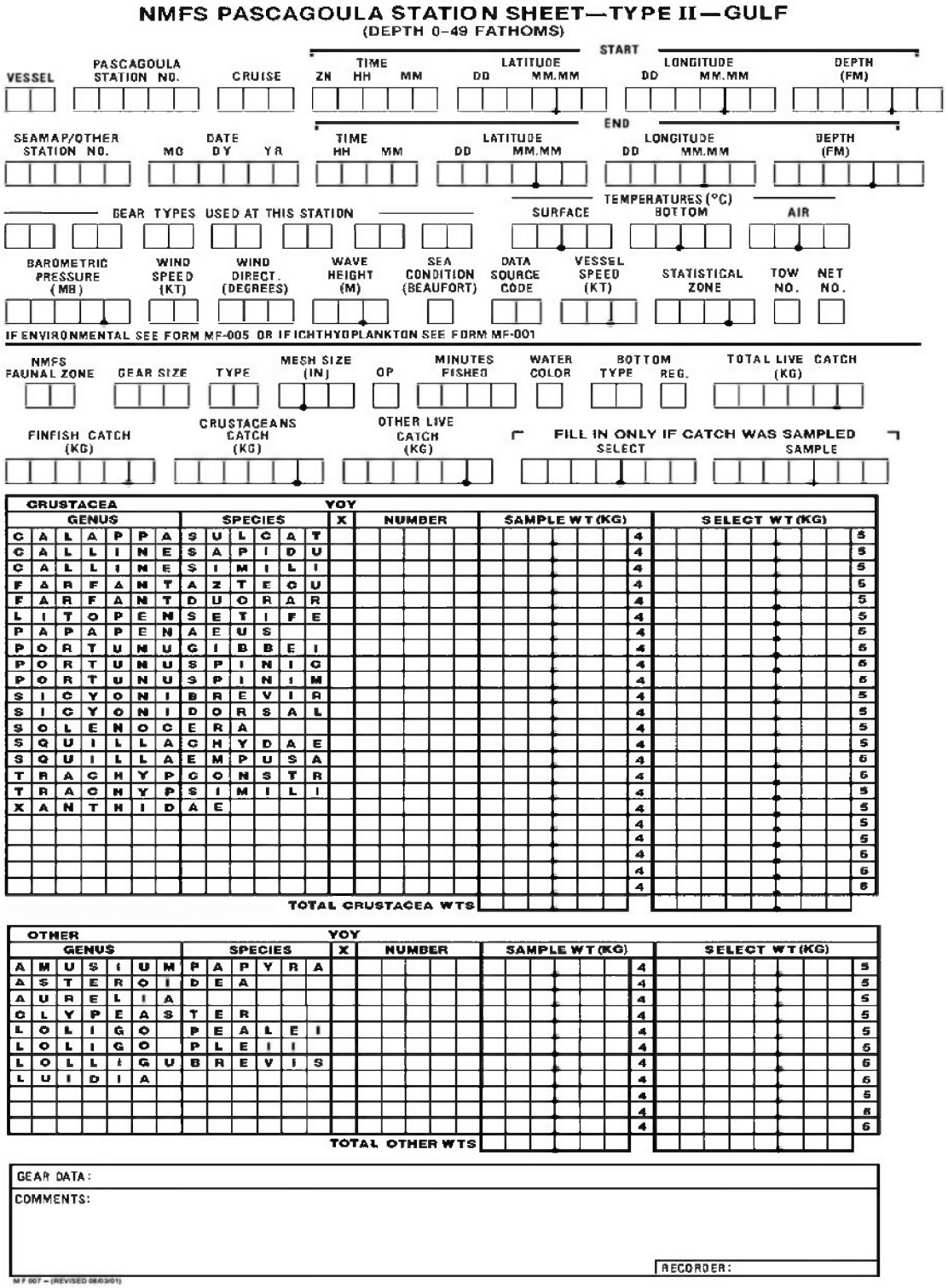
GEAR DATA - Detail gear used. If the same gear is to be used for the entire cruise, this section need be filled out only

for the first station.

COMMENTS - Enter comments or observations, problems encountered, samples saved, etc.

RECORDER - Enter initials of person(s) completing form.

Figure 1-1. NMFS Type II Field Data Sheet.



NMFS PASCAGOULA STATION SHEET—TYPE II—GULF

(DEPTH 0-49 FATHOMS)

START

VESSEL | PASCAGOULA STATION NO. | CRUISE | TIME ZN HH MM | LATITUDE DD MM.MM | LONGITUDE DD MM.MM | DEPTH (FM)

END

SEAMAP/OTHER STATION NO. | DATE MO DY YR | TIME HH MM | LATITUDE DD MM.MM | LONGITUDE DD MM.MM | DEPTH (FM)

GEAR TYPES USED AT THIS STATION

TEMPERATURES (°C): SURFACE | BOTTOM | AIR

BAROMETRIC PRESSURE (MB) | WIND SPEED (KT) | WIND DIRECT. (DEGREES) | WAVE HEIGHT (M) | SEA CONDITION (BEAUFORT) | DATA SOURCE CODE | VESSEL SPEED (KT) | STATISTICAL ZONE | TOW NO. | NET NO.

IF ENVIRONMENTAL SEE FORM MF-005 OR IF ICHTHYOPLANKTON SEE FORM MF-001

NMFS FAUNAL ZONE | GEAR SIZE | TYPE | MESH SIZE (IN) | OP | MINUTES FISHED | WATER COLOR | BOTTOM TYPE | REG. | TOTAL LIVE CATCH (KG)

FINFISH CATCH (KG) | CRUSTACEANS CATCH (KG) | OTHER LIVE CATCH (KG) | FILL IN ONLY IF CATCH WAS SAMPLED: SELECT | SAMPLE

CRUSTACEA — YOY

GENUS	SPECIES	X	NUMBER	SAMPLE WT (KG)		SELECT WT (KG)	
CALAPPA	SULCATA				4		5
CALLINES	SAPIDUS				4		5
CALLINES	SIMILIS				4		5
FARFANTE	AZTECUS				4		5
FARFANTE	DUORARUM				4		5
LITOPENS	SETIFERE				4		5
PAPAPEN	AEUS				4		5
PORTUNUS	GIBBESI				4		5
PORTUNUS	SPINICOR				4		5
PORTUNUS	SPINIMAN				4		5
SICYONIA	BREVIROS				4		5
SICYONIA	DORSALIS				4		5
SOLENOCE	ERA				4		5
SQUILLAC	HYDAE				4		5
SQUILLA	EMPUSA				4		5
TRACHYPE	CONSTRI				4		5
TRACHYPE	SIMILIS				4		5
XANTHID	AE				4		5
					4		5
					4		5
					4		5
					4		5
					4		5
TOTAL CRUSTACEA WTS							

OTHER — YOY

GENUS	SPECIES	X	NUMBER	SAMPLE WT (KG)		SELECT WT (KG)	
AMUSIUM	PAPYRA				4		5
ASTEROID	DEA				4		5
AURELIA					4		5
CLYPEAST	TER				4		5
LOLIGO	PEALEI				4		5
LOLIGO	PLEII				4		5
LOLLIGUN	BREVIS				4		5
LUIDIA					4		5
					4		5
					4		5
					4		5
TOTAL OTHER WTS							

GEAR DATA:

COMMENTS:

RECORDER:

MF 007 – (REVISED 08/03/01)

Figure 1-2. NMFS Gulf Shrimp Landing Statistical Zones.

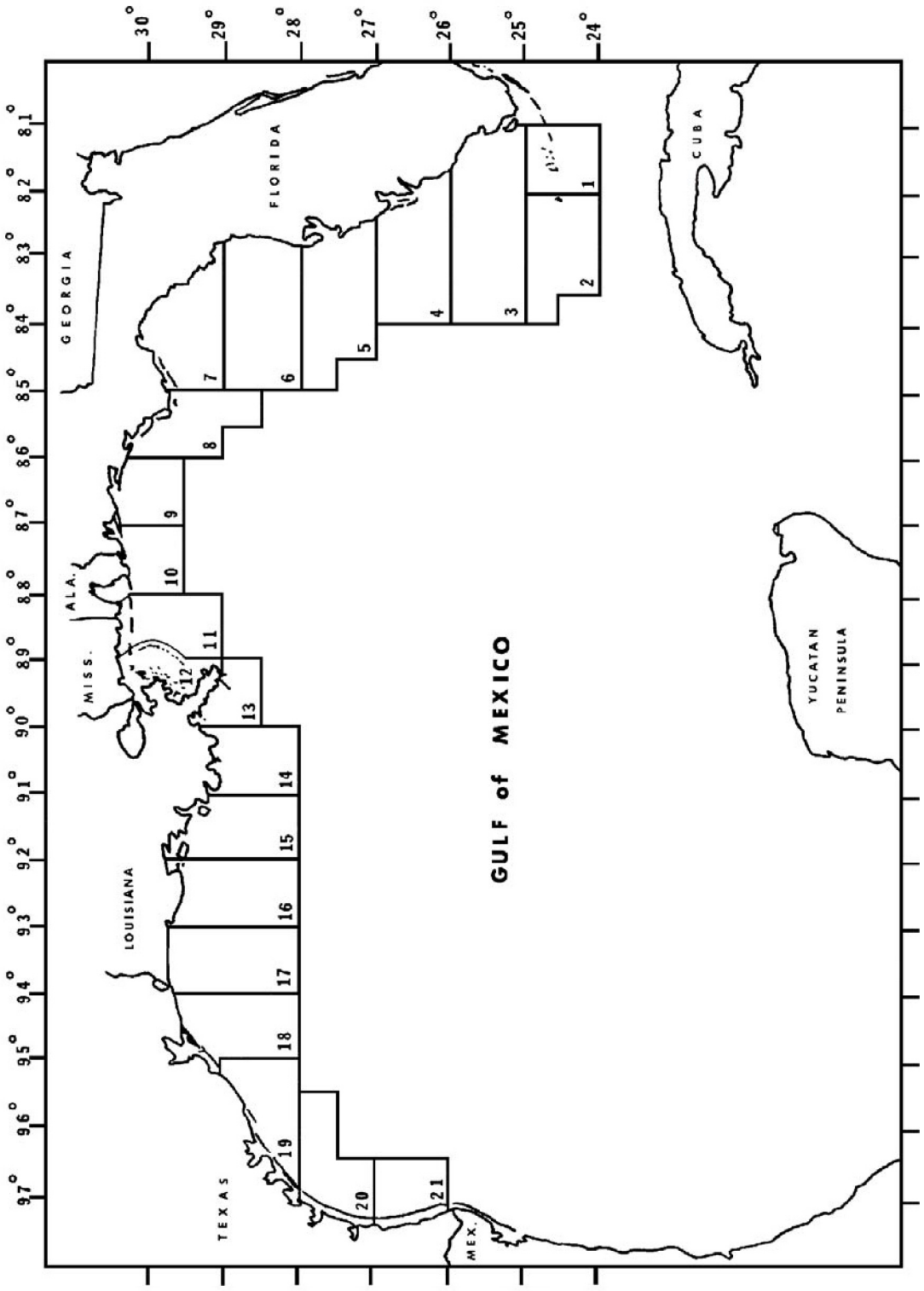
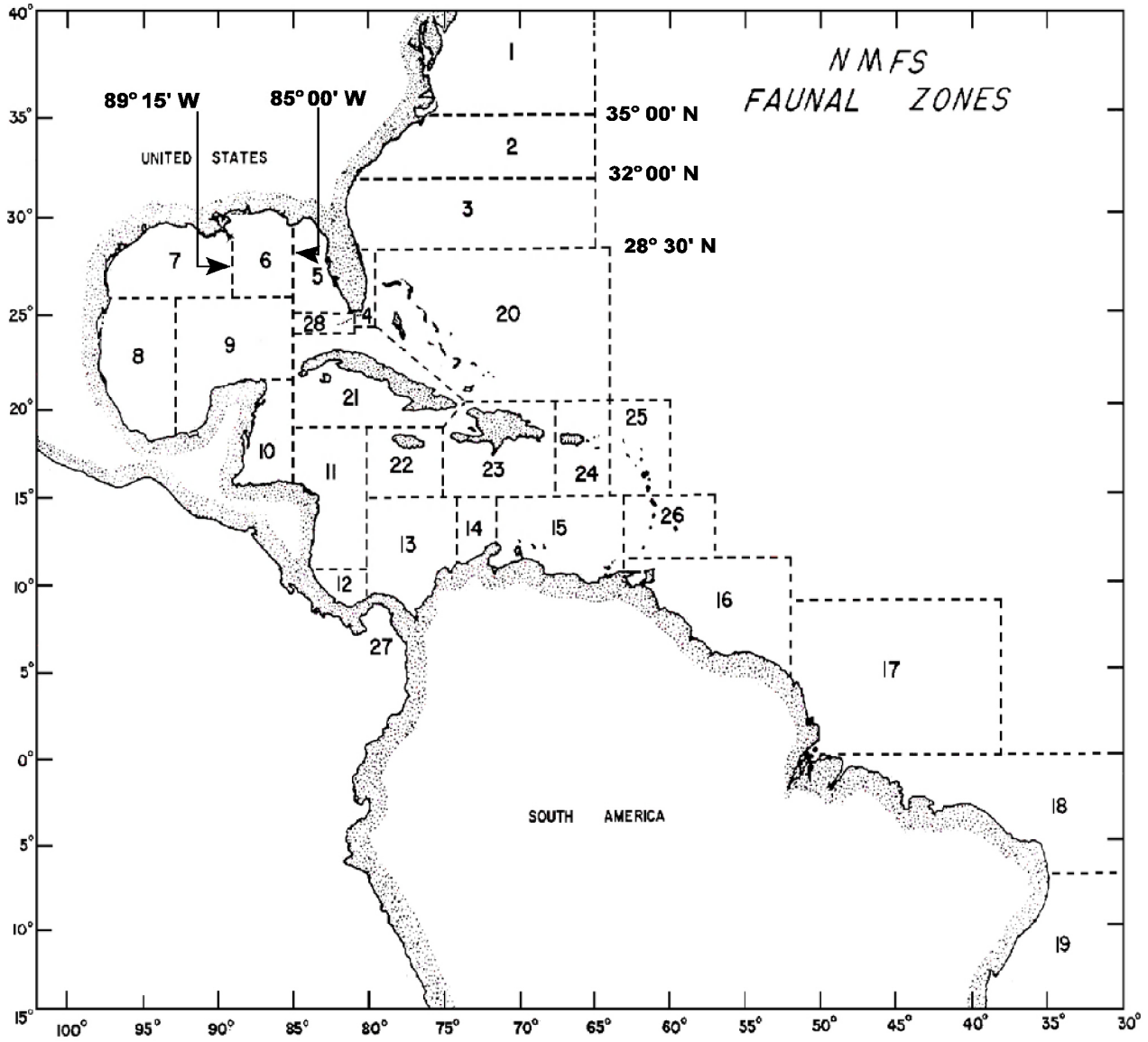


Figure 1-3. NMFS Faunal Zones.



D. NMFS LENGTH FREQUENCY FORM INSTRUCTIONS

1. INTRODUCTION

Length frequency data can be collected using a measuring board with millimeter divisions or the electronic fish measuring boards.

The General Length Frequency Data Form (Figure 1-4), page 1-14 can hold up to eight different species measurements for a given station. Please measure all or as many dominant species as possible for a given station (only if identifiable to the species level). For each station, randomly select a maximum of 20 specimens, or less if present, for a given species and sex every fifth one.

If more than one measurement per fish is taken or specimens are individually weighed, use the NMFS Reef/Large Fish Length Frequency Detailed Meristics Form (Figure 1-5), page 1-16.

The electronic fish measuring boards can be used in place of the General Length Frequency Data Form, NMFS Reef/Large Fish Length Frequency Detailed Meristics Form, and Shrimp Length Frequency Form.

2. GENERAL LENGTH FREQUENCY FORM (Figure 1-4) INSTRUCTIONS

VES-STATION-CRUISE-DATA SOURCE - Transcribe from Pascagoula station sheet Type II.

GENUS-SPECIES - Record first seven characters of the genus and the first six of the species.

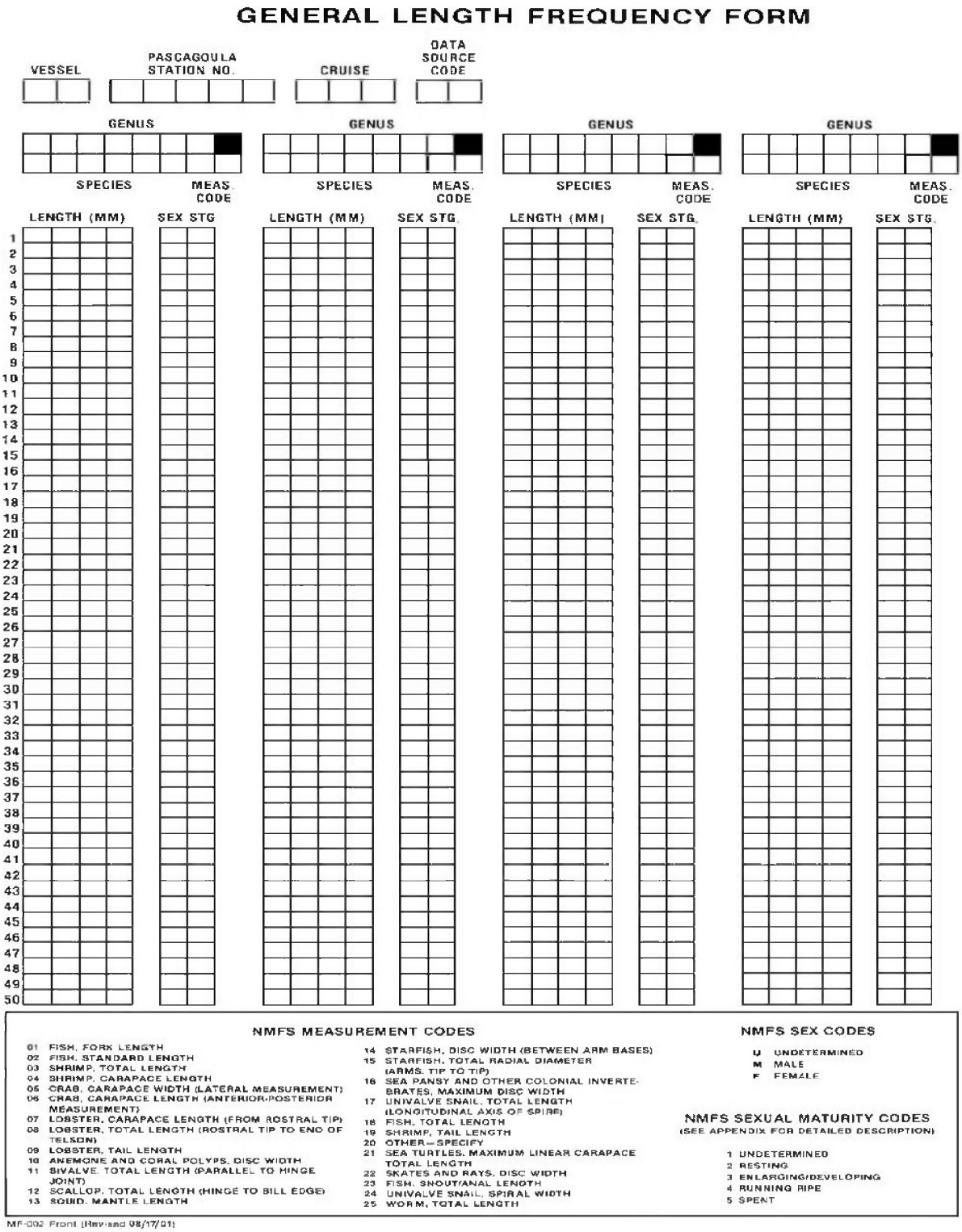
MEASUREMENT CODE - See Appendix 6, Alphabetic List of Species Length Frequency Measurement Codes, page A-8, for species length measurement codes. For species not listed refer to Appendix 7, Length Frequency Measurement Code Finder List, page A-19. Consult FPC if you are unsure of which measurement to use. A consistent measurement should be used for each species.

LENGTH - Enter measurement in millimeters.

SEX - Enter code:
U = Undetermined
M = Male
F = Female

STAGE - See Appendix 9, Five Point Sexual Maturity Scale, page A-27, for sexual maturity stage codes.

Figure 1-4. General Length Frequency Form.



GENERAL LENGTH FREQUENCY FORM

VESSEL | PASCAGOULA STATION NO. | CRUISE | DATA SOURCE CODE

GENUS / SPECIES / MEAS. CODE

LENGTH (MM) | SEX STG.

NMFS MEASUREMENT CODES

01 FISH, FORK LENGTH
02 FISH, STANDARD LENGTH
03 SHRIMP, TOTAL LENGTH
04 SHRIMP, CARAPACE LENGTH
05 CRAB, CARAPACE WIDTH (LATERAL MEASUREMENT)
06 CRAB, CARAPACE LENGTH (ANTERIOR-POSTERIOR MEASUREMENT)
07 LOBSTER, CARAPACE LENGTH (FROM ROSTRAL TIP)
08 LOBSTER, TOTAL LENGTH (ROSTRAL TIP TO END OF TELSON)
09 LOBSTER, TAIL LENGTH
10 ANEMONE AND CORAL POLYPS, DISC WIDTH
11 BIVALVE, TOTAL LENGTH (PARALLEL TO HINGE JOINT)
12 SCALLOP, TOTAL LENGTH (HINGE TO BILL EDGE)
13 SQUID, MANTLE LENGTH
14 STARFISH, DISC WIDTH (BETWEEN ARM BASES)
15 STARFISH, TOTAL RADIAL DIAMETER (ARMS, TIP TO TIP)
16 SEA PANSY AND OTHER COLONIAL INVERTEBRATES, MAXIMUM DISC WIDTH
17 UNIVALVE SNAIL, TOTAL LENGTH (LONGITUDINAL AXIS OF SPIRE)
18 FISH, TOTAL LENGTH
19 SHRIMP, TAIL LENGTH
20 OTHER—SPECIFY
21 SEA TURTLES, MAXIMUM LINEAR CARAPACE TOTAL LENGTH
22 SKATES AND RAYS, DISC WIDTH
23 FISH, SNOUT/ANAL LENGTH
24 UNIVALVE SNAIL, SPIRAL WIDTH
25 WORM, TOTAL LENGTH

NMFS SEX CODES

U UNDETERMINED
M MALE
F FEMALE

NMFS SEXUAL MATURITY CODES
(SEE APPENDIX FOR DETAILED DESCRIPTION)

1 UNDETERMINED
2 RESTING
3 ENLARGING/DEVELOPING
4 RUNNING RIPE
5 SPENT

MF-002 Front (Revised 08/17/01)

3. NMFS REEF/LARGE FISH DETAILED MERISTICS FORM INSTRUCTIONS,(Figure 1-5)

VES-STATION-CRUISE-DATA SOURCE - Transcribe from Pascagoula Station Sheet Type II.

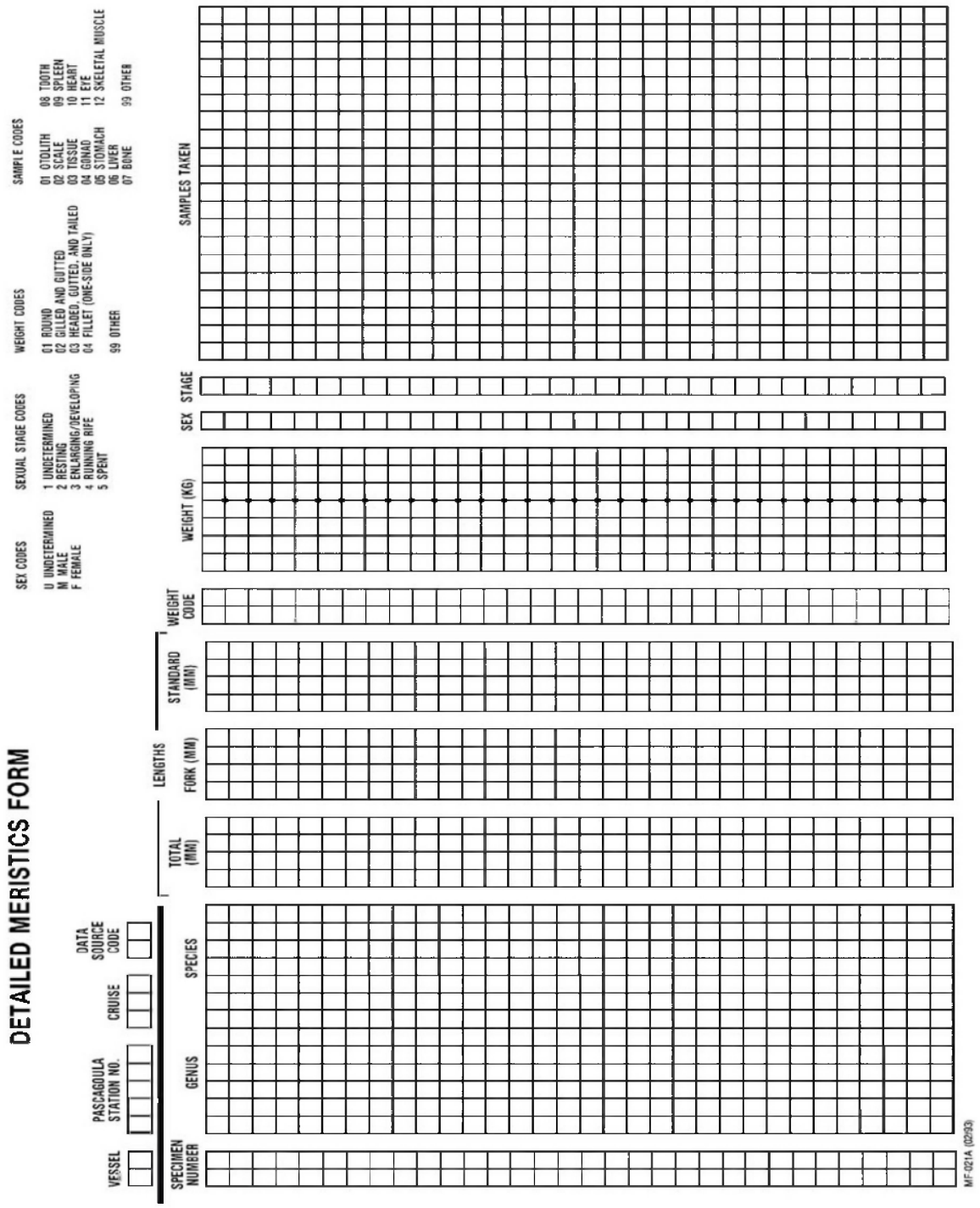
GENUS-SPECIES - Record first seven characters of the genus and the first six of the species.

TOTAL-FORK-STANDARD LENGTH - Record in millimeters.

WEIGHT - Record in kilograms, observing 2 indicated decimals.

SEX AND SEXUAL STAGE CODES - Obtain from top of form defined in Figure 1-4. These are not the same sexual stage codes as in Appendix 8 that are used for the General Length Frequency Form.

Figure 1-5. NMFS Reef/Large Fish Detailed Meristics Form.



4. SHRIMP LENGTH FREQUENCY FORM

The Shrimp Length Frequency Form (Figure 1-6, page 1-18) will be used only during the Summer SEAMAP Shrimp Survey. Please use the General Length Frequency Form, Figure 1-4 above, to measure shrimp during other SEAMAP Surveys. One Shrimp Length Frequency Form should be completed for each commercial shrimp species caught.

SHRIMP LENGTH FREQUENCY FORM INSTRUCTIONS

VESSEL, PASCAGOULA STATION NUMBER, CRUISE, DATA SOURCE CODES- Carry this data forward from the NMFS Pascagoula Station Sheet-TYPE II.

GEAR TYPE- 1 = SEMI-BALLOON
2 = BALLOON
3 = FLAT
4 = TRYNET
5 = MONGOOSE
6 = NO MUD ROLLERS
7 = WESTERN JIB

CATCHES (CRUSTACEA, FINFISH, SHRIMP, MISC., BROWN, PINK, WHITE)- Complete the detailed catch information below only for the first shrimp L/F sheet for a station. This information is automatically filled out by the data entry system for subsequent sheets for a station.

CRUSTACEA- Enter crustacea weight (including shrimp), in kilos, observing one indicated decimal.

FINFISH - Enter finfish catch weight, in kilos, observing one indicated decimal.

SHRIMP - Enter total shrimp catch weight, in kilos, observing one indicated decimal.

MISC. - Enter miscellaneous weight. (total catch minus fish and shrimp),in kilos, observing one indicated decimal.

BROWN, PINK, WHITE - Enter weight of each species caught, in kilos, observing three indicated decimals.

SPECIES CODE - enter **B** (brown), **P** (pink), or **W** (white)

TOTAL NUMBER CAUGHT/SPECIES - Enter total number of shrimp caught by species, right justified.

MEASUREMENTS -Randomly select up to 200 shrimp per species, then separate by sex. Measure total length from the tip of the rostrum to the tip of the telson in millimeters. Do not measure broken shrimp, substitute a similarly sexed shrimp from any excess over 200. Record and weigh by sex only the measured shrimp. The first block after each length is for tally marks, the second block is for a final number of tallies.

Figure 1-6. Shrimp Length Frequency Form.

SHRIMP LENGTH FREQUENCY FORM

VESSEL | PASCAGOULA STATION NO. | CRUISE | DATA SOURCE CODE | GEAR TYPE

Species Code
Brown = B
White = W
Pink = P

CRUSTACEA CATCH (KG) | FINFISH CATCH (KG) | SHRIMP CATCH (KG) | MISCELLANEOUS CATCH (KG)

BROWN SHRIMP (KG) | PINK SHRIMP (KG) | WHITE SHRIMP (KG)

SPECIES

TOTAL NO. CAUGHT/SPECIES

FEMALE										MALE									
TOTAL			TOTAL			TOTAL				TOTAL			TOTAL			TOTAL			
L mm			L mm			L mm				L mm			L mm			L mm			
50			4			8				50			4			8			
1			105			9				1			105			9			
2			6			160				2			6			160			
3			7			1				3			7			1			
4			8			2				4			8			2			
55			9			3				55			9			3			
6			110			4				6			110			4			
7			1			165				7			1			165			
8			2			6				8			2			6			
9			3			7				9			3			7			
60			4			8				60			4			8			
1			115			9				1			115			9			
2			6			170				2			6			170			
3			7			1				3			7			1			
4			8			2				4			8			2			
65			9			3				65			9			3			
6			120			4				6			120			4			
7			1			175				7			1			175			
8			2			6				8			2			6			
9			3			7				9			3			7			
70			4			8				70			4			8			
1			125			9				1			125			9			
2			6			180				2			6			180			
3			7			1				3			7			1			
4			8			2				4			8			2			
75			9			3				75			9			3			
6			130			4				6			130			4			
7			1			185				7			1			185			
8			2			6				8			2			6			
9			3			7				9			3			7			
80			4			8				80			4			8			
1			135			9				1			135			9			
2			6			190				2			6			190			
3			7			1				3			7			1			
4			8			2				4			8			2			
85			9			3				85			9			3			
6			140			4				6			140			4			
7			1			195				7			1			195			
8			2			6				8			2			6			
9			3			7				9			3			7			
90			4			8				90			4			8			
1			145			9				1			145			9			
2			6			200				2			6			200			
3			7							3			7						
4			8							4			8						
95			9							95			9						
6			150							6			150						
7			1							7			1						
8			2							8			2						
9			3							9			3						
100			4							100			4						
1			155							1			155						
2			6							2			6						
3			7							3			7						

TOTAL WT. OF MEASURED SHRIMP

TOTAL WT. OF MEASURED SHRIMP

MP 604 Front (Revised 01/89)

E. Instructions for Electronic Fish Measuring Boards

1. Introduction

These fish measuring board (FMB) instructions are for Watch Leaders and field personnel who are measuring biological specimens. Instructions for data file manipulations and data entry corrections are separately available for the Field Party Chief.

The instructions are basic key strokes and directions on how to measure specimens. All length measurement codes used with the FMB are the same as those used for the General Length Frequency Data Forms. Refer to Appendix 8, Electronic Meauring Board Species Codes with Length Measurement Codes, page A-22, for the code for each species to be measured. Refer to Appendix 6, Alphabetic List of Length Frequency Measurement Codes, page A-8, for species lacking a FMB species code.

Note: References to "fish" measurements and their codes also refer to the various invertebrates that are measured.

2. Software Setup Instructions

a. Computer Setup

Field Party Chief/Watch Leader Input-- keyboard instructions are in *ITALICS*, keys to press and commands to enter are in **BOLD**, the computer prompt is underlined, and other comments are in normal text.

(1) At the C:> *TYPE* **CD\LIMNO**

(2) C:\LIMNO> *TYPE* **GO** The FMB software will then start and change directories to MS.

(3) C:\LIMNO\MAIN> *TYPE* **MM** The software will generate a window titled : MAIN MENU.

(4) MAIN MENU
In this screen, using the down arrow key, scroll to
(**3**)MAINTAIN CRUISE DATA FILES
and *PRESS* **ENTER**, the software will go to a new window. Your choices are:

*1. CREATE NEW CRUISE DATA FILE SET
2. USE EXISTING DATA FILE SET
3. BACKUP CRUISE DATA FILE SET
4. REMOVE CRUISE DATA FILE SET
5. RESTORE CRUISE DATA FILE SET

Scroll with the arrow keys to make a selection and *PRESS* **ENTER**, the screen should switch back to the previous menu with your selected "file.name" at the top. *PRESS* **ESC** key to return to the MAIN MENU.

*Note: If you select (**1**), CREATE NEW CRUISE DATA FILE SET, you must use a name that meets DOS file name conventions, i.e. no more than 8 characters (O4CR2004).

(5) Back to MAIN MENU (using the down arrow key) scroll down to: (**4**) START LDCE/FMB'S, *PRESS ENTER*

(6) Go turn on all the boards and then *TYPE* **Y**

(7) Limnoterra Data capture will appear on the screen. *Press* **any key** to continue. The screen will then display:

CRUISE REC.DATA

(8) CRS ID, *PRESS* **CONTROL END**, then **F8**. This will take you to a blank space for the cruise you are working on. If the space is blank, enter the cruise number. (**F7** will take you back if you went too far).

a. Vessel Code-type the vessel code (*PRESS* **F3** for a list).
b. Data Source Code-type the source code.
c. First Station Number-type the first station number.
d. Last Station Number-enter the number that you think will be the last station number for the cruise. This can be changed if it is too low.
e. Gear Code-enter the gear code-01. *PRESS* **F9** to SAVE DATA.

(9) *PRESS* **F7**, to return to the previous level. The **CTRL END**, and then ***F8*** keys will allow you to find a blank space to *ENTER* the **STATION NUMBER** and *ENTER* **YOUR INITIALS**. Leave the logon number blank. *PRESS* **F9** to SAVE DATA.

(10) *PRESS F7* to return to your station number. Now you are ready to begin measuring fish, shrimp, crabs, etc.

b. Tips on Keyboard Use -

CTRL END takes you to the end of a record level.
CTRL HOME takes you to the top of a record level.
F8 scrolls down and **F7** scrolls up from record to record.
F9 saves data.
F10 saves new (inserted) data

c. Data Editing - Field Party Chief/Watch Leaders Only

To edit data or to enter something you missed, go to the computer and call up that species record.

To call up a record, *PRESS* **CTRL PAGE UP**. This will take you to the CRS ID level. Then *PRESS* **CTRL PAGE DOWN** to go to the LOGIN level. *PRESS* **F8** to scroll down (**F7** scrolls

up) to your LOGIN level. *PRESS* **CTRL RIGHT ARROW** to go to the station level, then the **F8** key to scroll down to your station number.

d. First or Next New Station

A new station number is required to be entered at the computer prior to a station number entry at the measuring boards. To begin a new station, return to the computer and *PRESS* **CTRL LEFT ARROW** to return to the LOGIN # level. Leave the number blank, it is auto-assigned, and *ENTER* **YOUR INITIALS**, *PRESS* **F9** to SAVE. Caution: Only enter one new station at a time, if you enter more than one it will create a horrendous error. *PRESS* **CTRL RIGHT ARROW** to return to the station level and use the **END** or **F8** key to scroll to a blank. *ENTER* the new STATION number and *PRESS* **F9** to SAVE DATA. Now you can return to the boards and begin entering new data under the new station number.

e. Shrimp Corrections and Missed Data

This is for use during the Summer Shrimp measurements. *PRESS* **CTRL PAGE DOWN** to go to the shrimp level. *PRESS* **CTRL PAGE DOWN** again to go to the shrimp species (SH. SP.) level filler. Use the **F8** key to scroll to the desired species.

PRESS **CTRL PAGE DOWN** again to get to the shrimp sex. Use the **F8** key to scroll to the desired sex. *PRESS* **CTRL PAGE DOWN** again to get to shrimp weights. Now do a **CTRL RIGHT ARROW** to get down to the shrimp lengths.

Use the **F8** key to scroll to the desired length or blank. You can delete the field by pressing the **DELETE** or **BACKSPACE** key. When the field is empty, *PRESS* **INSERT** and enter in the correct or new data. *PRESS* **F10** to SAVE DATA.

f. Fish and Other Non-shrimp Corrections

Beginning at the shrimp level, *PRESS* **CTRL RIGHT ARROW** to go to the "Fish" level. Use the **F8** key to scroll down (**F7** to scroll up) to the desired species.

PRESS **CTRL PAGE DOWN** to go to the fish length. Use the **F8** key to scroll down (**F7** to scroll up) to the desired length error or blank.

You can delete the field by *PRESS*ing the **DELETE** or **BACKSPACE** key. When the field is empty, *PRESS* **INSERT** and enter in the correct or new data. *PRESS* **F10** to SAVE DATA.

3. Data Entry At The Boards

All data at the measuring boards are entered with a magnetic probe. To use it just touch the desired place on the board. PRESSING down hard does not make it work, just touch the place. Be careful where you place the probe when you are not using it! In these instructions, named places on the board are referred to as **[KEYS]**. Everything on the board that is enclosed in parentheses ( ) requires the **[SHIFT]** key to go to the shift function mode. Once in the **[SHIFT]** mode you stay there until you touch the **[EXIT SHIFT]** to exit shift mode. For each station, you must always enter in this order: CRUISE, INITIALS, and STATION NUMBER before entering data. When entering data always monitor the LCD screen for an **OK** or error message, and listen for the **BEEPS** when data is entered. If an **OK** does not appear, you made an error and it has to be corrected now. To correct an error, touch [EXIT SHIFT] and then [LDCE QUERY]. Wait for the data error to appear on the LCD screen and use the [BACKSPACE] or [DELETE] key to delete the record and then reenter the data. On the board there are arrows to scroll right and left for data editing.

a. Entering Station Data

(1) With the probe *TOUCH* the **[SHIFT]** key.
(2) *TOUCH* **[CRUISE #]**, Enter cruise number by touching numbers on the number line.
(3) *TOUCH* **[SAVE DATA]**, Look for the OK on the LCD screen and listen for beeps.
(4) *TOUCH* **[INITIALS]**, Enter your initials from the alphabet line.
(5) *TOUCH* **[SAVE DATA]**, Look for the OK on the LCD screen and listen for beeps.
(6) *TOUCH* **[STATION #]**, Enter station number by touching numbers on the number line.
(7) *TOUCH* **[SAVE DATA]**, Look for the OK on the LCD screen and listen for beeps.

b. Entering "Fish" Measurements-
Fish, invertebrates, and fall cruise shrimp are measured in the following manner:

(1) a- *TOUCH* **[SHIFT][K]**, (3-DIGIT SPECIES CODE) Look up the desired fish code in Appendix 9, Electronic Measuring Board Species Codes, page A-22, and enter it from the number line. Go to b.(2) below.

b- For fish without a code, you will need to spell out the 7-character genus name and 6-character species name, 13 characters. If a genus name has fewer than 7-characters you need to enter a BLANK(s) for a total of 13 characters. Refer to Appendix 6, Alphabetical List of Length Frequency Measurement Codes, page A-16.

i. *TOUCH* **[SHIFT][L]** (13 CHAR. NAME), spell the name using the alphabet line.
ii. *TOUCH* **[SAVE][DATA]**, Query ready should display on the LCD screen
iii. *TOUCH* **[SHIFT][DATA MESSAGE]** to display the name, notice there is a blank at the end to enter the length code from the number line.
iv. Enter the length code number and *TOUCH* **[SAVE DATA]**. Go to b.(2) below.

c- To add measurements to an existing fish species -

i. *TOUCH* **[SHIFT][J]**, enter the fish code from the number line.
ii. *TOUCH* **[SAVE DATA]**, begin measuring the fish. Go to b.(2) below.

(2) *TOUCH* **[SAVE DATA]**, QUERY READY should display on the screen.
(3) *TOUCH* **[SHIFT][DATA MESSAGE]**, This will display the fish name and define the length measurement code, total, fork, standard, etc.
(4) *TOUCH* **[SAVE DATA]**.
(5) Start measuring the fish. It is not necessary to touch **[SAVE DATA]** for every fish. Enter the sex for every fifth fish. While measuring fish watch for <u>OK!</u> after each fish.

a-to enter sex after measuring the fish, *TOUCH* **[SEX CODE]** and then *TOUCH* **[MALE]**, **[FEMALE]** or **[UNDETERMINED]**.

b- *TOUCH* **[SEX STAGE]**, then *TOUCH* the appropriate sex stage, *TOUCH* [**SAVE DATA]**.

c- go to the next fish (specimen #6,#11, etc.)

(6) After the last specimen of a species, *TOUCH* **[SAVE DATA]**.
(7) Start a new species by returning to step a. above.

c. Shrimp Lengths For The Summer Cruise Only.

Shrimp are measured using this method for the summer cruise only. They are measured as "fish" during the Fall cruise.

(1) *TOUCH* **[SHIFT][BROWN]** or other shrimp species. All shrimp measurement functions are done in the shift mode.
(2) *TOUCH* **[SAVE][DATA]**.
(3) *TOUCH* **[SHRIMP][SEX]**,then *TOUCH* **[MALE]** or **[FEMALE]** from the ruler line. Watch the screen for the correct entry!

(4) *TOUCH* **[SAVE][DATA]** Begin measuring the shrimp.
(5) *TOUCH* **[SAVE][DATA]** Again when you have completed measuring the shrimp.
(6) *TOUCH* **[SHRIMP][WEIGHT]** Enter the weight from the number line. If the weight is less than a kilogram you must enter a leading zero before the decimal.
(7) *TOUCH* **[SAVE][DATA].**
(8) If you have another shrimp sex of the same species, *TOUCH* **[SHRIMP][SEX],** and enter the opposite sex of what you have already measured, then **[SAVE DATA].** Continue as in step c.(4) above.
(9) For a different shrimp species go back to step c.(1) above and enter a new species (**[WHITE]** or **[PINK]**) and continue.

d. Reef Fish - Detailed Meristics

(1) *TOUCH* **[SHIFT][K]** 3-digit species code.
(2) Enter 3-digit species code from the number line. *TOUCH* **[SAVE][DATA].**
(3) QUERY READY should appear on the LCD screen.
(4) *TOUCH* **[MESSAGE DATA]** The species name and measurement code will appear on the screen. Verify that it is correct.
(5) *TOUCH* **[SAVE DATA].**
(6) *TOUCH* **[SHIFT][P]** to exit shift mode.
(7) *TOUCH* **[DTL MERISTIC], [SAVE DATA].** Only one length is required "TL, or FL, or SL." The other two are optional.

a- Place the fish on the board and *TOUCH* **FORK LENGTH** to measure the fork length, *TOUCH* **STD LENGTH** to measure the standard length, or *TOUCH* **SHIFT TTL LENGTH** to measure the total length.

b- Place the fish on the board with the snout against the LCD screen end of the board. *TOUCH* the probe on the ruler line for the appropriate measurement.

(8) *TOUCH* **[WEIGHT CODE]** from the ruler line and only if the weight is other than round weight.
(9) *TOUCH* **[SPECIMEN WGT]** on the number line. Enter the weight with a leading zero if the weight is less than one kilogram. The board assumes the weight is in kilos. You can specify pounds by entering **[SHIFT][V].**
(10) *TOUCH* **[SEX CODE]** from the ruler line, enter **[MALE],** or **[FEMALE],** or **[UNDETERMINED].**
(11) *TOUCH* **[SEX STAGE]** from the ruler line enter the stage.

a- *TOUCH* **[SPECIMEN #]** on the number line. Enter the specimen number. This is required only if samples are taken from the fish.

b-*TOUCH* **[SAMPLE CODES]**. On the ruler line. Enter the code or codes of the samples collected, ex. scales, tissue, etc. Then you MUST ...

c- *TOUCH* **[END]** on the ruler line.

d- *TOUCH* **[SAVE DATA]**, go to another fish and repeat. If the same species, go to step d.(7)i. If a new species, go to step d.(1).

4. How To Correct Board Data Entry Errors

There are many places in the measurement procedure to make errors. When an error is entered, data cannot be bypassed or overwritten. All errors have to be deleted at the time they are made before correct data may be entered. Most errors are identified with a message, a few you will recognize when the screen does not display an OK!

a. DATA OUT OF RANGE

(1) While measuring fish- An entry error likely occurred prior to measurement. *TOUCH* **[SHIFT][PUT TEMP]** to temporarily save the current record. *TOUCH* **[SHIFT][P]** (exit shift), *TOUCH* **[LDCE QUERY]**, wait for the data error to appear on the screen. A legitimate length entry message can be overridden with a **[SHIFT][T]**. Otherwise, for a true error, use the **[DELETE]** and **[BACKSPACE]** keys to delete the record; it is deleted when LIMNOTERRA appears on the LCD screen. Now TOUCH **[SHIFT][GET TEMP]** and **[SAVE DATA]**. Continue measuring fish.

(2) While spelling a 13 character species name. *TOUCH* **[LDCE QUERY]** to call the record to the screen. Verify the correct spelling and make any corrections. Use the **[BLANK]**, **[DELETE]**, or **[BACKSPACE]** keys as necessary. If the name is correct, it is a new name and needs to be added into the database. To enter a new name, use the arrow keys to scroll to the left side of the display. Remove the "N" from "SN" combination. Scroll to the beginning of the display, *TOUCH* **[SHIFT][M]**, this will override the species name, *TOUCH* **[MEASURE][CODE]**, from the ruler line *TOUCH* the code for that species. *TOUCH* **[SHIFT DATA]** to verify that you have "BDMC_S" and the name. *TOUCH* **[SAVE DATA]**, you should get an OK!

b. RECALREADY EXISTS

(1) Summer Shrimp Measurements- the shrimp species you are trying to enter has already been entered. *TOUCH* **[LDCE QUERY]** to call the record to the screen. Delete the record. TOUCH **[EXISTING SHRIMP SPECIES]** then select that species from the ruler line and *TOUCH* **[SAVE DATA]**.

(1) Fish- *TOUCH* **[LDCE QUERY]** to call the record to the

screen. Delete the record. *TOUCH* **[EXISTING 3 DIGIT CODE]**, enter the code, *TOUCH* **[SAVE DATA].**

c. NOTSAMERECTYPE- when entering sample codes, this error will appear when you have not selected detail MERISTIC before entering the sample codes. Use **[LDCE QUERY]** to retrieve the record, delete the record, and select the correct fish record type, then redo the record.

d. NO REQUIRED DATA - if you have not completed an operation. For example, you touched weight and did not enter the weight and tried to enter something else you will get this message. Use **[LDCE QUERY]** to retrieve the record, delete the record, and reenter the correct data.

II. REAL-TIME DATA

II. REAL-TIME DATA

A. INTRODUCTION

Since 1982 the SEAMAP Subcommittee has committed to the distribution of catch data taken during the summer survey on a real-time basis. Data was collected and transmitted daily via satellite or radio to the NMFS Mississippi Laboratories. The data was then summarized, plotted and distributed weekly to fishermen, seafood processors, and scientists.

For each SEAMAP Station, please complete the SEAMAP Real Time Station Data Form, Station Record (Figure 2-1, page 2-5) and the SEAMAP Real-Time Length/Frequency Data Form, Catch Record (Figure 2-2, page 2-7). The Catch Record form can be computed from the station shrimp length frequency form. Remember, these two forms apply to the SEAMAP station number. If more than one trawl station is made to cover the depth strata, shrimp data from those multiple tows are to be combined on the completed form.

If you have any questions concerning the real-time data, please contact Perry Thompson, NMFS, (601) 762-4591 extension 271.

B. SEAMAP REAL-TIME STATION DATA FORM INSTRUCTIONS

STATION RECORD

Field	Entry
1	Card Code - Always 0
2	Platform Code- 1 = OREGON II, 2 = TOMMY MUNRO, 3 = JEFF & TINA, 4 = WESTERN GULF, 5 = SUNCOASTER, 6 = ALABAMA, 7 = Louisiana, 8 = TEXAS. OTHERS LEAVE BLANK
3-7	Station Number - Enter SEAMAP station number; use four alpha/numeric characters and right justify, but be consistent in field length T065, W102, **NOT T65 or W0102.**
8-13	Date - enter date, MMDDYY; E.g., '061585'.
14-18	Latitude - enter latitude, DDMM.M; observing 1 indicated decimal on minutes; e.g.: 29°16.5'.
19-23	Longitude - enter longitude, same as above.
24-25	Time - enter time start, Military time, nearest whole hour; e.g., 8:52 pm = '21'.
26-27	Depth - enter depth to nearest whole fathom.
28-30	Surface Temperature - enter surface temperature, degrees Celsius, observing 1 indicated decimal; e.g., 26.1°.
31-33	Bottom Temperature - same as above.
34-36	Fluorometer (Chlorophyll) - leave blank if not taken.
37-39	Bottom Dissolved Oxygen - enter BOD in PPM, observing 1 indicated decimal, if taken.
40-41	Gear Type - enter 'ST'.
42-44	Length of All Tows - enter total minutes fished (bottom time) at station.
45-45	Number of Tows - enter number of tows made for this SEAMAP station.
46-51	Total Shrimp - enter total kilograms (Kg) of shrimp caught at this SEAMAP station, observing 3 indicated decimal places.
52-58	Total Finfish - KG, observing 3 indicated decimal places.
59-65	Croaker - **if the catch was sampled, calculate the total weight caught from the sample weight using the formula on page 1-7.**

66-72 Spot - same as above.

73-79 Trout -same as above (combine C. nothus and C.arenarius).

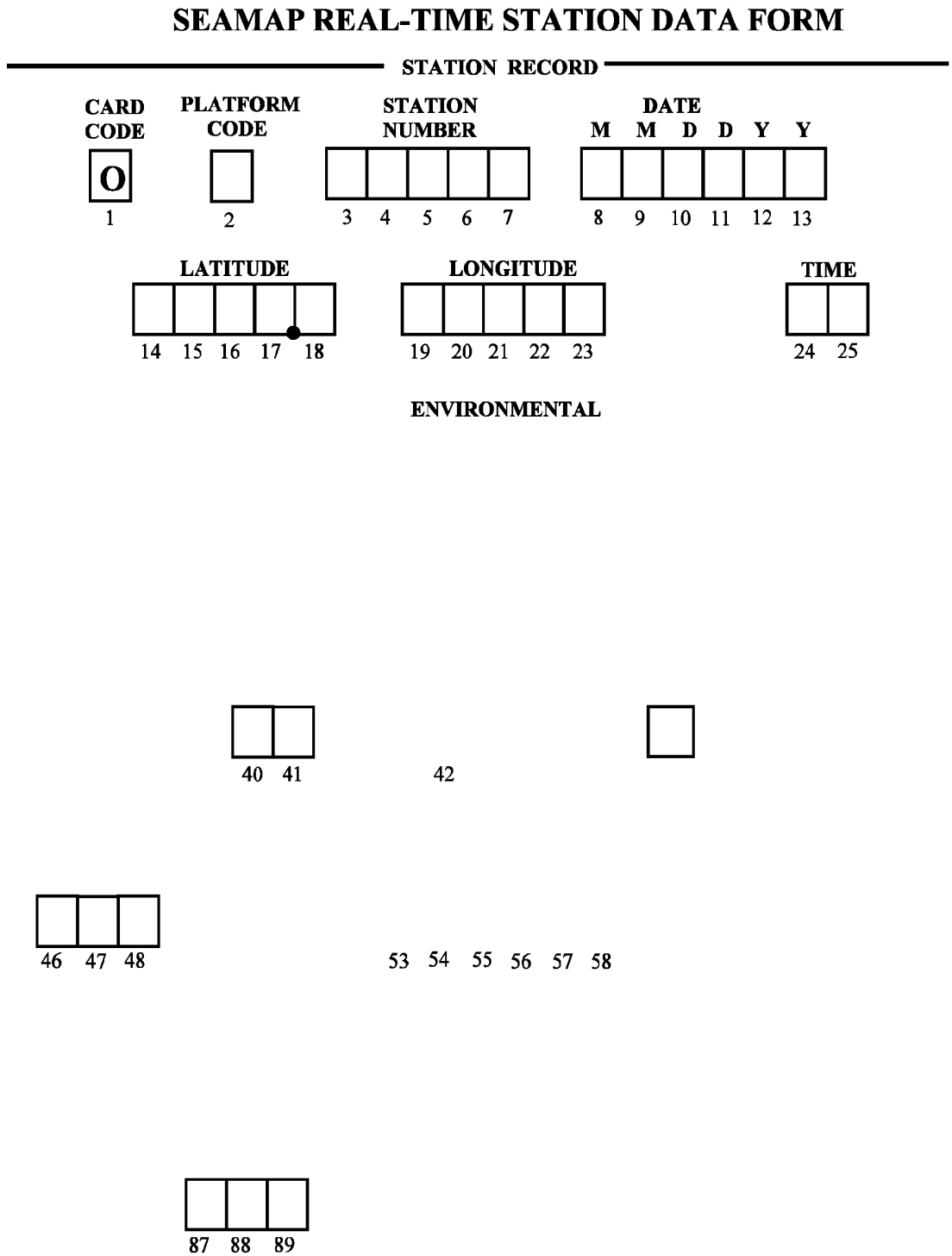
80-86 Catfish - same as above.

87-89 Dominant Species Code - enter code from Table A or B of the species which predominates the catch, if other than croaker, spot, trout, and catfish.

90-96 Dominant Species Catch - enter whole kilograms of coded species caught at this station.

NOTE: If the catch is very light and no species predominates, leave fields 87-96 blank.

Figure 2-1. SEAMAP Real Time Station Data Form.

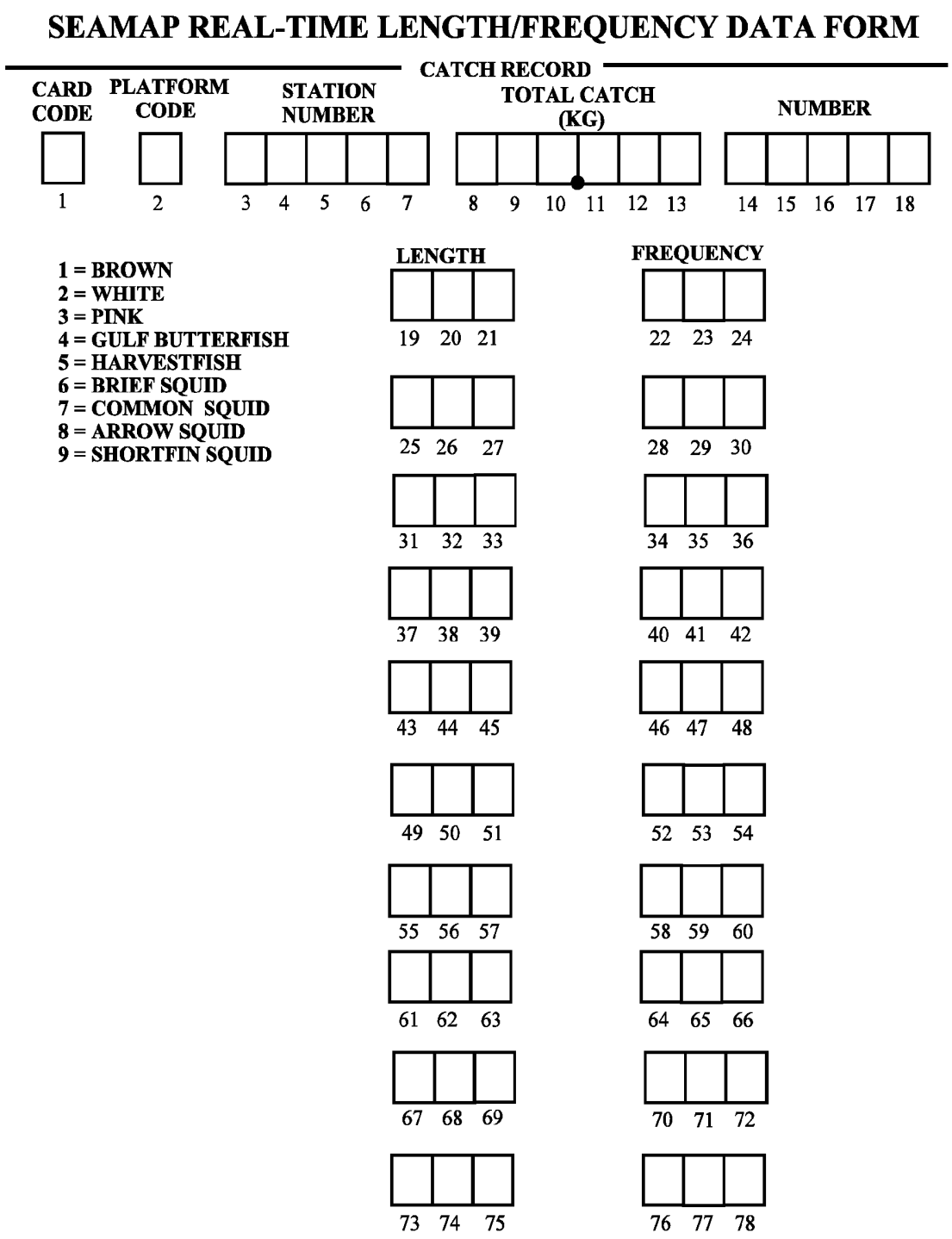


C. SEAMAP REAL-TIME LENGTH/FREQUENCY DATA FORM INSTRUCTIONS

CATCH RECORD

Field	Entry
1	Card Code - enter code for shrimp species for which length frequencies follow: 1 = Brown, 2 = White, and 3 = Pink.
2	Platform - same as page 1.
3-7	Station Number - same as page 1.
8-13	Total Catch - total weight in KG of this shrimp species caught at this SEAMAP station, observe 3 decimal places.
14-18	Number - total number caught at this station, this species.
19-24	Modal Length and Frequency - enter length in MM and frequency of the single largest group of shrimp at any one length. If no single measurement contained more shrimp than any other, there is no mode and these fields will be left blank.
25-78	Length/Frequencies - enter number of shrimp at each 1 cm (10 mm) interval; e.g., if 7 shrimp were measured between 130-139 mm Enter 130 007 for that group. Length groups in excess of 9 can be added on additional pages, filled out like the first page except that the modal slot (fields 19-24) can be used for L/F. Use as many sheets as necessary.

Figure 2-2. SEAMAP Real-Time Length/Frequency Data Form.



SEAMAP REAL-TIME LENGTH/FREQUENCY DATA FORM

CATCH RECORD

CARD CODE (1) | PLATFORM CODE (2) | STATION NUMBER (3 4 5 6 7) | TOTAL CATCH (KG) (8 9 10 11 12 13) | NUMBER (14 15 16 17 18)

1 = BROWN
2 = WHITE
3 = PINK
4 = GULF BUTTERFISH
5 = HARVESTFISH
6 = BRIEF SQUID
7 = COMMON SQUID
8 = ARROW SQUID
9 = SHORTFIN SQUID

LENGTH	FREQUENCY
19 20 21	22 23 24
25 26 27	28 29 30
31 32 33	34 35 36
37 38 39	40 41 42
43 44 45	46 47 48
49 50 51	52 53 54
55 56 57	58 59 60
61 62 63	64 65 66
67 68 69	70 71 72
73 74 75	76 77 78

NOTE: ON FIRST CATCH RECORD, THE FIRST LENGTH/FREQUENCY IS THE MODAL LENGTH FREQUENCY.

MF-016 (03/90)

Table A. SEAMAP Real-Time Alphabetic List of Species Codes.

SPECIES CODE	COMMON NAME
1	ANCHOVY
27	ANGEL SHARK
91	ATLANTIC MANTA
115	ATLANTIC THREADFIN
10	BANDED DRUM
41	BANK CUSK-EEL
2	BEARDED BROTULA
107	BEARDFISH
110	BIGEYE SCAD
28	BLACK DRUM
112	BLACKMOUTH BASS
37	BLACKEAR SEABASS
11	BLACKEDGE CUSKEEL
18	BLACKFIN SEAROBN
102	BLACKFIN GRENADIER
118	BLACKNOSE SHARK
19	BLACKWING SEAROBN
82	BLUNTNOSE STINGRAY
71	BLUE CRAB
3	BLUE RUNNER
80	BANDED SHRIMP EEL
99	BONNETHEAD SHARK
78	BRIEF SQUID
116	BROWN SHRIMP
15	BULL SHARK
5	BUMPER
65	CALICO SCALLOP
42	CHANNEL FLOUNDER
114	CHUB MACKERAL
88	CLEARNOSE SKATE
95	COBIA
34	COWNOSE RAY
66	CUSK-EEL
26	CUTLASSFISH
111	DEEPBODY BOARFISH
103	DUCKBILL FLATHEAD
23	DUSKY FLOUNDER
63	DWARF SAND PERCH
89	FLATFISH
60	FLOUNDER
40	GOATFISH
31	GRAY TRIGGERFISH
64	GREEN SEABISCUIT
109	GULF BUTTERFISH
86	GULF MENHADEN
94	HAKE
16	HARVESTFISH
51	HEART URCHIN
58	INSHORE LIZARDFISH
96	IRIDESCENT SWIMMING CRAB
56	JELLYFISH
13	KINGFISH
24	LIZARDFISH
67	LONG FINNED SQUID
81	LOGGERHEAD SEA TURTLE
22	LONGSPINE PORGY
119	LARGESCALE LIZARDFISH
54	LUMINOUS HAKE
87	MANTIS SHRIMP
59	MEXICAN FLOUNDER
52	OFFSHORE BLUE CRAB
106	OFFSHORE HAKE
45	ORANGE FILFISH
105	PANCAKE BATFISH
75	PAPER SCALLOP
53	PARAPENAEUS

SPECIES CODE	COMMON NAME
85	PEARLY RAZORFISH
76	PIGFISH
9	PINFISH
117	PINK SHRIMP
32	PUFFER
108	RED BARBER
30	RED DRUM
92	RED PORGY
12	RED SNAPPER
55	ROCK SEABASS
46	ROCK SHRIMP
25	ROUGH SCAD
113	ROUND HERRING
120	ROUND SCAD
57	ROUNDEL SKATE
48	SAND DOLLAR
7	SAND PERCH
97	SARGASSUM
8	SCALED SARDINE
83	SCORPIONFISH
4	SEA BASS
17	SEAROBIN
98	SHAMEFACED CRAB
61	SHARKSUCKER
20	SHARPNOSE SHRK
29	SHEEPSHEAD
33	SHOAL FLOUNDER
101	SHORTSPINE BOARFISH
90	SILVER JENNY
68	SLIPPER LOBSTER
62	SMOOTH PUFFER
93	SMOOTH HOUND SHARK
49	SNAKEFISH
72	SOLENOCERA
36	SOUTHERN FLOUNDER
43	SOUTHERN HAKE
100	SPECKLED SHRIMP
39	SPINY ARM CRAB
21	SPANISH MACKEREL
69	SPANISH SARDINE
47	SPONGE
38	SPOTFIN FLOUNDER
70	SQUID
50	STARFISH
79	SOUTHERN KINGFISH
74	SOUTHERN STINGRAY
6	STINGRAY
77	STRIPED ANCHOVY
14	THREAD HERRING
84	TRACHYPENAEUS
35	UNKNOWN SHARK
44	WENCHMAN
73	YELLOW CONGER
104	YELLOWHEAD DAMSEL

Table B. SEAMAP Real-Time Numeric List of Species Codes.

SPECIES CODE	COMMON NAME
1	ANCHOVY
2	BEARDED BROTULA
3	BLUE RUNNER
4	SEA BASS
5	BUMPER
6	STINGRAY
7	SAND PERCH
8	SCALED SARDINE
9	PINFISH
10	BANDED DRUM
11	BLACKEDGE CSKEEL
12	RED SNAPPER
13	KINGFISH
14	THREAD HERRING
15	BULL SHARK
16	HARVESTFISH
17	SEAROBIN
18	BLACKFIN SEAROBN
19	BLACKWING SEAROBN
20	SHARPNOSE SHARK
21	SPANISH MACKEREL
22	LONGSPINE PORGY
23	DUSKY FLOUNDER
24	LIZARDFISH
25	ROUGH SCAD
26	CUTLASSFISH
27	ANGEL SHARK
28	BLACK DRUM
29	SHEEPSHEAD
30	RED DRUM
31	GRAY TRIGGERFISH
32	PUFFER
33	SHOAL FLOUNDER
34	COWNOSE RAY
35	UNKNOWN SHARK
36	SOUTHERN FLOUNDER
37	BLACKEAR SEABASS
38	SPOTFIN FLOUNDER
39	SPINY ARM CRAB
40	GOATFISH
41	BANK CUSK-EEL
42	CHANNEL FLOUNDER
43	SOUTHERN HAKE
44	WENCHMAN
45	ORANGE FILFISH
46	ROCK SHRIMP
47	SPONGE
48	SAND DOLLAR
49	SNAKEFISH
50	STARFISH
51	HEART URCHIN
52	OFFSHORE BLUE CRAB
53	PARAPENAEUS
54	LUMINOUS HAKE
55	ROCK SEABASS
56	JELLYFISH
57	ROUNDEL SKATE
58	INSHORE LIZARDFISH
59	MEXICAN FLOUNDER
60	FLOUNDER
61	SHARKSUCKER
62	SMOOTH PUFFER
63	DWARF SAND PERCH
64	GREEN SEABISCUIT
65	CALICO SCALLOP
66	CUSK-EEL
67	LONG FINNED SQUID
68	SLIPPER LOBSTR
69	SPANISH SARDINE
70	SQUID
71	BLUE CRAB
72	SOLENOCERA
73	YELLOW CONGER
74	SOUTHERN STINGRAY
75	PAPER SCALLOP
76	PIGFISH
77	STRIPED ANCHVY
78	BRIEF SQUID
79	SOUTHERN KINGFISH
80	BANDED SHRIMP EEL
81	LOGGERHEAD SEA TURTLE
82	BLUNTNOSE STINGRAY
83	SCORPIONFISH
84	TRACHYPENAEUS
85	PEARLY RAZORFISH
86	GULF MENHADEN
87	MANTIS SHRIMP
88	CLEARNOSE SKATE
89	FLATFISH
90	SILVER JENNY
91	ATLANTIC MANTA
92	RED PORGY
93	SMOOTHHOUND SHARK
94	HAKE
95	COBIA
96	IRIDESCENT SWIMMING CRAB
97	SARGASSUM
98	SHAMEFACED CRAB
99	BONNETHEAD SHARK
100	SPECKLED SHRIMP
101	SHORTSPINE BOARFISH
102	BLACKFIN GRENADIER
103	DUCKBILL FLATHEAD
104	YELLOWHEAD DAMSEL
105	PANCAKE BATFISH
106	OFFSHORE HAKE
107	BEARDFISH
108	RED BARBER
109	GULF BUTTERFISH
110	BIGEYE SCAD
111	DEEPBODY BOARFISH
112	BLACKMOUTH BASS
113	ROUND HERRING
114	CHUB MACKEREL
115	ATLANTIC THREADFIN
116	BROWN SHRIMP
117	PINK SHRIMP
118	BLACKNOSE SHARK
119	LARGSCALE LIZARD
120	ROUND SCAD

III. STANDARD SEAMAP SHRIMP AND GROUNDFISH SAMPLING TRAWL GEAR SPECIFICATIONS

III. Standard SEAMAP Shrimp and Groundfish Sampling Trawl Gear Specifications

A. Introduction

The Summer and Fall SEAMAP trawl surveys use a 42' semi-balloon trawl with 8'x40" chain doors towed at 2.5 knots. The complete trawl and door specifications, towing warp scope ratio, efficiency checks, and inspection schedule for this gear have been included as a guide for proper use.

B. SEAMAP 42' Semiballon Trawl Specifications

Webbing (Nylon) :
Bosom, wings and comers - 2" stretched x #18 twine.
Intermediate - 1-1/2" stretched x #24 twine.
Codend - 1-5/8" stretched x #42 twine w/1/4" x 2" galvanized rings.
Chaffing gear - 3-1/2" stretched x #90 polyethylene 60 x 40.

Hanging Cable:
Headrope and footrope - 9/16" diameter (6x6) polyethylene cover stainless steel combination net rope.
Leglines - 6 ft with heavy duty wire rope thimbles.

Weight:
Loop chain - 1/4" galvanized chain, 16 links per loop, tied every foot. 67.8 ft of chain needed 48.13 lb.

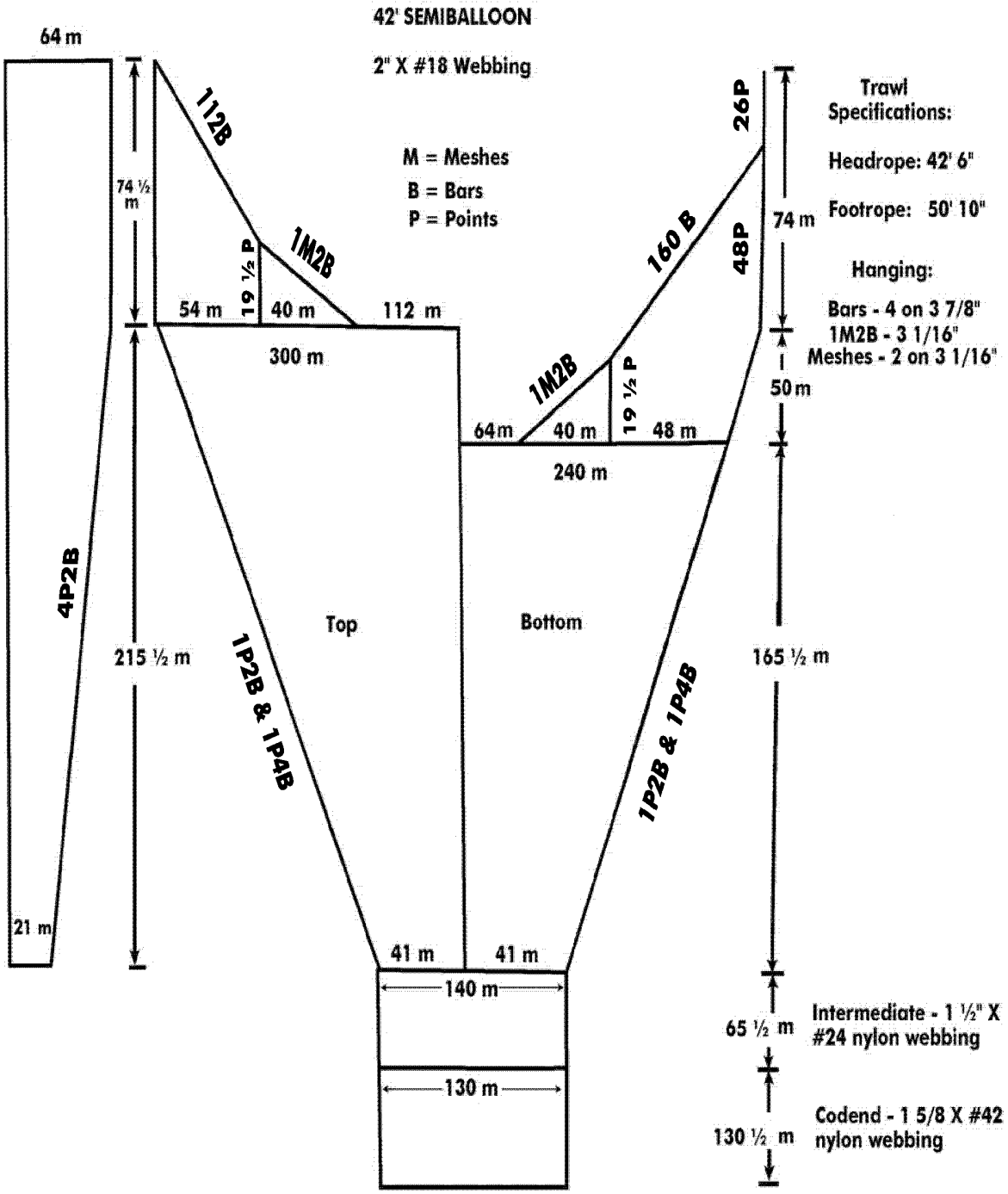
Mud Rollers:
17 mud rollers on a separate line (1/2" polypropylene) tied every 3 feet, with 3" of slack (top of roller to bottom of footrope).

Floatation:
Floats - 6- 3"x4" spongex floats spaced 5 ft apart, across the middle of the headrope.

Lazyline:
18 fathoms of 3/4" polydacron.
Purse rope - 3/4" polydacron 16 ft. long.

Net Treatment:
Green plastic net coat.

Figure 3-1. Standard SEAMAP 42' Trawl Schematic.



C. **Door Specifications**:
Length and Height 8'40"
Chain - 1/2" proof coil chain
Swivels - 1/2"
Bolts - 5/16"
Planking - 5/4 yellow pine, Grade 1
Stiffeners - 4"x4"
Uprights - 2"x10"
Shoe - 1"x6" stock
Lift pads in center
Bonded and bolted
Doors have 23-1/2" bridle (tow point to door face)

Tickler Chain Specifications:
Type - Standard free tickler
Size - 1/4" galvanized chain
Length - 42" shorter than the footrope including the leglines = 58.6' = 41.6 lb.

Bridle Specifications:
Wire Type - 6x19 strand marine lube
Diameter - 9/16"
Length - 30 fathoms

Total Trawl Twine Area:
240.2794 sq. ft.

Total Door Surface Area:
53.2 sq. ft. (per set)

Recommended Towing Speed:
2.5 knots

Figure 3-2. SEAMAP 8 Foot X 40 Inch Otter Door Design.

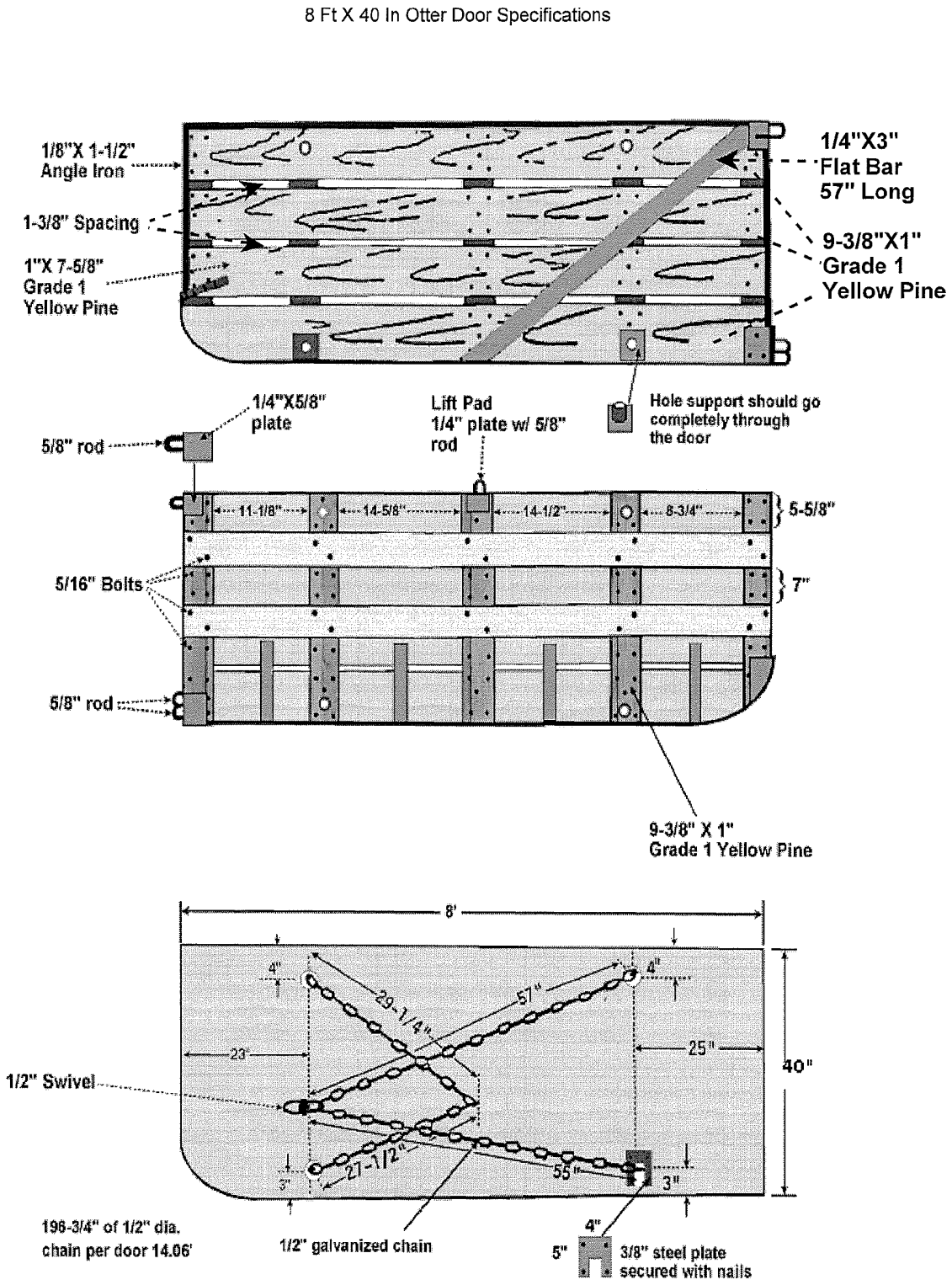
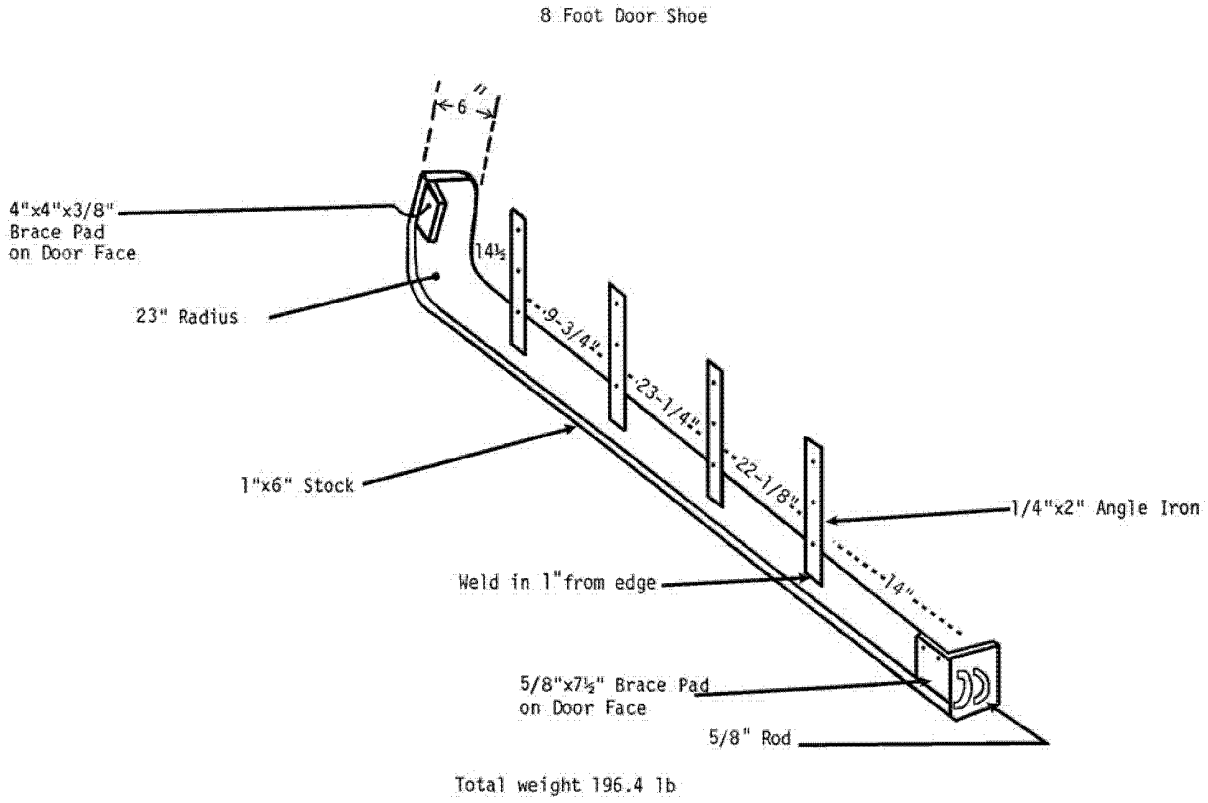


Figure 3-3. SEAMAP 8 Foot Door Shoe Design.



D. Recommended Towing Warp Scope Ratio Table

Water Depth Fathoms	Warp Fathoms	Scope Ratio	Water Depth Fathoms	Warp Fathoms	Scope Ratio
5	35	7.0	28	116	4.1
6	35	5.8	29	118	4.1
7	35	5.0	30	120	4.0
8	40	5.0	31	124	4.0
9	45	5.0	32	128	4.0
10	50	5.0	33	132	4.0
11	55	5.0	34	136	4.0
12	60	5.0	35	140	4.0
13	65	5.0	36	144	4.0
14	70	5.0	37	148	4.0
15	75	5.0	38	152	4.0
16	80	5.0	39	156	4.0
17	85	5.0	40	160	4.0
18	90	5.0	41	164	4.0
19	95	5.0	42	168	4.0
20	100	5.0	43	172	4.0
21	102	4.9	44	176	4.0
22	104	4.7	45	180	4.0
23	106	4.6	46	184	4.0
24	108	4.5	47	188	4.0
25	110	4.4	48	192	4.0
26	112	4.3	49	196	4.0
27	114	4.2	50	200	4.0

E. CHECKS TO DETERMINE TRAWL FISHING EFFICIENCY

1. SEAMAP Survey Trawl
   Door Shine- 8'x40" Doors
   a. If the door is fishing properly, shine will be down the entire length of the leading edge and should taper to a point on the front of the shoe.
   b. Shine only on the back, or heel, of the shoe indicates improper tow cable scope ratio, improper door chain setting, or too much setback in the leglines.
   c. If shine is uniform across the entire shoe width, the scope ratio may be incorrect or tilt angle of the door inadequate.
   d. Shine on the nose or front portion of the shoe indicates improper door chaining, inadequate setback in the trawl footrope, inadequate weight on the footrope, or too short of a scope ratio.
   e. Door angle of attack can be determined by measuring the angle of the shine. For maximum efficiency the angle of attack should be approximately 36°.

2. Footrope Loop Chain Shine
   a. Shine should be apparent on the middle 6 to 8 links of each loop of chain around the entire footrope length, indicating that the trawl is fishing at least 4 inches off the bottom.
   b. Hard bottom contact is indicated by shine on almost all links of the loops around the entire footrope length. This condition indicates the trawl is under spread or has too much weight on the footrope.
   c. No footrope-bottom contact is indicated by a lack of shine on any of the loop chain links. The trawl is overspread or has insufficient weight on the footrope.

3. Catch Composition and Consistency
   a. The amount of benthic invertebrates and debris in the catch indicates the degree of bottom contact and tickler chain efficiency.
   b. Variations in catch consistency can be an indication of possible gear adjustment problems.

GEAR AND RIGGING INSPECTION SCHEDULE

Gear or Rigging	Inspection	Interval
Doors	Shoe Shine	At least once a day.
Loop Chain	Shine	At least once a day.
Tickler Chain	Tangles, breaks, or stretching	Check for tangles or breaks every tow and stretch every fishing day
Trawl	Tears and holes	Every tow for obvious tears and holes. The trawl should be brought on board once a day to check for less obvious damage.
Bridle	Twists	If twists extend 25% or more of the bridle's length, the bridle should be untwisted.

IV. COLLECTING ENVIRONMENTAL DATA

IV. COLLECTING ENVIRONMENTAL DATA

A. INTRODUCTION

This document describes standard operational procedures for collecting environmental data at sea and establishes **primary measurements** (minimum requirements) for all SEAMAP cruises. Those measurements are: water temperature, salinity, dissolved oxygen, chlorophyll, Secchi disc depth, and Forel-Ule color. Sampling depths include the surface, mid-water, and bottom (or 200 meters where depths are greater than 200 meters). Samples are to be taken in conjunction with each biological station. Additional measurements and more frequent sampling may be required depending on the type of SEAMAP survey.

The SEAMAP is striving to acquire the most accurate data possible. A CTD or STD is primarily used to collect temperature, salinity, dissolved oxygen, chlorophyll, and transmissivity. The preferred chlorophyll sampling method is extraction. Water samples can be collected with water collection bottles. Dissolved oxygen is measured with in-situ D.O. sensors, onboard the vessel with D.O. meters (laboratory probe), or by a titration method. Secchi depth is measured with a standard white, 30 cm or 52 cm diameter Secchi disc. Water color measurements are made by use of the Forel-Ule color comparator.

When a CTD or STD is unavailable, hydrocasts with water collection bottles will be used to collect water samples for measurement of the parameters identified as minimal. Sampling depths will be calculated by using wire length and angle tables or by direct measurement, when possible. If no other method is available, then temperature of the water samples collected at the surface, mid-water and maximum depth will be determined by other acceptable methods. When salinity cannot be determined at sea, water samples should be collected and returned to shore for later analysis.

Instrument calibration checks are to be made on a daily basis for temperature and salinity. This means that a salinity sample should be taken for return to the laboratory and temperature should be measured independently of the CTD, STD, or other method. An XBT cast can be used to check sample depth and temperature against the CTD or STD. Calibration of chlorophyll measurements should be conducted prior to and after each cruise to ensure proper instrument functions. The dissolved oxygen instrument selected should be checked against Winkler determinations in the laboratory before and after each cruise. These quality assessment/quality control (QA/QC) checks are recorded on the data

sheets and should be maintained for inclusion into the metadata.

Please use a lead pencil and make entries dark and legible to facilitate data entry. All numeric fields on the Environmental Data Form (Figure 4-1) are to be right justified or aligned with the decimal place. Leading zeros are not required, but enter trailing zeros. On all SEAMAP surveys, an NMFS Pascagoula Station Biological Type II data sheet must be completed for every environmental station.

B. ENVIRONMENTAL FORM INSTRUCTIONS

The methods of collecting environmental data and the completion of the environmental data sheet are as follows:

1. Required Data.

VESSEL - Enter 2-digit numerical code from Appendix 1, Vessel Codes, page A-2. If your vessel has not been assigned a code, notify NMFS Pascagoula to receive one.

PASCAGOULA STATION NUMBER - This is a unique sequential consecutive 5-digit number within each cruise, preferably starting with "00001". For state vessels enter the 2-digit vessel code followed by a 3-digit station number. Transfer this station number to the environmental or plankton sheet. Do not duplicate this station number for other stations on a cruise.

CRUISE - Enter 3-digit cruise number. Except for the Oregon II and other vessels having historically different cruise numbering conventions, the cruise number for **ALL VESSELS** shall be the calendar year of the survey followed by the cruise number for the year, e.g. "011" first cruise for year 2001, "012"- second cruise for year 2001, etc. The leading zero is required. Use this cruise number on all sheets during a cruise; do not change it.

DATA SOURCE CODE - Enter data source code from Appendix 2-C.

CLOUD TYPE - Leave blank; cloud type is no longer collected on Gulf of Mexico SEAMAP cruises.

% CLOUD COVER - Enter percent cloud cover during daylight hours only. Cloud cover is determined for the entire sky, not just that portion overhead.

SECCHI DISC - Enter secchi disc reading in meters (see Tables

1, 2, and 3 for meter/feet/fathom conversion factors), observing one indicated decimal. Take readings only during daylight hours and from shady side of platform. See section C.1. below for transparency measurements with the Secchi disc.

WATER COLOR (F.U.) - Obtain Forel-Ule (F.U.) reading (daylight hours only); convert Roman numerals to Arabic. See section C.2. below for taking water color measurements.

STATION LOCATION CODE - Enter S (start) or E (end) for position location closest to where environmental data was actually collected. Enter U if location was unknown.

PRECIPITATION - Enter code from Appendix 5-D.

SAMPLE DEPTHS - Enter midwater and maximum sample depths in whole meters. See section C.3. below for the hydrocast sampling procedure.

WATER DEPTH - Enter water depth in meters, observing one indicated decimal place, at the point where environmental data were taken. This should be equal to or greater than the maximum sample depth.

TEMPERATURES - Enter surface, midwater, and maximum sample depth temperatures in degrees Celsius (see Table 4 for conversion factors), observing two indicated decimals, adding trailing zeros if needed. If state vessels have additional equipment for measuring temperature, please document type of equipment. Thermometer readings should be entered in the blocks provided at the bottom of the data sheet.

SALINITIES - Enter surface, midwater, and maximum sample depth salinity measurements in parts per thousand, observing three indicated decimals, adding trailing zeros if needed. If samples are taken for later analysis, record vessel code or name, cruise, station number, date, and sample depth on each sample. Indicate on the bottom of the form if samples were taken for later analysis. If salinity is determined with a refractometer, record the readings in the boxes provided at the bottom of the form. See Section C.4. below for collecting salinity samples from a hydrocast.

CHLOROPHYLL - Enter surface, midwater, and maximum sample depth chlorophyll determinations in milligrams per cubic meter observing four indicated decimals. If samples are taken for later analysis, document the number of samples taken at each depth on the bottom of the form. See Section C.5. below for

chlorophyll sampling procedures.

OXYGEN - Enter surface, midwater and maximum sample depth dissolved oxygen readings in parts per million, observing one indicated decimal place. See Section C-6 below for Dissolved Oxygen (D.O.) sampling procedures.

TRANSMISSIVITY - Enter transmission as percent transmission. No decimals are used. This is a measure of the amount of suspended material in the water.

2. REFERENCE AND SAMPLE TRACKING SECTION (NOT TO BE KEYPUNCHED)

SCAN NUMBER/CL/FILTER TYPE - Complete when CTD is used. Enter CTD scan number from which temperature, salinity, dissolved oxygen, fluorescence, and transmissivity data are taken. Under "CL" record the volume of water filtered for the chlorophyll sample. Under "filter type", record nucleopore, GF/C, or GF/F, depending on filter type used.

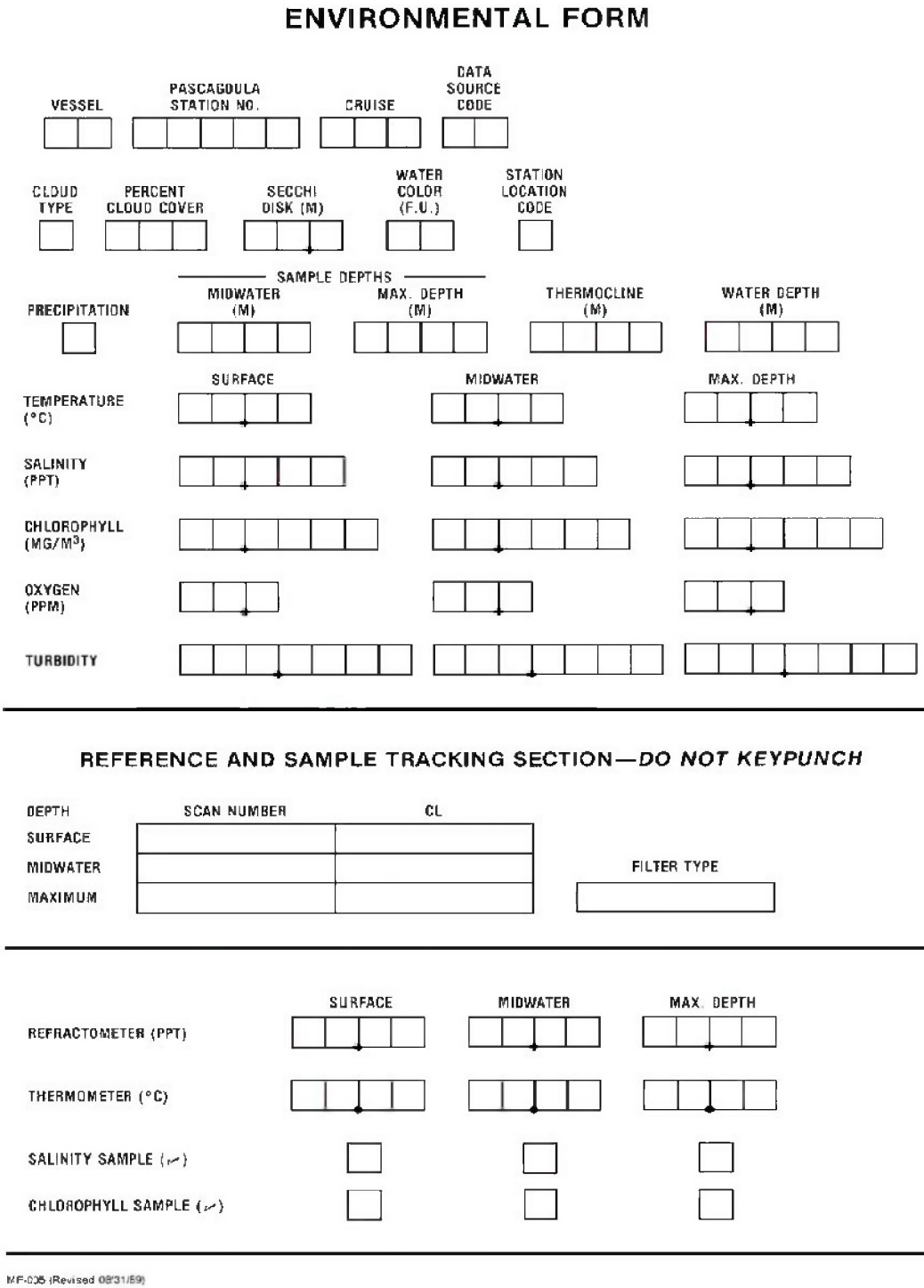
REFRACTOMETER (PPT) - Enter refractometer readings in ppt. Refractometer readings are not recorded if you are saving a salinity sample or have recorded other salinity measurements.

THERMOMETER (C°) - Enter thermometer temperature readings in degrees Celsius (C°). Temperature readings are not recorded in this section if you are using other equipment.

SALINITY SAMPLE (✓) - Enter a check in the appropriate boxes if you collect a salinity sample.

CHLOROPHYLL SAMPLE (✓) - Enter a check in the appropriate boxes if you collect a chlorophyll sample.

Figure 4-1. Environmental Data Form.



C. SAMPLE COLLECTION METHODOLOGY

1. MEASUREMENT OF TRANSPARENCY WITH SECCHI DISC

The Secchi disc is used to measure transparency of sea water (approximate index) and is dependent upon the available illumination, limiting measurements to daylight periods only. Daylight hours may be defined as being from one hour after sunrise to one hour before sunset. Either standard-sized Secchi disc can be used. For inshore stations, there is no difference in the readings depending on size. For very clear off-shore water, the larger size disc should be used.

a. DO NOT wear sunglasses during the measurements.

b. Lower Secchi disc with a rope marked in meters on the shaded side of the ship.

b. Lower disc until it is just perceptible.

c. Note the depth of the disc in meters. The measurement is made from the water surface to the disc.

e. Continue lowering until the disc is no longer visible.

f. Slowly raise the disc until it is barely visible and again note the depth of the disc.

g. Average the two depths and record the resulting depth in the appropriate blocks on the data sheet, observing one indicated decimal place.

2. MEASUREMENT OF WATER COLOR WITH FOREL-ULE

Water color is measured with the Forel-Ule color comparator against the Secchi disc background. The Forel scale (I-X) is primarily for offshore blue to green water. The Ule scale (XI-XXII) is used to measure color of the yellowish to brown inshore waters.

a. DO NOT wear sunglasses during measurement.

b. Lower the Secchi disc to a total depth of one meter below the water surface on the shaded side of the ship..

c. Insert the distilled water ampule in the blank hole in the Forel-Ule comparator.

d. Hold the comparator at arm's length so as to view both the Secchi disc and the Forel-Ule scale.

e. Compare the color as seen through the blank hole in the comparator with the color of the water as viewed over the Secchi disc.

f. Determine the value in the comparator that most nearly matches the color of the water over the Secchi disc. Record the value in the appropriate boxes on the data sheet.

3. HYDROCAST SAMPLING PROCEDURES

Water samples need to be collected for **QA/QC purposes** and to obtain temperature, salinity, D.O., and chlorophyll when a CTD, STD or XBT is unavailable. Water samples are collected with the aid of water collection bottles (Niskin) attached to a hydrowire at the surface, mid and bottom depths or at the surface, 100 meters and 200 meters for stations with depths greater than 200 meters. The procedure for a hydrocast with water collection bottles is as follows:

a. Verify (by communication with the bridge) that ship is on station, is "dead" in the water and oriented so cast is on weather side of ship.

b. Obtain bottom depth from bridge for proper bottle placement on the hydrowire.

c. Attach the deepest water collection bottle to the hydrowire above a hydroweight as follows:

(1) Ensure air vent and drain valve are closed.
(2) Attach the loop in the top stopper wire to the left release mechanism. The bottom stopper wire is clipped below the ball on the top stopper wire.
(3) Clamp the **water collection** bottle to the cable finger tight, top clamp first, then bottom clamp.

d. When the first bottle is ready for lowering (just below the sea surface), zero the meter wheel.

e. Lower this bottle until the meter wheel reads the equivalent of the desired depth and measure the wire angle with an inclinometer. Take into account the distance from the deck of the ship to the water surface before attaching the next bottle.

f. Calculate the length of wire required to reach desired depth of each bottle (see wire angle Table 8) or compute the depth by using the following formulas for computing wire required, depth of bottom bottle or COS angle:

depth of bottle = wire out ^{x} COS angle
wire required = depth ÷ COS angle
COS angle = depth ÷ wire out
(1 fathom = 1.83 meter = 6 feet)

At shallow water stations an alternative to Steps D and E is to initially "bump" the sea floor with the hydro-weight. Use the wire length to determine placement of the mid-water sample bottle. Retrieve the hydroweight and attach the midwater bottle.

g. Haul back or pay out wire until the meter wheel reads required wire length for second bottle.

h. Clamp a second water collection bottle to hydrowire and set stoppers.

i. Attach a messenger lanyard to the bottle at the right release mechanism and **CLIP THE MESSENGER TO THE HYDROWIRE** below the bottle.

j. Pay-out the wire and attach remaining bottles and messengers at the calculated wire length.

k. End cast preparation with a water collection bottle and attached messenger just below the surface. Record sample depths in appropriate boxes on data sheet.

l. **CLIP A MESSENGER** to the wire and release to trip the cast, allowing approximately 1 minute per 100 meters of wire length for messenger travel.

m. Retrieve the cast, observing ascending cable, and warning winch operator when each bottle is first visible.

n. Remove the bottle from the wire by loosening the bottom clamp first. Care should be taken so as to not shake the bottle or otherwise disturb the water sample before taking the D.O. samples.

o. Take temperature measurements by opening top stopper and immersing hand held thermometer. Record temperature in appropriate boxes on data sheet.

p. Immediately after taking temperature, draw dissolved oxygen samples before retrieving salinity samples.

4. COLLECTING WATER SAMPLES FOR SALINITY

a. Salinity samples are to be drawn after all the oxygen samples are collected.

b. Rinse the sample bottles three times, using about one-fourth bottle of water for each rinse.

c. Shake the bottles vigorously during each rinse and pour the rinse water inside the bottle cap to rinse it also.

d. Draw the salinity samples directly from the drain spigot, filling the sample bottle to within one-half (½) inch of the top.

e. Do not force the cap on the sample bottle too tightly. Pressure supplied between thumb and forefinger is sufficient.

f. Label each bottle with the vessel name, cruise number, station number, date, and depth (surface, mid-water, or bottom).

5. CHLOROPHYLL SAMPLING PROCEDURES

A surface chlorophyll water sample, sufficient for three replicate filters, should be collected at all SEAMAP stations except those stations inside 20 fathoms off Louisiana. At those Louisiana stations a bottom sample is collected along with the surface sample.

Samples should remain in the dark until the filtration step, which should be done in as low light as is realistic. Always use a forceps to handle the filters.

a. Obtain a 10 liter water sample at surface.

b. Filter three replicate samples up to 1000 ml each through the 25mm GF/F or GF/C filter or as much as possible in 3-5 minutes. (In rich coastal waters, 50 ml is sufficient.)

c. Do not exceed a setting on the vacuum pump of 10 psi in GE vacuum.

e. Using the forceps, fold each sample filter in half twice

so it resembles a pie wedge and place all three samples in a labeled plastic petri dish, wrap in aluminum foil, and label.

f. Record the following information on the petri dish, label, and environmental station sheets.

(1) Sample depth (S, M, B or actual depth)
(2) Station number
(3) Filter type
(4) Volume filtered
(5) Vessel
(6) Cruise
(7) Date

g. Check the appropriate boxes at the bottom of the data sheet if chlorophyll samples were obtained.

h. Place the samples in a low temperature (-80°C) freezer or in a liquid nitrogen dewer flask for storage until processing.

There are several points that need to be kept in mind when taking chlorophyll samples. The damaging or breaking of algal cells is a problem because when the cell ruptures the chlorophyll escapes and ends up passing through the filter. Using too high a vacuum pressure will damage the cells and should therefore be avoided. Acidity is a major problem because it also causes the algal cells to disintegrate with a consequent loss of chlorophyll. This is the reason that filters should never be touched with your fingers. Always use a forceps to handle the filters. While the samples are in storage, they get banged around and some of the algal cells may be knocked off the filters. To minimize this problem, fold the filter in half before placing it in the petri dish, preferably folded twice so it resembles a pie slice. At some locations there is occasionally a very high sediment load that makes it impossible to filter the optimal amount of water. In such a situation a smaller quantity of water can be filtered but this always creates some problems. Never pour unfiltered water off the filter. This will result in algal cells that should have been on the filter being dumped out as well. Generally one will realize after a few minutes that there is no way to filter the optimal amount. At that point it is recommended that you start over. Discard the filter and water sample that is over the filter. Put on a new filter and measure out a quantity of the sample water that you are certain will go through the filter.

Light will cause chlorophyll to break down. Never leave samples standing for long periods before filtering and once the filtration is finished the samples should be kept in the dark. That is the reason for wrapping samples in aluminum foil. Lastly, freeze the samples as soon as possible to prevent spoilage, at which time the cells break down and the chlorophyll escapes.

6. COLLECTING DISSOLVED OXYGEN (DO) PROCEDURES

Water samples for dissolved oxygen determination should be drawn from the water collection bottles as soon as the bottles are retrieved and before any other samples are taken.

a. Collecting the Water Sample

(1) Attach a clear plastic tube of the proper diameter, about 25 cm in length, to the spigot at the bottom of the water collection bottle. Lift the free end of the tubing to near the level of the air vent, and then open the air vent and the spigot, letting the tubing fill with water. There should be no air trapped in the tubing. If air bubbles are observed, let the water flow out slowly by slightly lowering the free end of the tubing and tapping on the tubing until the bubbles are cleared.

(2) Place the free end of the tube deep into the B.O.D. bottle (biochemical oxygen demand) and fill approximately 1/4 full.

(3) Close the drain valve, swirl the water around in the bottle to rinse it, and discard the water.

(4) Reinsert the tube into the bottle near the bottom and allow water to flow.

(5) Count the number of seconds it takes for the bottle to fill and begin to overflow the B.O.D. bottle.

(6) Continue counting and allow the water to overflow until the bottle has filled at least three times. For example: If it takes a count of 7 to fill the bottle, continue letting the water overflow and count to 21.

(7) Place the ground glass stopper in the top of the B.O.D. bottle and as you do so, twist it gently. Leave the excess water on top of the bottle. This provides

an additional air seal. Draw samples from the remaining water collection bottles following the same procedure.

(8) Samples are now ready to be measured with an oxygen meter or by the Winkler titration method within 30 minutes of collection.

b. Measuring Dissolved Oxygen with the YSI Meter

(1) Adjust the SALINITY knob on the YSI meter to the salinity of the sample (use a refractometer to determine salinity if a CTD is unavailable. If your refractometer measures in Brix, use the conversion factors in Table 5 to convert to salinity).

(2) Place probe and stirrer in the sample and switch on stirrer (toggle switch on top of probe).

(3) When the meter has stabilized, read D.O. The reading should be taken within 30 seconds of immersion of the probe.

(4) Leave the instrument on (switch at RED LINE) between measurements to avoid the necessity for repolarizing the probe.

(5) Record D.O. measurements in the appropriate blocks on the station sheet.

(6) A calibration check of the oxygen meter should be performed during the first hydrocast each day.

(7) If this is the first hydrocast of the day, draw a second water sample (Steps a.1-8 above) from each Niskin bottle and measure dissolved oxygen with a SECOND calibrated dissolved oxygen meter and probe.

(8) Record the second D.O. measurements just ABOVE the previously recorded measurements on the station sheet.

(9) Occasionally dissolved oxygen readings will appear lower or higher than expected, and may indicate conditions of hypoxia or supersaturation respectively. These readings should be substantiated when below 2 ppm or above saturation levels (Table 7) for the existing temperature and salinity of the sample. Water samples with questionable readings should be checked by both of

the following methods.

a- Run water sample for determination of dissolved oxygen using a SECOND calibrated meter.

b- Water sample should be titrated using the field titration kit (Hach) supplied.

c. Calibrating the YSI Oxygen Meter.

While these instructions are specific to a YSI meter, each type of oxygen meter should come with instructions on how to calibrate it and how often to calibrate. If you don't have calibration information for your instrument, contact the manufacturer for instructions. Air calibration of the YSI oxygen meter is straight forward and requires only a few minutes to accomplish once the meter and probe have been prepared and the instrument stabilizes. Preparing the instrument prior to making the hydrocast allows optimum time (30 minutes) for stabilization and reduces the time between drawing the samples and taking measurements. Procedures for air calibration follow:

1) Turn on the meter to Redline 30 minutes before calibration or use. Check probe membrane for tears and bubbles in the electrolyte. Replace membrane if necessary and refill probe with fresh electrolyte.

2) Place the probe in moisture saturated air. Use a B.O.D. bottle partially filled (about 1") with FRESH water.

3) Switch meter to RED LINE and adjust.

4) Switch meter to ZERO and adjust.

5) Adjust SALINITY knob to FRESH, i.e fully counter clock-wise.

6) Switch meter to TEMPERATURE and read.

7) Use probe temperature to determine calibration value from Table 6, "Solubility of Oxygen in Fresh Water", page T-10.

8) Switch to the desired dissolved oxygen range 0-5, 0-10,

or 0-20, and adjust CALIBRATE knob until meter reads the correct calibration value from Step 7. Verify calibration stability. Readjust if necessary.

The meter/probe is now calibrated and should be recalibrated before each use or hydro station.

D. CTD Procedures

1. INTRODUCTION

The CDT unit is the preferred method for collecting the various environmental measurements required by the SEAMAP. It is a delicate piece of equipment and requires care in handling. The CTD manufacturer's recommendations for a CTD/computer interface should be considered the minimal requirement for computer capabilities. A computer of lesser capabilities will be slow processing data.

NOTE: Field operation instructions for the NMFS CTD are undergoing major revision. Below are preliminary, introductory instructions for use with a SEABIRD CTD. SEAMAP members using various CTD instruments will have to compile their own detailed operational instructions for the present time. SEAMAP members are welcome to submit their CTD operation instructions for incorporation into this manual. Please study and follow the operational instructions furnished by the manufacturer.

The CTD operator should be familiar with the CTD unit hardware and software. As a minimum the operator should be able to identify all sensors, understand the plumbing arrangement, and know how to use programs required to make a cast.

2. INITIAL CTD INSPECTION PRIOR TO THE CRUISE.

a. Fill plastic tubing with water and inspect for leaks.

b. Inspect plastic tubing for kinks or any condition which may restrict water flow.

c. Make sure the orifice in the top of the inverted "Y" plastic tubing connector is not blocked.

d. Check that the sensors are attached firmly in the CTD cage and that the CTD cage is securely bolted and safety-wired to

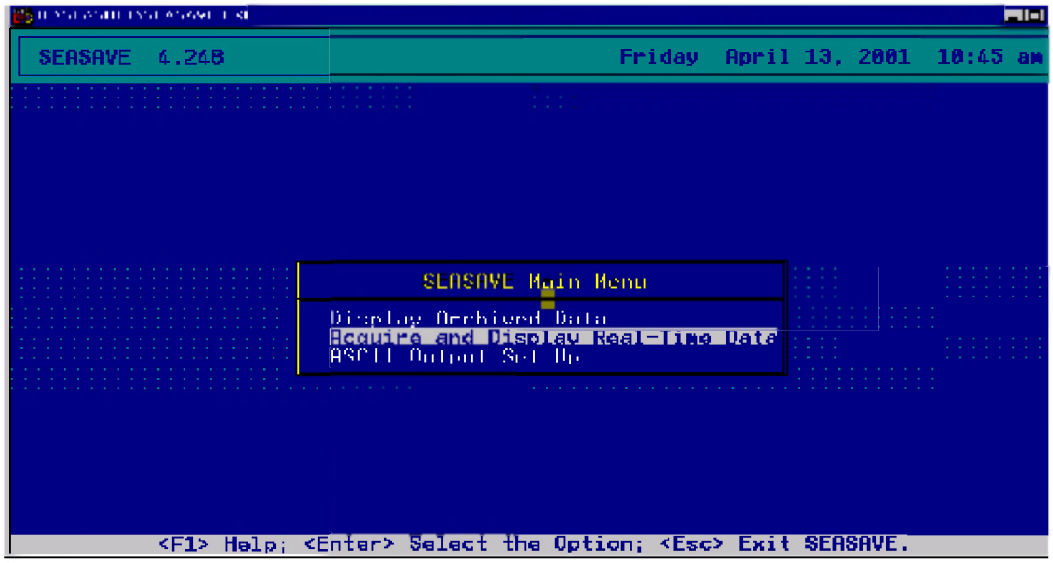
the frame.

e. Test fire the Rosette.

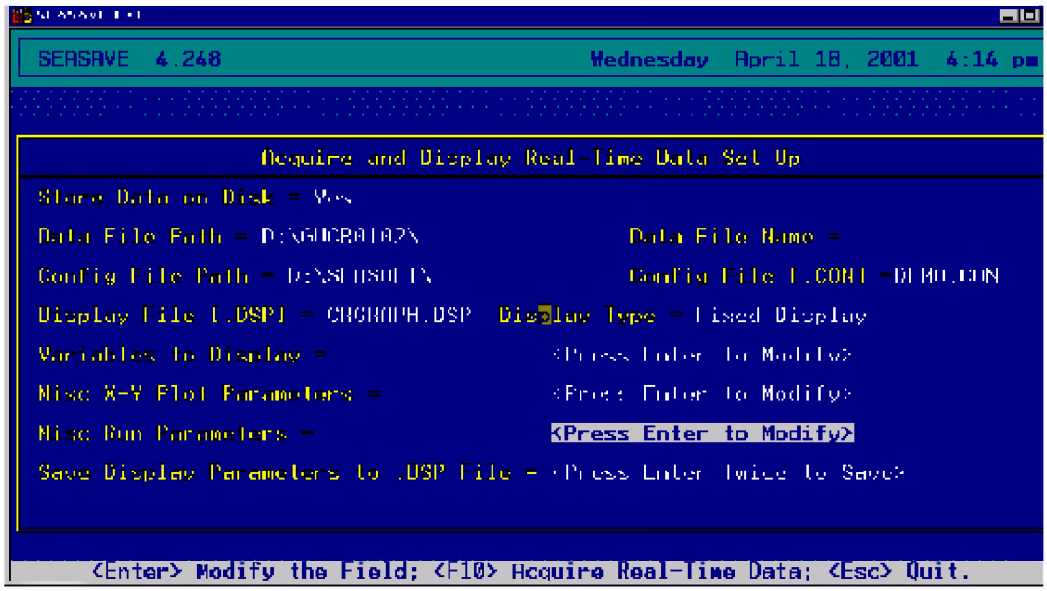
3. PRECRUISE SEASAVE SOFTWARE SETUP

a. Data Profile Header Form While dockside and making a wet test of the CTD unit before the ship sails, the Data Profile Header Form must be edited to conform with the current cruise. When making a cast, this Header Form information will be written in every CTD data profile taken. Instructions with display examples follow:

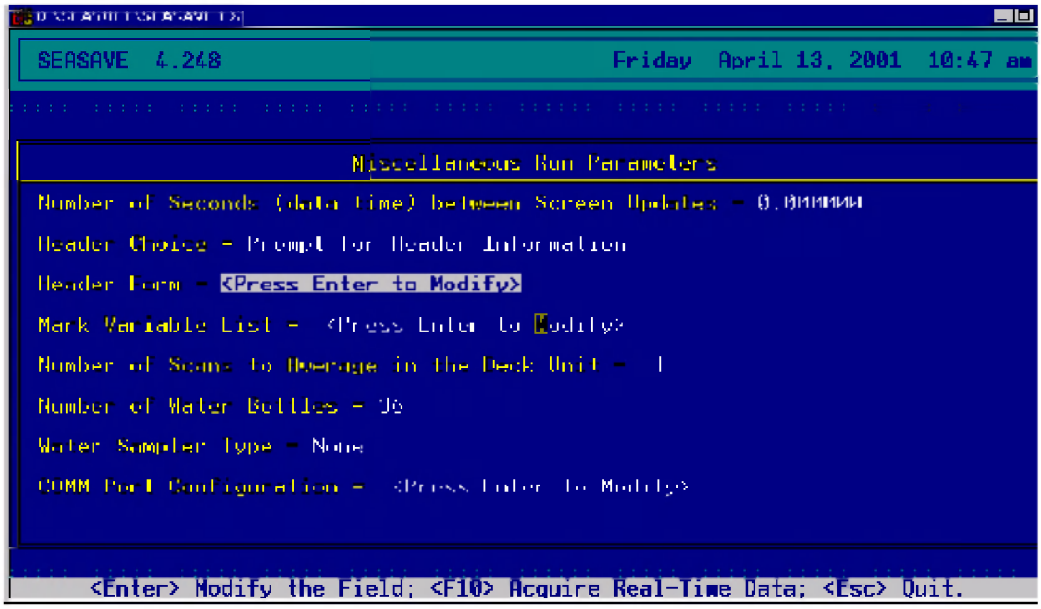
In the SEASAVE Main Menu window, scroll down and select Acquire and Display Real-Time Data.



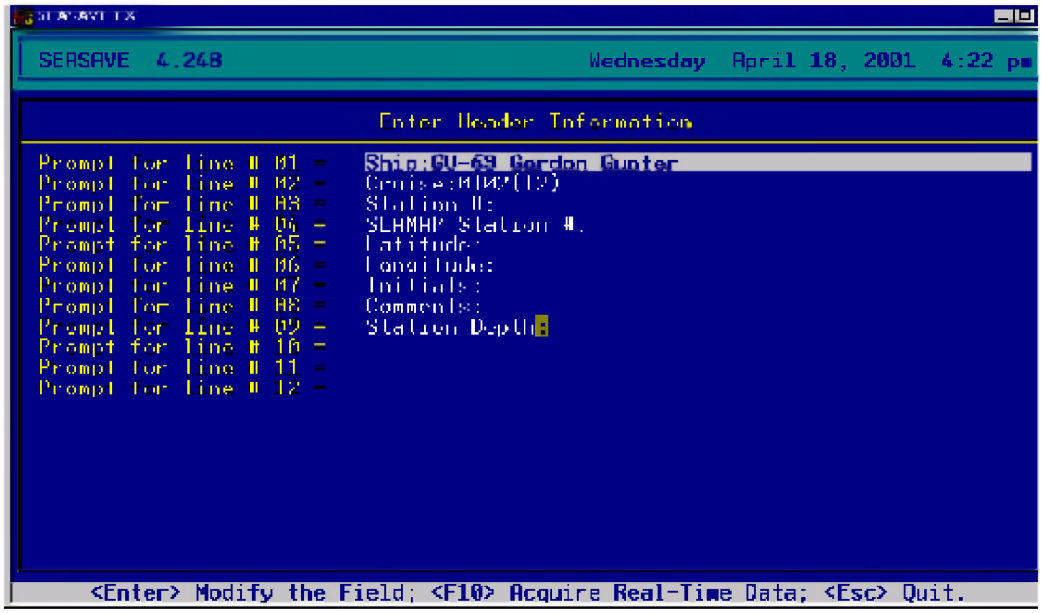
In the Acquire and Display Real-Time Data Set Up window, scroll down and select Misc Run Parameters.



In the Miscellaneous Run Parameters window, scroll down and select Header Form.



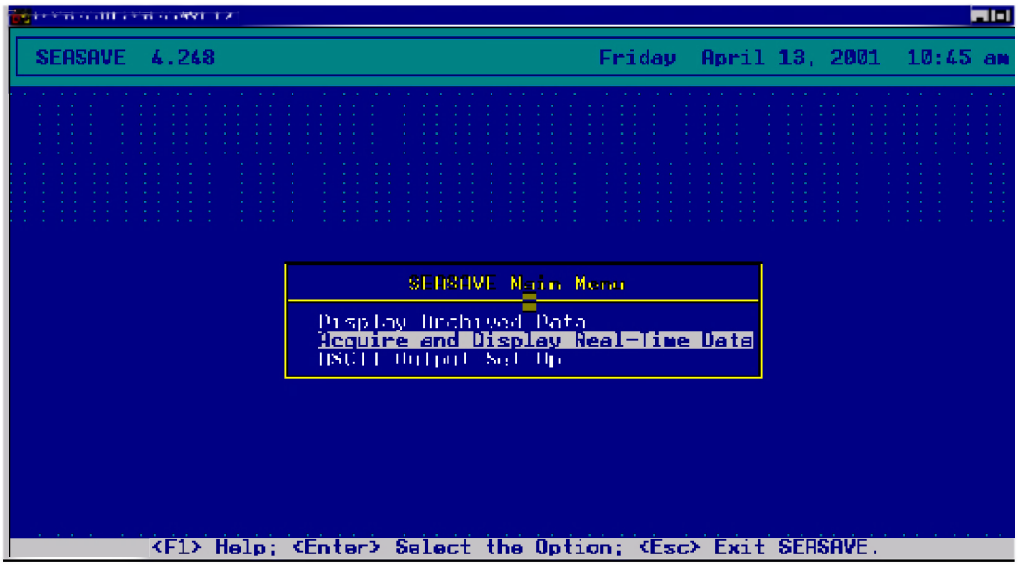
In the Enter Header Information window enter the information appropriate for your organization and vessel on each line.



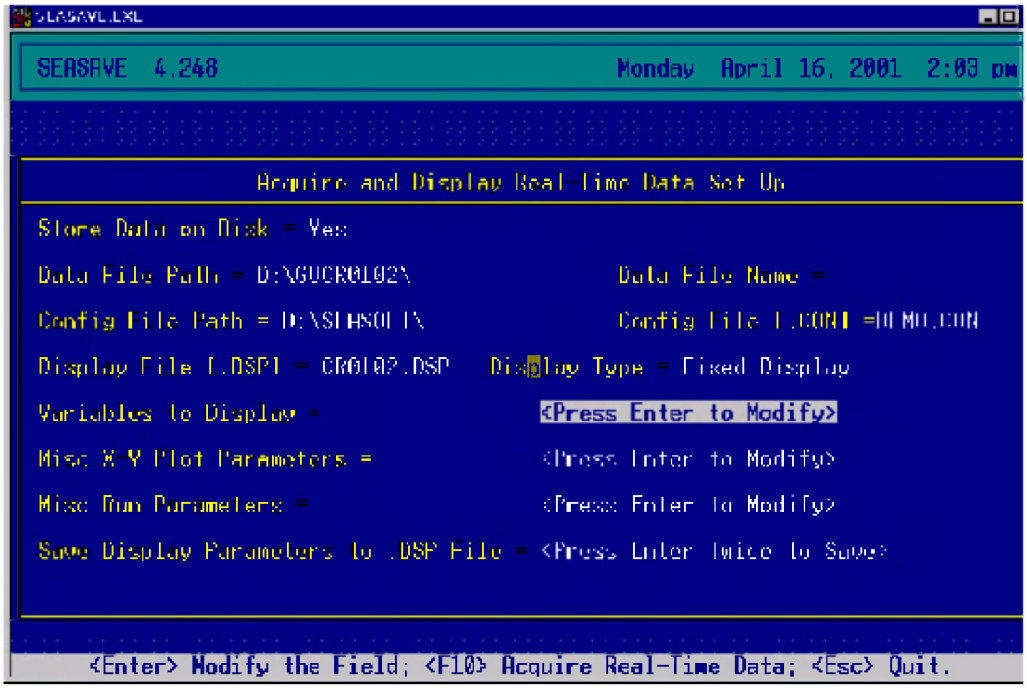
b. SEASAVE Display Forms While dockside and making a wet test of the CTD unit before the ship sails, a Data Display Form and Graph Display Form must be edited to conform with

the current cruise. When making a cast, the Display Form will be displayed so you can transcribe data to the Environmental Data Sheet. The Graph Display Form will be printed and given to the Field Party Chief for post cruise data profile quality control purposes. Instructions with display examples follow:

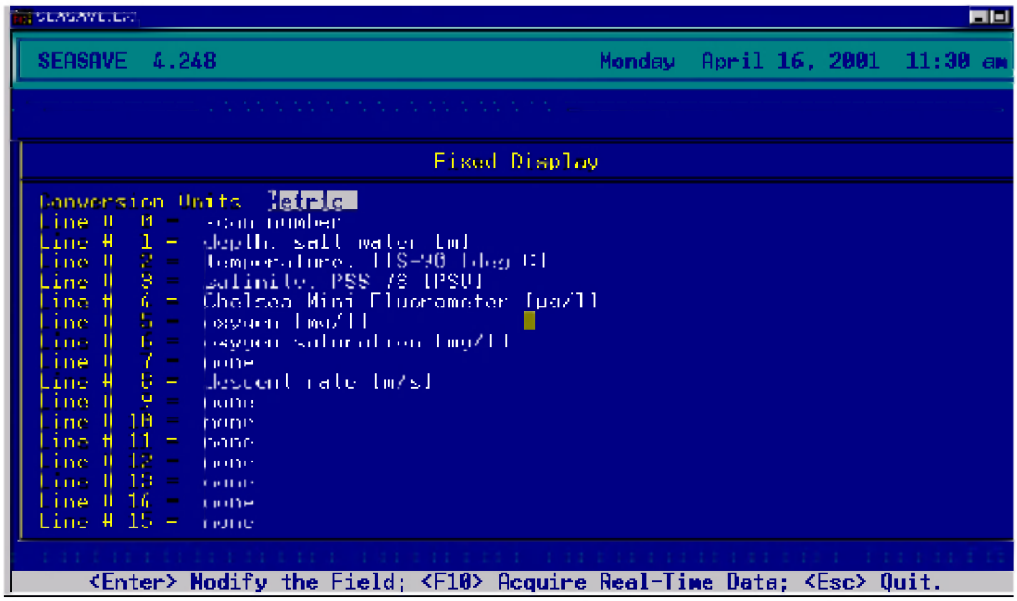
(1) Fixed Display Form In the SEASAVE Main Menu window, scroll down and select Acquire and Display Real-Time Data.



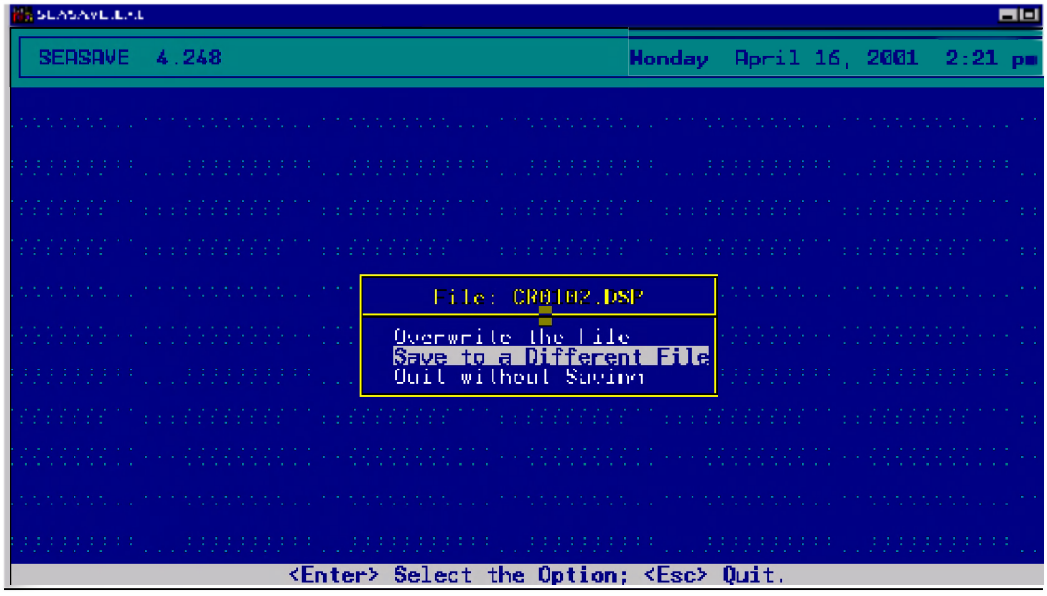
In the Acquire and Display Real-Time Data Set Up window, scroll down to Display Type and select Fixed Display, then select Variables to Display.



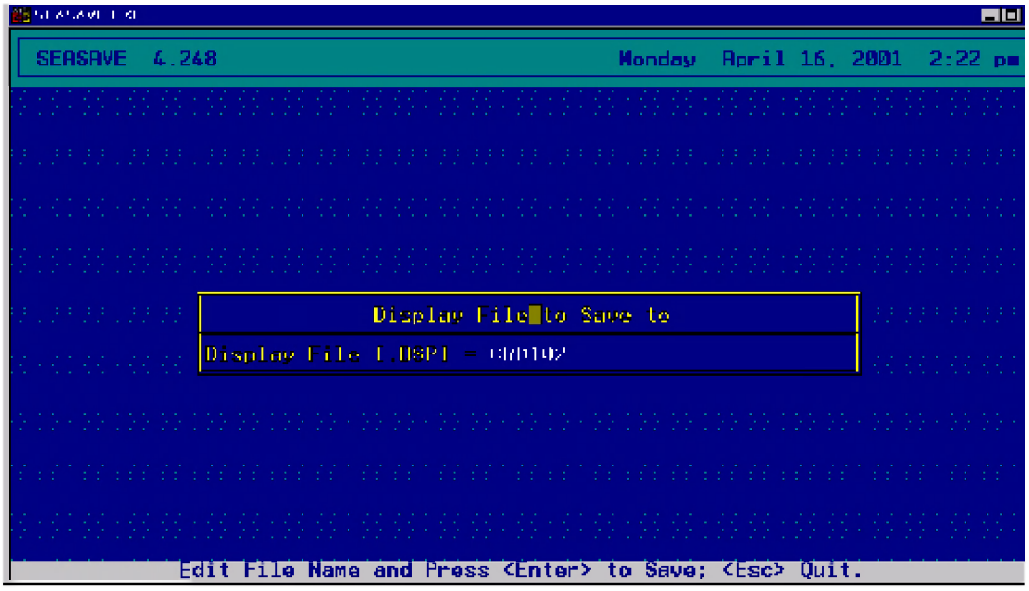
In the Fixed Display window, enter in each line the data parameters to display.



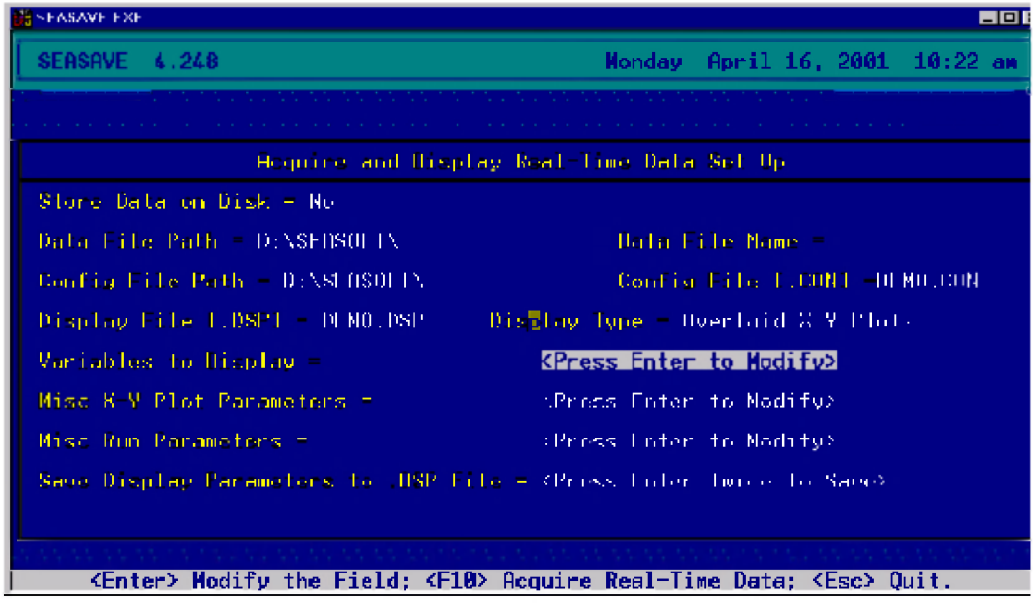
Press the 'ESC' key to return to the previous window. Return to the Acquire and Display Real Time Data Acquisition window. Press the 'ESC' key again to open a window that gives you an opportunity to save this Display file as a uniquely named file for this cruise. Scroll to select 'Save to a Different File.'



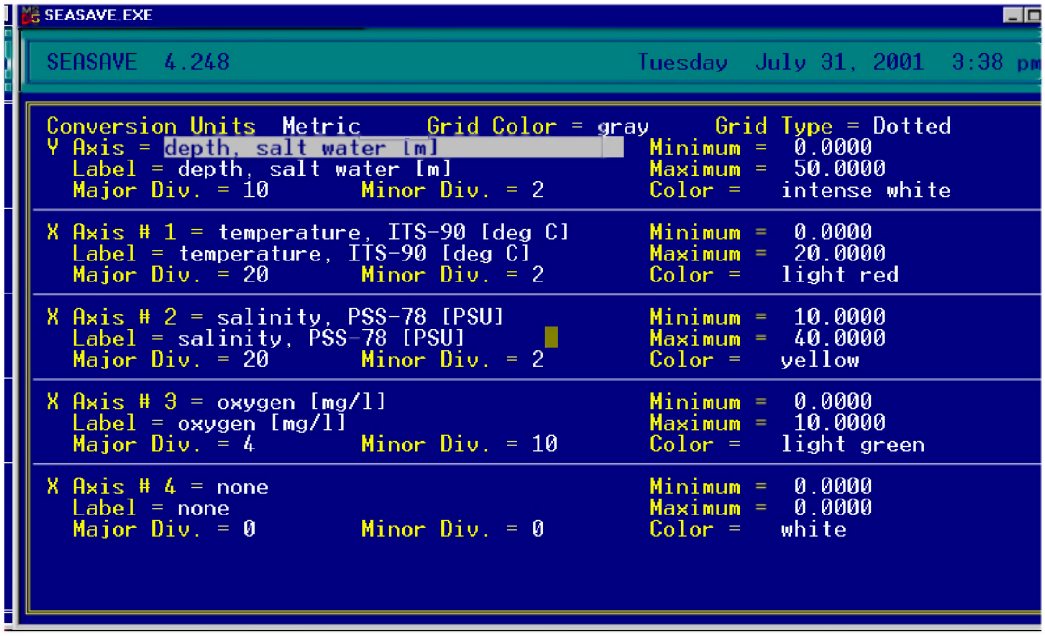
In the 'Display File to Save to' window, name the file appropriate for your cruise. Exit the window, but do not exit SEASAVE.



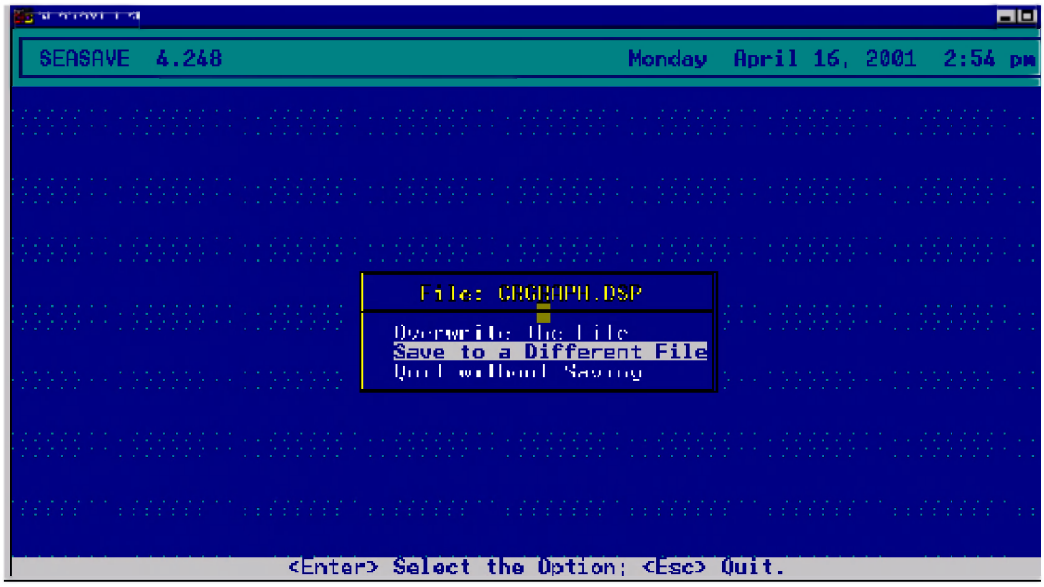
(2) Graph Display Form Return to the Acquire and Display Real Time Data Acquisition window. Scroll down to Display Type and select Overlaid X-Y Plots.



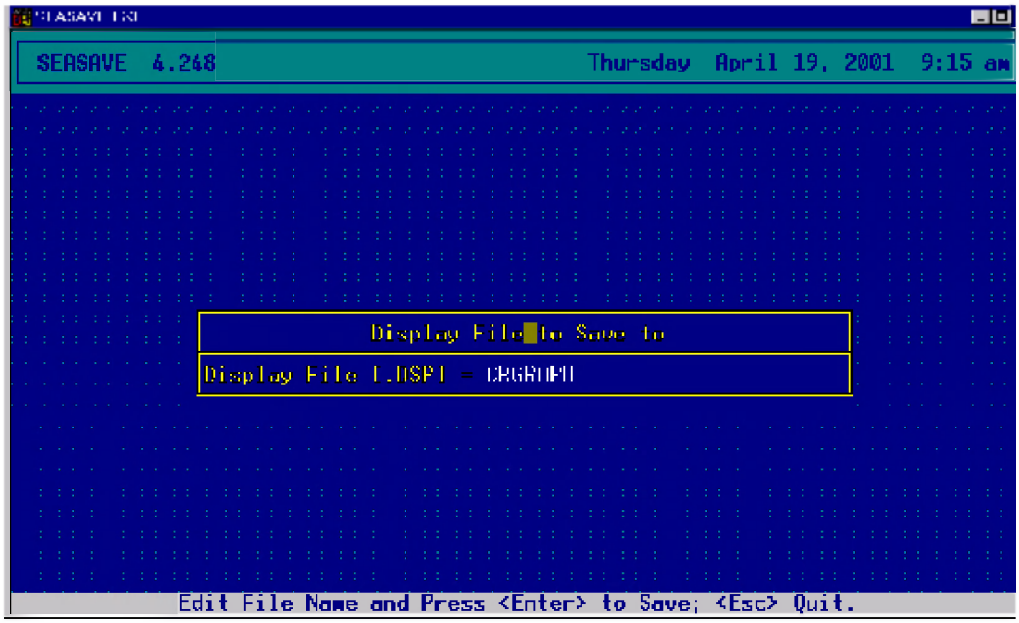
Then select Variables to Display. Fill in depth (M) on the 'Y' axis. Be sure to select saltwater and 29° Latitude. On the 'X' axis, fill in water temperature (°C), salinity (PSU), and dissolved oxygen (mg/l).



Press the 'ESC' key to return to the previous window. Return to the Acquire and Display Real Time Data Acquisition window. Press the 'ESC' key again to open a window that gives you an opportunity to save this Display file as a uniquely named file for this cruise. Scroll to select 'Save to a Different File.



In the 'Display File to Save to' window, name the file appropriate for your cruise. Exit the window and do not exit SEASAVE. Now you can make your first or dockside CTD cast.



4. MAKING A CTD CAST

a. Fill plastic tubing with water and inspect for leaks.

b. Inspect plastic tubing for kinks or any condition which may restrict water flow.

c. Make sure the orifice in the top of the inverted "Y" plastic tubing connector is not blocked. Check the orifice by using a fresh water hose to pressurize the plumbing and look for a small fountain squirting up from the orifice. If it is blocked, use a small wire (approx. 0.020" dia.) to clear the hole.

d. Check that the sensors are attached firmly in the CTD cage and that the CTD cage is securely bolted and safety chained to the ROSETTE frame.

e. Insure that the shackle holding the Rosette frame to the sea cable is tightened securely and safety wired.

f. If so equipped, turn off the topside power supply. Run the program "TERM11". At the program prompt, press the F2 function key.

The program will enter a parameter set-up menu. Verify that "vmain"is greater than or equal to 11.5 volts. If not, replace the D cell batteries. Verify that "v lithium" is greater than or equal to 5.5 volts. If not, contact Engineering support.

g. Turn on the topside power supply if so equipped. Press the F3 function key and verify that vmain exceeds 12 volts.

h. If required, use the "cc" command to set the conductivity turn-on frequency to 3500 for oceanic waters, or a lesser value for low salinity water where the CTD does not turn on reliably when it enters the water. Use a conductivity turn-on frequency of 0 only for on deck tests.

i. At the TERM11 prompt, issue the "il" command followed by the "qs" command. Exit TERM11 immediately. If any keys are inadvertently pressed after the "qs" command is issued and before exiting TERM11, the "qs" command must be given again.

j. Run the program SEASAVE and confirm the correct "*.con" file is selected. Select "YES" as the option for the "Store data to disk" menu item and make sure \CRXXX (where XXX is the cruise number) is chosen as the output data path. Select a name conforming to the following convention for saving data to disk if this is not an operational cast ("SSMMDD" where SS is replaced by O2 for OREGON II, GU for GORDON GUNTER, CR for CARETTA, or any appropriate initials for any other ship. Replace MM with the month 01-12 and replace DD with the day of the month 01-31. For example, a test cast on the CARETTA performed on July 9 would use the filename CR0709). Use the station number as the data filename for a normal cast. Enter a filename incorporating the station number, ex.,for the first Caretta station would be CR001. Select "Fixed Display" as an option for the "Display type" menu item. For variables to display, select scan number, depth, salinity, dissolved oxygen(mg/L), temperature, fluorometer (Sea Tech), light transmission, and descent rate (or a subset of these variables if not all of the sensors are used). Also, select "Overlaid X-Y Plots" as an option for the "Display Type" menu. For variables to display select depth, dissolved oxygen (mg/l), fluorometer, and transmissmivity. You will need both window displays open during your CTD cast. Press function key F10 to enter the data acquisition mode.

k. Disconnect the fill hose from the conductivity cell and turn on the magnetic switch.

l. Deploy the CTD over the side and hold it just below the

surface for 3 minutes. Monitor the computer display. The instrument should turn on about 1 minute after entering the water.

m. Commence lowering the CTD at 20 meters per minute. The descent rate display should be 0.333 meters per second. Use the descent rate display to call for a speed-up or slow-down of the winch.

n. Stop 1 meter off the bottom or at maximum depth, 200 meters. Wait 1 minute, press the pause key and record your readings on the Environmental Data Form. Take a water sample by PRESSING the rosette control switch. While a water sample is being taken, you can do a screen dump of the active Fixed Display window (ALT+PRINT SCREEN) to get a hard copy of the data at that point. Open Wordpad and paste the data display into the window. Print this file.

o. Press the space bar to resume data updates.

p. Haul the CTD up to midwater, wait 1 minute, press the PAUSE key and record your readings. Take a water sample by PRESSING the rosette control switch. While a water sample is being taken, you can do a screen dump of the active Fixed Display window (ALT+PRINT SCREEN) to get a hard copy of the data at that point. Open Wordpad and paste the data display into the window. Print this file.

q. Press the space bar to resume data updates.

r. Bring the CTD to the surface, wait one minute, press the PAUSE key and record your readings. Take a water sample by PRESSING the rosette control switch. While a water sample is being taken, you can do a screen dump of the active Fixed Display window (ALT+PRINT SCREEN) to get a hard copy of the data at that point. Open Wordpad and paste the data display into the window. Print this file.

s. Press the space bar to resume data updates.

t. When the cast is over and the CTD is back on deck, turn off the magnetic switch, and rinse the instrument down with fresh water. Reconnect the hose, flush the tube with fresh water, leave it filled with fresh water, and inspect for leaks.

5. PRINTING A CTD PROFILE GRAPH.

Click the mouse arrow on the Graph Display window to make it active. Press the 'ALT+PRINT SCREEN' keys to capture the graph

in the PC memory buffer. Open Wordpad and paste the graph into the window. Print this graph file and give it to the Field Party Chief.

V. COLLECTING ICHTHYOPLANKTON DATA

V. Collecting Ichthyoplankton Data

A. Introduction

When filling out station sheets, please use a lead pencil and make entries dark and legible. A NMFS PASCAGOULA STATION SHEET-TYPE I (Figure 5-1, page 5-16) must be completed for all ichthyoplankton stations. An ICHTHYOPLANKTON STATION FORM (Figure 5-2, page 5-20) must be filled out for all plankton stations where SEAMAP ichthyoplankton samples are collected. All numeric fields on field data sheets are to be right justified or aligned with the decimal place. On all NOAA vessels equipped with the Scientific Computing System (SCS), Watch Leaders should, prior to the first plankton station, confer with the Field Party Chief (FPC) on the selection of the most appropriate data to be collected during SCS plankton events.

A checklist of sampling equipment and supplies is listed in Appendix 10, page A-27. Prior to a cruise, the FPC should determine the equipment (kinds of collecting gear) and supplies (number of sample jars, approximate amount of formalin, and alcohol, etc.) that will be required for the cruise and submit those requirements to ichthyoplankton personnel for placement on the vessel.

B. SEAMAP ICHTHYOPLANKTON SAMPLING: General Comments

Important changes have been made so please review these procedures for collecting SEAMAP ichthyoplankton samples.

Some confusion has risen over just when weather conditions prohibit sampling. This is truly a subjective decision based on boat stability and personnel capabilities. In general, when wind speed approaches 15-20 knots, it is time to begin appraising the situation. In some cases, with larger ships and experienced crew, it is possible for operators to maneuver the boat into a lee position so that work can continue in winds over 20kts. At other times, specific sea conditions and/or inexperienced personnel may warrant stopping operations in 20 knot winds. Remember that high winds will cause the flowmeters to turn prior to submergence. When that becomes a problem, try to deploy the bongo net as quickly as possible or put a Styrofoam cup over the flowmeter rotor. Holding cod ends until the mouth of the bongo frame is submerged will reduce cracking and breakage of cod ends that are blown into the side of the ship in strong winds.

C. ICHTHYOPLANKTON STATION PROCEDURES

1. BONGO SAMPLING

When conducting bongo tows using the standard SEAMAP bongo configuration, without a **monitored depth sensing device** (SBE-19

or similar device), follow the directions outlined in **Station Operations I** (page 5-3). If a **monitored depth sensing device** (SBE-19 or other) is used, follow the protocols outlined in **Station Operations II** for use of that device (page 5-7).

Before and after each cast, check bongo array for:

Make sure cod ends are secure.

Check for major rips or holes in the mesh, especially in the lower 1/3 of the net. If holes are detected, repair them (see page 5-23) or replace the net.

Make sure there are NO air bubbles in the flowmeters. If needed, fill with silicone oil. Tap water (NOT distilled or salt water!) can be substituted in an emergency.

Check to insure that the flowmeter rotor spins freely and does not wobble, i.e., the shaft is not bent. If the flowmeter does not spin freely or a wobble is detected, replace the meter.

a. STATION OPERATIONS I

The following procedure should be used **when no monitored depth sensing device (SBE-19) is being used.**

(1) Record station information on station log sheets. *See page 5-17 for ichthyoplankton station sheet instructions*.

(2) Record flowmeter serial number and START readings.

(3) Upon notification that the Bridge and Deck are ready and upon your command, tell the deck crew to lower the gear to just above water surface; check that nets are streamed out straight. Zero meter wheel.

(4) Ship should be moving at 1.5-2.0 knots.

(5) Deploy gear. When nets enter water and **flowmeters start to turn**, record the time to nearest second **(Gear in)** using a wristwatch displaying seconds. **Watches should be synchronized with the ship's time.**

(6) Pay out wire, using **Table A** below as a guide, until the amount of wire is delivered to reach the Target Fishing Depth (TFD). In <200m water depth, the optimum TFD samples as much of the water column as possible. In water depths <50m, it is possible to sample within 1-2 m above the bottom. A word of caution, in 50-200 m depths, a small drop in the wire angle greatly increases the chance the bongo nets will hit the

bottom. As depth increases, the TFD should become more conservative. It can be as much as 4 m above the bottom in 199 m of water depth.

(7) Use Table 8, Towing Wire Required To Reach Depths of 1-500 Meters With Wire Angles from 30^0 To 60^0, to adjust amount of wire needed for net to actually reach target depth at the observed wire angle.

(8) Adjust ship speed to maintain a uniform wire angle, preferably 45°, during wire payout.

(9) At maximum depth, **stop payout of cable and immediately start retrieval (do not allow net to 'settle').** Record time, angle of wire, amount of wire out and the calculated depth (see ***** below) that the net reached. Please indicate in the remarks section that the standard ***calculated depth** was recorded in the **maximum depth field** of the Ichthyoplankton station form.

***Calculated max depth = max wire out x cosine of wire angle when max depth is reached**

(10) Retrieve net at a rate commensurate with the amount of wire out, using **Table A** as a guide while maintaining a 45° wire angle. It is **EXTREMELY IMPORTANT** that the wire angle be as close to 45° as possible **during retrieval.**

If angle exceeds 55°, falls to 35° OR if combined variation exceeds 15°, the tow should be repeated (save the sample until a better tow is completed).

TABLE A. APPROXIMATE RATES OF WIRE PAYOUT AND RETRIEVAL FOR SEAMAP BONGO NET COLLECTIONS. (Actual rates will depend on winch capabilities).

Target fishing DEPTH (m)	Total amount WIRE OUT (m)	PAYOUT RATE*	RETRIEVE RATE*
0 - 19	< 27	10m/min	10m/min
20 - 69	28 - 97	15m/min	15m/min
70 - 100	> 99	20 - 30m/min	20m/min
101-200	> 143	50m/min	20m/min

*****Once established, these rates must be held constant.

(11) Record time to the second **(Gear out)** when the net breaks surface and flowmeters stop turning, while an assistant or the winch operator immediately pulls the frame from the

water. Do not let the bongo array continue to fish once it breaks the surface.

(12) When possible, rinse plankton into the cod end of the net with a seawater hose while the net hangs over the side. In high winds, bring net directly on board and rinse down completely on deck. If using the **ring bongo frame, record the flowmeter readings before rinsing down the ichthyoplankton net.** If using the standard **MARMAP bongo frame or collar bongo, take care not to wash or spin the flowmeter rotor before the tow readings are taken.**

(13) Put bongo frame and net on deck (take care not to rest frame on net or scrape net with frame on the deck!) and record flowmeter readings. **After taking readings, check that the flowmeter shaft is not bent by spinning the flowmeter rotor gently.**

(14) Gently rinse the lower portion of net into cod ends. Visually check that no plankton is left in net, especially check seams and cod end sleeves. If mud or sand is present in both samples, the tow must be repeated. Save any marginal sample until completion of the next tow. If mud (no more than 2 tablespoons) is present in only one sample the tow need not be repeated. Save both samples and record the presence of mud in the sample in the remarks section of the Ichthyoplankton station sheet and the Plankton Transfer Record (Figure 5-4).

(15) Remove cod ends and place cod ends into bucket. **It is imperative that samples be preserved immediately upon collection. Keep samples in a dark temperature controlled area when possible.**

Note: Sometimes extremely fine phytoplankton material will be difficult to rinse out. It is not necessary to save this phytoplankton, if you are completely sure you have rinsed down all the zooplankton. ***(When in doubt, SAVE IT ALL!!!)*** *However, a dense accumulation of phytoplankton will clog the net and should be cleaned prior to the next station. Rinse net with your usual effort to obtain sample, preserve, then scrub net afterwards as needed.*

Rinse off any Sargassum, grass or other debris. Note the approximate type and volume of material (less than a handful, a handful, a half bucket, etc.) in the comment section of the NMFS Pascagoula Station Sheet-Type I (or on the Ichthyoplankton station sheet on cruises/stations where plankton is secondary), then discard after checking carefully for any clinging plankton material. Small adult fish and invertebrates that can easily fit in the sample jar should be saved. Larger fish may be

discarded (note on data sheets) unless needed for another purpose. (Freeze any unusual or rare specimens if at all possible!). Concentrate plankton using a fine mesh cone or sieve. Some samples are slow to filter; for these samples concentrate smaller quantities at a time and use a vigorous swirling motion. Jellyfish slime can be cut with a small amount (1-2 tsp) of ethanol (NOT formalin!!). If needed, preserve the sample "as-is", liquid and all. You may be able to condense the sample later when transferring to ethanol.

(16) Transfer plankton to sample jars with a seawater filled rinse bottle. **A plastic spoon may be used, but is not recommended. If necessary, use a plastic spoon to transfer a larger quantity of sample at one time into the jar. Never scrape plankton from the mesh cone or sieve with the spoon. This mutilates larvae and makes them impossible to identify.**

(17) Most SEAMAP plankton samples are initially fixed in 10% formalin. Add 50 ml of full strength formalin to the 0.5 liter jar or 100 ml of formalin to the 1 liter jar containing the plankton sample seawater mixture (jar should be at least half filled with seawater), then top off the jar with seawater. **Do not fill jars more than 1/3 full with plankton, use more jars and label each jar accordingly, i.e., 1 of 2, 2 of 2, etc.**

All samples should be transferred to 95% ethanol solution after a minimum of 48 hours for permanent preservation. **It is very important to not mix water into the sample at this stage.** Unless there is precipitate, it is not necessary to rinse sample, just drain and add ethanol. If you need to rinse, use ethanol and NOT seawater. If a sample has spoiled, rinse it lightly, subdivide into more jars (this time do not fill more than ¼ with sample), and fill with 10% formalin solution. After another 48 hours, transfer into 95% ethanol as usual. **Note preservation problems on the Ichthyoplankton station sheet, the Pascagoula station sheet and the Ichthyoplankton Sample Transfer Record.**

Sometimes SEAMAP samples are initially preserved in 95% ethanol; check with the FPC and Watch Leader to determine when this is to be the case. Initial preservative information should be recorded in the remarks section on the Ichthyoplankton station sheet. This information should also be written in the comments section of the inside labels and the 'gear' section of the outside sample labels.

(18) Follow instructions for labeling sample jars starting on page 5-20.

(19) After the station is completed fill in appropriate

information on the **Flowmeter Performance Tracking Form**, Figure 5-4, and the **Plankton Transfer Record**, Figure 5-5, as instructed on pages 5-22 to 5-23.

b. STATION OPERATIONS II

The following procedure should be used when a monitored depth sensing device (SBE-19) is used.

(1) *Deck Scientist*: Inspect underwater depth sensing device (SBE-19) by making sure the device is properly secured to the wire, connections are secure, Tygon tube is filled with water, magnetic switch is off and wires are not damaged. Report findings to Lab Scientist. The Watch Leader will report damages to Electronics Technician. Report both the left and right bongo flowmeter serial numbers and start readings to the Lab Scientist.

IMPORTANT: Measure the distance from the SBE-19 to the bottom of the bongo frame for use as a depth correction factor (DCF). This should be done by the FPC/Chief Ichthyoplankton Scientist prior to the first bongo tow and that number should be given to the Watch Leaders and displayed in the Lab where the SBE-19 operations will be conducted. Also record this value on the Pascagoula Type I sheet in the Comments section.

(2) *Lab Scientist*: Record both the left and right bongo flowmeter serial numbers and start readings on the Ichthyoplankton Station Form. Follow SBE-19 (SEACAT) Programming instructions. Determine if you are using a DOS or a Windows driven computer system. Select and follow appropriate instructions:

DOS:

Type "cd SBE4213"
turn on deck box
at C:\SBE4213> Type "term19"
blue screen, press Enter
at S> type "DS", hit Enter or just hit F3 to display status
check vmain (should be greater than 12 to run)
at S> type "IL", hit Enter or just hit F8 to initialize logging
at S> type "QS", hit Enter, then press F10 to exit
at C:\SBE4213> type "SEASAVE", hit Enter
file (on right part of screen), enter station # as filename
press F10 to fill out header form
to leave header, press esc
Save header and continue, press Enter

Acquire and display realtime data, press Enter
At the message prompt, turn the magnetic switch on the SBE-19
When data appears in the display, have the *Deck Scientist* and crew deploy the bongo.

Windows:
turn deck box on
double click on term19 icon
at S> type "DS", hit Enter or just hit F3 to display status
check vmain (should be greater than 12 to run)
at S> type "QS", hit Enter, then press F10 to exit
double click on SEASAVE icon
hit ok on the box that comes up
go to File on the menu bar and choose open Seasave configuration (*.cfg)
choose the file that has been set up for that cruise
go to Realtime Data on the menu bar and choose
Start Acquisition, hit Output data file button
Click on data folder and enter station number as the file name
Hit Green **Start Acquire** button - A header form will come up.
Fill it in.

Make sure the bridge and deck are ready to deploy before you hit 'Ok' at the bottom of the window because you will have only 60 seconds to turn on the magnetic switch after hitting 'Ok' or you will have to repeat the setup process.

When data appears in the display, have the *Deck Scientist* and crew deploy the bongo.

(3) On the *Lab Scientist*'s command, *Deck Scientist* should remove Tygon tubing, turn on magnetic switch and deploy. Submerge the bongo array and report the time of entry into the water (GEAR IN) to the *Lab Scientist*.

(4) *Lab Scientist*:Record GEAR IN for both right and left bongos on the Ichthyoplankton Station Form. Monitor net depth on computer constantly. Wire angle can also be monitored by *Lab Scientist* if electronic angle indicator is in operation. *Deck Scientist* reports wire angles periodically during downcast.

(5) *Lab Scientist* : For stations 100m or less, have winch operator pay out cable slowly **(Table A)**, until desired wire payout for fishing depth is reached. For stations greater than 100m, pay out cable at 50m per minute. **Remember to add the depth correction factor (DCF) to the observed depth to account for the distance from the SBE-19 to the bottom of the bongo frame.**

(6) On *the Lab Scientist*'s command **at maximum depth, stop payout of cable and immediately start retrieval (do not allow net to 'settle').** At that time the *Deck Scientist* will report **wire angle** and **wire out** to the *Lab Scientist*.

(7) *Lab Scientist*: At the top of the Ichthyoplankton station sheet, record **wire angle, time at max depth, wire out** and **observed maximum depth** for both left and right bongos. Do not allow the bongo array to settle. Please indicate in the remarks section of the Ichthyoplankton station form that the **observed depth** from the SBE-19 profile was recorded in the maximum depth field. **If the SEACAT (SBE-19) malfunctions, conduct the tow using the instructions given in Standard Operations I.**

(8) *Lab Scientist*: In the first block of the middle section of the field sheet (minute 1), record **wire angle** and meters of **wire out**.

(9) *Lab Scientist*: Tell the winch operator to slowly retrieve the bongo array at 20 m per minute for tow depths of 100 m or deeper; for shallower stations, refer to **Table A** for recommended retrieval rates.
Deck Scientist: must report wire angle and remaining wire out to *Lab Scientist* each minute during retrieval.
Lab Scientist: Record angle and amount of wire remaining at the end of each minute during retrieval of the net.

(10) *Deck Scientist* should report when the bongo array breaks the surface.
Lab Scientist: If this happens before a full minute is complete, this should be reflected in the end time for the cast.

(11) *Lab Scientist:* Record end tow time (GEAR OUT) for both left and right bongos. Beginning and end tow times should be recorded to the second (i.e., HH MM SS).
Under DOS: When done with the tow, hit F1 to stop recording, turn off the deck box and have the magnetic switch turned off. **Under Windows:** When the tow is done, go to Realtime Data on the menu bar and choose Stop Acquisition, then turn off the deck box and have the magnetic switch turned off. Exit File.

(12) *Deck Scientist:* If marginal operational conditions exist, land the bongo array, report flowmeter readings to the *Lab Scientist* and carefully wash the net down on deck.

Otherwise, thoroughly wash bongo array before landing, then

report flowmeter readings to the Lab.

(13) *Lab Scientist:* Record end flowmeter readings for both left and right bongos.
Deck Scientist: Collect samples for **preservation following procedures outlined for bongo collections on pages 5-2 to 5-6.**

2. NEUSTON SAMPLING

a. Deploy net so that the neuston frame is half submerged.

b. Tow at 1.5-2.0 Knots for 10 minutes (*±30 seconds*). Usually the bridge times this tow. Check with FPC for determination of who keeps the tow time during the survey. Record the beginning (start) and ending (stop) times to the second on the Ichthyoplankton station sheet. **Start time occurs when the gear is in the water half submerged and is fishing properly. End time occurs when the net is out of the water.**

The duration of a neuston tow may be shortened up to five minutes when there are high concentrations of jellyfish, ctenophores, Sargassum, floating weed and/or debris. **It is very important to keep accurate tow times, because tow duration is the only measure of fishing effort for neuston samples.**

c. Retrieve net. Rinse plankton into cod end with saltwater while net hangs over side (if windy, bring net directly on board and rinse on deck).

d. Gently rinse the lower portion of net into the end. Untie sleeve of net and carefully rinse plankton into bucket or remove cod ends (if used) as with bongo nets and place in bucket. Visually check that no plankton is left in net; especially check seams and cod end sleeves. **It is imperative that samples be preserved immediately upon collection.**

Note: Sometimes extremely fine phytoplankton material will be difficult to rinse out. It is not necessary to save this phytoplankton, if you are completely sure you have rinsed down all the zooplankton. ***(When in doubt, SAVE IT ALL!!!)*** *However, a dense accumulation of phytoplankton will clog the net and should be cleaned prior to the next station. Rinse net with your usual effort to obtain sample, preserve, then scrub net afterwards as needed.*

Rinse any Sargassum, grass or other extraneous material. Note

the approximate type and volume of material (less than a handful, a handful, a half bucket, etc.) in the comment section of the NMFS Pascagoula Station Sheet-Type I (or on the Ichthyoplankton data sheet on cruises/stations where plankton is secondary), then discard after checking carefully for any clinging plankton material. Small adult fish and invertebrates that can easily fit in the sample jar should be preserved in the sample. Larger fish may be discarded (note this accurately on the Ichthyoplankton data sheet) unless needed for another purpose. (Freeze any unusual or rare specimens if at all possible!) Concentrate plankton using a fine mesh cone or sieve. Some samples are difficult to condense. If material is slow to filter, work with smaller quantities at a time and use a vigorous swirling motion. Jellyfish slime can be cut with a SMALL amount (1-2 tsp) of ethanol (NOT formalin!). Large volume samples can be preserved "as-is" and then condensed later during transfer to ethanol.

e. Transfer plankton to sample jars with a **seawater** filled rinse bottle. **A plastic spoon may be used, but is not recommended. If necessary, use a plastic spoon to transfer a larger quantity of sample at one time into the jar. Never scrape plankton from the mesh cone or sieve with the spoon. This mutilates larvae and makes them impossible to identify.**

f. Most SEAMAP plankton samples are initially preserved in 10% formalin. Add 50 ml of formalin to the 0.5 liter jar or 100 ml of formalin to the 1 liter jar containing the plankton and seawater sample mixture (jar should be at least half filled with seawater), then top off the jar with **seawater. Do not fill jars more than 1/3 full with plankton, use more jars and label jar accordingly, i.e., 1 of 2, 2 of 2, etc.**

All samples should be transferred to 95% ethanol solution after a minimum of 48 hours. **It is very important not to mix the sample with water at this stage.** Unless there is a precipitate, it is not necessary to rinse the sample, just drain and add ethanol. If you need to rinse, use ethanol and NOT seawater. If sample has spoiled, rinse it lightly, subdivide into more jars (this time do not fill more than ¼ with sample), and again fill with formalin solution. After another 48 hours, transfer into 95% ethanol as usual. **Note preservation problems on BOTH the Ichthyoplankton data sheet and the Pascagoula station sheet.**

Sometimes SEAMAP samples are initially preserved in 95% ethanol; check with the FPC and Watch Leader to determine when this is to be the case. Initial preservative information should be recorded in the remarks section on the Ichthyoplank-ton station sheet. This information should be written in the comments section on the inside and outside labels.

g. Follow instructions for labeling sample jars starting on page 5-21.

h. After the station is completed, fill in appropriate information on the **Plankton Transfer Record**, Figure 5-4.

D. NMFS Pascagoula Station Sheet - Type I Instructions

GENERAL COMMENTS - A NMFS Pascagoula Station Sheet MUST be completed for every SEAMAP station. The top section (down to the heavy black line across page) MUST be completed for each station occupied, regardless of gear types(s) used. The Type I (Figure 5-1, page 5-16) data sheet species list is blank, and is used primarily for plankton surveys and as a continuation sheet for other surveys.

Please use a lead pencil and make entries DARK enough and LEGIBLE enough so that the key entry operator can read them. All numeric fields are to be right justified or aligned with the decimal place. Leading zeros are not required, but enter trailing zeros.

Data Requirements For All Stations:

FIELD BY FIELD INSTRUCTIONS

VESSEL - Enter 2-digit numerical code from Appendix 1, Vessel Codes, page A-2. If your vessel has not been assigned a code, notify NMFS Pascagoula to receive one.

PASCAGOULA STATION NUMBER - This is a unique sequential consecutive 5-digit number within each cruise, preferably starting with "00001". For state vessels enter the 2-digit vessel code followed by a 3-digit station number. Transfer this station number to the environmental or plankton sheet. Do not duplicate this station number for other stations on a cruise.

CRUISE - Enter 3-digit cruise number. Except for the Oregon II and other vessels having historically different cruise numbering conventions, the cruise number for **ALL VESSELS** shall be the calendar year of the survey followed by the cruise number for the year, e.g. "011" first cruise for year 2001, "012"- second cruise for year 2001, etc. The leading zero is required. Use this cruise number on all sheets during a cruise; do not change it.

START TIME - Obtain time zone code from Appendix 2-A, Time Zone Codes, page A-3. Enter military time (0000-2359), HHMM, of start of station. For fishing stations, enter dog-off time or end of gear set. For environmental and plankton stations, enter the time data acquisition started.

START LATITUDE & LONGITUDE - Enter position occupied at start time in degrees, minutes, and hundredths of minutes, observing indicated decimals and entering trailing zeros.

START DEPTH - Enter starting depth in fathoms and tenths.

SEAMAP/OTHER STATION NO. - Use for SEAMAP or other alternate station numbers. For SEAMAP Station numbers, use four alpha/numeric characters and right justify, but be consistent in field length - all numbers should be the same number of characters, T065, W102, **NOT T65 or W0102.**

DATE - Enter station date (based on start time), in the format MMDDYY.

END TIME - Enter as for start time - fishing stations end at start of haulback, others when data acquisition ends.

END LATITUDE & LONGITUDE - Enter position occupied at end time in degrees, minutes, and hundredths of minutes, observing indicated decimals and entering trailing zeros.

END DEPTH - Enter end depth in fathoms and tenths.

GEAR TYPES USED AT THIS STATION - Enter codes for all gear types used at this station - see Appendix 3 for codes.

SURFACE AND BOTTOM TEMPERATURES - If taken, enter temperatures in degrees Celsius, observing 2 indicated decimals. Add trailing zeros if necessary. If more than one method is used, data entry precedence is 1) CTD, 2) XBT, and 3) bucket.

All weather data should be rounded off to nearest hour, i.e. if the time is 13:31 then record weather data collected at 14:00 hours.

Wind speed and direction measurements are a concern for some vessels. Handheld anemometers are available from wildlife and fishery supply houses and should be used to measure wind speed. Wind direction can be determined by a handheld compass

AIR TEMPERATURE - Enter in degrees Celsius and tenths (dry bulb).

BAROMETRIC PRESSURE - Enter in millibars of mercury, observing 1 indicated decimal.

WIND SPEED - Enter wind speed in whole knots.

WIND DIRECTION - Enter wind direction in compass degrees, 001-360.

WAVE HEIGHT - Enter wave height in meters, observing 1 indicated decimal.

SEA CONDITION - Enter Beaufort scale- see Appendix 2-B, Beaufort Sea Condition Table, page A-3.

DATA SOURCE CODE - Enter code identifying data collecting entity- see Appendix 2-C, Data Source Codes, page A-3.

VESSEL SPEED - Enter vessel speed, in knots, during the station, observing 1 indicated decimal.

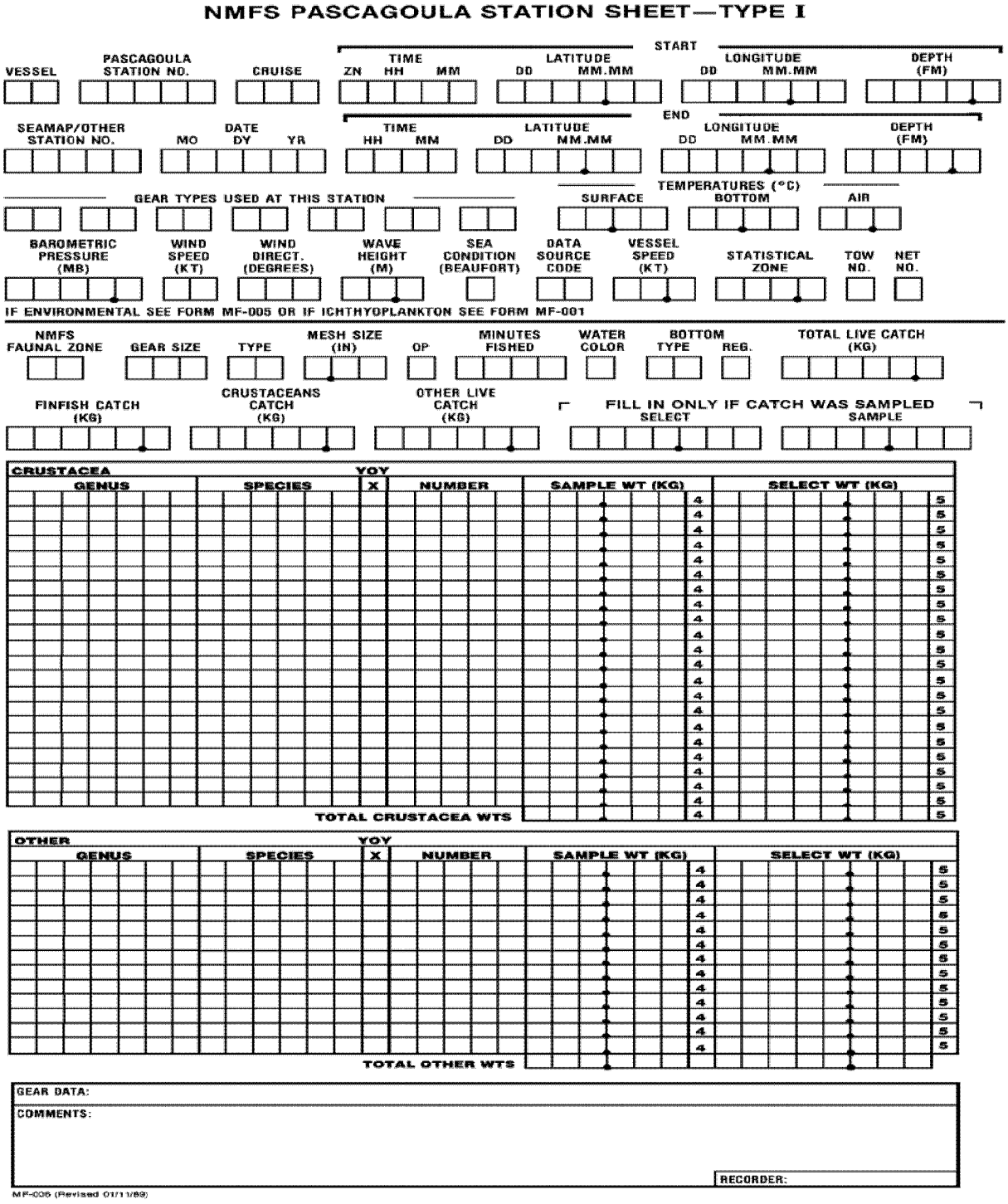
STATISTICAL ZONE - Enter GCSD statistical zone from Figure 1-2. Leave blank if you are outside a statistical zone.

TOW NO. - Consecutive number of the tow within a SEAMAP station.

NET NO. - 1 = Port, 2 = Starboard and 3 = Stern Trawl.

The data above must be recorded regardless of station type.

Figure 5-1. NMFS PASCAGOULA STATION SHEET TYPE-I.



NMFS PASCAGOULA STATION SHEET—TYPE I

START

VESSEL | PASCAGOULA STATION NO. | CRUISE | TIME ZN HH MM | LATITUDE DD MM.MM | LONGITUDE DD MM.MM | DEPTH (FM)

END

SEAMAP/OTHER STATION NO. | DATE MO DY YR | TIME HH MM | LATITUDE DD MM.MM | LONGITUDE DD MM.MM | DEPTH (FM)

GEAR TYPES USED AT THIS STATION

TEMPERATURES (°C): SURFACE | BOTTOM | AIR

BAROMETRIC PRESSURE (MB) | WIND SPEED (KT) | WIND DIRECT. (DEGREES) | WAVE HEIGHT (M) | SEA CONDITION (BEAUFORT) | DATA SOURCE CODE | VESSEL SPEED (KT) | STATISTICAL ZONE | TOW NO. | NET NO.

IF ENVIRONMENTAL SEE FORM MF-005 OR IF ICHTHYOPLANKTON SEE FORM MF-001

NMFS FAUNAL ZONE | GEAR SIZE | TYPE | MESH SIZE (IN) | OP | MINUTES FISHED | WATER COLOR | BOTTOM TYPE | REG. | TOTAL LIVE CATCH (KG)

FINFISH CATCH (KG) | CRUSTACEANS CATCH (KG) | OTHER LIVE CATCH (KG)

FILL IN ONLY IF CATCH WAS SAMPLED: SELECT | SAMPLE

CRUSTACEA

GENUS	SPECIES	YOY X	NUMBER	SAMPLE WT (KG)	SELECT WT (KG)
				4 5	4 5

TOTAL CRUSTACEA WTS

OTHER

GENUS	SPECIES	YOY X	NUMBER	SAMPLE WT (KG)	SELECT WT (KG)
				4 5	4 5

TOTAL OTHER WTS

GEAR DATA:

COMMENTS:

RECORDER:

MF-005 (Revised 01/11/89)

E. ICHTHYOPLANKTON STATION FORM INSTRUCTIONS

GENERAL COMMENTS - An Ichthyoplankton Station Form (Figure 5-2, page 5-20) must be completed for all trawl stations where ichthyoplankton tows are made and for all ichthyoplankton stations.

Please use a lead pencil and make entries DARK enough and LEGIBLE enough so that the key entry operator can read them. All numeric fields are to be right justified or aligned with the decimal place. Leading zeros are not required, but enter trailing zeros.

VESSEL - Enter 2-digit numerical code from Appendix 1, Vessel Codes, page A-2. If your vessel has not been assigned a code, notify NMFS Pascagoula to receive one.

PASCAGOULA STATION NUMBER - This is a unique sequential consecutive 5-digit number within each cruise, preferably starting with "00001". For state vessels enter the 2-digit vessel code followed by a 3-digit station number. Transfer this station number to the environmental or plankton sheet. Do not duplicate this station number for other stations on a cruise.

CRUISE - Enter 3-digit cruise number. Except for the Oregon II and other vessels having historically different cruise numbering conventions, the cruise number for **ALL VESSELS** shall be the calendar year of the survey followed by the cruise number for the year, e.g. "011" first cruise for year 2001, "012"- second cruise for year 2001, etc. The leading zero is required. Use this cruise number on all sheets during a cruise; do not change it.

DATA SOURCE CODE - Enter Data Source Code from Appendix 2-C.

TIME AT MAX DEPTH - Enter Time Zone (ZN) from Appendix 2-A. Enter military time (24 hours) when the bongo net reaches maximum depth to the nearest minute, just prior to haulback. For plankton stations in which only a neuston net is towed, enter the start time of the neuston tow.

ANGLE - Enter angle at maximum depth, just prior to haulback.

WIRE OUT - Record the amount of wire required to reach the targeted maximum tow depth with the 45° wire angle using Table 8. **Before the tow begins, get an estimate of total wire out needed to reach max. depth with a 45° wire angle. Please note that if, during wire payout, it appears that the wire angle upon reaching your targeted maximum depth will differ by more than ±5° from 45°, reduce or increase accordingly the amount of wire ultimately paid**

out using Table 8, Wire Angle Table, page T-12.

VESSEL SPEED (KT) - Record towing speed in knots and tenths. Should be approximately 1.5 - 2.0 knots to maintain a 45° wire angle with the bongo or half the neuston frame submerged.

RIGHT BONGO

SEAMAP Sample No. - Leave blank. **These identifying numbers are assigned at the Pascagoula Lab.**

GEAR CODE - Enter numeric gear code (refer to Appendix 10-A).

MESH CODE - Enter numeric mesh code (refer to Appendix 10-B).

GEAR IN (bongo) - Enter time when gear enters water and commences fishing (military time).

GEAR OUT(bongo) - Enter time when gear is completely out of the water and is no longer fishing (military time).

FLOWMETER SERIAL # - **Record serial number for left and right flowmeters at every station.**

FLOWMETER START - Enter beginning flowmeter reading (double check readings) left to right. Point the rotor end of the flowmeter to the right; an unobstructed view of the values should be observable. Read and record these values from left to right. *CAUTION: It is critical to read the series of numbers located in the rounded viewing chamber!!* **When recording flowmeter readings, be mindful of:**

1. **Backward readings.**
2. **Numbers out of sequence.**
3. **The recording of less than six (6) numbers.**

FLOWMETER FINISH - Enter flowmeter reading (double check readings) after tow is finished and sampler is not fishing or it is on deck.

MIN DEPTH (M) - Enter minimum depth bongo reached in the water in meters (usually zero).

MAX DEPTH (M) - Enter **calculated or observed** maximum depth bongo reached in the water in meters; normally this should not exceed 200 m. **Remember to note on the Ichthyoplankton data sheet whether the max tow depth was calculated using wire out and wire angle OR max depth was taken from the depth sensing device (SBE-19).**

LEFT BONGO - Repeat as with right bongo.

MIN ANGLE - Start recording wire angle one minute (60 seconds) after commencing haulback (DO NOT record angle on the way down the water column).

WIRE OUT - Start recording amount of wire out in meters one minute (60 seconds) after commencing haulback. Record wire and angle every minute thereafter until tow is completed.

RECORDER - Enter name of person responsible for the watch. Other initials may be included.

NEUSTON OR OTHER - If other gear type, specify.

SEAMAP Sample No. - Leave blank.

GEAR CODE - Enter gear code (refer to Appendix 11-A, page A-28).

MESH CODE - Enter mesh code (refer to Appendix 11-B, page A-28).

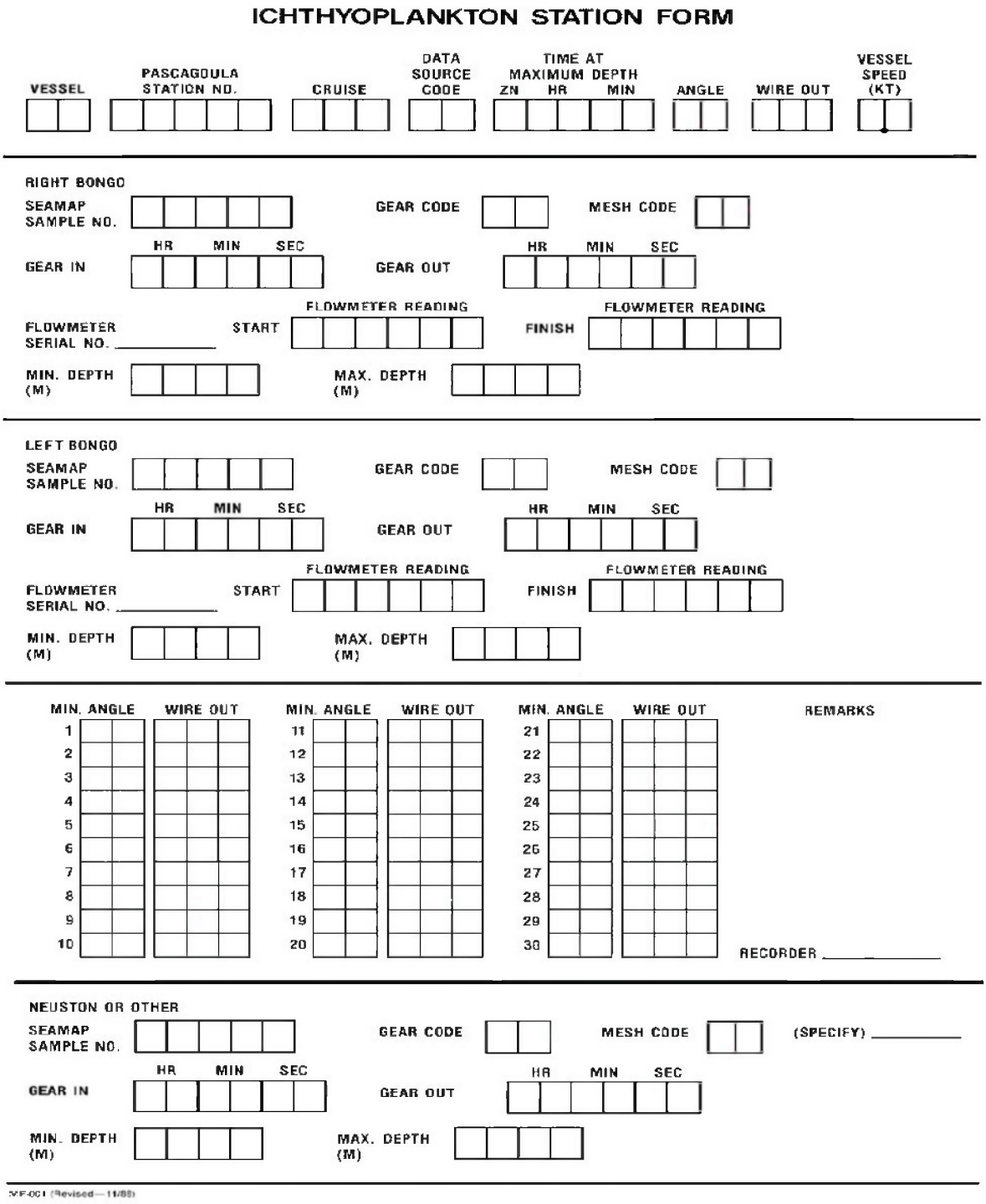
GEAR IN (neuston)- Enter military time down to seconds when **the gear is in the water half submerged and is fishing properly.** If there is only a neuston tow conducted at a station, record that value in the time at max depth field at top of station sheet.

GEAR OUT (neuston)- Enter military time when gear is out of the water down to seconds.

MIN DEPTH (M) - Enter minimum depth gear is in the water in meters (**0.5 m**).

MAX DEPTH (M) - Enter maximum depth gear is in the water in meters **(0.5 m). It is important that min and max depths are identical for gear like the neuston net that is hauled at the same depth throughout the tow.**

Figure 5-2. Ichthyoplankton Station Form.



ICHTHYOPLANKTON STATION FORM

VESSEL | PASCAGOULA STATION NO. | CRUISE | DATA SOURCE CODE | TIME AT MAXIMUM DEPTH ZN HR MIN | ANGLE | WIRE OUT | VESSEL SPEED (KT)

RIGHT BONGO
SEAMAP SAMPLE NO. | GEAR CODE | MESH CODE
GEAR IN (HR MIN SEC) | GEAR OUT (HR MIN SEC)
FLOWMETER SERIAL NO. _____ | START (FLOWMETER READING) | FINISH (FLOWMETER READING)
MIN. DEPTH (M) | MAX. DEPTH (M)

LEFT BONGO
SEAMAP SAMPLE NO. | GEAR CODE | MESH CODE
GEAR IN (HR MIN SEC) | GEAR OUT (HR MIN SEC)
FLOWMETER SERIAL NO. _____ | START (FLOWMETER READING) | FINISH (FLOWMETER READING)
MIN. DEPTH (M) | MAX. DEPTH (M)

	MIN. ANGLE	WIRE OUT		MIN. ANGLE	WIRE OUT		MIN. ANGLE	WIRE OUT
1			11			21		
2			12			22		
3			13			23		
4			14			24		
5			15			25		
6			16			26		
7			17			27		
8			18			28		
9			19			29		
10			20			30		

REMARKS

RECORDER _____

NEUSTON OR OTHER
SEAMAP SAMPLE NO. | GEAR CODE | MESH CODE | (SPECIFY) _____
GEAR IN (HR MIN SEC) | GEAR OUT (HR MIN SEC)
MIN. DEPTH (M) | MAX. DEPTH (M)

MF-001 (Revised—11/88)

F. INSTRUCTIONS FOR COMPLETING ICHTHYOPLANKTON SAMPLE LABELS

Label accuracy and completeness is essential, but **never delay** preserving the samples just for station position and station time. The most important sample identifiers recorded on the inside and outside jar labels are Vessel, Cruise, Station Number and Gear (Figure 5-3, Sample Completed Labels, page 5-23). Station latitude, longitude and time correspond to the start position and time, but if an exact position cannot be received from the Bridge in a timely manner, then use the targeted station position and a good estimate of station time. **Always double check inside sample labels before placing them in the jars.**

1. OUTSIDE SAMPLE LABEL

Serial number - Leave blank, this is reserved for **SEAMAP** number assignment at the NMFS Pascagoula Laboratory.

Vessel - Use appropriate **SEAMAP** vessel code or FPC approved vessel name.

Cruise - SEAMAP cruise number.

Station - Use Pascagoula station number.

Haul - Fill in only if multiple net systems are used at this station, i.e., Tucker trawl, MOCNESS, or if multiple deployments of the same gear are made.

Mesh - mesh size of net used to collect the sample.

Number of jars - **This information is critical to postcruise sample inventory.** Write in the jar number of the total number of jars used to contain the sample; i.e. 1/1 if only one jar was used, 1/2 and 2/2 if two jars were used, etc.

Vol. - Unless otherwise instructed, leave blank.

Gear - Fill in with gear type used and other pertinent information; i.e., Left, right, or single/double neuston; gear size, and initial preservative (formalin or alcohol).

Sort 1 - Leave blank.

Sort 2 - Leave blank.

2. INSIDE SAMPLE LABEL

FRONT:

Station # - Use Pascagoula station number.

Vessel - Use appropriate **SEAMAP** vessel code or FPC approved vessel name.

Cruise - **SEAMAP** cruise number.

Comments - Write in the **SEAMAP** (or other) station number ('B' numbers) and the initial preservative used (eg., Form or Ethanol).

BACK:

Sample # - Leave blank. Reserved for **SEAMAP** inventory number assignment.

Latitude - Record station target position or actual start position if time permits.

Longitude - Record station target position or actual start position if time permits.

Zone - Record time zone being used on the vessel collecting the samples (eg. NOAA vessels use zones 3 or 4 throughout the Gulf during a survey. *This is not necessarily the time zone in which the station is located and the sample is taken.*

GMT date/time - Do **NOT** use GMT (Greenwich Mean Time), use local time which will be either Standard or Daylight Savings Mode. Use time at preservation. At the request of the Polish Sorting Center, **do not use a numeric format for date**, e.g., 7/15/01, use the format **15 Jul 01 instead.**

Haul - Fill only if a multiple net system is used at this station; i.e., Tucker trawl, MOCNESS.

MESH - Fill in with appropriate mesh size of net used to collect the sample.

GEAR - Write in gear type used and other pertinent information; i.e. Left, right bongo, net 1 tucker trawl, left, right neuston or just neuston.

NUMBER OF JARS - **This information is critical to postcruise sample inventory.** Write in the jar number of the total number of jars used to contain the sample; i.e. 1/1 if only one jar was used, 1/2 and 2/2 if two jars were used etc.

Figure 5-3. Sample Completed Labels.

INSIDE LABEL

FRONT

NOAA NATIONAL MARINE FISHERIES SERVICE MISSISSIPPI LABS	
STATION # **63001**	
VESSEL **G. Gunter**	CRUISE **002**
COMMENTS **B165** **FORM** (Over)	

BACK

SAMPLE #	
LATITUDE **29°00'00"** N	
LONGITUDE **86°00'00 w**	
ZONE **4**	GMT DATE/TIME **27 Jan 00/1330**
HAUL	MESH **0.335**
GEAR **60cm** **RIGHT**	1__of__1 **Bongo**

OUTSIDE LABEL

SERIAL NO.		
VESSEL **G. GUNTER**		CRUISE **002**
STATION **63001**	HAUL	MESH **0.947**
_1__ OF _1__		VOL
GEAR **1 x 2m** **RIGHT NEUSTON** **FORM**		SORT 1
		SORT 2

G. FLOWMETER PERFORMANCE TRACKING FORM

We have introduced the **Flowmeter Performance Tracking Form** (**FPT**, Figure 5-4, page 5-25) because malfunctioning flowmeters and incorrect flowmeter readings are the single most serious error found in SEAMAP field data. Completion of this form is required of Watch Leaders. Field Party Chiefs are asked to make sure that the form is filled out consistently throughout the cruise and is used by the Watch Leaders for early detection of failing flowmeters and erroneous flowmeter readings.

1. Record the **Pascagoula station number, flowmeter serial number** and the **position** of the flowmeter in the bongo frame (**L**eft or **R**ight).

2. Record **start** and **finish** flowmeter readings.

3. Calculate the **Total counts** column, which is the difference between the **finish** and **start flowmeter readings** for a given tow.

4. **Tow depth** is the maximum depth the gear was fished in meters, i.e, the maximum depth as noted on the Ichthyoplankton station sheet.

5. **Total tow time** is the elapsed time in **minutes** (include seconds as the fraction of a minute, eg. 1' 30" = 1.5') between the recorded values for **gear out** and **gear in.**

6. Number of counts per minute **(Counts/min)** is the **total counts** divided by the **total tow time.**

7. The Ichthyoplankton Watch Leader and FPC should review the FPT form regularly, first to make sure it is being filled out in its entirety and secondly, to check if flowmeters are performing consistently. The counts/min values within a cruise should be relatively uniform among tows to similar maximum tow depths.

Figure 5-4. Flowmeter performance tracking form.

Project:_____ **CRUISE:**_____

PASCAGOULA STATION NO.	SERIAL NUMBER	POSITION (Left or Right Bongo)	FLOWMETER COUNTS			TOW DEPTH	TOTAL TOW TIME	COUNTS/ MINUTE
			START	FINISH	TOTAL			

COUNTS= ACTUAL NUMBERS READ ON FLOWMETER

H. ICHTHYOPLANKTON SAMPLE TRANSFER RECORD FORM

Fill out the **Ichthyoplankton Sample Transfer Record** after each station (Figure 5-5, page 5-26). This will provide the Field Party Chief and the Ichthyoplankton Team with information required to track and inventory plankton samples after the cruise.

Please record information in the fields in **bold print** after initial preservation of the sample:

PASCAGOULA STATION #
DATE / TIME
RIGHT BONGO*
LEFT BONGO*
RIGHT NEUSTON*
LEFT NEUSTON*
OTHER*
TRANSFER DATE
INITIALS

The fields listed above in **bold italics** with an **asterisk**, should be filled in with the **actual number of jars** used for **each gear type**. Initials should be those of the individual responsible for the initial preservation. After 48 hours, or when weather conditions permit, transfer the samples as outlined and record the transfer date. If the number of jars changes due to consolidation during transfer, note this on this form. **Place right bongo, left bongo and neuston samples into separate boxes and label.**

Figure 5-5. Ichthyoplankton Sample Transfer Record Form.

PROJECT _____ **CRUISE** _____

PASCAGOULA STATION NO.	**DATE / TIME**	**SAMPLES:** Record number and types of jars used.					**TRANSFER DATE**	**INITIALS**
		RIGHT BONGO	LEFT BONGO	RIGHT NEUSTON	LEFT NEUSTON	OTHER		

I. HANDLING AND STORAGE OF PLANKTON GEAR DURING CRUISES

1. Bongo Net 0.333/0.335 mm mesh\0.61 cm MARMAP frame.
The bongo nets are fragile and easily torn. They should be handled with care and not stepped on. The bongo frame is a sturdy piece of equipment, but care should be taken when putting it over the side of the ship and retrieving it. Try not to bang it against the side of the ship. Be sure the frame is not leaning on the net. When the nets are not in use (entering port), they should be cleaned, dried out, and stored in the net box on board ship. Check the nets frequently for holes and tears. **Holes in the lower half of the net must be repaired immediately when found, before another sample is collected. Use the tube of silicone sealant in the gear box to repair holes and small rips. Ask the FPC if you are uncertain about net repair. Replace entire nets when damage is extensive.**

2. Neuston Net 0.947/0.950 mm mesh\1x2 m or 1x4 m frames.
These nets are just as fragile as the bongo net. While not in use, make sure that the net is not being chafed or abraded by the frame, deck, or other ship's surface. If oil or tar should get caught up in the net, scrub as much as possible off the net using detergent, then store and inform the person in charge of gear of the net condition.

3. 2030R General Oceanics Mechanical Flowmeter.
The flowmeter should be **handled with care.** When in use, the flowmeter should be filled with silicone oil or plain tap water - not distilled water. When not in use, the flowmeter should be taken off the bongo frame, cleaned and stored according to the manufacture's guidelines, which includes being washed out with a white vinegar and water solution in order to remove any salt and debris from the inside chamber. Flowmeters should be stored dry, i.e., without any liquid inside. Calibration by General Oceanics maintenance before and after each cruise is recommended.

4. Cod Ends.
Cod ends (collecting buckets) consist of two pieces of PVC pipe that can be easily damaged, so please take care to prevent the cod ends from hitting the side of the ship when deploying or retrieving plankton gear. Rinse both sections of the cod ends thoroughly after each station. At the end of a survey, wash the bucket and spray WD-40 on hose clamps and quick-release mechanisms before storage.

J. DISPOSITION OF SAMPLES

After each survey, give the samples, Ichthyoplankton Sample Transfer Record sheets, Flowmeter Performance Tracking sheets, and the Ichthyoplankton station sheets to an **Ichthyoplankton Team Member.** When the samples are in the ichthyoplankton laboratory, count the boxes, inventory the samples, request, receive and assign SEAMAP sample numbers from NMFS Pascagoula and store in a cool place before transport. The **right bongo and neuston** samples should be boxed and sent to the **Pascagoula Laboratory**, which has the responsibility for preparation of samples for shipment to the Polish Sorting and Identification Center. The current (January 2001) contact is **Alonzo N. Hamilton, Jr., National Marine Fisheries Service, 3209 Frederic Street, P O 1207, Pascagoula, MS 39568-1207; e-mail:** Alonzo.N.Hamilton@noaa.gov. Contact **Mr. Hamilton (228-762-4591 ext. 279)** to inform him of what you are sending and when they should arrive. At the same time you send the samples, please also send the original Ichthyoplankton sheets (keep copies) and copies of all other SEAMAP field data sheets (Type I or II and the environmental). Left bongo samples should be sent to **Sara LeCroy, USM/Gulf Coast Research Laboratory, P O Box 7000, 703 East Beach Drive, Ocean Springs, MS 39564; e-mail:** **sara.lecroy@usm.edu** (Current as of Jan. 2001). Contact **Ms. LeCroy (228-872-4238)** to inform her of what you are sending and when it should arrive.

K. NOTES

VI. APPENDICES

Appendix 1. VESSEL CODES

01---OREGON
02---SILVER BAY
03---GEORGE M. BOWERS
04---OREGON II
05---COMBAT
06---PELICAN
07---FRIGATA
08---KINGFISHER
09---HERNAN CORTEZ
10---GERONIMO
11---UNDAUNTED
12---ANTILLAS
13---CALAMAR
14---ALCYON
15---GULF RANGER
16---WESTERN GULF
17---TOMMY MUNRO
18---TANYA & JOE
19---ONJUNKU
20---JEFF & TINA
21---DELAWARE II
22---OSV ANTELOPE
23---ALABAMA INSHORE VESSELS
24---FLORENCE MAY
25---LOUISIANA INSHORE VESSELS
26---SUNCOASTER
27---MISSISSIPPI INSHORE VESSELS
28---CHAPMAN
29---NISSIHINO MARU #201
30---R/V BELLOWS
31---R.J. KEMP (ARANSAS BAY)
32---MATAGORDA BAY
33---LAGUNA MADRE
34---GALVESTON BAY
35---LUMCON PELICAN
36---HERNAN CORTEZ II (CORAL SEA)
37---OLD COLONY
38---SEAWOLF
39---ATLANTIC HARVESTER
40---SABINE
41---PERSISTANCE
42---CAPTAIN GRUMPY
43---GULF STREAM
44---KELCY ANN
45---MR. JUG
46---CALANUS
47---A. NEEDLER
48---B.I.P.
49---ALBATROSS IV
50---MOLLY M.
51---LADY LISA
52---MISS CARRIE
53---CSS HUDSON
63---GORDON GUNTER
64---FERREL
65---TRINITY BAY
67---NUECES
99---OTHER VESSELS

Appendix 2. Time Zone Codes, Beaufort Sea Condition Table, and Data Source Codes.

2.A. Time Zone Codes

1---Eastern Standard Time
2---Eastern Daylight Savings Time
3---Central Standard Time
4---Central Daylight Savings Time
8---Greenwich Mean Time
9---Other - Explain in Comment Section

2.B. Beaufort Sea Condition Table

Beaufort Sea Condition	Description
0	Wind speed under 1 knot, sea like a mirror.
1	Wind speed 1-3 knots; small ripples on surface with the appearance of scales.
2	Wind speed 4-6 knots; small wavelets with glassy appearance.
3	Wind speed 7-10 knots; large wavelets; crests begin to break; scattered whitecaps.
4	Wind speed 11-16 knots; small waves becoming longer; numerous whitecaps.
5	Wind speed 17-21 knots; moderate waves taking longer to form; many whitecaps; some spray.
6	Wind speed 22-27 knots; larger waves forming; whitecaps everywhere; more spray.
7	Wind speed 28-33 knots; sea heaps up; white foam from breaking waves begins to be blown in streaks.
8	Wind speed 34-40 knots; moderately high waves of greater length; edges of crests begin to break into spin-drift; foam is blown in well marked streaks.
9	Wind speed 41-47 knots; high waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.

2.C._Data Source Codes

NC-- North Carolina
SC-- South Carolina
GA-- Georgia
FL-- Florida
AL-- Alabama
MS-- Mississippi
LA-- Louisiana
TX-- Texas
US-- National Marine Fisheries Service
99-- Other

Appendix 3. Gear Codes and Examples on Use.

CODE	GEAR TYPE	CODE	GEAR TYPE
*T	TRAWL, STAR	MO	PLANKTON, MOCNESS
01	COMBINATION--SS+CC	MQ	MARQUESETTE
02	COMBINATION--SS+PR	MS	TRANSMISSIVITY
03	COMBINATION--CC+PR	MT	TRAWL, MIDWATER
04	COMBINATION--SS+CC+PR	NN	PLANKTON, SINGLE NEUSTON OR NEKTON
05	COMBINATION--FM+SS	NS	NETSONDE
06	COMBINATION--FM+SS+PR	OB	LONGLINE, OFF-BOTTOM
07	COMBINATION--FM+PR	OD	ODOMETER
A	ASSORTED	OF	OVERFLIGHT
AC	BIOSONICS ACOUSTIC SYSTEM	OH	OXYGEN, TITRATION, HACH KIT
BB	TRAWL, BIB	OI	OXYGEN, SENSOR, IN SITU
BC	BOTTLE CAST	OO	OXYGEN, SENSOR, ON DECK
BG	BATHYTHERMOGRAPH (CTD, STD)	OR	OYSTER RAKE
BL	LONGLINE , BOTTOM	OW	OXYGEN, TITRATION, WINKLER
BS	SEINE, BEACH	OX	OXYGEN, SENSOR, CTD
BT	TRAWL, BEAM	OY	OXYGEN, SENSOR, YSI
CA	CHLOROPHYLL, EXTRACTION	PN	PLANKTON, GENERAL (BONGO, ETC.)
CC	CAMERA, CLOSED CIRCUIT TELEVISION	PR	PROFILER, 3.5 KHZ SUB-BOTTOM
		PS	SEINE, PURSE
CD	DREDGE, CLAM	PT	TRAWL, SCALLOP
CM	CURRENT DOPPLER	QD	DREDGE, QUAHOG
CR	CORAL REEF MODUAL	RE	SALINITY, REFRACTOMETER
CS	CONTINUOUS FLOW SYSTEM	RF	RECORDING FATHOMETER
CT	TRAP, CRAB	RG	PLANKTON, RING NET
DL	DEEP LINE	RL	TAG RELEASE
DN	PLANKTON, DOUBLE NEUSTON OR NEKTON	RN	ROUND NET
		RR	ROD AND REEL
DR	SURFACE DRIFTER	RS	TRAWL, NON-STANDARD
DV	DIVING	RT	ROTENONE
EF	TRAWL, FISH, EXPERIMENTAL	RV	REMOTELY OPERATED VEHICLE (ROV)
ES	TRAWL, SHRIMP, EXPERIMENTAL	S5	TRAWL, MONGOOSE
FD	TRAWL, FISH DEFLECTOR	S6	TRAWL MONGOOSE
FE	TRAWL, FISH EXCLUDER	SA	SALINITY, AUTOSAL
FL	FLUORESCENCE, CONTINUOUS FLOW SYSTEM	SB	SALINITY, BECKMAN RS5
		SC	CAMERA, STILL
FM	FATHOMETER	SD	DREDGE, SCALLOP
FP	FISH PUMP	SE	SECCHI DISC
FT	TRAWL, FISH	SF	SALINITY, CONTINUOUS FLOW SYSTEM
FX	FLUORESCENCE, IN SITU	SH	TRAWL, SHUMAN
GN	GILL NET	SI	SALINITY, SENSOR, IN SITU
GR	BOTTOM GRAB OR CORE SAMPLER	SL	SALINITY, BENCH TOP/LABORATORY
HL	HANDLINE	SJ	SQUID JIG
HO	TRAWL, HIGH OPENING BOTTOM	SM	TRAWL, STANDARD MONGOOSE
IT	TRAP, ICHTHYOPLANKTON, ILLUMINATED	SN	TRAWL, SEPARATOR
		SO	SONAR
JP	JACKPOLE	SS	SONAR, SIDE SCAN
KP	LONGLINE, KALI POLE	ST	TRAWL, SHRIMP
KT	TRAWL, WING	SX	SALINITY, CTD
LL	LONGLINE, SURFACE	SY	SALINITY,YSI
LN	LIFT NET	T3	TEMPERATURE SCS
LP	SEINE, LAMPARA	TA	TEMPERATURE, CONTINUOUS FLOW SYSTEM
LR	TRAP, LOBSTER, REED	TB	TEMPERATURE, BECKMAN RS5
LT	NIGHT LIGHT	TC	TEMPERATURE, CTD
LW	TRAP, LOBSTER, WIRE	TD	DREDGE, TUMBLER
MC	CAMERA, MOVIE	TE	TRAWL, TURTLE EXCLUDER
ML	MISCELLANEOUS- DETAIL IN COMMENTS	TF	TEMPERATURE, FLUKE
		TG	TROLLING GEAR
MN	MICROPEKTON	TH	TEMPERATURE, THERMOMETER

CODE	GEAR TYPE
TI	TEMPERATURE, SENSOR, IN SITU
TM	TEMPERATURE, BUCKET
TN	TRAWL, TRY NET
TO	TEMPERATURE, SENSOR, ON DECK
TR	TRAP, FISH
TS	SEINE, PURSE, TURTLE
TT	TRAWL, TWIN
TU	PLANKTON, TUCKER TRAWL
TV	TRAP VIDEO
TY	TEMPERATURE, YSI
UD	DREDGE, UNSPECIFIED
VC	CAMERA, VIDEO
VD	VERTICAL DRIFTLINE
VJ	VISUAL OBSERVATION
VP	VERTICAL PROFILE
WI	WEATHER INSTRUMENT
WT	TRAP, LOBSTER, WOOD
XB	EXPENDABLE BATHYTHERMOGRAPH (XBT)

SEAMAP Examples of Gear Code Use

For Chlorophyll- Sample obtained from bottle cast for extraction BC, CA

For Salinity- Reading obtained by CTD: BG, SI

Sample obtained from bottle cast for AUTOSAL analysis BC, SL

For- Oxygen reading obtained by CTD: BG, OI

Sample obtained from bottle cast for titration by the Winkler method BC, OW

For Temperature- Reading obtained by CTD: BG, TI

Scenario Example-

Procedures at a SEAMAP station included a CTD profile, a Secchi disc reading, a bottle cast for water samples, a sediment grab, and a trawl.

BG, BC, TI, SI, SE, OI, CA, GR, and ST

There are only seven spaces on the data sheet to enter the nine listed gear types used. Record in the Comment section the additional two gear types used.

Appendix 4. Operation Codes.

A = Net not spread
B = Gear bogged
C = Bag choked
D = Gear not digging
E = Twisted warp or line
F = Gear fouled
G = Bag untied
H = Hooks or traps lost
I = Fish not attracted
K = Bad weather stopped operation
L = Lost whole rig
M = Miscellaneous (detail in comments)
N = Shark damage
O = Gear off bottom
P = Vessel off position
T = Torn webbing
U = Unknown
W = Water haul
X = Lost fish
Z = Hangup

Appendix 5. Water Color Codes, Bottom Type, Bottom Regularity, and Precipitation codes.

Appendix 5-A.
Water Color Codes

Record as follows:

Blue or clear = B
Green = G
Blue green = T
Yellow = Y
Muddy or brown = M

Appendix 5-B.
Bottom Type

Record as follows:

Boulders = BD
Marl = ML
Clay = CL
Ooze = OZ
Coral = CO
Rock = RK
Gravel = G
Sand = S
Grass = GR
Shell = SH
Mud = M
Sponge = SP
Mud & Sand = MS
Mud & Clay = MC

Appendix 5-C.
Bottom Regularity

Record as follows:

Smooth = S
Steep = P
Slight = L
Irregular = E
Moderate = O
Lump = M

Appendix 5-D.
Precipitation Codes

0 None
1 Light Rain
2 Moderate Rain
3 Heavy Rain
4 Snow
5 Sleet
6 Sleet/Rain
7 Hail

There has been some question about the meanings of the precipitation codes. This is an attempt to provide some standardization to the meanings.

Light rain would be a rate of precipitation such that most people wouldn't hesitate to step out into it for a couple of minutes or to go from one location to another without protection.

In a moderate rain you would want at least as much protection as would be provided by an umbrella. You would be very wet if you were out without protection for two minutes.

. . . . . .

A heavy rain is when you don't want to go out into it at all and you would be soaked to the skin instantly without protection.

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes.

GENUS SPECIES	MC	FMB	BIOCODE
ABLENNEHIANS	1	368	147010101
ABRALIAREDFIE	13		348030203
ABRALIAVERANY	13		348030204
ABUDEFDSAXATI	1		170270101
ACANTHEARMATA	3		228290102
ACANTHOALEXAN	5		229260301
ACETES AMERIC	3		228020105
ACHIRUSLINEAT	18	196	183040105
AEQUIPEGLYPTU	12	352	330231101
AEQUIPEMUSCOS	12		330231106
AETOBATNARINA	22		110070101
AGRIOPOTEXASI	11		335641601
ALBUNEAPARETI	6		229310102
ALECTISCILIAR	1	214	170110101
ALLOTHYMEXICA	25		694040301
ALOSA ALABAM	1		121050101
ALOSA CHRYSO	1		121050106
ALOSA SAPIDI	1		121050105
ALPHEUSFORMOS	3		228150102
ALUTERUHEUDEI	18	290	189040401
ALUTERUMONOCE	18	230	189040402
ALUTERUSCHOEP	18	150	189040403
ALUTERUSCRIPT	18	250	189040404
AMUSIUMDALLI	12		330234401
AMUSIUMPAPYRA	12	49	330234402
ANACANTLONGIR	22	377	110100202
ANADARABAUGHM	11	175	328043602
ANADARABRASIL	11	336	328043601
ANADARALIENOS	11		328043604
ANADARAOVALIS	11	338	328043607
ANADARATRANSV	11		328043608
ANASIMULATUS	6	103	229210601
ANCHOA CUBANA	1	253	121060104
ANCHOA HEPSET	1	32	121060101
ANCHOA LAMPRO	1	317	121060102
ANCHOA LYOLEP	1	136	121060105
ANCHOA MITCHI	1	76	121060103
ANCHOA NASUTA	1	244	121060106
ANCHOVIPERFAS	1	152	121060302
ANCYLOPDILECT	18	80	183012102
ANCYLOPQUADRO	18	85	183012105
ANOMIA SIMPLE	12		330390102
ANTENNAOCELLA	18		195020101
ANTENNARADIOS	18	115	195020102
ANTENNASTRIAT	18	236	195020103
ANTHENOPEIRCE	15		691060501
ANTIGONCAPROS	1		162030101
ANTIGONCOMBAT	1		162030102
APHRODIOBTECT	25		649030101
APLATOPCHAULI	18	365	143150601
APLYSIAWILLCO	17		316020104
APOGON AFFINI	1		170060204
APOGON AUROLI	1	268	170060201
APOGON MACULA	1		170060203
APOGON PSEUDO	1	248	170060207
ARBACIAPUNCTU	14		693050101
ARCHITENOBILI	24	343	307310102
ARCHOSAPROBAT	1		170213601
ARCINELCORNUT	12		334020402
ARENAEUCRIBRA	5	140	229110101
ARGENTISTRIAT	1		121110101
ARGONAUARGO	24		350110101
ARGOPECGIBBUS	12	199	330231201
ARIOMMABONDI	1	221	170530101
ARIOMMAMELANU	1	420	170530102
ARIOMMAREGULU	1	406	170530104
ARIUS FELIS	1	40	141020101
ASTARTEGLOBUL	12		335260104
ASTEROPANNULA	14	329	692050202
ASTRAPOALUTUS	1		170060101
ASTRAEAPHOEBI	24		306110104
ASTROCYCAECIL	14		692050501
ASTROGOCACAOT	14		692050401
ASTROPEALLIGA	15		691010109
ASTROPEAMERIC	15	179	691010101
ASTROPEANTILL	15		691010108
ASTROPEARTICU	15		691010102
ASTROPECINGUL	15	422	691010106
ASTROPEDUPLIC	15	148	691010105
ASTROPHMURICA	14		692050301
ASTROSCY-GRAE	18	210	170340102

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS SPECIES	MC	FMB	BIOCODE
ATRINA SEMINU	11	339	329020103
ATRINA SERRAT	11		329020102
AULOSTOMACULA	2		151010101
AURELIAAURITA	16		616010201
AXIANASARENAR	8		229180101
BAGRE MARINU	1	120	141020401
BAIRDIECHRYSO	18	186	170200502
BALANUSTRIGON	20		213010101
BALISTECAPRIS	1	44	189030502
BARBATICANCEL	11	337	328040702
BARBATICANDID	11		328040701
BARNEA TRUNCA	11		337010102
BATHYANMEXICA	1	151	170023102
BELLATOBRACHY	18		168020801
BELLATOEGRETT	18		168020802
BELLATOMILITA	18	94	168020803
BEMBROPANATIR	18		170320201
BEMBROPGOBIOI	18	241	170320202
BENTHODTENUIS	1		170460503
BOLLMANCOMMUN	18	90	170554301
BOTHUS LUNATU	18		183012202
BOTHUS OCELLA	18	381	183012203
BOTHUS ROBINS	18	291	183012204
BRACHIDEXUSTU	11		329011202
BREGMACATLANT	18	122	148030101
BREVOORGUNTER	1	310	121050301
BREVOORPATRON	1	64	121050302
BREVOORSMITHI	1		121050303
BRISSOPATLANT	14		693110102
BROSMICIMBERB	18		148020301
BROTULABARBAT	18	70	170390301
BUSYCONCANDEL	17		308070109
BUSYCONCOARCT	17		308070104
BUSYCONCONTRA	17	283	308070103
BUSYCONPERVER	17		308070105
BUSYCONPULLEY	17		308070113
BUSYCONSPIRAT	17	335	308070107
CAELORICARIBB	18		148061201
CALAMUSARCTIF	1	411	170210601
CALAMUSBAJONA	1		170210602
CALAMUSCALAMU	1	256	170210603

GENUS SPECIES	MC	FMB	BIOCODE
CALAMUSLEUCOS	1	201	170210604
CALAMUSNODOSU	1	246	170210608
CALAMUSPENNA	1	260	170210610
CALAPPAFLAMME	5	191	229260102
CALAPPASULCAT	5	52	229260105
CALLIACTRICOL	10		619380301
CALLIANLATISP	3		229040101
CALLINEMARGIN	5		229110205
CALLINESAPIDU	5	57	229110203
CALLINESIMILI	5	4	229110206
CALLIONHIMANT	2		170420101
CALOCARHIRSUT	8		229170101
CANCELLRETICU	17		308150101
CANTHARCANCEL	17		308040502
CANTHERMACROC	18		189040101
CANTHIDSUFFLA	1	380	189030402
CANTHIGROSTRA	1		189080101
CARANX BARTHO	1		170110801
CARANX CRYSOS	1	62	170110803
CARANX HIPPOS	1	184	170110804
CARANX LATUS	1		170110805
CARANX RUBER	1		170110807
CARCHARACRONO	18	192	108020201
CARCHARBREVIP	18	305	108020207
CARCHARFALCIF	18	301	108020202
CARCHARISODON	18		108020215
CARCHARLEUCAS	18		108020204
CARCHARLIMBAT	18	234	108020205
CARCHAROBSCUR	18		108020209
CARCHARPLUMBE	18		108020208
CARCHARPOROSU	18		108020210
CARDITAFLORID	12	349	335200202
CARETTACARETT	21	325	531070201
CAULOLACYANOP	18		170070101
CAULOLAINTERM	18	89	170070102
CAULOLAMICROP	18	269	170070103
CENTROPOCYURA	2	111	170024804
CENTROPPHILAD	2	6	170024805
CENTROSLONGIS	14		693010201
CHAETODAYA	2	298	170260301
CHAETODCAPIST	2		170260302

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
CHAETODFABER		2	50	170250101
CHAETODOCELLA		2	419	170260307
CHAETODSEDENT		2		170260309
CHAMA	CONGRE	12		334020201
CHASCANLUGUBR		18	331	183010201
CHICOREFLORIF		17		308012701
CHILOMYATINGA		18	319	189090202
CHILOMYSCHOEP		18	153	189090203
CHIONE	CLENCH	11	300	335643609
CHIONE	LATILI	11		335643605
CHIROPSQUADRU		16		618050101
CHLAMYSBENEDI		12		330231601
CHLOEIAVIRIDI		25	347	649110101
CHLOROSCHRYSU		1	14	170110902
CHROMISENCHRY		1	286	170270302
CHROMISSCOTTI		1		170270303
CHRYSAOQUINQU		16		616010101
CIRCOMPSTRIGI		11		335640201
CIRRHIPLEUTKE		16		619420101
CITHARIARCTIF		18		183010301
CITHARIARENAC		18		183010308
CITHARICORNUT		18	247	183010303
CITHARIMACROP		18	129	183010304
CITHARISPILOP		18	61	183010305
CLYPEASPROSTR		14	424	693100103
CLYPEASRAVENE		14	373	693100104
COELOCESPINOS		6	394	229211301
COLLODELEPTOC		6		229210801
COLLODEROBUST		6		229210803
COMACTIMERIDI		20		690020101
CONGER	OCEANI	18	281	143130501
CONGER	TRIPOR	18		143130502
CONODONNOBILI		1	416	170190601
CONUS	AUSTIN	17	274	308190101
CONUS	CLARKI	17		308190110
CONUS	STIMPS	17		308190135
COOKEOLBOOPS		1		170050301
CORNIGESPINOS		1		161110701
CORYPHAHIPPUR		1		170130202
CRASSOSVIRGIN		12		330410101
CREPIDUCONVEX		17		307640302
CRUCIBUAURICU		17		307640201
CYCLOPSCHITTE		18	45	183010401
CYCLOPSFIMBRI		18	226	183010403
CYMATIUPARTHE		17		307780119
CYMATIUPILEAR		17		307780109
CYNOSCIARENAR		18	8	170200901
CYNOSCINEBULO		18		170200903
CYNOSCINOTHUS		18	25	170200904
CYPSELUCYANOP		1		147040703
CYPSELUEXSILI		1	370	147040704
CYPSELUFURCAT		1		147040705
CYPSELUHETERU		1		147040706
DACTYLOQUINQU		16		618030101
DACTYLOVOLITA		18		179010301
DANIELUIXBAUC		5		229102601
DARDANUFUCOSU		6		229450102
DARDANUINSIGN		6	425	229450101
DASYATIAMERIC		22	190	110050201
DASYATICENTRO		22		110050202
DASYATISABINA		22	235	110050204
DASYATISAY		22	273	110050205
DECAPTEMACARE		1	415	170111201
DECAPTEPUNCTA		1	104	170111202
DECAPTETABL		1		170111203
DECODONPUELLA		2	144	170283001
DIAPHUSSPLEND		18		131010219
DIBRANCATLANT		18		195050301
DICROLEINTRON		18		170390701
DINOCARROBUST		11	350	335291001
DIODON	HYSTRI	18	384	189090302
DIOPATRCUPREA		25		649090101
DIPLECTBIVITT		2	15	170020905
DIPLECTFORMOS		2	96	170020903
DIPLOGRPAUCIR		18	404	170420401
DISTAPLBERMUD				596050201
DISTORSCLATHR		17	334	307780401
DOROSOMPETENE		1	372	121051202
DROMIDIANTILL		5		229250301
DRYMONEDALMAT		16		618020201
DYSOMMAAPHODO		18		143170101
DYSPANOTEXANA		5		229030102

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
ECHENEINAUCRA		18	145	170090101
ECHENEINEUCRA		18		170090102
ECHINASSERPEN		15		691030104
ECHIOPHINTERT		18	263	143150302
ECHIOPHMORDAX		18	366	143150301
ECHIOPHPUNCTI		18		143150303
ELOPS	SAURUS	1	378	124010101
ENCOPE	ABERRA	14		693030303
ENCOPE	MICHEL	14		693030302
ENGRAULEURYST		1	131	121060201
ENGYOPHSENTA		18	97	183011401
EPIGONUPANDIC		18		170760101
EPINEPHADSCEN		1		170021203
EPINEPHFLAVOL		1	181	170021206
EPINEPHGUTTAT		1	356	170021208
EPINEPHMORIO		1		170021211
EPINEPHNIGRIT		1	359	170021202
EPINEPHNIVEAT		1		170021201
EPINNULMAGIST		1		170450102
EPINNULORIENT		1	405	170450103
EQUETUSACUMIN		18	142	170201103
EQUETUSIWAMOT		18	183	170201108
EQUETUSLANCEO		18	417	170201104
EQUETUSPULCHE		18		170201101
EQUETUSPUNCTA		18		170201107
EQUETUSUMBROS		18	107	170201105
EROTELISMARAG		1		170541201
ETELIS	OCULAT	1		170150501
ETHUSA	MICROP	6	340	229370301
ETROPUSCROSSO		18	38	183010602
ETROPUSCYCLOS		18	137	183010607
ETROPUSINTERM		18	259	183010603
ETROPUSMICROS		18	188	183010605
ETROPUSRIMOSU		18	164	183010606
ETRUMEUTERES		1	77	121051602
EUCIDARTRIBUL		14		693060201
EUCINOSARGENT		1	282	170180301
EUCINOSGULA		1	41	170180303
EUCRASSSPECIC		12		335270501
EULEPTOVELOX		1		147040401
EUPHROSCLAUSA		5		229381201
EURYPANDEPRES		5		229030301
EUTHYNNALLETT		1	314	170440201
EXHIPPOOPLOPH		3		228170201
EXOCOETOBTUSI		1		147040301
FASCIOLHUNTER		17		308100101
FASCIOLLILIUM		17		308100107
FASCIOLTULIPA		17		308100103
FICUS	COMMUN	17		307810104
FISTULAPETIMB		2	361	151020101
FISTULATABACA		2	328	151020102
FOETOREAGASSI		2		170420501
FUSINUSCOUEI		17		308100301
GALATHEROSTRA		8		229190201
GALEOCECUVIER		18		108022201
GASTROPFRONTA		18		183011501
GERRES	CINERE	1		170180601
GINGLYMCIRRAT		18	320	113010101
GLYCERAABRANC		25		649050101
GNATHAGEGREGI		18		170340901
GOBIOIDBROUSS		18	407	170550301
GOBIONEBOLEOS		18		170552304
GOBIONEHASTAT		18	267	170552303
GOBIONEOCEANI		18		170552301
GOBIONESMARAG		18		170552309
GOBIONESTIGMA		18		170552302
GOBIOSOOCEANO		18		170550208
GONEPLAHIRSUT		5		229380302
GONIASTTESSEL		15		691060103
GUNTERILONGIP		18		171010601
GYMNACHMELAS		18	198	183040802
GYMNACHNUDUS		18		183040803
GYMNACHTEXAE		18	95	183040804
GYMNOTHFUNEBR		18		143060201
GYMNOTHKOLPOS		18	233	143060209
GYMNOTHMORING		18		143060202
GYMNOTHNIGROM		18	127	143060203
GYMNOTHOCELLA		18	258	143060204
GYMNOTHSAXICO		18	146	143060205
GYMNOTHVICINJ		18		143060206
GYMNURAALTAVE		22		110050401
GYMNURAMICRUR		22		110050402

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
HAEMULOAUROLI		1	102	170191003
HAEMULOCARBON		1		170191018
HAEMULOCHRYSA		1		170191015
HAEMULOPARRAI		1		170191014
HAEMULOPLUMIE		1		170191008
HAEMULOSTRIAT		1		170191013
HALICHOBATHYP		2	409	170281201
HALICHOBIVITT		2		170281202
HALICHOGARNOT		2		170281205
HALICHOPICTUS		2		170281206
HALIEUTACULEA		18	36	195050401
HARENGUJAGUAN		1	26	121052004
HEILPRITIMESS		17		308100701
HEMANTHAUREOR		1	280	170025003
HEMANTHLEPTUS		1	285	170025002
HEMANTHVIVANU		1	303	170025001
HEMICARAMBLYR		1	162	170111501
HEMIPTEMARTIN		2		170282902
HEMIPTENOVACU		2	239	170282903
HEMIRAMBRASIL		1	369	147040502
HEPATUSEPHELI		5	117	229260201
HEPATUSPUDIBU		5		229260203
HEPTRANPERLO		18		105020101
HERMODICARUNC		25	324	649110201
HEXAPANANGUST		5		229030501
HEXAPANPAULEN		5		229030503
HILDEBRFLAVA		18	81	143132401
HILDEBRGRACIL		18	313	143132402
HIPPOCAERECTU		18	304	151060601
HIPPOCAREIDI		18		151060604
HIPPOCAZOSTER		18		151060606
HIRUNDIAFFINI		1		147040901
HIRUNDIRONDEL		1	321	147040903
HISTRIOHISTRI		18		195020301
HOLACANBERMUD		1		170290102
HOLACANCILIAR		1		170290103
HOLANTHMARTIN		1		170025101
HOLOCENADSCEN		1	363	161110201
HOLOCENRUFUS		1		161110202
HOMOLA BARBAT		5		229430101
HOPLOSTOCCIDE		1		161050103
HOPLUNNDIOMED		18	207	143090301
HOPLUNNMACRUR		18	84	143090302
HOPLUNNTENUIS		18		143090303
HYPOCONARCUAT		5		229250101
HYPOCONSPINOS		5		229250103
HYPORHAUNIFAS		1		147041201
ILLACANLIODAC		6	389	229070202
ILLEX COINDE		13		348100102
ILLEX ILLECE		13		348100101
KATHETOALBIGJ		18	93	170340501
LACTOPHBICAUD		18		189070201
LACTOPHPOLYGO		18	382	189070202
LACTOPHQUADRI		18	158	189070203
LACTOPHTRIQUE		18	330	189070206
LAEVICALAEVIG		11		335291201
LAEVICAPICTUM		11	351	335291203
LAEVICASYBARI		11	353	335291204
LAGOCEPLAEVIG		18	31	189080501
LAGODONRHOMBO		1	12	170211601
LARIMUSFASCIA		18	92	170201604
LEANDERTENUIC		3		228121101
LEIOLAMNITIDJ		5	215	229400101
LEIOSTOXANTHJ		18	13	170201701
LEPIDOCKEMPI		21		531070301
LEPOPHIBREVIB		18	37	171010202
LEPOPHIJEANNA		18	123	171010205
LEPTOGOVIRGUL		20		619170301
LIBINIADUBIA		6	197	229080102
LIBINIAEMARGI		6	139	229080101
LIMULUSPOLYPH		20		655010101
LOBOPILAGASSI		5		229100801
LOLIGO PEALEI		13	17	347020201
LOLIGO PLEII		13	88	347020202
LOLLIGUBREVIS		13	27	347020101
LONCHOPMICROG		18	222	170310103
LOPHIODBEROE		18	386	195010303
LOPHIODMONODI		18		195010301
LOPHIODRETICJ		18		195010302
LOPHIUSAMERIC		18		195010202
LOPHIUSGASTRO		18		195010201
LOPHOLACHAMAE		18		170070201

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS SPECIES	MC	FMB	BIOCODE
LUIDIA ALTERN	14	309	691010201
LUIDIA CLATHR	14	176	691010203
LUTJANUCAMPEC	1	10	170151107
LUTJANUGRISEU	1	299	170151109
LUTJANUSYNAGR	1	46	170151113
LUTJANUVIVANU	1		170151114
LYROPECNODOSU	12		330233102
LYSIOSQSCABRI	3	242	225030101
LYSMATAWURDEM	3		228170101
MACOMA BREVIF	11	327	335441008
MACOMA CONSTR	11	277	335441001
MACOMA PULLEY	11		335441007
MACROCAMACULA	11		335644702
MACROCOCAMPTC	6	397	229211601
MACRORHSCOLOP	18		151030201
MANTA BIROST	22		110080201
MANUCOMUNGULA	6		229052702
MAUROLIMUELLE	1		121140801
MELLITAQUINQU	14		693030203
MENIDIABERYLL	1		165022202
MENIPPEADINA	5	294	229100303
MENIPPEMERCEN	5	265	229100302
MENTICIAMERIC	18	60	170201801
MENTICILITTOR	18	177	170201803
MENTICISAXATI	18	261	170201806
MERCENACAMPEC	11		335644101
MERCENAMERCEN	11	323	335644102
MERLUCCALBIDU	18		148041401
METAPENGOODEI	3		228011701
METOPORCALCAR	6	302	229212801
MICROGOGULOSU	18		170553001
MICROPASCULPT	5		229030602
MICROPOUNDULA	18	3	170201902
MICROSPCHRYSU	1		170270201
MITHRAXACUTIC	6		229211706
MITSUKUOWSTON	18		107010101
MOBULA HYPOST	22		110080301
MODIOLUAMERIC	11		329014301
MOIRA ATROPU	14		693080301
MOLGULAMANHAT	25		596100102
MOLPADIBARBOU	25		694050102
MOLPADICUBANA	20	423	694050101
MONACANCILIAT	18	289	189040201
MONACANHISPID	18	68	189040204
MONACANSETIFE	18	194	189040205
MONOLENATRIMA	18		183011602
MONOLENMEGALE	18		183011603
MONOLENSESSIL	18	296	183011604
MUGIL CEPHAL	1	228	165010801
MUGIL CUREMA	1	364	165010802
MULLOIDMARTIN	1	418	170220101
MULLUS AURATU	1	66	170220203
MUNIDA FORCEP	8	392	229190303
MUNIDA IRIS	8		229190304
MUREX CABRIT	17		308010513
MUREX DONMOO	17		308010523
MUREX FLORIF	17		308010502
MURICANFULVES	17	254	308011501
MUSTELUCANIS	18	125	108031101
MUSTELUNORRIS	18	157	108031103
MYCTEROBONACI	18		170022101
MYCTEROMICROL	1	357	170022104
MYCTEROPHENAX	1	358	170022105
MYLIOBAFREMIN	22	249	110070301
MYLIOBAGOODEI	22	376	110070302
MYROPHIPUNCTA	18	367	143151902
MYROPSIQUINQU	6	220	229070301
NARCINEBRASIL	22	252	111010201
NARCISSTRIGON	15		307080201
NATICA MAROCH	17		307760408
NEALOTUTRIPES	1		170450401
NEMOCARTRANSV	11		335291503
NEOBYTHGILLII	18	163	170391001
NEOBYTHMARGIN	18		170391002
NEOCONGMUCRON	18		143081601
NEOEPINAMERIC	1		170450201
NEOMERIHEMING	18	126	168011403
NEPHROPACULEA	8		229020201
NEROCILACUMIN	3		223040101
NES LONGUS	18		170551401
NEVERITDUPLIC	17	264	307761101
NEZUMIABAIRDI	18		148061501

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
NIBILIAANTILC		6	395	229211401
NOMEUS	GRONOV	1		170510301
NOTOMASLOBATU		25		650120101
OCTOPUSBRIARE		13		350020101
OCTOPUSBURRYI		13		350020102
OCTOPUSMACROP		13		350020105
OCTOPUSVULGAR		13	308	350020106
OCYPODEQUADRA		5	393	229140101
OCYURUSCHRYSU		1		170151501
ODONTASTAURUS		18		107080101
ODONTOSDENTEX		18	297	170202201
OGCOCEPCORNIG		18	225	195050209
OGCOCEPDECLIV		18	110	195050204
OGCOCEPNASUTU		18	387	195050203
OGCOCEPPANTOS		18	169	195050205
OGCOCEPPARVUS		18	287	195050206
OGCOCEPPUMILU		18	257	195050201
OGCOCEPRADIAT		18	237	195050207
OGCOCEPVESPER		18		195050208
OLENCIRPRAEGU		3		223040301
OLIGOPLSAURUS		1	187	170112201
OLIVA	SAYANA	17		308110205
OPHICHTGOMESI		18	155	143150401
OPHICHTOPHIS		18		143150405
OPHICHTPUNCTI		18	262	143150402
OPHICHTREX		18		143150407
OPHICHTSPINIC		18		143150406
OPHIDIOGRAYI		18	166	171010302
OPHIDIOHOLBRO		18	138	171010303
OPHIDIOMARGIN		18	403	171010306
OPHIDIOSELENO		18		171010304
OPHIDIOWELSHI		18	91	171010305
OPHIODEBREVIS		14	312	692040101
OPHIODEDEVANE		14		692040102
OPHIOLEELEGAN		14	426	692030101
OPHIONERETICU		14		692100101
OPHIOTHANGULA		14		692110101
OPISTHOOGLINU		1	48	121053002
OPSANUSBETA		18	270	193010601
OPSANUSPARDUS		18	288	193010602
OPSANUSTAU		18	385	193010603

GENUS	SPECIES	MC	FMB	BIOCODE
ORNITHOANTILL		13		348100301
ORTHOPRCHRYSO		1	59	170191702
OSTREA EQUEST		12	348	330410302
OTOPHIDDORMIT		18		171010403
OTOPHIDOMOSTI		18		171010402
OVALIPEFLORID		5	204	229110603
OVALIPEOCELLA		5	232	229110602
PAGRUS PAGRUS		1	156	170212302
PAGURISHUMMI		6		229450202
PAGURISLYMANI		6		229450209
PAGURISSERICE		6		229450205
PAGURISTRIANG		6		229450208
PAGURUSBULLIS		6		229050601
PAGURUSIMPRES		6		229050606
PAGURUSPOLLIC		6		229050611
PALICUSALTERN		5		229390102
PALICUSOBESA		5		229390104
PANOPEUBERMUD		5	388	229030402
PANOPEUHERBST		5		229030403
PANULIRARGUS		8		229010301
PARACAUCHILEN		25		694050201
PARACONCAUDIL		18	224	143131502
PARAHOLLINEAT		18		189020301
PARALICALBIGU		18	159	183012401
PARALICDENTAT		18		183012403
PARALICLETHOS		18	58	183012404
PARALICSQUAMI		18	180	183012407
PARANTHFURCIF		10		170022701
PARANTHRAPIFO		10		619090101
PARAPENPOLITU		3	178	228010503
PARASQUCOCCIN		3	391	225020401
PAREXOCBRACHY		1		147040601
PARTHENAGONUS		5		229400201
PARTHENGRANUL		5	342	229400206
PARTHENPOURTA		5		229400203
PARTHENSERRAT		5	227	229400205
PECTEN RAVENE		12		330230703
PECTEN ZICZAC		12		330230705
PENAEUAZTECUS		7		228010701
PENAEUDUORAR		3	78	228010703
PENAEUSETIFER		3	28	228010705

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
PENAEOPSERRAT		3		228011602
PENOPUSMICROP		18		170391201
PENTAMEPULCHE		25		694040201
PEPRILUALEPID		1	42	170511101
PEPRILUBURTI		1	5	170511103
PERIPLOFRAGIL		11		338110406
PERISTEGRACIL		18	170	168020402
PERISTEMINIAT		18		168020405
PERISTETRUNCA		18		168020410
PERSEPHCRINIT		6	295	229070405
PERSEPHMEDITE		6	251	229070406
PETROCHDIOGEN		6	271	229051403
PHAEOPTCONKLI		18		170060801
PHAEOPTXENUS		18		170060802
PHALIUMGRANUL		17		307770702
PHIMOCHHOLTHU		6		229052801
PHYLLONPOMUM		17		308012901
PHYLLORPUNCTA		16		618040301
PHYSALIPHYSAL		16		616030101
PHYSICUFULVUS		18	216	148020201
PILUMNUDASYPC		5		229100901
PILUMNUSAYI		5		229100905
PINNA CARNEA		11		329020601
PITAR CORDAT		11	171	335644904
PLAGUSIDEPRES		5		229131401
PLANES MINUTU		5		229130801
PLATYBEARGALU		1		147010201
PLESIONEDWARD		3		228190502
PLESIONENSIS		3		228190503
PLESIONLONGIC		3	219	228190509
PLESIONLONGIP		3	390	228190504
PLESIONTENUIP		3		228190507
PLEUROPGIGANT		17		308100201
PODOCHERIISEI		6		229210904
PODOCHESIDNEY		6	206	229210905
POGONIACROMIS		18	185	170203101
POLYDACOCTONE		1	55	166010401
POLYMIXLOWEI		1		161010101
POLYSTIALBIDA		17	213	308181701
POLYSTITELLEA		17	307	308181702
POMACENPICTUS		1		170270503
POMACENPLANIF		1		170270506
POMACENVARIAB		1		170270504
POMATOMSALTAT		1	121	170080101
PONTINULONGIS		18	124	168010502
PONTINURATHBJ		18	332	168010504
PORCELLSAYANA		6	231	229240602
PORCELLSIGSBE		6		229240601
PORICHTPLECTR		18	29	193010806
PORTUNUGIBBES		5	20	229110803
PORTUNUORDWAY		5		229110806
PORTUNUSAYI		5		229110811
PORTUNUSPINIC		5	34	229110808
PORTUNUSPINIM		5	65	229110809
PRIACANARENAT		1	83	170050101
PRIACANCRUENT		1	200	170050102
PRIONOTALATUS		18	275	168020501
PRIONOTCAROLI		18	333	168020503
PRIONOTLONGIS		18	9	168020519
PRIONOTMARTIS		18	195	168020509
PRIONOTOPHRYA		18	99	168020512
PRIONOTPARALA		18	30	168020513
PRIONOTPUNCTA		18		168020517
PRIONOTROSEUS		18	98	168020518
PRIONOTRUBIO		18	63	168020528
PRIONOTSCITUL		18	108	168020521
PRIONOTSTEARN		18	35	168020523
PRIONOTTRIBUL		18	51	168020525
PRISTIGALTA		1	173	170050401
PRISTIPAQUILO		1	24	170151802
PRISTIPMACROP		1		170151801
PROGNICGIBBIF		1	371	147041001
PROMETHPROMET		1		170450901
PROTANKGRAYI		25	427	694060101
PSENES MACULA		1		170510203
PSEUDOCRADIAN		12		334020301
PSEUDOMAGASSI		5		229100701
PSEUDORQUADRI		5		229380901
PSEUDUPMACULA		1	408	170220701
PTERIA COLYMB		11	306	330070601
PYROMAICUSPID		6		229211002
RACHYCECANADJ		1	147	170100101

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
RAJA	EGLANT	22	149	110040205
RAJA	LAEVIS	22		110040211
RAJA	LENTIG	22		110040212
RAJA	OLSENI	22	238	110040213
RAJA	OREGON	22		110040214
RAJA	TEEVAN	22	374	110040217
RAJA	TEXANA	22	87	110040218
RANGIA	CUNEAT	11		335331101
RANINOILOEVIS		6	346	229350202
RANINOILOUISI		6	118	229350203
REMORA	AUSTRA	1		170090302
REMORA	REMORA	1	189	170090301
RENILLAMULLER		16	113	619310101
RENILLARENIFO		16	326	619310102
RHECHIAVICINA		20		143130701
RHINOBALENTIG		18	375	110010201
RHINOPTBONASU		22	223	110120101
RHIZOPRTERRAE		18	79	108021802
RHOMBOPAURORU		1	106	170152001
ROCHINICRASSA		6	396	229211501
ROCHINITANNER		6		229211505
RYPTICUMACULA		18	165	170030106
RYPTICUSAPONA		18	360	170030104
SARDA	SARDA	1		170440701
SARDINEAURITA		1	86	121053801
SAURIDABRASIL		1	22	129040201
SAURIDACARIBB		1	116	129040202
SAURIDANORMAN		1	284	129040203
SCAPHELDUBIA		17		308140903
SCHIZASORBIGN		14	428	691120101
SCIAENOOCELLA		18	205	170203701
SCOMBERCAVALL		1	100	170440801
SCOMBERJAPONI		1	101	170440603
SCOMBERMACULA		1	75	170440803
SCONSIASTRIAT		17	341	307770801
SCORPAEAGASSI		18	401	168010701
SCORPAEBRASIL		18	193	168010703
SCORPAECALCAR		18	69	168010704
SCORPAEDISPAR		18	174	168010705
SCORPAEINERMI		18		168010709
SCORPAEPLUMIE		18	402	168010712
SCYLIORRETIFE		18		108011104
SCYLLARAEQUIN		8		229150101
SCYLLARAMERIC		8		229150202
SCYLLARCHACEI		8	211	229150204
SCYLLARDEPRES		8	255	229150206
SCYLLARNODIFE		8	229	229150102
SELAR	CRUMEN	1	82	170112801
SELENE	SETAPI	1	47	170113004
SELENE	VOMER	1	109	170113003
SEMIROSEQUALI		13		345040901
SEMIROSTENERA		13		345040902
SERIOLADUMERI		1	130	170113101
SERIOLAFASCIA		1	240	170113103
SERIOLARIVOLI		1	414	170113105
SERIOLAZONATA		1	413	170113106
SERRANIPUMILI		1	154	170025401
SERRANUATROBR		1	19	170024202
SERRANUNOTOSP		1		170024207
SERRANUPHOEBE		1	218	170024208
SERRANUSUBLIG		1		170024209
SETARCHGUENTH		18		168011601
SICYONIBREVIR		3	23	228320101
SICYONIBURKEN		3	160	228320106
SICYONIDORSAL		3	43	228320102
SICYONILAEVIG		3		228320107
SICYONIPARRI		3		228320108
SICYONISTIMPS		3	182	228320104
SICYONITYPICA		3		228320105
SINUM	PERSPE	17	345	307760702
SIRATUSBEAUII		17		308012801
SOLECURCUMING		11		335460301
SOLENOCATLANT		3		228300401
SOLENOCNECOPI		3	316	228300402
SOLENOCVIOSCA		3	134	228300403
SPEOCARLOBATJ		5		229380601
SPHOERODORSAL		18	119	189080603
SPHOERONEPHEL		18	383	189080607
SPHOEROPACHYG		18		189080608
SPHOEROPARVUS		18	33	189080611
SPHOEROSPENGL		18	172	189080610
SPHOEROTESTUD		18	243	189080609

Appendix 6. Alphabetic List of Species Length Frequency Measurement Codes. Continued...

GENUS	SPECIES	MC	FMB	BIOCODE
SPHYRAEBARRAC		1		165030101
SPHYRAEBOREAL		1	279	165030102
SPHYRAEGUACHA		1	71	165030103
SPHYRAEPICUDI		1	322	165030105
SPHYRNALEWINI		18	209	108040102
SPHYRNAMOKARR		18		108040103
SPHYRNATIBURO		18	133	108040104
SQUALUSCUBENS		18		109011503
SQUATINDUMERI		18	161	106010101
SQUILLACHYDAE		3	72	225010112
SQUILLAEDENTA		3		225010102
SQUILLAEMPUSA		3	16	225010103
SQUILLANEGLEC		3	245	225010108
STEINDAARGENT		18	132	148041501
STELLIFLANCEO		18	112	170203902
STENOCICOELAT		6	398	229211801
STENOCIFURCAT		6	399	229211802
STENOCISPINIM		6	293	229211803
STENOCISPINOS		6	272	229211804
STENOPUSCUTEL		3	292	228240201
STENORHSETICO		6	141	229211101
STENOTOCAPRIN		1	2	170213403
STOMOLOMELEAG		16		618040201
STROMBUALATUS		17	344	307580101
STYELA PLICAT		20		596080101
STYLOCIAFFINI		14		693060501
SYACIUMGUNTER		18	39	183011001
SYACIUMMICRUR		18	203	183011002
SYACIUMPAPILL		18	56	183011003
SYMPHURCIVITA		18	212	183050701
SYMPHURDIOMED		18	114	183050702
SYMPHURPARVUS		18		183050712
SYMPHURPELICA		18	379	183050705
SYMPHURPLAGIU		18	73	183050707
SYMPHURUROSPI		18		183050709
SYNAGROBELLA		1	315	170060701
SYNAGROSPINOS		1	208	170060704
SYNGNATFLORID		18		151061508
SYNGNATLOUISI		18	362	151061506
SYNGNATSCOVEL		18		151061510
SYNGNATSPRING		18		151061504
SYNODUSFOETEN		1	1	129040302
SYNODUSINTERM		1	217	129040303
SYNODUSPOEYI		1	54	129040304
SYNODUSSYNODJ		1		129040306
TAGELUSPLEBEI		11		335460403
TAMOYA HAPLON		16		616040201
TELLINAALTERN		11	311	335441403
TEREBRAFLORID		17		308200104
TETHYASGRANDI		15		691010901
TETRAXABIDENT		5	400	229101002
TETRAXARATHBJ		5	421	229101001
THAIS HAEMAS		17		308011003
THYONELGEMMAT		25		694020302
TONNA GALEA		17		307800201
TORPEDONOBILI		22		111010403
TRACHINCAROLI		1	202	170113601
TRACHINFALCAT		1	412	170113603
TRACHINMYOPS		1	135	129040101
TRACHURLATHAM		1	18	170113802
TRACHYPCONSTR		3	128	228011801
TRACHYPSIMILI		3	67	228011802
TRICHIURLEPTUR		23	21	170460402
TRICHOPVENTRA		18	53	183011801
TRINECTINSCRI		18	266	183040202
TRINECTMACULA		18	167	183040201
UMBRINACOROID		18	410	170204001
UPENEUSPARVUS		1	11	170220605
UPOGEBIAFFINI		3		229040301
URASPISSECUND		1		170114202
UROCONGSYRING		18		143131401
UROPHYCCIRRAT		18	105	148010102
UROPHYCFLORID		18	74	148010103
UROPHYCREGIA		18	278	148010105
UROSALPCINERE		17		308011401
UROSALPPERRUG		17		308011402
VENTRICRIGIDA		11	355	335640501
VERMICUKNORRI		17		307350502
VESICOMVENUST		11	354	335600402
VIRGULAPRESBY		20		619070101
XENOPHOCONCHY		17		307650202
XIPHOPEKROYER		3	168	228010901

GENUS	SPECIES	MC	FMB	BIOCODE
ZALIEUTMCGINT		18	318	195050501
ZENOPSICONCHI		1		162010201
ZENOPSIOCELLA		1		162010202
ZOOBOTRPELLUC		20		642060101

Appendix 7. Length Frequency Measurement Code Finder List.

FISH - DO NOT MEASURE IF ONLY THE GENUS IS KNOWN

Fish, default Measurement, no instructions - standard length.

Code No.	Type measurement	Species (Alphabetical List Attached, Appendix 6)
01	Fish, fork length	Alphabetical list
02	Fish, standard length	Alphabetical list
18	Fish, total length * if fish has produced caudal ray elements at the fork or upper and/or lower caudal lobes take standard length, Code 02 measurement	Alphabetical list
20	Other - specify and check with Field party Chief for special Code no.	
22	Skates and rays, disc width	Alphabetical list
23	Fish, snout/anal length	Alphabetical list

CRUSTACEANS - DO NOT MEASURE IF ONLY THE GENUS IS KNOWN

Code No.	Type measurement	Species (Alphabetical List Attached)
03	Shrimp, total length (Default Measurement)	
04	Shrimp, carapace length (measure when requested)	
19	Shrimp tail length (measure when requested)	

Appendix 7. Length Frequency Measurement Code Finder List, Continued...

05	Crab, carapace width (lateral measurement) If carapace length exceeds carapace width-measure carapace length instead (code 06)	Alphabetical list
06	Crab, carapace length (Default measurement) If carapace length exceeds carapace width (measure when requested other wise)	Alphabetical list
07	Lobster, carapace length (from rostral tip) (Default measurement all lobsters)	Alphabetical list
08	Lobster, total length (rostral tip to end of telson) (Measure when requested)	Alphabetical list

OTHER SPECIES - DO NOT MEASURE IF GENUS ONLY KNOWN
(Exclusive of fish and crustaceans)

Code No.	Type of measurement	Species (Alphabetical List Attached)
10	Disc width anemones and corals (solitary)	
11	Bivalve, total length (clams) (All bivalves except scallops) Parallel to hinge joint, umbo to bill edge	
12	Scallop, total length (All scallops) (hinge to bill length)	
13	Squid, mantle length	

Appendix 7. Length Frequency Measurement Code Finder List, Continued...

14	Starfish- disc width(between arm bases- default measurement); Sand dollars, sea biscuits, heart urchins, etc.- greatest linear distance
15	Starfish, total radial diameter (measure when requested).
16	Sea pansy and other colonial invertebrates, maximum disc width; Jellyfish- bell diameter.
17	Univalve snails (most univalves): total length- point to point; shelled- Columella total length (apex to tip of anterior canal - Spire axis); for Abalones and Chitons use maximum total length of shell; for sea hares use total length.
21	Sea turtles - maximum linear carapace total length
24	Univalve snails, spiral width (includes Argonauts).
25	Worm, total length.

Appendix 8. Measuring Board Species Codes with Length Measurement Codes.

	Species Code	Measurement Code		Species Code	Measurement Code
ABLENNEHIANS	368	1	BELLATOMILITA	94	18
ACHIRUSLINEAT	196	18	BEMBROPGOBIOI	241	18
AEQUIPEGLYPTU	352	12	BOLLMANCOMMUN	90	18
ALECTISCILIAR	214	1	BOTHUS ROBINS	291	18
ALUTERUHEUDEL	290	18	BOTHUS OCELLA	381	18
ALUTERUSCHOEP	150	18	BREGMACATLANT	122	18
ALUTERUSCRIPT	250	18	BREVOORGUNTER	310	1
ALUTERUMONOCE	230	18	BREVOORPATRON	64	1
AMUSIUMPAPYRA	49	12	BROTULABARBAT	70	18
ANACANTLONGIR	377	22	BUSYCONCONTRA	283	17
ANADARABRASIL	336	11	BUSYCONSPIRAT	335	17
ANADARABAUGHM	175	11	CALAMUSARCTIF	411	1
ANADARAOVALIS	338	11	CALAMUSCALAMU	256	1
ANASIMULATUS	103	6	CALAMUSLEUCOS	201	1
ANCHOA CUBANA	253	1	CALAMUSPENNA	260	1
ANCHOA HEPSET	32	1	CALAMUSNODOSU	246	1
ANCHOA LYOLEP	136	1	CALAPPAFLAMME	191	5
ANCHOA LAMPRO	317	1	CALAPPASULCAT	52	5
ANCHOA NASUTA	244	1	CALLINESIMILI	4	5
ANCHOA MITCHI	76	1	CALLINESAPIDU	57	5
ANCHOVIPERFAS	152	1	CANTHIDSUFFLA	380	1
ANCYLOPDILECT	80	18	CARANX CRYSOS	62	1
ANCYLOPQUADRO	85	18	CARANX HIPPOS	184	1
ANTENNASTRIAT	236	18	CARCHARBREVIP	305	18
ANTENNARADIOS	115	18	CARCHARACRONO	192	18
APLATOPCHAULI	365	18	CARCHARFALCIF	301	18
APOGON AUROLI	268	1	CARCHARLIMBAT	234	18
APOGON PSEUDO	248	1	CARDITAFLORID	349	12
ARCHITENOBILI	343	24	CARETTACARETT	325	21
ARENAEUCRIBRA	140	5	CAULOLAINTERM	89	1
ARGOPECGIBBUS	199	12	CAULOLAMICROP	269	18
ARIOMMABONDI	221	1	CENTROPOCYURA	111	2
ARIOMMAREGULU	406	1	CENTROPPHILAD	6	2
ARIOMMAMELANU	420	1	CHAETODAYA	298	2
ARIUS FELIS	40	1	CHAETODFABER	50	2
ASTEROPANNULA	329	14	CHAETODOCELLA	419	2
ASTROPEAMERIC	179	15	CHASCANLUGUBR	331	18
ASTROPEDUPLIC	148	15	CHILOMYATINGA	319	18
ASTROSCY-GRAE	210	18	CHILOMYSCHOEP	153	18
ATRINA SEMINU	339	11	CHIONE CLENCH	300	11
BAGRE MARINU	120	1	CHLOEIAVIRIDI	347	25
BAIRDIECHRYSO	186	18	CHLOROSCHRYSU	14	1
BALISTECAPRIS	44	1	CHROMISENCHRY	286	1
BARBATICANCEL	337	11	CITHARICORNUT	247	18
BATHYANMEXICA	151	1	CITHARIMACROP	129	18

Appendix 8. Measuring Board Species Codes with Length Measurement Codes, Continued...

	Species Code	Measurement Code		Species Code	Measurement Code
CITHARISPILOP	61	18	ETRUMEUTERES	77	1
CLYPEASRAVENE	373	16	EUCINOSARGENT	282	1
COELOCESPINOS	394	6	EUTHYNNALLETT	314	1
CONGER OCEANI	281	18	FISTULAPETIMB	361	2
CONODONNOBILI	416	1	FISTULATABACA	328	2
CONUS AUSTIN	274	17	GINGLYMCIRRAT	320	18
CYCLOPSCHITTE	45	18	GOBIOIDBROUSS	407	18
CYCLOPSFIMBRI	226	18	GOBIONEHASTAT	267	18
CYNOSCIARENAR	8	18	GYMNACHMELAS	198	18
CYNOSCINOTHUS	25	18	GYMNACHTEXAE	95	18
CYPSELUEXSILI	370	1	GYMNOTHKOLPOS	233	18
DASYATIAMERIC	190	22	GYMNOTHOCELLA	258	18
DASYATISAY	273	22	GYMNOTHNIGROM	127	18
DASYATISABINA	235	22	GYMNOTHSAXICO	146	18
DECAPTEMACARE	415	1	HAEMULOAUROLI	102	1
DECAPTEPUNCTA	104	1	HALICHOBATHYP	409	2
DECODONPUELLA	144	2	HALIEUTACULEA	36	18
DINOCARROBUST	350	12	HARENGUJAGUAN	26	1
DIODON HYSTRI	384	18	HEMANTHAUREOR	280	1
DIPLECTBIVITT	15	2	HEMANTHLEPTUS	285	1
DIPLECTFORMOS	96	2	HEMANTHVIVANU	303	1
DIPLOGRPAUCIR	404	18	HEMICARAMBLYR	162	1
DISTORSCLATHR	334	17	HEMIPTENOVACU	239	2
DOROSOMPETENE	372	1	HEMIRAMBRASIL	369	1
ECHENEINAUCRA	145	18	HEPATUSEPHELI	117	5
ECHIOPHINTERT	263	18	HERMODICARUNC	324	25
ECHIOPHMORDAX	366	18	HILDEBRGRACIL	313	18
ELOPS SAURUS	378	1	HILDEBRFLAVA	81	18
ENGRAULEURYST	131	1	HIPPOCAERECTU	304	20
ENGYOPHSENTA	97	18	HIRUNDIRONDEL	321	1
EPINEPHGUTTAT	356	1	HOLOCENADSCEN	363	1
EPINEPHFLAVOL	181	1	HOPLUNNDIOMED	207	18
EPINEPHNIGRIT	359	1	HOPLUNNMACRUR	84	18
EPINNULORIENT	405	1	ILIACANLIODAC	389	6
EQUETUSACUMIN	142	18	KATHETOALBIGU	93	18
EQUETUSIWAMOT	183	18	LACTOPHQUADRI	158	18
EQUETUSLANCEO	417	18	LACTOPHPOLYGO	382	18
EQUETUSUMBROS	107	18	LACTOPHTRIQUE	330	18
ETHUSA MICROP	340	6	LAEVICAPICTUM	351	12
ETROPUSCROSSO	38	18	LAEVICASYBARI	35	12
ETROPUSCYCLOS	137	18	LAGOCEPLAEVIG	31	18
ETROPUSINTERM	259	18	LAGODONRHOMBO	12	1
ETROPUSMICROS	188	18	LARIMUSFASCIA	92	18
ETROPUSRIMOSU	164	18	LEIOLAMNITIDU	215	5

Appendix 8. Measuring Board Species Codes with Length Measurement Codes, Continued...

	Species Code	Measurement Code		Species Code	Measurement Code
LEIOSTOXANTHU	13	18	MYROPSIQUINQU	220	6
LEPOPHIBREVIB	37	18	NARCINEBRASIL	252	22
LEPOPHIJEANNA	123	18	NEOBYTHGILLII	163	18
LIBINIADUBIA	197	6	NEOMERIHEMING	126	18
LIBINIAEMARGI	139	6	NEVERITDUPLIC	264	17
LOLIGO PEALEI	17	13	IBILIAANTILO	395	6
LOLIGO PLEII	88	13	OCTOPUSVULGAR	308	13
LOLLIGUBREVIS	27	13	OCYPODEQUADRA	393	5
LONCHOPMICROG	222	18	ODONTOSDENTEX	297	18
LOPHIODBEROE	386	18	OGCOCEPCORNIG	225	18
LUIDIA ALTERN	309	14	OGCOCEPDECLIV	110	18
LUIDIA CLATHR	176	14	OGCOCEPPANTOS	169	18
LUTJANUCAMPEC	10	1	OGCOCEPRADIAT	237	18
LUTJANUGRISEU	299	1	OGCOCEPPUMILU	257	18
LUTJANUSYNAGR	46	1	OGCOCEPNASUTU	387	18
LYSIOSQSCABRI	242	3	OGCOCEPPARVUS	287	18
MACOMA BREVIF	327	11	OLIGOPLSAURUS	187	1
MACOMA CONSTR	277	11	OPHICHTGOMESI	155	18
MACROCOCAMPTO	397	6	OPHICHTOCELLA	262	18
MENIPPEADINA	294	5	OPHIDIOHOLBRO	138	18
MENIPPEMERCEN	265	5	OPHIDIOGRAYI	166	18
MENTICIAMERIC	60	18	OPHIDIOMARGIN	403	18
MENTICILITTOR	177	18	OPHIDIOWELSHI	91	18
MENTICISAXATI	261	18	OPHIODEBREVIS	312	14
MERCENAMERCEN	323	11	OPISTHOOGLINU	48	1
METOPORCALCAR	302	6	OPSANUSBETA	270	18
MICROPOUNDULA	3	18	OPSANUSTAU	385	18
MONACANCILIAT	289	18	OPSANUSPARDUS	288	18
MONACANHISPID	68	18	ORTHOPRCHRYSO	59	1
MONACANSETIFE	194	18	OSTREA EQUEST	348	12
MONOLENSESSIL	296	18	OVALIPEFLORID	204	5
MUGIL CUREMA	364	1	OVALIPEOCELLA	232	5
MUGIL CEPHAL	228	1	OVALIPESTEPHE	143	5
MULLOIDMARTIN	418	1	PAGRUS PAGRUS	156	1
MULLUS AURATU	66	1	PANOPEUBERMUD	388	5
MUNIDA FORCEP	392	8	PARACONCAUDIL	224	18
MURICANFULVES	254	17	PARALICALBIGU	159	18
MUSTELUCANIS	125	18	PARALICSQUAMI	180	18
MUSTELUNORRIS	157	18	PARALICLETHOS	58	18
MYCTEROMICROL	357	1	PARAPENPOLITU	178	3
MYCTEROPHENAX	358	1	PARASQUCOCCIN	391	3
MYLIOBAGOODEI	376	22	PARTHENGRANUL	342	5
MYLIOBAFREMIN	249	22	PARTHENSERRAT	227	5
MYROPHIPUNCTA	367	18	PENAEUSAZTECUS	7	3

Appendix 8. Measuring Board Species Codes with Length Measurement Codes, Continued...

	Species Code	Measurement Code		Species Code	Measurement Code
PENAEUSDUORAR	78	3	RAJA EGLANT	149	22
PENAEUSSETIFE	28	3	RAJA TEEVAN	374	22
PEPRILUBURTI	5	1	RAJA OLSENI	238	22
PEPRILUALEPID	42	1	RAJA TEXANA	87	22
PERISTEGRACIL	170	18	RANINOILOEVIS	346	6
PERSEPHCRINIT	295	6	RANINOILOUISI	118	6
PERSEPHMEDITE	251	6	REMORA REMORA	189	1
PETROCHDIOGEN	271	6	RENILLARENIFO	326	16
PHYSICUFULVUS	216	18	RENILLAMULLER	113	16
PITAR CORDAT	171	11	RHINOBALENTIG	375	18
PLESIONLONGIC	219	3	RHINOPTBONASU	223	22
PLESIONLONGIP	390	3	RHIZOPRTERRAE	79	18
PODOCHESIDNEY	206	6	RHOMBOPAURORU	106	1
POGONIACROMIS	185	18	ROCHINICRASSA	396	6
POLYDACOCTONE	55	1	RYPTICUSAPONA	360	18
POLYSTIALBIDA	213	17	RYPTICUMACULA	165	18
POLYSTITELLEA	307	11	SARDINEAURITA	86	1
POMATOMSALTAT	121	1	SAURIDABRASIL	22	1
PONTINURATHBU	332	18	SAURIDACARIBB	116	1
PONTINULONGIS	124	18	SAURIDANORMAN	284	1
PORCELLSAYANA	231	6	SCIAENOOCELLA	205	18
PORICHTPLECTR	29	18	SCOMBERCAVALL	100	1
PORTUNUGIBBES	20	5	SCOMBERJAPONI	101	1
PORTUNUSPINIC	34	5	SCOMBERMACULA	75	1
PORTUNUSPINIM	65	5	SCONSIASTRIAT	341	17
PRIACANCRUENT	200	1	SCORPAEDISPAR	174	18
PRIACANARENAT	83	1	SCORPAEBRASIL	193	18
PRIONOTCAROLI	333	18	SCORPAECALCAR	69	18
PRIONOTALATUS	275	18	SCORPAEAGASSI	401	18
PRIONOTMARTIS	195	18	SCORPAEPLUMIE	402	18
PRIONOTLONGIS	9	18	SCYLLARCHACEI	211	8
PRIONOTPARALA	30	18	SCYLLARDEPRES	255	8
PRIONOTSTEARN	35	18	SCYLLARNODIFE	229	8
PRIONOTTRIBUL	51	18	SELAR CRUMEN	82	1
PRIONOTRUBIO	63	18	SELENE SETAPI	47	1
PRIONOTROSEUS	98	18	SELENE VOMER	109	1
PRIONOTOPHRYA	99	18	SERIOLADUMERI	130	1
PRIONOTSCITUL	108	18	SERIOLAFASCIA	240	1
PRISTIGALTA	173	1	SERIOLARIVOLI	414	1
PRISTIPAQUILO	24	1	SERIOLAZONATA	413	1
PROGNICGIBBIF	371	1	SERRANIPUMILI	154	1
PSEUDUPMACULA	408	1	SERRANUATROBR	19	1
PTERIA COLYMB	306	11	SERRANUPHOEBE	218	1
RACHYCECANADU	147	1	SICYONIBREVIR	23	3

Appendix 8.Measuring Board Species Codes with Length Measurement Codes, Continued...

	Species Code	Measurement Code		Species Code	Measurement Code
SICYONIDORSAL	43	3	TETRAXABIDENT	400	5
SICYONIBURKEN	160	3	TETRAXARATHBU	421	5
SICYONISTIMPS	182	3	TRACHINCAROLI	202	1
SINUM PERSPE	34	17	TRACHINFALCAT	412	1
SOLENOCNECOPI	316	3	TRACHINMYOPS	135	1
SOLENOCVIOSCA	134	3	TRACHURLATHAM	18	1
SPHOERODORSAL	119	18	TRACHYPCONSTR	128	3
SPHOEROSPENGL	172	18	TRACHYPSIMILI	67	3
SPHOEROPARVUS	33	18	TRICHIULEPTUR	21	23
SPHOEROTESTUD	243	18	TRICHOPVENTRA	53	18
SPHOERONEPHEL	383	18	TRINECTINSCRI	266	18
SPHYRAEBOREAL	279	1	TRINECTMACULA	167	18
SPHYRAEGUACHA	71	1	UMBRINACOROID	410	18
SPHYRAEPICUDI	322	1	UPENEUSPARVUS	11	1
SPHYRNALEWINI	209	18	UROPHYCCIRRAT	105	18
SPHYRNATIBURO	133	18	UROPHYCFLORID	74	18
SQUATINDUMERI	161	18	UROPHYCREGIUS	278	18
SQUILLACHYDAE	72	3	VENTRICRIGIDA	355	11
SQUILLAEMPUSA	16	3	VESICOMVENUST	354	11
SQUILLANEGLEC	245	3	XIPHOPEKROYER	168	3
SQUILLALIJDIN	276	3	ZALIEUTMCGINT	318	18
STEINDAARGENT	132	18			
STELLIFLANCEO	112	18			
STENOCICOELAT	398	6			
STENOCIFURCAT	399	6			
STENOCISPINOS	272	6			
STENOCISPINIM	293	6			
STENOPUSCUTEL	292	3			
STENORHSETICO	141	6			
STENOTOCAPRIN	2	1			
STROMBUALATUS	344	17			
SYACIUMGUNTER	39	18			
SYACIUMMICRUR	203	18			
SYACIUMPAPILL	56	18			
SYMPHURCIVITA	212	18			
SYMPHURDIOMED	114	18			
SYMPHURPLAGIU	73	18			
SYMPHURPELICA	379	18			
SYNAGROBELLA	315	1			
SYNAGROSPINOS	208	1			
SYNGNATLOUISI	362	18			
SYNODUSFOETEN	1	1			
SYNODUSINTERM	217	1			
SYNODUSPOEYI	54	1			
TELLINAALTERN	311	11			

Appendix 9. Five Point Sexual Maturity Scale

CODE	STAGE	DESCRIPTION
U-1	Undetermined	Gonads undeveloped, sex and stage determination Impossible by gross examination.
F-1, M-1	Immature virgin	Gonads very small, uninflated and occupies about 1/3 of body cavity. Sex determinable by gross examination. F- cigar shaped, amber, pink or red. M- triangular, gray or white.
F-2, M-2	Resting-(maturing virgin or recovering spent)	Gonads about 1/2 length of body cavity F- pinkish, yellow, or red, no eggs visible through ovarian membrane; M- white, no milt when testes ruptured.
F-3, M-3	Enlarging/ developing (ripening)	Gonads occupy 1/2 to 3/4 of body cavity; F- opaque eggs visible through membrane; ovary predominantly yellow; M- milt present when testes ruptured..
F-4, M-4	Running ripe	Gonads occupy 3/4 or more of body cavity. F- translucent eggs visible giving mottled appearance; all eggs may not be translucent. M- milt easily released from testes with little or no pressure.
F-5, M-5	Spent	Gonads shrunken to less than 3/4 of body cavity. Walls loose. F- flaccid, some remnants of opaque and ripe eggs, bloodshot. M-flaccid, some milt present, bloodshot.

U = Undetermined gonad stage or sex
F = Female
M = Male

Appendix 10. Equipment Checklist for Ichthyoplankton Cruises.

Alcohol
Angle indicator
Angle/wire out tables
Batteries for ctd & bongo
Bleach bottle
Bongo frames
Bongo nets
Bridge log
Cable ties
Carboys
Chemical pump
Clip boards
Cod end buckets (bongo/tucker trawl)
Cod end hose clamp (bongo/tucker trawl)
Cod end sleeve (bongo/tucker trawl)
Concentrators (sieves)of appropriate mesh
sizes
Crimping tool
Cruise chart
Diskettes
Duct tape
Flowmeters
Forceps, large and small
Formalin
Formalin dispenser
Hoses (nozzles)
Hose y- connector
Ichthyoplankton station sheets
Inside labels
Knife
Disposable latex gloves
Lead weight (80 lbs) or depressor
Messengers (tucker trawl)
Monofilament and sleeves
Net repair material
Neuston frames
Neuston nets
Nylon rope (1/4 in) to attach neuston net to frame
Pascagoula station sheets type I
Pencils
Permanent markers fine point (12)
Plastic buckets (6)
Plastic syringe
Rope or line
Safety glasses
Sample jars (lids)
Scissors
Screwdriver
Shackles
Silicone oil
Silicone grease
Stick on labels (outside)
Stop watches
Squeeze bottles
Syringes to fill flowmeters
Table
Twine
Tucker trawl
Tucker trawl nets
Wide mouth funnels
WD 40

Appendix 11. Ichthyoplankton Data Sheet Gear and Mesh Codes

11-A Ichthyoplankton Gear Codes

61 Cm bongo.....01
1 Meter ring net.....02
1x2 Meter neuston.....03
½ Meter ring net.....04
20 Cm bongo.....05
Open or Blank.....06
1 m^2 Tucker trawl.....07
Double 1x2 Neuston....08
1 m^2 MOCNESS.....09
4 m^2 MOCNESS.....10
60 CM o/c Bongo.....11
20 CM o/c Bongo.....12
60 CM BNF1.....13
70cm Bongo.....14

11-B. Ichthyoplankton Net Mesh Codes

0.300/0.303	=	01
0.999	=	02
0.333/0.335	=	03
0.253	=	04
0.500/0.505	=	05
Unknown	=	06
0.947/0.950	=	09
0.363	=	10
0.153	=	11
0.202	=	12
0.760	=	13
0.64	=	14
0.100	=	15
0.707	=	16

VII. TABLES

Table 1. Conversions for meters to fathoms. The center "Units" column denotes a depth in either meters or fathoms. To convert from either scale to the other, simply go to the value in the "Units" column that you desire to convert. If meters to fathoms look in the right hand "Fathoms" column for the fathom equivalent of that meter value. If fathoms to meters look in the left hand "Meters" column for the meter equivalent of that fathom value. For example, 10 Units read as meters will equal 5.47 fathoms and 10 Units read as fathoms will equal 18.29 meters.

Meters	Units	Fathoms	Meters	Units	Fathoms	Meters	Units	Fathoms
1.83	1	0.55	74.98	41	22.42	148.13	81	44.29
3.66	2	1.09	76.81	42	22.97	149.96	82	44.84
5.49	3	1.64	78.64	43	23.51	151.79	83	45.38
7.32	4	2.19	80.47	44	24.06	153.62	84	45.93
9.14	5	2.73	82.30	45	24.61	155.45	85	46.48
10.97	6	3.28	84.13	46	25.15	157.28	86	47.02
12.80	7	3.83	85.95	47	25.70	159.11	87	47.57
14.63	8	4.37	87.78	48	26.25	160.94	88	48.12
16.46	9	4.92	89.61	49	26.79	162.76	89	48.67
18.29	**10**	**5.47**	**91.44**	**50**	**27.34**	**164.59**	**90**	**49.21**
20.12	11	6.01	93.27	51	27.89	166.42	91	49.76
21.95	12	6.56	95.10	52	28.43	168.25	92	50.31
23.77	13	7.11	96.93	53	28.98	170.08	93	50.85
25.60	14	7.66	98.76	54	29.53	171.91	94	51.40
27.43	15	8.20	100.59	55	30.07	173.74	95	51.95
29.26	16	8.75	102.41	56	30.62	175.57	96	52.49
31.09	17	9.30	104.24	57	31.17	177.40	97	53.04
32.92	18	9.84	106.07	58	31.71	179.22	98	53.59
34.75	19	10.39	107.90	59	32.26	181.05	99	54.13
36.58	**20**	**10.94**	**109.73**	**60**	**32.81**	**182.88**	**100**	**54.68**
38.41	21	11.48	111.56	61	33.35	184.71	101	55.23
40.23	22	12.03	113.39	62	33.90	186.54	102	55.77
42.06	23	12.58	115.22	63	34.45	188.37	103	56.32
43.89	24	13.12	117.04	64	35.00	190.20	104	56.87
45.72	25	13.67	118.87	65	35.54	192.03	105	57.41
47.55	26	14.22	120.70	66	36.09	193.85	106	57.96
49.38	27	14.76	122.53	67	36.64	195.68	107	58.51
51.21	28	15.31	124.36	68	37.18	197.51	108	59.05
53.04	29	15.86	126.19	69	37.73	199.34	109	59.60
54.86	**30**	**16.40**	**128.02**	**70**	**38.28**	**201.17**	**110**	**60.15**
56.69	31	16.95	129.85	71	38.82	203.00	111	60.69
58.52	32	17.50	131.68	72	39.37	204.83	112	61.24
60.35	33	18.04	133.50	73	39.92	206.66	113	61.79
62.18	34	18.59	135.33	74	40.46	208.49	114	62.34
64.01	35	19.14	137.16	75	41.01	210.31	115	62.88
65.84	36	19.68	138.99	76	41.56	212.14	116	63.43
67.67	37	20.23	140.82	77	42.10	213.97	117	63.98
69.50	38	20.78	142.65	78	42.65	215.80	118	64.52
71.32	39	21.33	144.48	79	43.20	217.63	119	65.07
73.15	**40**	**21.87**	**146.31**	**80**	**43.74**	**219.46**	**120**	**65.62**

Table 1. Conversions for meters to fathoms. Continued...

Meters	Units	Fathoms	Meters	Units	Fathoms	Meters	Units	Fathoms
221.29	121	66.16	312.73	171	93.50	404.17	221	120.84
223.12	122	66.71	314.56	172	94.05	406.00	222	121.39
224.94	123	67.26	316.39	173	94.60	407.83	223	121.94
226.77	124	67.80	318.21	174	95.14	409.66	224	122.48
228.60	125	68.35	320.04	175	95.69	411.48	225	123.03
230.43	126	68.90	321.87	176	96.24	413.31	226	123.58
232.26	127	69.44	323.70	177	96.78	415.14	227	124.12
234.09	128	69.99	325.53	178	97.33	416.97	228	124.67
235.92	129	70.54	327.36	179	97.88	418.80	229	125.22
237.75	**130**	**71.08**	**329.19**	**180**	**98.42**	**420.63**	**230**	**125.76**
239.58	131	71.63	331.02	181	98.97	422.46	231	126.31
241.40	132	72.18	332.85	182	99.52	424.29	232	126.86
243.23	133	72.72	334.67	183	100.06	426.12	233	127.40
245.06	134	73.27	336.50	184	100.61	427.94	234	127.95
246.89	135	73.82	338.33	185	101.16	429.77	235	128.50
248.72	136	74.36	340.16	186	101.70	431.60	236	129.04
250.55	137	74.91	341.99	187	102.25	433.43	237	129.59
252.38	138	75.46	343.82	188	102.80	435.26	238	130.14
254.21	139	76.01	345.65	189	103.35	437.09	239	130.69
256.03	**140**	**76.55**	**347.48**	**190**	**103.89**	**438.92**	**240**	**131.23**
257.86	141	77.10	349.30	191	104.44	440.75	241	131.78
259.69	142	77.65	351.13	192	104.99	442.57	242	132.33
261.52	143	78.19	352.96	193	105.53	444.40	243	132.87
263.35	144	78.74	354.79	194	106.08	446.23	244	133.42
265.18	145	79.29	356.62	195	106.63	448.06	245	133.97
267.01	146	79.83	358.45	196	107.17	449.89	246	134.51
268.84	147	80.38	360.28	197	107.72	451.72	247	135.06
270.67	148	80.93	362.11	198	108.27	453.55	248	135.61
272.49	149	81.47	363.94	199	108.81	455.38	249	136.15
274.32	**150**	**82.02**	**365.76**	**200**	**109.36**	**457.21**	**250**	**136.70**
276.15	151	82.57	367.59	201	109.91			
277.98	152	83.11	369.42	202	110.45			
279.81	153	83.66	371.25	203	111.00			
281.64	154	84.21	373.08	204	111.55			
283.47	155	84.75	374.91	205	112.09			
285.30	156	85.30	376.74	206	112.64			
287.12	157	85.85	378.57	207	113.19			
288.95	158	86.39	380.39	208	113.73			
290.78	159	86.94	382.22	209	114.28			
292.61	**160**	**87.49**	**384.05**	**210**	**114.83**			
294.44	161	88.03	385.88	211	115.37			
296.27	162	88.58	387.71	212	115.92			
298.10	163	89.13	389.54	213	116.47			
299.93	164	89.68	391.37	214	117.02			
301.76	165	90.22	393.20	215	117.56			
303.58	166	90.77	395.03	216	118.11			
305.41	167	91.32	396.85	217	118.66			
307.24	168	91.86	398.68	218	119.20			
309.07	169	92.41	400.51	219	119.75			
310.90	**170**	**92.96**	**402.34**	**220**	**120.30**			

Table 2. Conversions for meters to feet. The center "Units" column denotes a depth in either meters or feet. To convert from either scale to the other, simply go to the value in the "Units" column that you desire to convert. If meters to feet look in the right hand "Feet" column for the feet equivalent of that meter value. If feet to meters look in the left hand "Meters" column for the meter equivalent of that feet value. For example, 10 Units read as meters will equal 32.81 feet and 10 Units read as feet will equal 3.05 meters.

Meters	Units	Feet	Meters	Units	Feet	Meters	Units	Feet
0.30	1	3.28	12.50	41	134.51	24.69	81	265.75
0.61	2	6.56	12.80	42	137.79	24.99	82	269.03
0.91	3	9.84	13.11	43	141.08	25.30	83	272.31
1.22	4	13.12	13.41	44	144.36	25.60	84	275.59
1.52	5	16.40	13.72	45	147.64	25.91	85	278.87
1.83	6	19.68	14.02	46	150.92	26.21	86	282.15
2.13	7	22.97	14.33	47	154.20	26.52	87	285.43
2.44	8	26.25	14.63	48	157.48	26.82	88	288.71
2.74	9	29.53	14.94	49	160.76	27.13	89	291.99
3.05	**10**	**32.81**	**15.24**	**50**	**164.04**	**27.43**	**90**	**295.27**
3.35	11	36.09	15.54	51	167.32	27.74	91	298.56
3.66	12	39.37	15.85	52	170.60	28.04	92	301.84
3.96	13	42.65	16.15	53	173.88	28.35	93	305.12
4.27	14	45.93	16.46	54	177.16	28.65	94	308.40
4.57	15	49.21	16.76	55	180.45	28.96	95	311.68
4.88	16	52.49	17.07	56	183.73	29.26	96	314.96
5.18	17	55.77	17.37	57	187.01	29.57	97	318.24
5.49	18	59.05	17.68	58	190.29	29.87	98	321.52
5.79	19	62.34	17.98	59	193.57	30.18	99	324.80
6.10	**20**	**65.62**	**18.29**	**60**	**196.85**	**30.48**	**100**	**328.08**
6.40	21	68.90	18.59	61	200.13	30.78	101	331.36
6.71	22	72.18	18.90	62	203.41	31.09	102	334.64
7.01	23	75.46	19.20	63	206.69	31.39	103	337.93
7.32	24	78.74	19.51	64	209.97	31.70	104	341.21
7.62	25	82.02	19.81	65	213.25	32.00	105	344.49
7.92	26	85.30	20.12	66	216.53	32.31	106	347.77
8.23	27	88.58	20.42	67	219.82	32.61	107	351.05
8.53	28	91.86	20.73	68	223.10	32.92	108	354.33
8.84	29	95.14	21.03	69	226.38	33.22	109	357.61
9.14	**30**	**98.42**	**21.34**	**70**	**229.66**	**33.53**	**110**	**360.89**
9.45	31	101.71	21.64	71	232.94	33.83	111	364.17
9.75	32	104.99	21.95	72	236.22	34.14	112	367.45
10.06	33	108.27	22.25	73	239.50	34.44	113	370.73
10.36	34	111.55	22.56	74	242.78	34.75	114	374.01
10.67	35	114.83	22.86	75	246.06	35.05	115	377.30
10.97	36	118.11	23.16	76	249.34	35.36	116	380.58
11.28	37	121.39	23.47	77	252.62	35.66	117	383.86
11.58	38	124.67	23.77	78	255.90	35.97	118	387.14
11.89	39	127.95	24.08	79	259.19	36.27	119	390.42
12.19	**40**	**131.23**	**24.38**	**80**	**262.47**	**36.58**	**120**	**393.70**

Table 2. Conversions for meters to feet. Continued...

Meters	Units	Feet	Meters	Units	Feet	Meters	Units	Feet
36.88	121	396.98	52.12	171	561.02	67.36	221	725.06
37.19	122	400.26	52.43	172	564.30	67.67	222	728.34
37.49	123	403.54	52.73	173	567.58	67.97	223	731.63
37.80	124	406.82	53.04	174	570.86	68.28	224	734.91
38.10	125	410.10	53.34	175	574.15	68.58	225	738.19
38.40	126	413.38	53.64	176	577.43	68.89	226	741.47
38.71	127	416.67	53.95	177	580.71	69.19	227	744.75
39.01	128	419.95	54.25	178	583.99	69.49	228	748.03
39.32	129	423.23	54.56	179	587.27	69.80	229	751.31
39.62	**130**	**426.51**	**54.86**	**180**	**590.55**	**70.10**	**230**	**754.59**
39.93	131	429.79	55.17	181	593.83	70.41	231	757.87
40.23	132	433.07	55.47	182	597.11	70.71	232	761.15
40.54	133	436.35	55.78	183	600.39	71.02	233	764.43
40.84	134	439.63	56.08	184	603.67	71.32	234	767.71
41.15	135	442.91	56.39	185	606.95	71.63	235	771.00
41.45	136	446.19	56.69	186	610.23	71.93	236	774.28
41.76	137	449.47	57.00	187	613.52	72.24	237	777.56
42.06	138	452.75	57.30	188	616.80	72.54	238	780.84
42.37	139	456.04	57.61	189	620.08	72.85	239	784.12
42.67	**140**	**459.32**	**57.91**	**190**	**623.36**	**73.15**	**240**	**787.40**
42.98	141	462.60	58.22	191	626.64	73.46	241	790.68
43.28	142	465.88	58.52	192	629.92	73.76	242	793.96
43.59	143	469.16	58.83	193	633.20	74.07	243	797.24
43.89	144	472.44	59.13	194	636.48	74.37	244	800.52
44.20	145	475.72	59.44	195	639.76	74.68	245	803.80
44.50	146	479.00	59.74	196	643.04	74.98	246	807.08
44.81	147	482.28	60.05	197	646.32	75.29	247	810.37
45.11	148	485.56	60.35	198	649.60	75.59	248	813.65
45.42	**149**	**488.84**	60.66	199	652.89	75.90	249	816.93
45.72	150	492.12	**60.96**	**200**	**656.17**	**76.20**	**250**	**820.21**
46.02	151	495.41	61.27	201	659.45			
46.33	152	498.69	61.57	202	662.73			
46.63	153	501.97	61.87	203	666.01			
46.94	154	505.25	62.18	204	669.29			
47.24	155	508.53	62.48	205	672.57			
47.55	156	511.81	62.79	206	675.85			
47.85	157	515.09	63.09	207	679.13			
48.16	158	518.37	63.40	208	682.41			
48.46	159	521.65	63.70	209	685.69			
48.77	**160**	**524.93**	**64.01**	**210**	**688.97**			
49.07	161	528.21	64.31	211	692.26			
49.38	162	531.49	64.62	212	695.54			
49.68	163	534.78	64.92	213	698.82			
49.99	164	538.06	65.23	214	702.10			
50.29	165	541.34	65.53	215	705.38			
50.60	166	544.62	65.84	216	708.66			
50.90	167	547.90	66.14	217	711.94			
51.21	168	551.18	66.45	218	715.22			
51.51	169	554.46	66.75	219	718.50			
51.82	**170**	**557.74**	**67.06**	**220**	**721.78**			

Table 3. Conversions for feet to fathoms. The center "Units" column denotes a depth in either feet or fathoms. To convert from either scale to the other, simply go to the value in the "Units" column that you desire to convert. If feet to fathoms look in the right hand "Fathom" column for the fathom equivalent of that feet value. If fathoms to feet look in the left hand "Feet" column for the feet equivalent of that fathom value. For example, 10 Units read as feet will equal 1.67 fathoms and 10 Units read as fathoms will equal 60.00 feet.

Feet	Units	Fathoms	Feet	Units	Fathoms	Feet	Units	Fathoms
6.00	1	0.17	246.00	41	6.83	486.00	81	13.50
12.00	2	0.33	252.00	42	7.00	492.00	82	13.67
18.00	3	0.50	258.00	43	7.17	498.00	83	13.83
24.00	4	0.67	264.00	44	7.33	504.00	84	14.00
30.00	5	0.83	270.00	45	7.50	510.00	85	14.17
36.00	6	1.00	276.00	46	7.67	516.00	86	14.33
42.00	7	1.17	282.00	47	7.83	522.00	87	14.50
48.00	8	1.33	288.00	48	8.00	528.00	88	14.67
54.00	9	1.50	294.00	49	8.17	534.00	89	14.83
60.00	**10**	**1.67**	**300.00**	**50**	**8.33**	**540.00**	**90**	**15.00**
66.00	11	1.83	306.00	51	8.50	546.00	91	15.17
72.00	12	2.00	312.00	52	8.67	552.00	92	15.33
78.00	13	2.17	318.00	53	8.83	558.00	93	15.50
84.00	14	2.33	324.00	54	9.00	564.00	94	15.67
90.00	15	2.50	330.00	55	9.17	570.00	95	15.83
96.00	16	2.67	336.00	56	9.33	576.00	96	16.00
102.00	17	2.83	342.00	57	9.50	582.00	97	16.17
108.00	18	3.00	348.00	58	9.67	588.00	98	16.33
114.00	19	3.17	354.00	59	9.83	594.00	99	16.50
120.00	**20**	**3.33**	**360.00**	**60**	**10.00**	**600.00**	**100**	**16.67**
126.00	21	3.50	366.00	61	10.17	606.00	101	16.83
132.00	22	3.67	372.00	62	10.33	612.00	102	17.00
138.00	23	3.83	378.00	63	10.50	618.00	103	17.17
144.00	24	4.00	384.00	64	10.67	624.00	104	17.33
150.00	25	4.17	390.00	65	10.83	630.00	105	17.50
156.00	26	4.33	396.00	66	11.00	636.00	106	17.67
162.00	27	4.50	402.00	67	11.17	642.00	107	17.83
168.00	28	4.67	408.00	68	11.33	648.00	108	18.00
174.00	29	4.83	414.00	69	11.50	654.00	109	18.17
180.00	**30**	**5.00**	**420.00**	**70**	**11.67**	**660.00**	**110**	**18.33**
186.00	31	5.17	426.00	71	11.83	666.00	111	18.50
192.00	32	5.33	432.00	72	12.00	672.00	112	18.67
198.00	33	5.50	438.00	73	12.17	678.00	113	18.83
204.00	34	5.67	444.00	74	12.33	684.00	114	19.00
210.00	35	5.83	450.00	75	12.50	690.00	115	19.17
216.00	36	6.00	456.00	76	12.67	696.00	116	19.33
222.00	37	6.17	462.00	77	12.83	702.00	117	19.50
228.00	38	6.33	468.00	78	13.00	708.00	118	19.67
234.00	39	6.50	474.00	79	13.17	714.00	119	19.83
240.00	**40**	**6.67**	**480.00**	**80**	**13.33**	**720.00**	**120**	**20.00**

Table 3. Conversions for feet to fathoms. Continued...

726.00	121	20.17	1026.00	171	28.50	1326.00	221	36.83
732.00	122	20.33	1032.00	172	28.67	1332.00	222	37.00
738.00	123	20.50	1038.00	173	28.83	1338.00	223	37.17
744.00	124	20.67	1044.00	174	29.00	1344.00	224	37.33
750.00	125	20.83	1050.00	175	29.17	1350.00	225	37.50
756.00	126	21.00	1056.00	176	29.33	1356.00	226	37.67
762.00	127	21.17	1062.00	177	29.50	1362.00	227	37.83
768.00	128	21.33	1068.00	178	29.67	1368.00	228	38.00
774.00	129	21.50	1074.00	179	29.83	1374.00	229	38.17
780.00	**130**	**21.67**	**1080.00**	**180**	**30.00**	**1380.00**	**230**	**38.33**
786.00	131	21.83	1086.00	181	30.17	1386.00	231	38.50
792.00	132	22.00	1092.00	182	30.33	1392.00	232	38.67
798.00	133	22.17	1098.00	183	30.50	1398.00	233	38.83
804.00	134	22.33	1104.00	184	30.67	1404.00	234	39.00
810.00	135	22.50	1110.00	185	30.83	1410.00	235	39.17
816.00	136	22.67	1116.00	186	31.00	1416.00	236	39.33
822.00	137	22.83	1122.00	187	31.17	1422.00	237	39.50
828.00	138	23.00	1128.00	188	31.33	1428.00	238	39.67
834.00	139	23.17	1134.00	189	31.50	1434.00	239	39.83
840.00	**140**	**23.33**	**1140.00**	**190**	**31.67**	**1440.00**	**240**	**40.00**
846.00	141	23.50	1146.00	191	31.83	1446.00	241	40.17
852.00	142	23.67	1152.00	192	32.00	1452.00	242	40.33
858.00	143	23.83	1158.00	193	32.17	1458.00	243	40.50
864.00	144	24.00	1164.00	194	32.33	1464.00	244	40.67
870.00	145	24.17	1170.00	195	32.50	1470.00	245	40.83
876.00	146	24.33	1176.00	196	32.67	1476.00	246	41.00
882.00	147	24.50	1182.00	197	32.83	1482.00	247	41.17
888.00	148	24.67	1188.00	198	33.00	1488.00	248	41.33
894.00	149	24.83	1194.00	199	33.17	1494.00	249	41.50
900.00	**150**	**25.00**	**1200.00**	**200**	**33.33**	**1500.00**	**250**	**41.67**
906.00	151	25.17	1206.00	201	33.50			
912.00	152	25.33	1212.00	202	33.67			
918.00	153	25.50	1218.00	203	33.83			
924.00	154	25.67	1224.00	204	34.00			
930.00	155	25.83	1230.00	205	34.17			
936.00	156	26.00	1236.00	206	34.33			
942.00	157	26.17	1242.00	207	34.50			
948.00	158	26.33	1248.00	208	34.67			
954.00	159	26.50	1254.00	209	34.83			
960.00	**160**	**26.67**	**1260.00**	**210**	**35.00**			
966.00	161	26.83	1266.00	211	35.17			
972.00	162	27.00	1272.00	212	35.33			
978.00	163	27.17	1278.00	213	35.50			
984.00	164	27.33	1284.00	214	35.67			
990.00	165	27.50	1290.00	215	35.83			
996.00	166	27.67	1296.00	216	36.00			
1002.00	167	27.83	1302.00	217	36.17			
1008.00	168	28.00	1308.00	218	36.33			
1014.00	169	28.17	1314.00	219	36.50			
1020.00	**170**	**28.33**	**1320.00**	**220**	**36.67**			

Table 4. Temperature conversion table. The numbers in the Unit column between those marked C and F refer to the temperature in either Centigrade or Fahrenheit when it is desired to convert into the other scale. If converting from Fahrenheit to Centigrade find the equivalent temperature in the left hand column marked C and in like manner find equivalent temperature in the right hand column when converting from Centigrade to Fahrenheit.

°C	Unit	°F	°C	Unit	°F	°C	Unit	°F	°C	Unit	°F
-20.0	-4	24.8	-0.6	31	87.8	16.1	61	141.8	32.8	91	195.8
-19.4	-3	26.6	0.0	32	89.6	16.7	62	143.6	33.3	92	197.6
-13.9	-2	28.4	0.6	33	91.4	17.2	63	145.4	33.9	93	199.4
-18.3	-1	30.2	1.1	34	93.2	17.8	64	147.2	34.4	94	201.2
-17.8	0	32.0	1.7	35	95.0	18.3	65	149.0	35.0	95	203.0
			2.2	36	95.8	18.9	66	150.8	35.6	96	204.8
-17.2	1	33.8	2.8	37	98.6	19.4	67	152.6	36.1	97	206.6
-16.7	2	35.6	3.3	38	100.4	20.0	68	154.4	36.7	98	208.4
-16.1	3	37.4	3.9	39	102.2	20.6	69	156.2	37.2	99	210.2
-15.6	4	39.2	4.4	40	104.0	21.1	70	158.0	37.8	100	212.0
-15.0	5	41.0									
-14.4	6	42.8	5.0	41	105.8	21.7	71	159.8	38.3	101	213.8
-13.9	7	44.6	5.6	42	107.6	22.2	72	161.6	38.9	102	215.6
-13.3	8	46.4	6.1	43	109.4	22.8	73	163.4	39.4	103	217.4
-12.8	9	48.2	6.7	44	111.2	23.3	74	165.2	40.0	104	219.2
-12.2	10	50.0	7.2	45	113.0	23.9	75	167.0	40.6	105	221.0
			7.8	46	114.8	24.4	76	168.8	41.1	106	222.8
-11.7	11	51.8	8.3	47	116.6	25.0	77	170.6	41.7	107	224.6
-11.1	12	53.6	8.9	48	118.4	25.6	78	172.4	42.2	108	226.4
-10.6	13	55.4	9.4	49	120.2	26.1	79	174.2	42.8	109	228.2
-10.0	14	57.2	10.0	50	122.0	26.7	80	176.0	43.3	110	230.0
-9.4	15	59.0									
-8.9	16	60.8	10.6	51	123.8	27.2	81	177.8			
-8.3	17	62.6	11.1	52	125.6	27.8	82	179.6			
-7.8	18	64.4	11.7	53	127.4	28.3	83	181.4			
-7.2	19	66.2	12.2	54	129.2	28.9	84	183.2			
-6.7	20	68.0	12.8	55	131.0	29.4	85	185.0			
			13.3	56	132.8	30.0	86	186.8			
-6.1	21	69.8	13.9	57	134.6	30.6	87	188.6			
-5.0	23	73.4	14.4	58	136.4	31.1	88	190.4			
-4.4	24	75.2	15.0	59	138.2	31.7	89	192.2			
-3.9	25	77.0	15.6	60	140.0	32.2	90	194.0			
-3.3	26	78.8									
-2.8	27	80.6									
-2.2	28	82.4									
-1.7	29	84.2									
-1.1	30	86.0									

Table 5. Refractometer Conversion of Brix to Salinity.

Brix	Salinity (PPT)	Brix	Salinity (PPT)
2.5	18.8	3.8	28.8
2.6	19.6	**3.9**	**29.4**
2.7	20.4	4.0	30.2
2.8	21.2	4.1	31.0
2.9	**22.0**	4.2	31.8
3.0	22.7	4.3	32.5
3.1	23.5	**4.4**	**33.3**
3.2	24.2	4.5	34.2
3.3	25.0	4.6	35.0
3.4	**25.8**	4.7	35.5
3.5	26.4	4.8	36.3
3.6	27.2	**4.9**	**37.2**
3.7	28.0	5.0	38.0

Table 6. Solubility of Oxygen in Fresh Water.

Temperature °C	Dissolved Oxygen PPM	Temperature °C	Dissolved Oxygen PPM
0	14.6	23	8.7
1	14.2	24	8.5
2	13.9	**25**	**8.4**
3	13.5	26	8.2
4	13.2	27	8.1
5	**12.8**	28	7.9
6	12.5	29	7.8
7	12.2	**30**	**7.7**
8	11.9	31	7.5
9	11.6	32	7.4
10	**11.3**	33	7.3
11	11.1	34	7.2
12	10.8	**35**	**7.1**
13	10.6	36	7.0
14	10.4	37	6.8
15	**10.2**	38	6.7
16	9.9	39	6.6
17	9.7	**40**	**6.5**
18	9.5	41	6.4
19	9.3	42	6.3
20	**9.2**	43	6.2
21	9.0	44	6.1
22	8.8	**45**	**6.0**

Table 7. Dissolved Oxygen Saturation Values (MG/L) in Sea Water

Chlorinity	0	0	10	15	16	17	18	19	20
Salinity	0	9.06	18.08	27.11	28.91	30.72	32.52	34.33	36.11
Temperature °C									
0	14.6	13.8	13.0	12.1	11.9	11.8	11.6	11.4	11.3
1	14.2	13.4	12.6	11.8	11.6	11.5	11.3	11.1	11.0
2	13.8	13.1	12.3	11.5	11.3	11.2	11.1	10.9	10.8
3	13.5	12.7	12.0	11.2	11.1	10.8	10.7	10.6	10.5
4	13.1	12.4	11.7	11.0	10.8	10.6	10.5	10.4	10.3
5	**12.8**	**12.1**	**11.4**	**10.7**	**10.6**	**10.4**	**10.3**	**10.1**	**10.0**
6	12.5	11.8	11.1	10.5	10.4	10.2	10.1	9.9	9.8
7	12.2	11.5	10.9	10.2	10.2	10.0	9.9	9.7	9.6
8	11.9	11.2	10.6	10.0	10.0	9.8	9.7	9.5	9.4
9	11.6	11.0	10.4	9.8	9.7	9.6	9.5	9.3	9.2
10	**11.3**	**10.7**	**10.1**	**9.6**	**9.5**	**9.4**	**9.2**	**9.1**	**9.0**
11	11.1	10.5	9.9	9.4	9.3	9.2	9.0	8.8	8.8
12	10.8	10.3	9.7	9.2	9.1	9.0	8.8	8.6	8.6
13	10.6	10.1	9.5	9.0	8.8	8.7	8.6	8.5	8.5
14	10.4	9.9	9.3	8.8	8.6	8.5	8.5	8.3	8.3
15	**10.2**	**9.7**	**9.1**	**8.6**	**8.5**	**8.4**	**8.3**	**8.2**	**8.1**
16	10.0	9.5	9.0	8.5	8.3	8.3	8.2	8.1	8.0
17	9.7	9.3	8.8	8.3	8.1	8.1	8.0	7.9	7.8
18	9.5	9.1	8.6	8.2	8.0	8.0	7.9	7.8	7.7
19	9.4	8.9	8.5	8.0	7.9	7.8	7.7	7.6	7.6
20	**9.2**	**8.7**	**8.3**	**7.9**	**7.8**	**7.7**	**7.6**	**7.5**	**7.4**
21	9.0	8.6	8.1	7.7	7.7	7.6	7.4	7.4	7.3
22	8.8	8.4	8.0	7.6	7.5	7.4	7.3	7.2	7.1
23	8.7	8.3	7.9	7.4	7.4	7.3	7.2	7.1	7.0
24	8.5	8.1	7.7	7.3	7.3	7.1	7.0	6.9	6.9
25	**8.4**	**8.0**	**7.6**	**7.2**	**7.1**	**7.0**	**6.9**	**6.8**	**6.7**
26	8.2	7.8	7.4	7.0	7.0	6.9	6.8	6.7	6.6
27	8.1	7.7	7.3	6.9	6.8	6.8	6.7	6.6	6.5
28	7.9	7.5	7.1	6.8	6.6	6.6	6.5	6.4	6.4
29	7.8	7.4	7.0	6.6	6.5	6.5	6.4	6.3	6.3
30	**7.6**	**7.3**	**6.9**	**6.5**	**6.4**	**6.3**	**6.3**	**6.2**	**6.1**

Supersaturation may be 30% greater

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°.

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
1	1.15	1.22	1.31	**1.41**	1.56	1.74	2.00
2	2.31	2.44	2.61	**2.83**	3.11	3.49	4.00
3	3.46	3.66	3.92	**4.24**	4.67	5.23	6.00
4	4.62	4.88	5.22	**5.66**	6.22	6.97	8.00
5	**5.77**	**6.10**	**6.53**	**7.07**	**7.78**	**8.72**	**10.00**
6	6.93	7.32	7.83	**8.49**	9.33	10.46	12.00
7	8.08	8.55	9.14	**9.90**	10.89	12.20	14.00
8	9.24	9.77	10.44	**11.31**	12.45	13.95	16.00
9	10.39	10.99	11.75	**12.73**	14.00	15.69	18.00
10	**11.55**	**12.21**	**13.05**	**14.14**	**15.56**	**17.43**	**20.00**
11	12.70	13.43	14.36	**15.56**	17.11	19.18	22.00
12	13.86	14.65	15.66	**16.97**	18.67	20.92	24.00
13	15.01	15.87	16.97	**18.38**	20.22	22.66	26.00
14	16.17	17.09	18.28	**19.80**	21.78	24.41	28.00
15	**17.32**	**18.31**	**19.58**	**21.21**	**23.34**	**26.15**	**30.00**
16	18.48	19.53	20.89	**22.63**	24.89	27.90	32.00
17	19.63	20.75	22.19	**24.04**	26.45	29.64	34.00
18	20.78	21.97	23.50	**25.46**	28.00	31.38	36.00
19	21.94	23.19	24.80	**26.87**	29.56	33.13	38.00
20	**23.09**	**24.42**	**26.11**	**28.28**	**31.11**	**34.87**	**40.00**
21	24.25	25.64	27.41	**29.70**	32.67	36.61	42.00
22	25.40	26.86	28.72	**31.11**	34.23	38.36	44.00
23	26.56	28.08	30.02	**32.53**	35.78	40.10	46.00
24	27.71	29.30	31.33	**33.94**	37.34	41.84	48.00
25	**28.87**	**30.52**	**32.64**	**35.36**	**38.89**	**43.59**	**50.00**
26	30.02	31.74	33.94	**36.77**	40.45	45.33	52.00
27	31.18	32.96	35.25	**38.18**	42.00	47.07	54.00
28	32.33	34.18	36.55	**39.60**	43.56	48.82	56.00
29	33.49	35.40	37.86	**41.01**	45.12	50.56	58.00
30	**34.64**	**36.62**	**39.16**	**42.43**	**46.67**	**52.30**	**60.00**
31	35.80	37.84	40.47	**43.84**	48.23	54.05	62.00
32	36.95	39.06	41.77	**45.25**	49.78	55.79	64.00
33	38.11	40.29	43.08	**46.67**	51.34	57.53	66.00
34	39.26	41.51	44.38	**48.08**	52.89	59.28	68.00
35	**40.41**	**42.73**	**45.69**	**49.50**	**54.45**	**61.02**	**70.00**
36	41.57	43.95	46.99	**50.91**	56.01	62.76	72.00
37	42.72	45.17	48.30	**52.33**	57.56	64.51	74.00
38	43.88	46.39	49.61	**53.74**	59.12	66.25	76.00
39	45.03	47.61	50.91	**55.15**	60.67	67.99	78.00
40	**46.19**	**48.83**	**52.22**	**56.57**	**62.23**	**69.74**	**80.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
41	47.34	50.05	53.52	**57.98**	63.78	71.48	82.00
42	48.50	51.27	54.83	**59.40**	65.34	73.22	84.00
43	49.65	52.49	56.13	**60.81**	66.90	74.97	86.00
44	50.81	53.71	57.44	**62.23**	68.45	76.71	88.00
45	**51.96**	**54.93**	**58.74**	**63.64**	**70.01**	**78.46**	**90.00**
46	53.12	56.16	60.05	**65.05**	71.56	80.20	92.00
47	54.27	57.38	61.35	**66.47**	73.12	81.94	94.00
48	55.43	58.60	62.66	**67.88**	74.67	83.69	96.00
49	56.58	59.82	63.96	**69.30**	76.23	85.43	98.00
50	**57.74**	**61.04**	**65.27**	**70.71**	**77.79**	**87.17**	**100.00**
51	58.89	62.26	66.58	**72.12**	79.34	88.92	102.00
52	60.04	63.48	67.88	**73.54**	80.90	90.66	104.00
53	61.20	64.70	69.19	**74.95**	82.45	92.40	106.00
54	62.35	65.92	70.49	**76.37**	84.01	94.15	108.00
55	**63.51**	**67.14**	**71.80**	**77.78**	**85.56**	**95.89**	**110.00**
56	64.66	68.36	73.10	**79.20**	87.12	97.63	112.00
57	65.82	69.58	74.41	**80.61**	88.68	99.38	114.00
58	66.97	70.80	75.71	**82.02**	90.23	101.12	116.00
59	68.13	72.03	77.02	**83.44**	91.79	102.86	118.00
60	**69.28**	**73.25**	**78.32**	**84.85**	**93.34**	**104.61**	**120.00**
61	70.44	74.47	79.63	**86.27**	94.90	106.35	122.00
62	71.59	75.69	80.94	**87.68**	96.45	108.09	124.00
63	72.75	76.91	82.24	**89.10**	98.01	109.84	126.00
64	73.90	78.13	83.55	**90.51**	99.57	111.58	128.00
65	**75.06**	**79.35**	**84.85**	**91.92**	**101.12**	**113.32**	**130.00**
66	76.21	80.57	86.16	**93.34**	102.68	115.07	132.00
67	77.36	81.79	87.46	**94.75**	104.23	116.81	134.00
68	78.52	83.01	88.77	**96.17**	105.79	118.55	136.00
69	79.67	84.23	90.07	**97.58**	107.34	120.30	138.00
70	**80.83**	**85.45**	**91.38**	**98.99**	**108.90**	**122.04**	**140.00**
71	81.98	86.67	92.68	**100.41**	110.46	123.78	142.00
72	83.14	87.90	93.99	**101.82**	112.01	125.53	144.00
73	84.29	89.12	95.29	**103.24**	113.57	127.27	146.00
74	85.45	90.34	96.60	**104.65**	115.12	129.02	148.00
75	**86.60**	**91.56**	**97.91**	**106.07**	**116.68**	**130.76**	**150.00**
76	87.76	92.78	99.21	**107.48**	118.24	132.50	152.00
77	88.91	94.00	100.52	**108.89**	119.79	134.25	154.00
78	90.07	95.22	101.82	**110.31**	121.35	135.99	156.00
79	91.22	96.44	103.13	111.72	122.90	137.73	158.00
80	**92.38**	**97.66**	**104.43**	**113.14**	**124.46**	**139.48**	**160.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
81	93.53	98.88	105.74	**114.55**	126.01	141.22	162.00
82	94.69	100.10	107.04	**115.97**	127.57	142.96	164.00
83	95.84	101.32	108.35	**117.38**	129.13	144.71	166.00
84	96.99	102.55	109.65	**118.79**	130.68	146.45	168.00
85	**98.15**	**103.77**	**110.96**	**120.21**	**132.24**	**148.19**	**170.00**
86	99.30	104.99	112.27	**121.62**	133.79	149.94	172.00
87	100.46	106.21	113.57	**123.04**	135.35	151.68	174.00
88	101.61	107.43	114.88	**124.45**	136.90	153.42	176.00
89	102.77	108.65	116.18	**125.87**	138.46	155.17	178.00
90	**103.92**	**109.87**	**117.49**	**127.28**	**140.02**	**156.91**	**180.00**
91	105.08	111.09	118.79	**128.69**	141.57	158.65	182.00
92	106.23	112.31	120.10	**130.11**	143.13	160.40	184.00
93	107.39	113.53	121.40	**131.52**	144.68	162.14	186.00
94	108.54	114.75	122.71	**132.94**	146.24	163.88	188.00
95	**109.70**	**115.97**	**124.01**	**134.35**	**147.79**	**165.63**	**190.00**
96	110.85	117.19	125.32	**135.76**	149.35	167.37	192.00
97	112.01	118.42	126.62	**137.18**	150.91	169.11	194.00
98	113.16	119.64	127.93	**138.59**	152.46	170.86	196.00
99	114.32	120.86	129.24	**140.01**	154.02	172.60	198.00
100	**115.47**	**122.08**	**130.54**	**141.42**	**155.57**	**174.34**	**200.00**
101	116.62	123.30	131.85	**142.84**	157.13	176.09	202.00
102	117.78	124.52	133.15	**144.25**	158.68	177.83	204.00
103	118.93	125.74	134.46	**145.66**	160.24	179.58	206.00
104	120.09	126.96	135.76	**147.08**	161.80	181.32	208.00
105	**121.24**	**128.18**	**137.07**	**148.49**	**163.35**	**183.06**	**210.00**
106	122.40	129.40	138.37	**149.91**	164.91	184.81	212.00
107	123.55	130.62	139.68	**151.32**	166.46	186.55	214.00
108	124.71	131.84	140.98	**152.74**	168.02	188.29	216.00
109	125.86	133.06	142.29	**154.15**	169.57	190.04	218.00
110	**127.02**	**134.29**	**143.59**	**155.56**	**171.13**	**191.78**	**220.00**
111	128.17	135.51	144.90	**156.98**	172.69	193.52	222.00
112	129.33	136.73	146.21	**158.39**	174.24	195.27	224.00
113	130.48	137.95	147.51	**159.81**	175.80	197.01	226.00
114	131.64	139.17	148.82	**161.22**	177.35	198.75	228.00
115	**132.79**	**140.39**	**150.12**	**162.63**	**178.91**	**200.50**	**230.00**
116	133.95	141.61	151.43	**164.05**	180.46	202.24	232.00
117	135.10	142.83	152.73	**165.46**	182.02	203.98	234.00
118	136.25	144.05	154.04	**166.88**	183.58	205.73	236.00
119	137.41	145.27	155.34	**168.29**	185.13	207.47	238.00
120	**138.56**	**146.49**	**156.65**	**169.71**	**186.69**	**209.21**	**240.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
121	139.72	147.71	157.95	**171.12**	188.24	210.96	242.00
122	140.87	148.93	159.26	**172.53**	189.80	212.70	244.00
123	142.03	150.16	160.57	**173.95**	191.35	214.44	246.00
124	143.18	151.38	161.87	**175.36**	192.91	216.19	248.00
125	**144.34**	**152.60**	**163.18**	**176.78**	**194.47**	**217.93**	**250.00**
126	145.49	153.82	164.48	**178.19**	196.02	219.67	252.00
127	146.65	155.04	165.79	**179.61**	197.58	221.42	254.00
128	147.80	156.26	167.09	**181.02**	199.13	223.16	256.00
129	148.96	157.48	168.40	**182.43**	200.69	224.90	258.00
130	**150.11**	**158.70**	**169.70**	**183.85**	**202.24**	**226.65**	**260.00**
131	151.27	159.92	171.01	**185.26**	203.80	228.39	262.00
132	152.42	161.14	172.31	**186.68**	205.36	230.13	264.00
133	153.58	162.36	173.62	**188.09**	206.91	231.88	266.00
134	154.73	163.58	174.92	**189.50**	208.47	233.62	268.00
135	**155.88**	**164.80**	**176.23**	**190.92**	**210.02**	**235.37**	**270.00**
136	157.04	166.03	177.54	**192.33**	211.58	237.11	272.00
137	158.19	167.25	178.84	**193.75**	213.13	238.85	274.00
138	159.35	168.47	180.15	**195.16**	214.69	240.60	276.00
139	160.50	169.69	181.45	**196.58**	216.25	242.34	278.00
140	**161.66**	**170.91**	**182.76**	**197.99**	**217.80**	**244.08**	**280.00**
141	162.81	172.13	184.06	**199.40**	219.36	245.83	282.00
142	163.97	173.35	185.37	**200.82**	220.91	247.57	284.00
143	165.12	174.57	186.67	**202.23**	222.47	249.31	286.00
144	166.28	175.79	187.98	**203.65**	224.02	251.06	288.00
145	**167.43**	**177.01**	**189.28**	**205.06**	**225.58**	**252.80**	**290.00**
146	168.59	178.23	190.59	**206.48**	227.14	254.54	292.00
147	169.74	179.45	191.89	**207.89**	228.69	256.29	294.00
148	170.90	180.67	193.20	**209.30**	230.25	258.03	296.00
149	172.05	181.90	194.51	**210.72**	231.80	259.77	298.00
150	**173.21**	**183.12**	**195.81**	**212.13**	**233.36**	**261.52**	**300.00**
151	174.36	184.34	197.12	**213.55**	234.91	263.26	302.00
152	175.51	185.56	198.42	**214.96**	236.47	265.00	304.00
153	176.67	186.78	199.73	**216.37**	238.03	266.75	306.00
154	177.82	188.00	201.03	**217.79**	239.58	268.49	308.00
155	**178.98**	**189.22**	**202.34**	**219.20**	**241.14**	**270.23**	**310.00**
156	180.13	190.44	203.64	**220.62**	242.69	271.98	312.00
157	181.29	191.66	204.95	**222.03**	244.25	273.72	314.00
158	182.44	192.88	206.25	**223.45**	245.80	275.46	316.00
159	183.60	194.10	207.56	**224.86**	247.36	277.21	318.00
160	**184.75**	**195.32**	**208.87**	**226.27**	**248.92**	**278.95**	**320.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
161	185.91	196.54	210.17	**227.69**	250.47	280.69	322.00
162	187.06	197.77	211.48	**229.10**	252.03	282.44	324.00
163	188.22	198.99	212.78	**230.52**	253.58	284.18	326.00
164	189.37	200.21	214.09	**231.93**	255.14	285.93	328.00
165	**190.53**	**201.43**	**215.39**	**233.35**	**256.69**	**287.67**	**330.00**
166	191.68	202.65	216.70	**234.76**	258.25	289.41	332.00
167	192.83	203.87	218.00	**236.17**	259.81	291.16	334.00
168	193.99	205.09	219.31	**237.59**	261.36	292.90	336.00
169	195.14	206.31	220.61	**239.00**	262.92	294.64	338.00
170	**196.30**	**207.53**	**221.92**	**240.42**	**264.47**	**296.39**	**340.00**
171	197.45	208.75	223.22	**241.83**	266.03	298.13	342.00
172	198.61	209.97	224.53	**243.24**	267.58	299.87	344.00
173	199.76	211.19	225.84	**244.66**	269.14	301.62	346.00
174	200.92	212.41	227.14	**246.07**	270.70	303.36	348.00
175	**202.07**	**213.64**	**228.45**	**247.49**	**272.25**	**305.10**	**350.00**
176	203.23	214.86	229.75	**248.90**	273.81	306.85	352.00
177	204.38	216.08	231.06	**250.32**	275.36	308.59	354.00
178	205.54	217.30	232.36	**251.73**	276.92	310.33	356.00
179	206.69	218.52	233.67	**253.14**	278.47	312.08	358.00
180	**207.85**	**219.74**	**234.97**	**254.56**	**280.03**	**313.82**	**360.00**
181	209.00	220.96	236.28	**255.97**	281.59	315.56	362.00
182	210.16	222.18	237.58	**257.39**	283.14	317.31	364.00
183	211.31	223.40	238.89	**258.80**	284.70	319.05	366.00
184	212.46	224.62	240.19	**260.22**	286.25	320.79	368.00
185	**213.62**	**225.84**	**241.50**	**261.63**	**287.81**	**322.54**	**370.00**
186	214.77	227.06	242.81	**263.04**	289.36	324.28	372.00
187	215.93	228.28	244.11	**264.46**	290.92	326.02	374.00
188	217.08	229.51	245.42	**265.87**	292.48	327.77	376.00
189	218.24	230.73	246.72	**267.29**	294.03	329.51	378.00
190	**219.39**	**231.95**	**248.03**	**268.70**	**295.59**	**331.25**	**380.00**
191	220.55	233.17	249.33	**270.11**	297.14	333.00	382.00
192	221.70	234.39	250.64	**271.53**	298.70	334.74	384.00
193	222.86	235.61	251.94	**272.94**	300.25	336.49	386.00
194	224.01	236.83	253.25	**274.36**	301.81	338.23	388.00
195	**225.17**	**238.05**	**254.55**	**275.77**	**303.37**	**339.97**	**390.00**
196	226.32	239.27	255.86	**277.19**	304.92	341.72	392.00
197	227.48	240.49	257.17	**278.60**	306.48	343.46	394.00
198	228.63	241.71	258.47	**280.01**	308.03	345.20	396.00
199	229.79	242.93	259.78	**281.43**	309.59	346.95	398.00
200	**230.94**	**244.15**	**261.08**	**282.84**	**311.14**	**348.69**	**400.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
201	232.09	245.38	262.39	**284.26**	312.70	350.43	402.00
202	233.25	246.60	263.69	**285.67**	314.26	352.18	404.00
203	234.40	247.82	265.00	**287.09**	315.81	353.92	406.00
204	235.56	249.04	266.30	**288.50**	317.37	355.66	408.00
205	**236.71**	**250.26**	**267.61**	**289.91**	**318.92**	**357.41**	**410.00**
206	237.87	251.48	268.91	**291.33**	320.48	359.15	412.00
207	239.02	252.70	270.22	**292.74**	322.03	360.89	414.00
208	240.18	253.92	271.52	**294.16**	323.59	362.64	416.00
209	241.33	255.14	272.83	**295.57**	325.15	364.38	418.00
210	**242.49**	**256.36**	**274.14**	**296.98**	**326.70**	**366.12**	**420.00**
211	243.64	257.58	275.44	**298.40**	328.26	367.87	422.00
212	244.80	258.80	276.75	**299.81**	329.81	369.61	424.00
213	245.95	260.02	278.05	**301.23**	331.37	371.35	426.00
214	247.11	261.25	279.36	**302.64**	332.92	373.10	428.00
215	**248.26**	**262.47**	**280.66**	**304.06**	**334.48**	**374.84**	**430.00**
216	249.42	263.69	281.97	**305.47**	336.04	376.58	432.00
217	250.57	264.91	283.27	**306.88**	337.59	378.33	434.00
218	251.72	266.13	284.58	**308.30**	339.15	380.07	436.00
219	252.88	267.35	285.88	**309.71**	340.70	381.81	438.00
220	**254.03**	**268.57**	**287.19**	**311.13**	**342.26**	**383.56**	**440.00**
221	255.19	269.79	288.50	**312.54**	343.81	385.30	442.00
222	256.34	271.01	289.80	**313.96**	345.37	387.05	444.00
223	257.50	272.23	291.11	**315.37**	346.93	388.79	446.00
224	258.65	273.45	292.41	**316.78**	348.48	390.53	448.00
225	**259.81**	**274.67**	**293.72**	**318.20**	**350.04**	**392.28**	**450.00**
226	260.96	275.90	295.02	**319.61**	351.59	394.02	452.00
227	262.12	277.12	296.33	**321.03**	353.15	395.76	454.00
228	263.27	278.34	297.63	**322.44**	354.71	397.51	456.00
229	264.43	279.56	298.94	**323.85**	356.26	399.25	458.00
230	**265.58**	**280.78**	**300.24**	**325.27**	**357.82**	**400.99**	**460.00**
231	266.74	282.00	301.55	**326.68**	359.37	402.74	462.00
232	267.89	283.22	302.85	**328.10**	360.93	404.48	464.00
233	269.05	284.44	304.16	**329.51**	362.48	406.22	466.00
234	270.20	285.66	305.47	**330.93**	364.04	407.97	468.00
235	271.35	286.88	306.77	**332.34**	365.60	409.71	470.00
236	272.51	288.10	308.08	**333.75**	367.15	411.45	472.00
237	273.66	289.32	309.38	**335.17**	368.71	413.20	474.00
238	274.82	290.54	310.69	**336.58**	370.26	414.94	476.00
239	275.97	291.77	311.99	**338.00**	371.82	416.68	478.00
240	**277.13**	**292.99**	**313.30**	**339.41**	**373.37**	**418.43**	**480.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
241	278.28	294.21	314.60	**340.83**	374.93	420.17	482.00
242	279.44	295.43	315.91	**342.24**	376.49	421.91	484.00
243	280.59	296.65	317.21	**343.65**	378.04	423.66	486.00
244	281.75	297.87	318.52	**345.07**	379.60	425.40	488.00
245	**282.90**	**299.09**	**319.82**	**346.48**	**381.15**	**427.14**	**490.00**
246	284.06	300.31	321.13	**347.90**	382.71	428.89	492.00
247	285.21	301.53	322.44	**349.31**	384.26	430.63	494.00
248	286.37	302.75	323.74	**350.72**	385.82	432.37	496.00
249	287.52	303.97	325.05	**352.14**	387.38	434.12	498.00
250	**288.68**	**305.19**	**326.35**	**353.55**	**388.93**	**435.86**	**500.00**
251	289.83	306.41	327.66	**354.97**	390.49	437.61	502.00
252	290.98	307.64	328.96	**356.38**	392.04	439.35	504.00
253	292.14	308.86	330.27	**357.80**	393.60	441.09	506.00
254	293.29	310.08	331.57	**359.21**	395.15	442.84	508.00
255	**294.45**	**311.30**	**332.88**	**360.62**	**396.71**	**444.58**	**510.00**
256	295.60	312.52	334.18	**362.04**	398.27	446.32	512.00
257	296.76	313.74	335.49	**363.45**	399.82	448.07	514.00
258	297.91	314.96	336.80	**364.87**	401.38	449.81	516.00
259	299.07	316.18	338.10	**366.28**	402.93	451.55	518.00
260	**300.22**	**317.40**	**339.41**	**367.70**	**404.49**	**453.30**	**520.00**
261	301.38	318.62	340.71	**369.11**	406.04	455.04	522.00
262	302.53	319.84	342.02	**370.52**	407.60	456.78	524.00
263	303.69	321.06	343.32	**371.94**	409.16	458.53	526.00
264	304.84	322.28	344.63	**373.35**	410.71	460.27	528.00
265	**306.00**	**323.51**	**345.93**	**374.77**	**412.27**	**462.01**	**530.00**
266	307.15	324.73	347.24	**376.18**	413.82	463.76	532.00
267	308.31	325.95	348.54	**377.60**	415.38	465.50	534.00
268	309.46	327.17	349.85	**379.01**	416.93	467.24	536.00
269	310.61	328.39	351.15	**380.42**	418.49	468.99	538.00
270	**311.77**	**329.61**	**352.46**	**381.84**	**420.05**	**470.73**	**540.00**
271	312.92	330.83	353.77	**383.25**	421.60	472.47	542.00
272	314.08	332.05	355.07	**384.67**	423.16	474.22	544.00
273	315.23	333.27	356.38	**386.08**	424.71	475.96	546.00
274	316.39	334.49	357.68	**387.49**	426.27	477.70	548.00
275	**317.54**	**335.71**	**358.99**	**388.91**	**427.82**	**479.45**	**550.00**
276	318.70	336.93	360.29	**390.32**	429.38	481.19	552.00
277	319.85	338.15	361.60	**391.74**	430.94	482.93	554.00
278	321.01	339.38	362.90	**393.15**	432.49	484.68	556.00
279	322.16	340.60	364.21	**394.57**	434.05	486.42	558.00
280	**323.32**	**341.82**	**365.51**	**395.98**	**435.60**	**488.17**	**560.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
281	324.47	343.04	366.82	**397.39**	437.16	489.91	562.00
282	325.63	344.26	368.12	**398.81**	438.71	491.65	564.00
283	326.78	345.48	369.43	**400.22**	440.27	493.40	566.00
284	327.93	346.70	370.74	**401.64**	441.83	495.14	568.00
285	**329.09**	**347.92**	**372.04**	**403.05**	**443.38**	**496.88**	**570.00**
286	330.24	349.14	373.35	**404.47**	444.94	498.63	572.00
287	331.40	350.36	374.65	**405.88**	446.49	500.37	574.00
288	332.55	351.58	375.96	**407.29**	448.05	502.11	576.00
289	333.71	352.80	377.26	**408.71**	449.60	503.86	578.00
290	**334.86**	**354.02**	**378.57**	**410.12**	**451.16**	**505.60**	**580.00**
291	336.02	355.25	379.87	**411.54**	452.72	507.34	582.00
292	337.17	356.47	381.18	**412.95**	454.27	509.09	584.00
293	338.33	357.69	382.48	**414.36**	455.83	510.83	586.00
294	339.48	358.91	383.79	**415.78**	457.38	512.57	588.00
295	**340.64**	**360.13**	**385.10**	**417.19**	**458.94**	**514.32**	**590.00**
296	341.79	361.35	386.40	**418.61**	460.49	516.06	592.00
297	342.95	362.57	387.71	**420.02**	462.05	517.80	594.00
298	344.10	363.79	389.01	**421.44**	463.61	519.55	596.00
299	345.26	365.01	390.32	**422.85**	465.16	521.29	598.00
300	**346.41**	**366.23**	**391.62**	**424.26**	**466.72**	**523.03**	**600.00**
301	347.56	367.45	392.93	**425.68**	468.27	524.78	602.00
302	348.72	368.67	394.23	**427.09**	469.83	526.52	604.00
303	349.87	369.89	395.54	**428.51**	471.38	528.26	606.00
304	351.03	371.12	396.84	**429.92**	472.94	530.01	608.00
305	**352.18**	**372.34**	**398.15**	**431.34**	**474.50**	**531.75**	**610.00**
306	353.34	373.56	399.45	**432.75**	476.05	533.49	612.00
307	354.49	374.78	400.76	**434.16**	477.61	535.24	614.00
308	355.65	376.00	402.07	**435.58**	479.16	536.98	616.00
309	356.80	377.22	403.37	**436.99**	480.72	538.73	618.00
310	**357.96**	**378.44**	**404.68**	**438.41**	**482.27**	**540.47**	**620.00**
311	359.11	379.66	405.98	**439.82**	483.83	542.21	622.00
312	360.27	380.88	407.29	**441.23**	485.39	543.96	624.00
313	361.42	382.10	408.59	**442.65**	486.94	545.70	626.00
314	362.58	383.32	409.90	**444.06**	488.50	547.44	628.00
315	**363.73**	**384.54**	**411.20**	**445.48**	**490.05**	**549.19**	**630.00**
316	364.89	385.76	412.51	**446.89**	491.61	550.93	632.00
317	366.04	386.99	413.81	**448.31**	493.16	552.67	634.00
318	367.19	388.21	415.12	**449.72**	494.72	554.42	636.00
319	368.35	389.43	416.42	**451.13**	496.28	556.16	638.00
320	**369.50**	**390.65**	**417.73**	**452.55**	**497.83**	**557.90**	**640.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
321	370.66	391.87	419.04	**453.96**	499.39	559.65	642.00
322	371.81	393.09	420.34	**455.38**	500.94	561.39	644.00
323	372.97	394.31	421.65	**456.79**	502.50	563.13	646.00
324	374.12	395.53	422.95	**458.21**	504.05	564.88	648.00
325	**375.28**	**396.75**	**424.26**	**459.62**	**505.61**	**566.62**	**650.00**
326	376.43	397.97	425.56	**461.03**	507.17	568.36	652.00
327	377.59	399.19	426.87	**462.45**	508.72	570.11	654.00
328	378.74	400.41	428.17	**463.86**	510.28	571.85	656.00
329	379.90	401.63	429.48	**465.28**	511.83	573.59	658.00
330	**381.05**	**402.86**	**430.78**	**466.69**	**513.39**	**575.34**	**660.00**
331	382.21	404.08	432.09	**468.10**	514.94	577.08	662.00
332	383.36	405.30	433.40	**469.52**	516.50	578.82	664.00
333	384.52	406.52	434.70	**470.93**	518.06	580.57	666.00
334	385.67	407.74	436.01	**472.35**	519.61	582.31	668.00
335	**386.82**	**408.96**	**437.31**	**473.76**	**521.17**	**584.05**	**670.00**
336	387.98	410.18	438.62	**475.18**	522.72	585.80	672.00
337	389.13	411.40	439.92	**476.59**	524.28	587.54	674.00
338	390.29	412.62	441.23	**478.00**	525.83	589.29	676.00
339	391.44	413.84	442.53	**479.42**	527.39	591.03	678.00
340	**392.60**	**415.06**	**443.84**	**480.83**	**528.95**	**592.77**	**680.00**
341	393.75	416.28	445.14	**482.25**	530.50	594.52	682.00
342	394.91	417.50	446.45	**483.66**	532.06	596.26	684.00
343	396.06	418.73	447.75	**485.08**	533.61	598.00	686.00
344	397.22	419.95	449.06	**486.49**	535.17	599.75	688.00
345	**398.37**	**421.17**	**450.37**	**487.90**	**536.72**	**601.49**	**690.00**
346	399.53	422.39	451.67	**489.32**	538.28	603.23	692.00
347	400.68	423.61	452.98	**490.73**	539.84	604.98	694.00
348	401.84	424.83	454.28	**492.15**	541.39	606.72	696.00
349	402.99	426.05	455.59	**493.56**	542.95	608.46	698.00
350	**404.15**	**427.27**	**456.89**	**494.97**	**544.50**	**610.21**	**700.00**
351	405.30	428.49	458.20	**496.39**	546.06	611.95	702.00
352	406.45	429.71	459.50	**497.80**	547.61	613.69	704.00
353	407.61	430.93	460.81	**499.22**	549.17	615.44	706.00
354	408.76	432.15	462.11	**500.63**	550.73	617.18	708.00
355	**409.92**	**433.37**	**463.42**	**502.05**	**552.28**	**618.92**	**710.00**
356	411.07	434.60	464.72	**503.46**	553.84	620.67	712.00
357	412.23	435.82	466.03	**504.87**	555.39	622.41	714.00
358	413.38	437.04	467.34	**506.29**	556.95	624.15	716.00
359	414.54	438.26	468.64	**507.70**	558.50	625.90	718.00
360	**415.69**	**439.48**	**469.95**	**509.12**	**560.06**	**627.64**	**720.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
361	416.85	440.70	471.25	**510.53**	561.62	629.38	722.00
362	418.00	441.92	472.56	**511.95**	563.17	631.13	724.00
363	419.16	443.14	473.86	**513.36**	564.73	632.87	726.00
364	420.31	444.36	475.17	**514.77**	566.28	634.61	728.00
365	**421.47**	**445.58**	**476.47**	**516.19**	**567.84**	**636.36**	**730.00**
366	422.62	446.80	477.78	**517.60**	569.39	638.10	732.00
367	423.78	448.02	479.08	**519.02**	570.95	639.84	734.00
368	424.93	449.25	480.39	**520.43**	572.51	641.59	736.00
369	426.08	450.47	481.70	**521.84**	574.06	643.33	738.00
370	**427.24**	**451.69**	**483.00**	**523.26**	**575.62**	**645.08**	**740.00**
371	428.39	452.91	484.31	**524.67**	577.17	646.82	742.00
372	429.55	454.13	485.61	**526.09**	578.73	648.56	744.00
373	430.70	455.35	486.92	**527.50**	580.28	650.31	746.00
374	431.86	456.57	488.22	**528.92**	581.84	652.05	748.00
375	**433.01**	**457.79**	**489.53**	**530.33**	**583.40**	**653.79**	**750.00**
376	434.17	459.01	490.83	**531.74**	584.95	655.54	752.00
377	435.32	460.23	492.14	**533.16**	586.51	657.28	754.00
378	436.48	461.45	493.44	**534.57**	588.06	659.02	756.00
379	437.63	462.67	494.75	**535.99**	589.62	660.77	758.00
380	**438.79**	**463.89**	**496.05**	**537.40**	**591.18**	**662.51**	**760.00**
381	439.94	465.12	497.36	**538.82**	592.73	664.25	762.00
382	441.10	466.34	498.67	**540.23**	594.29	666.00	764.00
383	442.25	467.56	499.97	**541.64**	595.84	667.74	766.00
384	443.41	468.78	501.28	**543.06**	597.40	669.48	768.00
385	**444.56**	**470.00**	**502.58**	**544.47**	**598.95**	**671.23**	**770.00**
386	445.71	471.22	503.89	**545.89**	600.51	672.97	772.00
387	446.87	472.44	505.19	**547.30**	602.07	674.71	774.00
388	448.02	473.66	506.50	**548.71**	603.62	676.46	776.00
389	449.18	474.88	507.80	**550.13**	605.18	678.20	778.00
390	**450.33**	**476.10**	**509.11**	**551.54**	**606.73**	**679.94**	**780.00**
391	451.49	477.32	510.41	**552.96**	608.29	681.69	782.00
392	452.64	478.54	511.72	**554.37**	609.84	683.43	784.00
393	453.80	479.76	513.03	**555.79**	611.40	685.17	786.00
394	454.95	480.99	514.33	**557.20**	612.96	686.92	788.00
395	**456.11**	**482.21**	**515.64**	**558.61**	**614.51**	**688.66**	**790.00**
396	457.26	483.43	516.94	**560.03**	616.07	690.40	792.00
397	458.42	484.65	518.25	**561.44**	617.62	692.15	794.00
398	459.57	485.87	519.55	**562.86**	619.18	693.89	796.00
399	460.73	487.09	520.86	**564.27**	620.73	695.64	798.00
400	**461.88**	**488.31**	**522.16**	**565.69**	**622.29**	**697.38**	**800.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
401	463.03	489.53	523.47	**567.10**	623.85	699.12	802.00
402	464.19	490.75	524.77	**568.51**	625.40	700.87	804.00
403	465.34	491.97	526.08	**569.93**	626.96	702.61	806.00
404	466.50	493.19	527.38	**571.34**	628.51	704.35	808.00
405	**467.65**	**494.41**	**528.69**	**572.76**	**630.07**	**706.10**	**810.00**
406	468.81	495.63	530.00	**574.17**	631.62	707.84	812.00
407	469.96	496.86	531.30	**575.58**	633.18	709.58	814.00
408	471.12	498.08	532.61	**577.00**	634.74	711.33	816.00
409	472.27	499.30	533.91	**578.41**	636.29	713.07	818.00
410	**473.43**	**500.52**	**535.22**	**579.83**	**637.85**	**714.81**	**820.00**
411	474.58	501.74	536.52	**581.24**	639.40	716.56	822.00
412	475.74	502.96	537.83	**582.66**	640.96	718.30	824.00
413	476.89	504.18	539.13	**584.07**	642.51	720.04	826.00
414	478.05	505.40	540.44	**585.48**	644.07	721.79	828.00
415	**479.20**	**506.62**	**541.74**	**586.90**	**645.63**	**723.53**	**830.00**
416	480.36	507.84	543.05	**588.31**	647.18	725.27	832.00
417	481.51	509.06	544.35	**589.73**	648.74	727.02	834.00
418	482.66	510.28	545.66	**591.14**	650.29	728.76	836.00
419	483.82	511.50	546.97	**592.56**	651.85	730.50	838.00
420	**484.97**	**512.73**	**548.27**	**593.97**	**653.40**	**732.25**	**840.00**
421	486.13	513.95	549.58	**595.38**	654.96	733.99	842.00
422	487.28	515.17	550.88	**596.80**	656.52	735.73	844.00
423	488.44	516.39	552.19	**598.21**	658.07	737.48	846.00
424	489.59	517.61	553.49	**599.63**	659.63	739.22	848.00
425	**490.75**	**518.83**	**554.80**	**601.04**	**661.18**	**740.96**	**850.00**
426	491.90	520.05	556.10	**602.45**	662.74	742.71	852.00
427	493.06	521.27	557.41	**603.87**	664.29	744.45	854.00
428	494.21	522.49	558.71	**605.28**	665.85	746.20	856.00
429	495.37	523.71	560.02	**606.70**	667.41	747.94	858.00
430	**496.52**	**524.93**	**561.33**	**608.11**	**668.96**	**749.68**	**860.00**
431	497.68	526.15	562.63	**609.53**	670.52	751.43	862.00
432	498.83	527.37	563.94	**610.94**	672.07	753.17	864.00
433	499.99	528.60	565.24	**612.35**	673.63	754.91	866.00
434	501.14	529.82	566.55	**613.77**	675.18	756.66	868.00
435	**502.29**	**531.04**	**567.85**	**615.18**	**676.74**	**758.40**	**870.00**
436	503.45	532.26	569.16	**616.60**	678.30	760.14	872.00
437	504.60	533.48	570.46	**618.01**	679.85	761.89	874.00
438	505.76	534.70	571.77	**619.43**	681.41	763.63	876.00
439	506.91	535.92	573.07	**620.84**	682.96	765.37	878.00
440	**508.07**	**537.14**	**574.38**	**622.25**	**684.52**	**767.12**	**880.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
441	509.22	538.36	575.68	**623.67**	686.07	768.86	882.00
442	510.38	539.58	576.99	**625.08**	687.63	770.60	884.00
443	511.53	540.80	578.30	**626.50**	689.19	772.35	886.00
444	512.69	542.02	579.60	**627.91**	690.74	774.09	888.00
445	**513.84**	**543.24**	**580.91**	**629.33**	**692.30**	**775.83**	**890.00**
446	515.00	544.47	582.21	**630.74**	693.85	777.58	892.00
447	516.15	545.69	583.52	**632.15**	695.41	779.32	894.00
448	517.31	546.91	584.82	**633.57**	696.96	781.06	896.00
449	518.46	548.13	586.13	**634.98**	698.52	782.81	898.00
450	**519.62**	**549.35**	**587.43**	**636.40**	**700.08**	**784.55**	**900.00**
451	520.77	550.57	588.74	**637.81**	701.63	786.29	902.00
452	521.92	551.79	590.04	**639.22**	703.19	788.04	904.00
453	523.08	553.01	591.35	**640.64**	704.74	789.78	906.00
454	524.23	554.23	592.65	**642.05**	706.30	791.52	908.00
455	**525.39**	**555.45**	**593.96**	**643.47**	**707.85**	**793.27**	**910.00**
456	526.54	556.67	595.27	**644.88**	709.41	795.01	912.00
457	527.70	557.89	596.57	**646.30**	710.97	796.76	914.00
458	528.85	559.11	597.88	**647.71**	712.52	798.50	916.00
459	530.01	560.34	599.18	**649.12**	714.08	800.24	918.00
460	**531.16**	**561.56**	**600.49**	**650.54**	**715.63**	**801.99**	**920.00**
461	532.32	562.78	601.79	**651.95**	717.19	803.73	922.00
462	533.47	564.00	603.10	**653.37**	718.74	805.47	924.00
463	534.63	565.22	604.40	**654.78**	720.30	807.22	926.00
464	535.78	566.44	605.71	**656.20**	721.86	808.96	928.00
465	**536.94**	**567.66**	**607.01**	**657.61**	**723.41**	**810.70**	**930.00**
466	538.09	568.88	608.32	**659.02**	724.97	812.45	932.00
467	539.25	570.10	609.63	**660.44**	726.52	814.19	934.00
468	540.40	571.32	610.93	**661.85**	728.08	815.93	936.00
469	541.55	572.54	612.24	**663.27**	729.63	817.68	938.00
470	**542.71**	**573.76**	**613.54**	**664.68**	**731.19**	**819.42**	**940.00**
471	543.86	574.98	614.85	**666.09**	732.75	821.16	942.00
472	545.02	576.21	616.15	**667.51**	734.30	822.91	944.00
473	546.17	577.43	617.46	**668.92**	735.86	824.65	946.00
474	547.33	578.65	618.76	**670.34**	737.41	826.39	948.00
475	**548.48**	**579.87**	**620.07**	**671.75**	**738.97**	**828.14**	**950.00**
476	549.64	581.09	621.37	**673.17**	740.52	829.88	952.00
477	550.79	582.31	622.68	**674.58**	742.08	831.62	954.00
478	551.95	583.53	623.98	**675.99**	743.64	833.37	956.00
479	553.10	584.75	625.29	**677.41**	745.19	835.11	958.00
480	**554.26**	**585.97**	**626.60**	**678.82**	**746.75**	**836.85**	**960.00**

Table 8. Towing wire required to reach depths of 1-500 m with wire angles from 30 to 60°. Continued...

DEPTH(m)	WIRE OUT IN METERS FOR OBSERVED WIRE ANGLE 30°	35°	40°	**45°**	50°	55°	60°
481	555.41	587.19	627.90	**680.24**	748.30	838.60	962.00
482	556.57	588.41	629.21	**681.65**	749.86	840.34	964.00
483	557.72	589.63	630.51	**683.07**	751.41	842.08	966.00
484	558.88	590.85	631.82	**684.48**	752.97	843.83	968.00
485	**560.03**	**592.08**	**633.12**	**685.89**	**754.53**	**845.57**	**970.00**
486	561.18	593.30	634.43	**687.31**	756.08	847.32	972.00
487	562.34	594.52	635.73	**688.72**	757.64	849.06	974.00
488	563.49	595.74	637.04	**690.14**	759.19	850.80	976.00
489	564.65	596.96	638.34	**691.55**	760.75	852.55	978.00
490	**565.80**	**598.18**	**639.65**	**692.96**	**762.30**	**854.29**	**980.00**
491	566.96	599.40	640.95	**694.38**	763.86	856.03	982.00
492	568.11	600.62	642.26	**695.79**	765.42	857.78	984.00
493	569.27	601.84	643.57	**697.21**	766.97	859.52	986.00
494	570.42	603.06	644.87	**698.62**	768.53	861.26	988.00
495	**571.58**	**604.28**	**646.18**	**700.04**	**770.08**	**863.01**	**990.00**
496	572.73	605.50	647.48	**701.45**	771.64	864.75	992.00
497	573.89	606.72	648.79	**702.86**	773.19	866.49	994.00
498	575.04	607.95	650.09	**704.28**	774.75	868.24	996.00
499	576.20	609.17	651.40	**705.69**	776.31	869.98	998.00
500	**577.35**	**610.39**	**652.70**	**707.11**	**777.86**	**871.72**	**1000.0**

US Department of Commerce

National Marine Fisheries Service

3209 Frederic St.

Pascagoula, MS 39567

Project Instructions

Date Submitted: 28 January 2011

Platform: NOAA Ship *Oregon II*

Cruise Number: R2-11-01 (293)

Project Title: NRDA Winter Ichthyoplankton Survey

Cruise Dates: 16 February – 22 March 2011

Prepared by: _____ Date: _____
Glenn A. Zapfe
Field Party Chief
NMFS, Pascagoula Laboratory

Approved by: _____ Date: _____
Dr. Lisa Desfosse
Director, Mississippi Laboratory
NMFS, Pascagoula, MS

Approved by: _____ Date: _____
Dr. Bonnie Ponwith
Director, SEFSC
NMFS, Miami, FL

Approved by: _____ Date: _____
Captain David A. Score, NOAA
Commanding Officer
Marine Operations Center - Atlantic

Commanding Officer
NOAA Ship: *Oregon II*

PROJECT INSTRUCTIONS
NOAA Ship *Oregon II* Cruise R2-11-01 (293)

I. Overview

A. Project Period: February 16 to March 22, 2011

Operating Area: United States northern Gulf of Mexico (GOM) with emphasis near the vicinity of the DeepWater Horizon (DWH) well site from 83°00' to 93°00' W and 27°00' to 30°00' N. A list of the station locations and a map of the area of operations are found in Table 1 and Figure 1 respectively.

B. Summary of Objectives:

1. ***Primary Objectives***
   a. Assess the occurrence, abundance and geographical distribution of the early life stages of winter spawning fishes (especially groupers and tilefishes) near the DWH well site from the continental shelf to deep GOM waters using a bongo frame fitted with a 0.335 mm net and a neuston frame fitted with a 0.947 mm net at selected Southeast Area Monitoring and Assessment Program (SEAMAP) stations in conjunction with the Natural Resource Damage Assessment (NRDA) program.
   b. Describe the pelagic habitat of fish larvae through measurements of various physical and biological parameters:
      i. Record profiles through the water column of temperature, salinity, fluorescence, dissolved oxygen, and turbidity using a Conductivity/Temperature/Depth (CTD) unit at SEAMAP stations.
   c. Collect detailed observations of net-caught jellyfish and ctenophores.
   d. Measure the vertical distribution of fish larvae by sampling at discrete depths in the water column at selected locations along the survey grid using a 1 m Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS).

2. ***Secondary Objectives***
   a. Observational data on pelagic birds will be conducted along the survey trackline.

C. Participating Institutions:

1. National Marine Fisheries Service (NMFS) – Pascagoula Laboratory
2. Defenders of Wildlife
3. ENTRIX/BP
4. NRDA

D. Personnel (Science Party)

Name	Title	Sex	Organization	Citizenship
LEG 1 (Feb 16 – Mar 2, 2011)				
Glenn Zapfe	Field Party Chief	M	NMFS	US
Plus up to 9 additional scientists to be named later.				
LEG 2 (Mar 8 – Mar 22, 2011)				
Glenn Zapfe	Field Party Chief	M	NMFS	US
Plus up to 9 additional scientists to be named later.				

E. Administrative:

1. Points of Contact:
   a. Field Party Chief: Glenn Zapfe; 3209 Frederic St., Pascagoula, MS 39567; (228) 549-1650; Glenn.Zapfe@noaa.gov
   b. Operations Officer: Lt. Jonathan E. Taylor; NOAA Ship *Oregon II*, 151 Watts Ave, Pascagoula, MS 39567; (228) 762-6422; OPS.Oregon@noaa.gov

2. Diplomatic Clearances: N/A

3. Licenses and Permits:
   This cruise will be conducted under the following permits:
   a. Florida State Permit
   b. Alabama State Permit
   c. Mississippi State Permit
   d. Louisiana State Permit
   e. Texas State Permit
   f. Southeast NMFS Regional Permit
   g. Sea Turtle Permit

II. Operations

A. Cruise Plan/Itinerary:

Leg	Date	Location	Days
1	02/16/11	Depart Pascagoula, MS	15
	03/02/11	Arrive Pascagoula, MS	
2	03/08/11	Depart Pascagoula, MS	15
	03/22/11	Arrive Pascagoula, MS	

B. Staging and Destaging: PASCAGOULA / PASCAGOULA

C. Operations to be conducted:

Operational Plans:

This survey was initially a SEAMAP/NRDA cooperation, but the SEAMAP portion was cancelled and the entire survey is now a NRDA funded project. The NOAA Ship *Oregon*

II will depart Pascagoula, MS on February 16, 2011 to conduct the NRDA Winter Plankton survey. The 30-day cruise will be conducted in two 15-day legs. The station positions and primary gear to be used at each of the 110 targeted stations (Figure 1) are listed in Table 1. The station order as provided is subject to change by the Field Party Chief (FPC) during the survey after consultation with the Commanding Officer (CO). The survey will require 24 hr operations with 2 scientific watches: 12 am – 12 pm, 12 pm – 12 am.

Prior to arrival at the first station the SBE 9/11 plus CTD and the SEACAT SBE 19 CTD (with a weight) will be deployed in order to test the functionality of the winches, hydraulics, CTD array, and SEACAT. Any problems encountered during the test can then be corrected prior to arriving on the first station. The Chief Engineer will be made aware of expected time of arrival at the first station so the salt water pumps can be turned on and ready.

Standard SEAMAP sampling protocols will be followed at each station for the primary gear: oblique bongo tow to a maximum depth of 200 m, 10 min neuston tow, and CTD profile to a maximum depth of 200 m. At selected locations, additional sampling will be conducted using a 1 m MOCNESS. The projected number and position of extra casts will be determined prior to departure from Pascagoula and in consultation with the CO. Remaining survey time and weather will determine priority of these samples. The MOCNESS will be used during both legs of the survey.

Communication between the scientists and the bridge while on station will be accomplished via hand held radios. During rough weather, the watch leader with consultation from the ship's crew will determine which sampling gear can be deployed safely. The FPC should be notified of any delays to sampling due to mechanical, medical, or weather issues as well.

PRIMARY STATION OPERATIONS – At the Bridge's 10 min warning, scientists and deck personnel will proceed to duty stations and prepare for station. Scientists and deck personnel should be ready and standing by for bridge's call that the ship is on station and ready to proceed. Smoking is not permitted near or while handling any plankton nets due to the likelihood of burning holes in the nets.

Bongo sampling

The SEAMAP bongo plankton sampler is comprised of two 61 cm diameter collars with two 0.335 mm mesh nets. Prior to deployment of the bongo sampler, the watch leader must run software programs and prepare them for the bongo cast. The lab scientist should wait for the bridge and deck to relay their readiness to deploy gear, hit ok on the program, have the deck turn on the magnetic switch at the appropriate time, and wait for data to begin scrolling. There is a small delay between the switch and data scroll, therefore, the lab scientist will relay to the deck when to put the net into the water. The bongo sampler is towed in an oblique path from near bottom, or 200 m maximum, to the surface. The SBE-19 SEACAT which is mounted above the bongo array on the sea cable will be used to monitor the tow path of the bongo net. Vessel speed should be adjusted during the bongo tow to maintain a 45-degree wire angle in order to uniformly sample throughout the water column. If angle exceeds 55°, falls to 35° OR if combined variation exceeds 15°, then the tow must be repeated (the samples will be saved until a better tow is completed). The net depth will be monitored by the watch leader. The deck scientist (or winch operator) will report wire angles periodically during downcast. On the watch leader's command at maximum depth, the winch operator will stop payout of cable and

immediately start retrieval (do not allow net to settle). At that time, the wire angle and wire out should be reported to the watch leader from the deck. The watch leader will ask the winch operator to slowly retrieve the bongo array at 20 m per min for tow depths of 100 m or deeper; for shallower stations the retrieval rate will be determined at each station based on station depth. The wire angle and remaining wire out should be reported from the deck to the watch leader regularly or as requested (on upcast or downcast).

The deck personnel should report when the bongo array breaks the surface. Time will be recorded to the second (by the lab scientist) when the net breaks surface and flowmeters stop turning, at which time the winch operator immediately pulls the frame from the water; taking care not to let the bongo array continue to fish once it breaks the surface. When possible, the sample will be rinsed into the cod end of the net with a seawater hose while the net hangs over the side. In high winds, the scientist may request that the net is brought directly on board and rinsed down completely on deck. The bongo frame and net are placed on deck.

Great care must be taken not to rest the frame on the nets, scrape the net with the frame against the deck, or walk on the plankton nets. The abrasions can easily cause holes in the nets requiring repair or replacement of these expensive sampling devices.

If bottom sediment is present in both samples, the tow must be repeated. Any marginal sample will be saved until completion of the next tow. If bottom sediment (no more than 2 Tbs) is present in only 1 sample the tow need not be repeated. Preservation of the bongo samples will be determined prior to sailing. All samples will be released to Louisiana State University for sorting and identification.

Neuston sampling

The neuston net is a 1 x 2 m frame outfitted with a 0.947 mm mesh net. Each neuston tow will be conducted for 10 min at a vessel speed of approximately 2 kt to keep half the frame submerged in the water (i.e., maintain a sampling depth of 0.5 m). If necessary, the ship will steam forward in a wide arc to keep the neuston net (mouth opening) out of the influence of the prop wash. The duration of a neuston tow may be shortened to no less than 5 min when high concentrations of jellyfish, ctenophores, *Sargassum*, floating weed and/or debris are present in the water, or weather requires it. After retrieval, the sample is rinsed into the cod end with seawater while the net hangs over the side (if windy, deck scientist may request net to be brought directly on board and rinsed on deck). Preservation of the neuston samples will be determined prior to sailing. All samples will be released to Louisiana State University for sorting and identification.

CTD profiles and environmental data collection

After the CTD array is overboard, clear of all personnel and being lowered to just below the surface, the watch leader (lab scientist) will turn on the power to the unit and start the CTD recording. The unit must remain at the surface for 3 min for temperature equilibration, after which time the unit is lowered to approximately 2 m above the bottom or a max depth of 200 m. After the cast, the CTD should be carefully set on deck, taking care not to jar the sensitive electronics. The Electronics Technician will clear the y-connections periodically throughout the cruise. Additional environmental data that will be collected at each designated plankton station during daylight hours are secchi disc depth, water color Forel-Ule, percent cloud cover, and sea condition. The TSG will be in

use 24 hours/day. Dissolved oxygen concentrations from sensors on the CTD will be verified using an Orion 3 Star Portable D.O. meter made by Thermo Scientific at the beginning of each leg and then every 5 days by the FPC.

1 m MOCNESS Sampling

A 1 m MOCNESS equipped with a maximum of nine 0.505 mm mesh nets will be deployed from the stern with the MOCNESS winch using 3/8 in conducting wire and podded termination. Prior to deployment, the ship speed will be maintained at 2 kt. Once deployed, a series of up to 9 nets can be opened independently at specific depths to obtain a discrete sample of that depth bin. Winch and ship speed will be controlled by the watch leader throughout the tow via communication with the deck and bridge. This is done in order to maintain the gear in a specific depth stratum and allow the net to filter the targeted volume of water, i.e. 250 m^3 per net. The watch leader will let the bridge know when to disengage the props as the nets reach the surface during retrieval. After retrieval, samples will be rinsed into cod ends with seawater before bringing the MOCNESS on deck. Preservation of the MOCNESS samples will be determined prior to sailing. All samples will be released to Louisiana State University for sorting and identification.

Jellyfish data collection

Jellyfish and select ctenophores collected in plankton samples will be rinsed, removed from the sample (when time permits), identified, counted, measured, and weighed. These data will be recorded on special data sheets and noted in the Access database.

Modifications to Field Operations

Sampling protocol may be altered by the FPC or watch leader in order to optimize sampling for time conservation. The FPC may alter the project instructions in order to accomplish mission objectives but will do so only after consulting with the CO. If additional time becomes available during a leg, the FPC will provide the ship with further station locations at that time, after consulting with the CO.

D. Dive Plan: N/A

E. Applicable Restrictions: N/A

III. Equipment

A. Equipment and Capabilities Provided by the Ship:

1. Scientific Computing System (SCS) version 4.0
2. Because of the importance of the CTD equipment package to record environmental data and the need for the SCS, an Electronics Technician is imperative.
3. Hydrographic winch with wire and meter readout to accomplish CTD/bottle casts and bongo tows up to a 500 m depth. Winch speed should be variable to include 50 m/min during pay-out and 20 m/min during haul back (for bongo tows). Spare slip rings for each winch. Fully functional wire readouts for each winch.

4. Winch, crane, and wire for deploying neuston net.
5. Winch with wire for deployment of 1 m MOCNESS.
6. ADCP
7. One (1) Primary SBE 9plus CTD configured as follows;
    a. Unit should be mounted horizontally and mounted in the water sampling frame. The frame should be examined to ensure it is in good physical condition and there are no breaks present in any of the welds supporting the frame.
    b. The standard 12 position SBE 32 Carousel should be properly mounted in the water sampler section of the frame and tested to ensure that all 12 bottle positions are working properly and respond to software requests for firing.
    c. The internal Digiquartz pressure sensor should be in good working order and have a calibration/service date not to exceed 365 days.
    d. The primary sensor suite should be installed and consist of the following (the sensors should have a calibration date as recent as possible, not to exceed 365 days):
        i. One (1) SBE 3 Premium Temperature sensor
        ii. One (1) SBE 4 Conductivity sensor
        iii. One (1) SBE 43 Dissolved Oxygen sensor
        iv. One (1) "Y" air bleeder valve. Valve should be checked to ensure it is not clogged.
        v. One (1) Wetlabs Wetstar pumped fluorometer
        vi. One (1) SBE 5T pump that has been checked by Seabird within the last 365 days for proper operation
        vii. One (1) Wetlabs C-Star transmissometer
        viii. Proper plumbing. Tubing should be checked to ensure it meets Seabird's recommended method of plumbing and is free from cracks and holes. With red end caps for proper storage between stations.
    e. The secondary sensor suite should be installed and consist of the following (the sensors should have a calibration date as recent as possible, not to exceed 365 days):
        i. One (1) SBE 3 Premium Temperature sensor
        ii. One (1) SBE 4 Conductivity sensor
        iii. One (1) SBE 43 Dissolved Oxygen sensor
        iv. One (1) "Y" air bleeder valve. Valve should be checked to ensure it is not clogged
        v. One (1) Wetlabs Wetstar pumped fluorometer
        vi. One (1) SBE 5T pump that has been checked by Seabird within the last 365 days for proper operation
        vii. One (1) Wetlabs C-Star transmissometer
        viii. Proper plumbing. Tubing should be checked to ensure it meets Seabird's recommended method of plumbing and is free from cracks and holes.
    f. The unit should be properly terminated and connected to a properly functioning SBE 11 Deck Unit. The deck unit should be connected to allow the following:
        i. Proper control of the SBE Water Sampler Carousel via the SEASAVE application
        ii. Integration of a proper NMEA signal from a GPS unit.
6. A second SBE 9plus profiler should be available as well. Unit does not have to be configured as a complete functioning ready-to-install on the sea cable unit; however, it should have the following components available:
    a. Sensors for a Primary suite (with a calibration date as recent as possible, not to exceed 365 days):

i. One (1) SBE 3 Premium Temperature sensor
ii. One (1) SBE 4 Conductivity sensor
iii. One (1) SBE 43 Dissolved Oxygen sensor
iv. One (1) "Y" air bleeder valve. Valve should be checked to ensure it is not clogged.
v. One (1) Wetlabs Wetstar pumped fluorometer
vi. One (1) SBE 5T pump that has been checked by Seabird within the last 365 days for proper operation.
vii. One (1) Wetlabs C-Star transmissometer
viii. Proper plumbing. Tubing should be checked to ensure it meets Seabird's recommended method of plumbing and is free from cracks and holes.

b. Sensors for a complete Secondary suite (with a calibration date as recent as possible, not to exceed 365 days):
i. One (1) SBE 3 Premium Temperature sensor
ii. One (1) SBE 4 Conductivity sensor
iii. One (1) SBE 43 Dissolved Oxygen sensor
iv. One (1) "Y" air bleeder valve. Valve should be checked to ensure it is not clogged.
v. One (1) Wetlabs Wetstar pumped fluorometer
vi. One (1) SBE 5T pump that has been checked by Seabird within the last 365 days for proper operation.
vii. One (1) Wetlabs C-Star transmissometer.
viii. Proper plumbing. Tubing should be checked to ensure it meets Seabird's recommended method of plumbing and is free from cracks and holes.

7. A second SBE 11 Deck Unit should be on the ship to be put into service if needed.
8. Two (2) fully operational SBE 19 Seacat profilers should be available. One of the units should be installed on the sea cable. Both units should have calibration dates not to exceed 365 days.
9. Two (2) functional SBE 36 Deck units should be available, 1 for backup, which are configured for the model Seacat being supplied.
10. Two (2) PDIM units should be available for use with the SBE 19 units. One of these PDIM units should be installed on the primary SBE19 on the sea cable. These PDIM units should also be the proper units that are used with the model Seacat being used.
11. A fully functional SBE 21 thermosalinograph should be available for the survey. The unit should have calibrations that do not exceed 365 days. The calibration data must be verified/entered into the SEABIRD-TSB.CAL file in the Ship Directory of SCS.
12. The Turner 10-AU Fluorometer associated with the flow-through system should be verified as working. Proper spare bulbs should be made available to the rotating ET so they can be replaced as needed during the survey.
13. It is highly desirable to have the following additional spare sensors on-board if possible:
    a. One (1) SBE 43 DO Sensor
    b. One (1) SBE 3 Temperature Sensor
    c. One (1) SBE 4 Conductivity Sensor
    d. One (1) Wetlabs Wetstar pumped fluorometer
    e. One (1) Wetlabs C-Star Transmissometer
    f. One (1) SBE 5T Pump
14. Copies of all calibration sheets for CTD profilers, TSG, and spare sensors should be provided to the laboratories' Shipboard System Specialist prior to sailing.

15. CTD capable winch and J-frame for CTD casts, with sufficient electromechanical cable for casts to 500 m.
16. NMEA GPS input to CTD header file.
17. SCS data requested: The SCS system should be fully operational for the duration of the survey. A listing of any sensors that will not be functional for the survey should be provided prior to sailing to the FPC, taking into consideration that event templates will have to be checked by the Shipboard System Specialists to ensure there will be no impact or an alternative sensor can be selected.
    a. Furuno 951 GPS
        i. UTC time
        ii. Latitude
        iii. Longitude
        iv. Speed over ground
        v. Course over ground
    b. Furuno GP-90 GPS
        i. Latitude
        ii. Longitude
        iii. Speed over ground
        iv. Course over ground
    c. Furuno doppler speed log
        i. Speed through the water
        ii. Speed over ground
    d. EQ50 and EK60 depth in meters
    e. Gyro-heading
    f. Air temperature (°C)
    g. Corrected barometric pressure
    h. True wind speed
    i. True wind direction
    j. Information should be passed to the Rotating ET to ensure the following:
        iii. The Automatic Logger Control on the SCS Server must be enabled anytime ACQ is started and should use the default of 0:00:00 (Midnight GMT).
        iv. The contents of the Eventdata folder should be allowed to remain present for the duration of the survey (they should not be deleted between legs). This will ensure that event IDs do not restart for the respective events during the survey.
    k. SEASAVE SOFTWARE: Prior to sailing, the proper .CON files should be built in SEASAVE. The software should be set to look for the proper .CON file for the respective instrument.
    l. It is also highly desirable that the ASCII Out function be allowed to feed CTD data into SCS via serial cable.

B. Equipment and Capabilities Provided by the Scientists:
1. Flowmeters (6)
2. 2- 61 cm bongo frames, chain and weight, (6) 0.335 mm nets
3. 2- 1 x 2 m neuston frames, (4) 0.947 mm nets
4. 1 m MOCNESS frame, (9) 0.505 mm nets, and electronic equipment
5. Conducting wire (3/8-in) and corresponding block for MOCNESS tows

6. Bongo/neuston gear and equipment box
7. Plankton sampling supplies box
8. Plankton preserving jars, lids and labels
9. Chemical transfer pumps
10. Formalin and ethyl alcohol
11. Triton (R) X-100
12. 4 Garden hoses for washing down nets, nozzles, and hose repair parts
13. Plankton transfer table
14. 5 gallon buckets
15. Various clerical supplies
16. Spare batteries for the SBE 19 Seacat profilers

IV. Hazardous Materials

A. Policy and Compliance:

The FPC shall be responsible for complying with MOCDOC 15, Fleet Environmental Compliance #07, Hazardous Material and Hazardous Waste Management Requirements for Visiting Scientists, released July 2002. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and the anticipated quantity brought aboard, MSDS and appropriate neutralizing agents, buffers, and/or absorbents in amounts adequate to address spills of a size equal to the amount of chemicals brought aboard. The amount of hazardous material arriving and leaving the vessel shall be accounted for by the FPC.

B. Radioactive Isotopes: N/A

C. Inventory: Expected hazardous materials to be brought on board for this cruise are:

1. Ethanol – 165 gallons
2. Formaldehyde – 15 gallons
3. Triton-X – 1 pint concentrate & 2 gallon carboy of 1% dilution

V. Additional Projects

A. Supplementary ("Piggyback") Projects: N/A

B. NOAA Fleet Ancillary Projects: N/A

V. Disposition of Data and Reports

A. Data Responsibilities:

The ship's ET Department is requested to provide the FPC with copies of SCS folders, "EventData" and "SCS_Datalog", as well as the raw data files associated with both the SBE 9-11 profiler and SBE-19 SEACAT at the end of each survey leg (on CD or DVD). The ET Department is also asked to collect and archive the SCS Datalog in the following manner:

1. The contents of the Primary SCS **EventData** folder should be emptied prior to the start of the survey and should not be erased between legs of the survey. All other Datalog folders should be emptied in accordance to the guideline specified in the SCS Documentation. That is, at the start of a survey all data files should be deleted from

the **Datalog** and from its sub-folders prior to the survey with the exception of the **Coastline** sub-folder. The contents of the **Coastline** folder and the folder itself should never be deleted. All other sub-folders in the **Datalog** may have their contents deleted. If the **EventData** sub-folder contains sub-folders for each event that was previously run, these folders should be deleted along with their data files as the Event Logger will recreate the folders for the respective events the first time they are run.

2. The Automatic Logger Control on the Logger Control form of SCS should be set to **Enable Logging for Auto Start/Stop** each time acquisition (ACQ) is started. The time value should be set to the default of 0 Hours, 0 Minutes, 0 Seconds GMT.
3. The raw data files, *.RAW in the **Datalog** folder may be deleted between legs if space for logging is needed provided the data have been backed up to CD and the CD verified prior to deletion.
4. The entire **Datalog** should be backed up to the Backup SCS server for the duration of the cruise at a frequency of at least once per hour. Prior to sailing, this **Datalog** should be reset in accordance to the directions as specified above, and as is done on the Primary SCS ACQ computer.
5. Prior to sailing, the current SCS software on the primary SCS server will be mirrored on the backup SCS server. Thus, the same version of the executables for SCS along with all templates, events, real-time displays, gauges, and sensor.scf configuration files should be present on the Backup SCS server in the event of a Primary SCS system failure.
6. Prior to sailing, the lab's Shipboard Systems Specialist will be provided with copies of all calibration data for each sensor installed on the ship associated with the primary and secondary SBE 9-11 profiler and SBE19 SEACAT. This information is useful to track problems in the .CON files should they arise.

The FPC is responsible for submission of a ROSCOP II form (NOAA, Form 2423) to the National Oceanographic Data Center within 30 days after cruise termination.

B. Cruise Meetings:
Welcome aboard Meeting: On the ship prior to departure, the FPC will conduct a meeting of the scientific party to train them in sample collection and inform them of cruise objectives. Some vessel protocols, e.g., meals, etiquette, etc. will be presented by the ship's Operations Officer.

Post-Cruise Meeting: If need be, upon completion of the cruise, a post-cruise meeting will be held and attended by the ship's officers, the FPC and members of the scientific party, the Vessel Coordinator, and the Port Captain to review the cruise. Concerns regarding safety, efficiency and suggestions for improvement for future cruises should be discussed. Minutes of the post-cruise meeting will be taken by the Pascagoula Port Captain and distributed to all participants with e-mail to the CO.MOC.Atlantic@noaa.gov and ChiefOps.MOA@noaa.gov . A cruise report will be prepared by the FPC and submitted to the Director, SEFSC, within 30 days after the cruise is completed.

C. Ship Operation Evaluation Report:
Within 7 days of the completion of the cruise, a Ship Operation Evaluation form is to be

completed by the FPC. The preferred method of transmittal of this form is via email to OMAO.Customer.Satisfaction@noaa.gov . If email is not an option, a hard copy may be forwarded to:

Director, NOAA Marine and Aviation Operations
NOAA Office of Marine and Aviation Operations
8403 Colesville Road, Suite 500
Silver Spring, MD 20910

A file copy of each completed evaluation form will be sent to the SEFSC Mississippi Laboratory Director and the SEFSC Vessel Coordinator.

VI. Miscellaneous

A. Meals and Berthing:

Meals and berthing are required for up to 10 scientists per leg. Meals will be served 3 times daily beginning 1 hour before scheduled departure, extending throughout the cruise, and ending 2 hours after the termination of the cruise. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least 7 days prior to the survey.

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the FPC. The FPC and CO will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The FPC is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The FPC is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The FPC will ensure that all non NOAA or non Federal scientists aboard also have proper orders. It is the responsibility of the FPC to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the CO. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 7, 1999 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts:

The NOAA Health Services Questionnaire (NHSQ, Revised: 08/08) must be completed in advance by each participating scientist. The NHSQ can be obtained from the FPC or the NOAA website at http://www.omao.noaa.gov/medical/NHSQ_Final_wi_Instructions_fill.pdf

The completed form should be sent to the Regional Director of Health Services at Marine Operations Center. The participant can mail, fax, or scan the form into an email using the contact information below. The NHSQ should reach the Health Services Office no later than 4 weeks prior to the cruise to allow time for the participant to obtain and submit additional information that health services might require before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of the NHSQ. Be sure to include proof of tuberculosis (TB) testing, sign and date the form, and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757.441.6320
Fax 757.441.3760
E-mail MOA.Health.Services@noaa.gov

Prior to departure, the FPC must provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.

C. Shipboard Safety:

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Hard hats are required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required. Refer to the Office of Marine and Aviation Operations (OMAO) procedure 1110.01 for operations near Deepwater Horizon MC252 effluents. Proper fit-tests for respirators will be required for all personnel participating in the survey.

D. Communications:

A progress report on operations prepared by the Chief Scientist/FPC may be relayed to the program office. Sometimes it is necessary for the Chief Scientist/FPC to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist/FPC. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required it must be arranged at least 30 days in advance. Communication between the bridge, the dry lab, and the deck during plankton operations will be by VHS radio. We request 30 min and 10 min notification prior to arriving at stations.

E. IT Security:

Any computer that will be hooked into the ship's network must comply with the NMAO Fleet IT Security Policy prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

1. Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
2. Installation of the latest critical operating system security patches.
3. No external public Internet Service Provider (ISP) connections.

Completion of these requirements prior to boarding the ship is required. Non-NOAA personnel using the ship's computers or connecting their own computers to the ships network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms: N/A

Table 1. NOAA Ship *Oregon II* cruise R2-11-01 (293), plankton stations 16 February – 22 March 2011. Bongo (PN) and neuston (NN) tows will be taken at all stations in addition to CTD (CTD). MOCNESS tows will be completed at designated stations (MOC). Station order is subject to change.

SEAMAP ISS Number	Plankton Gear	Latitude	Longitude
B001	PN,NN,MOC,CTD	88° 00'00	29° 00'00
B002	PN,NN,CTD	87° 00'00	29° 00'00
B003	PN,NN,MOC,CTD	87° 00'00	28° 00'00
B004	PN,NN,MOC,CTD	87° 00'00	27° 00'00
B005	PN,NN,MOC,CTD	86° 00'00	27° 00'00
B011	PN,NN,MOC,CTD	88° 00'00	27° 00'00
B012	PN,NN,MOC,CTD	89° 00'00	27° 00'00
B015	PN,NN,MOC,CTD	90° 00'00	27° 00'00
B016	PN,NN,MOC,CTD	90° 00'00	28° 00'00
B017	PN,NN,CTD	91° 00'00	28° 00'00
B018	PN,NN,MOC,CTD	91° 00'00	27° 00'00
B021	PN,NN,MOC,CTD	92° 00'00	27° 00'00
B022	PN,NN,CTD	92° 00'00	28° 00'00
B057	PN,NN,MOC,CTD	92° 00'00	27° 30'00
B060	PN,NN,MOC,CTD	91° 00'00	27° 30'00
B061	PN,NN,MOC,CTD	90° 00'00	27° 30'00
B064	PN,NN,MOC,CTD	89° 00'00	27° 30'00
B065	PN,NN,MOC,CTD	88° 00'00	27° 30'00
B078	PN,NN,MOC,CTD	86° 00'00	27° 30'00
B079	PN,NN,MOC,CTD	87° 00'00	27° 30'00
B080	PN,NN,MOC,CTD	87° 00'00	28° 30'00
B081	PN,NN,MOC,CTD	88° 00'00	28° 30'00
B082	PN,NN,MOC,CTD	88° 00'00	28° 00'00
B083	PN,NN,MOC,CTD	89° 00'00	28° 00'00
B115	PN,NN,CTD	83° 37'00	29° 30'00
B116	PN,NN,CTD	83° 30'00	29° 00'00
B117	PN,NN,CTD	83° 30'00	28° 30'00
B118	PN,NN,CTD	83° 30'00	28° 00'00
B119	PN,NN,CTD	83° 30'00	27° 30'00

Table 1 continued.

SEAMAP ISS Number	Plankton Gear	Latitude	Longitude
B120	PN,NN,CTD	83° 30'00	27° 00'00
B133	PN,NN,CTD	84° 00'00	27° 00'00
B134	PN,NN,CTD	84° 00'00	27° 30'00
B135	PN,NN,CTD	84° 00'00	28° 00'00
B136	PN,NN,CTD	84° 00'00	28° 32'00
B137	PN,NN,CTD	84° 00'00	29° 00'00
B138	PN,NN,CTD	84° 00'00	29° 30'00
B140	PN,NN,CTD	84° 30'00	29° 30'00
B141	PN,NN,CTD	84° 30'00	29° 00'00
B142	PN,NN,CTD	84° 30'00	28° 30'00
B143	PN,NN,CTD	84° 30'00	28° 00'00
B144	PN,NN,CTD	84° 30'00	27° 30'00
B145	PN,NN,CTD	84° 30'00	27° 00'00
B151	PN,NN,CTD	85° 00'00	27° 00'00
B152	PN,NN,MOC,CTD	85° 00'00	27° 30'00
B153	PN,NN,CTD	85° 00'00	28° 00'00
B154	PN,NN,CTD	85° 00'00	28° 30'00
B155	PN,NN,CTD	85° 00'00	29° 00'00
B156	PN,NN,CTD	84° 56'00	29° 30'00
B158	PN,NN,CTD	85° 31'00	29° 30'00
B159	PN,NN,CTD	85° 30'00	29° 00'00
B160	PN,NN,CTD	85° 30'00	28° 40.2'00
B161	PN,NN,CTD	85° 30'00	28° 00'00
B162	PN,NN,MOC,CTD	85° 30'00	27° 30'00
B163	PN,NN,MOC,CTD	86° 00'00	28° 00'00
B164	PN,NN,CTD	86° 00'00	28° 30'00
B165	PN,NN,CTD	86° 00'00	29° 12'00
B166	PN,NN,CTD	86° 00'00	29° 30'00
B167	PN,NN,CTD	86° 00'00	30° 00'00

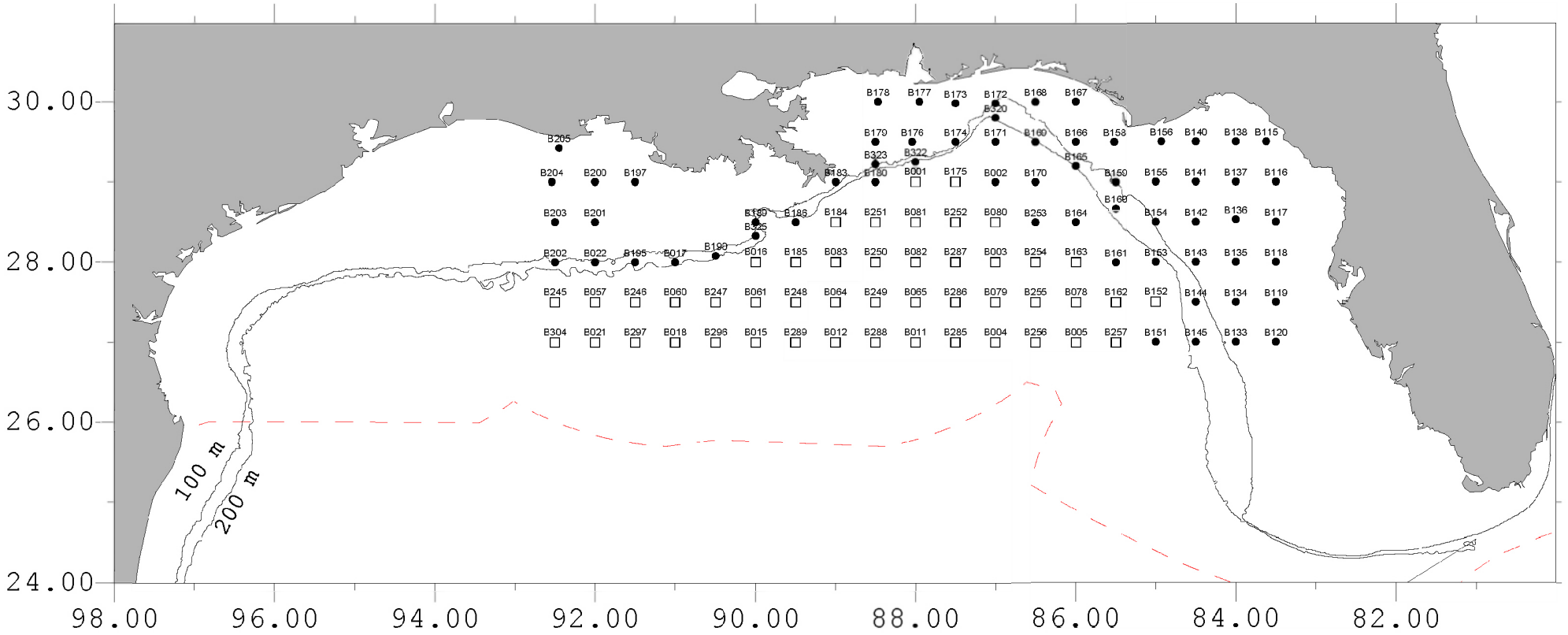
Table 1 continued

SEAMAP ISS Number	Plankton Gear	Latitude	Longitude
B168	PN,NN,CTD	86° 30'00	30° 00'00
B169	PN,NN,CTD	86° 30'00	29° 30'00
B170	PN,NN,CTD	86° 30'00	29° 00'00
B171	PN,NN,CTD	87° 00'00	29° 30'00
B172	PN,NN,CTD	87° 00'00	29° 59'00
B173	PN,NN,CTD	87° 30'00	29° 59'00
B174	PN,NN,CTD	87° 30'00	29° 30'00
B175	PN,NN,MOC,CTD	87° 30'00	29° 00'00
B176	PN,NN,CTD	88° 02.4'00	29° 30'00
B177	PN,NN,CTD	87° 57'00	30° 00'00
B178	PN,NN,CTD	88° 28.2'00	30° 00'00
B179	PN,NN,CTD	88° 30'00	29° 30'00
B180	PN,NN,CTD	88° 30'00	29° 00'00
B183	PN,NN,CTD	89° 00'00	29° 00'00
B184	PN,NN,MOC,CTD	89° 00'00	28° 30'00
B185	PN,NN,MOC,CTD	89° 30'00	28° 00'00
B186	PN,NN,CTD	89° 30'00	28° 30'00
B189	PN,NN,CTD	90° 00'00	28° 30'00
B190	PN,NN,CTD	90° 30'00	28° 05'00
B195	PN,NN,CTD	91° 30'00	28° 00'00
B197	PN,NN,CTD	91° 30'00	29° 00'00
B200	PN,NN,CTD	92° 00'00	29° 00'00
B201	PN,NN,CTD	92° 00'00	28° 30'00
B202	PN,NN,CTD	92° 30'00	28° 00'00
B203	PN,NN,CTD	92° 30'00	28° 30'00
B204	PN,NN,CTD	92° 32'30	29° 00'00
B205	PN,NN,CTD	92° 27'24	29° 25'00
B245	PN,NN,MOC,CTD	92° 30'00	27° 30'00
B246	PN,NN,MOC,CTD	91° 30'00	27° 30'00

Table 1 continued.

SEAMAP ISS Number	Plankton Gear	Latitude	Longitude
B247	PN,NN,MOC,CTD	90° 30'00	27° 30'00
B248	PN,NN,MOC,CTD	89° 30'00	27° 30'00
B249	PN,NN,MOC,CTD	88° 30'00	27° 30'00
B250	PN,NN,MOC,CTD	88° 30'00	28° 00'00
B251	PN,NN,MOC,CTD	88° 30'00	28° 30'00
B252	PN,NN,MOC,CTD	87° 30'00	28° 30'00
B253	PN,NN,CTD	86° 30'00	28° 30'00
B254	PN,NN,MOC,CTD	86° 30'00	28° 00'00
B255	PN,NN,MOC,CTD	86° 30'00	27° 30'00
B256	PN,NN,MOC,CTD	86° 30'00	27° 00'00
B257	PN,NN,MOC,CTD	85° 30'00	27° 00'00
B285	PN,NN,MOC,CTD	87 ° 30'00	27° 00'00
B286	PN,NN,MOC,CTD	87° 30'00	27° 30'00
B287	PN,NN,MOC,CTD	87° 30'00	28° 00'00
B288	PN,NN,MOC,CTD	88° 30'00	27° 00'00
B289	PN,NN,MOC,CTD	89° 30'00	27° 00'00
B296	PN,NN,MOC,CTD	90° 30'00	27° 00'00
B297	PN,NN,MOC,CTD	91° 30'00	27° 00'00
B304	PN,NN,MOC,CTD	92° 30'00	27° 00'00
B320	PN,NN,CTD	87° 00'00	29° 48'00
B322	PN,NN,CTD	88° 00'00	29° 15'00
B323	PN,NN,CTD	88° 30'00	29° 13.2'00
B325	PN,NN,CTD	90° 00	28° 20

Figure 1. Cruise track with plankton stations for NOAA Ship *Oregon II* cruise R2-11-01 (293), 16 February – 22 March 2011. Open squares represent stations where a bongo, neuston, and MOCNESS tow will be attempted. Closed circles represent stations where only bongo and neuston tows will be attempted.



SUBJECT: Safety Plan

PREPARED FOR: NRDA (Natural Resources Damage Assessment) Field Operations

REVISION: December 8, 2010

1. INTENT

1.1. The intent of this Field Safety Plan is to establish a structured process and disciplined approach to the mitigation of health, safety and environmental risks associated with our operations and activities. This safety plan applies to the Natural Resources Damage Assessment (NRDA) Team. This plan does not apply under the following situations:

- When water and air temperatures are both below 50 degrees Fahrenheit
- In air temperatures below 38 degrees Fahrenheit
- During small craft advisories
- When wind speeds exceed 25 knots
- Operations during dusk/evening
- In bad visibility and bad weather
- Offshore operations

If it is deemed necessary for operations to continue in any of the conditions outlined above, a separate job hazard evaluation must be approved and authorized by the NRDA On-Site Lead, BP-Cardno Entrix, applicable trustee representatives, the NRDA Safety Officer and NRDA Field Operations.

2. COMMUNICATIONS

2.1. A central responsible person not in the field should be aware of the daily plan, work locations, and team members for each team.

2.2. NRDA Field Teams will contact NRDA Operations (located at ICP New Orleans) as identified below to help ensure personnel accountability. Human Use field teams will report to Stratus Headquarters in Boulder, CO.

2.2.1. Departing for daily op area.

2.2.2. Mid day.

2.2.3. Termination of operations (e.g. transition to over-the-road vehicle and/or arrival place of lodging).

2.2.4. As soon as practical to report any health, safety, security, or environmental incident.

2.2.5. Using the 700mhz Radio and/or one of the following NRDA Ops contact numbers:

2.2.5.1. PRIMARY - NRDA Field Ops 504-303-2086/504-335-0863

2.2.5.2. SECONDARY – NRDA On-Site Lead 985-291-5186 (cell); noaa.mc252.nrdacoord@noaa.gov

2.2.5.3. For non-routine issues and the two above numbers can not be reached, CALL Nir Barnea (NOAA Safety) - 2 0 6 – 3 6 9 – 5 0 1 5 [nir.barnea@noaa.gov] or Troy Baker (ARD SE Regional Manager) – 225 -326-9765 [troy.baker@noaa.gov].

2.3. NRDA Team Members at ICP New Orleans will update the Field Teams Status Display upon notification from a NRDA Field Team.

2.4. Each NRDA Field Team will be provided with a copy of this safety plan

3. MINIMUM EQUIPMENT/RESOURCES FOR NEARSHORE AND SHORE-BASED OPERATIONS

3.1. One primary form of communication directly to the non-field responsible person (i.e. Cell Phone, 700/800 MHz Radio, or equivalent).

3.2. Secondary form of communication capable of directly reaching rescue personal in case of an emergency (i.e. Cell Phone or Marine VHF, etc.)

3.3. Marine VHF is required for all vessel-based operations. All vessels must have a fixed mount (not handheld)VHF Marine radio on board. Handheld GPS

3.4. First Aid Kit

3.5. Foul Weather Gear (rain jacket/pants)

3.6. PFD, Float Coat, and/or Immersion Suit as appropriate to Job Hazard Analysis

3.7. Cold Weather Kit (Dry Bag, Emergency Blanket, Warm Blanket, Dry Cloths, and Hand/Feet Warmers)

4. VEHICLE SAFETY

4.1. Pre-Trip Plan (Maps, directions)

4.2. Seat Belt use is mandatory

4.3. Observe posted safety notifications and speed limits.

4.4. DRIVER - Cell phone use both hand-held and hands-free, texting, and e-mailing is prohibited while driving. If necessary, park in a safe location (off the road) and use while parked.

5. ACCIDENTS – INJURIES – SPILLS – NEAR MISSES

5.1. Accidents and injuries should first be reported to an entity that can provide emergency assistance, if needed (USCG, 911, etc.)

5.2. Accidents, injuries, spills or near misses should then be reported to NRDA Field Ops within 15 minutes.

5.3. As soon as practical (but generally within 1 hour) accidents, injuries, spills or near misses must be reported by the NRDA Field Ops to the NRDA On-Site Lead. Required documentation will be managed by the NRDA On-Site Lead with assistance by involved personnel. The NRDA On-Site Lead will notify appropriate Incident

Management Team personnel including the BP Safety Officer at the Incident Command Post.

5.4. The NRDA On-Site Lead will report accidents, injuries, spills, or near misses to the all relevant federal, state, contractor, and BP/Entrix managers by email as soon as practicable following the incident.

6. TRAINING

6.1. Any member of a NRDA Field Team is required to have the following Safety Training.

- Level I and II BP Safety Induction
- HAZWOPER Certification
- PHI Helicopter Pre-Flight Safety Briefing (if flying in helicopters)
- Heat stress and cold stress training/awareness

7. PERSONAL PROTECTIVE EQUIPMENT

7.1. NRDA Field Team members are expected to utilize Personal Protective Equipment for the activity being performed. A task requiring PPE shall not be performed unless PPE is used (refer to the Job Hazard Analysis incorporated with this document).

7.2. Staff must adhere to and follow pilot/captain/operators safety related instructions at all times. The NRDA On-Site Lead is responsible for directing team activities and will help decide if safety issues preclude scheduled activities. All team members are responsible for individual and collective safety.

8. PRE OPERATION MEETING (Tail Gate Meeting)

A daily pre-operations meeting will be conducted on-site with each team by the field team leader. Job Hazard Analysis' are located below. Specific topics of discussion will include:

- Lessons learned from the prior day's mission or other missions
- Current weather and short-term forecast
- PPE requirements
- Communications / Notification Requirements
- Food and Water
- Location of nearest treatment facility or hospital
- Potential hazards to watch out for
- Overall situational awareness

9. JOB HAZARD ANALYSIS (see following pages)

- Shore Operations
- Small Boat / Air Boat Operations
- Helicopter Operations
- Fixed Wing Operations for biological aerial surveys

- Fencing/Station marking operations
- Pom-pom inspections
- Chain drags
- Oyster sample collection
- Water quality testing
- Sampling in Phragmites
- Marine-based operations in cold weather

10. DWH NRDA SAFETY, COMMUNICATION, AND ACCOUNTABILITY CHECKLIST

Technical Working Group:_____ State:_____

Field Activity:_____

Number of Teams:_____ Persons p/Team:_____ Duration:_____

Activity Type (check as appropriate): ☐ Shore-based Activity (i.e. does not require boat/aircraft) ☐ Small Boat/Shore Activity (i.e. requires small boat transport to sampling location) ☐ Vessel-Based Activity	**Cell Phone Service Availability** (check as appropriate): ☐ Reliable cell phone service from ALL major providers, at all times. ☐ Reliable cell phone service from some providers at all times. ☐ Limited or no cell phone service at some times.
Access to Emergency Assistance (check as appropriate): ☐ Direct access to local EMS services within 15 minutes. ☐ Delayed access to local EMS services (15-45 minutes). ☐ EMS access requires vessel and/or air evacuation.	**Accountability System** ☐ NRDA ICP Houma Field Ops ☐ NRDA Offshore Cruises ☐ MC252 Air Ops ☐ Alternative System: Responsible Person: _____ 24hr Phone#:_____
Primary Form of Communication (check one or more): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System	**Secondary Form of Communication** (check as appropriate): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System ☐ Marine VHF ☐ EPRIB/PLB or SPOT Tracker
Additional Safety and Accountability Resources (check as appropriate): ☐ Directions to Medical Facilities / Staging Areas ☐ First Aid Kit ☐ Advanced First Aid Kit ☐ Medically Trained Personnel ☐ Handheld GPS	

TASK	**NRDA Shore Survey Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New **X** Revised	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Goggles *(tinted as necessary)* Tyvek Coveralls and Boot Covering Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Walking Shore	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Insect Bites / Stings	Use mosquito repellant; and maintain Sting Swabs in First Aid Kit.
	Eye strain (sun light)	Wear tinted eyewear.
	Animals (snakes, alligators, and other non-domestic types)	Careful placement of feet and hands; No open toed shoes.
	Fall Into Water	Wear Personal Flotation Device when 10-feet or closer to water.
	Loss of Communication	Establish and maintain communications with ICP Houma, other vessels, and never separate NRDA workers from vessel where communications cannot be maintained.
	Working alone	Maintain buddy system at all times, personnel should not work alone
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin as well as clothing	Wear Tyvek (or similar) boot covering and coveralls; Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.
Use of Tools	Cuts / Scrapes	Use tools as designed and refrain from over-exerting shovel tips where loss of control could happen.

TASK	**Small Boat / Air Boat Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Sun Glasses Hearing Protection

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Vessel in Transit	Fall Overboard	Personal Flotation Device.
	No communication to/from vessel	All vessels must have a VHF Marine radio on board, permanently bolted to the structure
	Collision, Allision, or Grounding	Follow Navigational Rules of the Road; Maintain awareness; Know location; Maintain Communications.
	Overloading Vessel	Distribute weight evenly and do not exceed vessel capacity plate.
	Mechanical Issues	Keep spare parts, tools, etc. onboard and always know your fuel levels.
	Airborne Particulates and Insects	Wear safety glasses or safety goggles.
	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Pinch Points	Maintain control of doors/hatches; Keep fingers and feet clear of lines/ropes
	Noise	Double hearing protection must be worn onboard air boats.

TASK	**Air Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Heliports and along affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New X Revised	**PPE REQUIREMENTS**	Hearing Protection Personal Flotation Device (PFD)

Issue of Concern / Activity	Potential Hazards	Control Measures
Boarding Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured
In Flight	Noise, Water Landing, Motion Sickness	Hearing Protection, PFD, Medication
Departing Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured

TASK	**Fencing/marking operations**	**PERFORMED BY**	Nir Barnea (Safety Officer)
LOCATION	Affected area	**REVIEWED BY**	
DATE PREPARED	11/22/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Work gloves • Goggles • Hearing Protection • Hard toe boots • Personal Flotation Device (PFD) if near water

Issue of Concern / Activity	Potential Hazards	Control Measures
Driving stakes in the ground	• Hand, finger and foot injury from hammer impact • Hand and finger injury from slivers and sharp stakes • Eye injury from flying particles • Hearing impact from excessive noise • Drowning if work is near water	**PPE:** Use gloves, goggles, hard toe boots, hearing protection, and PFD (when working near water) **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Pom-Pom Inspection**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Boat Launches/Marinas in Louisiana, Alabama, Mississippi and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	11/23/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Plate Glass in UV Box • Goggles (if plate glass is absent) • Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Pom-pom inspection under ultra violet light	• Skin irritation is possible if exposure occurs for long periods of time. • Eye inflammation and irritation is possible if looking directly at the source of radiation	**PPE:** Plate glass should be in place in the UV box. Goggles (or glasses) should be worn if plate glass is missing. Nitrile gloves should be worn when handling pom-poms. **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Chain drags**
LOCATION	Nearshore locations in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile Gloves • Safety Glasses • PFDs

Issue of Concern / Activity	Potential Hazards	Control Measures
Lifting and handling the chains	• Back strain from handling chain with improper form • Hand contamination • Potential hand or finger injury if catches in the chain.	**PPE:** Nitrile gloves should be worn if there is potential for contamination when handling sentinels, pom-poms, chains and seawater and other materials. PFDs should be worn on the water **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin	Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.

TASK	**Use of sharp objects (Scissors, wire cutters)**
LOCATION	Nearshore waters and shoreline from Louisiana to Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Kevlar work gloves • PFD (if on the water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Use of sharp objects	• Cuts, scrape, etc.	**PPE:** Wear knit Kevlar work gloves when using sharp tools and a risk of cutting exists **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Oyster sample collection**	**PERFORMED BY**	Alāna Wilson
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	11/23/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Nitrile gloves • Knit Kevlar work gloves • PFD

Issue of Concern / Activity	Potential Hazards	Control Measures
Dredging	• Heavy lifting	**PPE:** • PFD (both on the water and when collecting samples from shore) **Administrative:** • Follow proper ergonomic behavior for heavy lifting • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Collection of oyster samples (via dredge, quadrat or by hand)	• Contact with sharp objects • Slippery footing in intertidal zones	**PPE:** • Wear disposable knit Kevlar work gloves OVER nitrile gloves anytime handling sharp objects (e.g. oysters) • PFD (both on the water and when collecting samples from shore) • Waders, with proper grip for walking during intertidal sampling

TASK	**Water quality testing**
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Alāna Wilson
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile gloves • Goggles to prevent eye contact with the calibration solution if splash occurs

Issue of Concern / Activity	Potential Hazards	Control Measures
Calibration of water quality meter	• Contact with calibration solution	**PPE:** Wear nitrile gloves and goggles when calibrating the water quality meters **Administrative:** • Include MSDS in meter kit
Measurement of water quality parameters	• Contact with potentially contaminated seawater	**PPE:** Wear nitrile gloves when handling the meter probe and when lowering it into or pulling it out of the water

TASK	**Sampling in Phragmites**	**PERFORMED BY**	Allan Hooker
LOCATION	Phragmites stands	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/04/2003 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Kevlar gloves • Fully enclosed goggles • Full length, heavyweight shirt and pants • PFD (if on water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any work within Phragmites	• Eye injury • Skin punctures/abrasions • Drowning if work in near water	**PPE:** Kevlar gloves and full length shirt and pants should be worn to prevent skin punctures/abrasions. Fully enclosed goggles should be worn to protect the eyes. A PFD should be worn when working on or near the water. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Marine-based Operations in Cold Weather**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Throughout Louisiana, Mississippi, Alabama and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/06/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Float Coats • Warm clothing

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any marine based operations when water temperatures are below 60 degrees Fahrenheit.	• Cold Stress (Hypothermia, Frostbite, Trench Foot, Chilblain-Red, Surface Transportation and Icing)	**PPE:** Multiple layers of clothing should be worn and clothing to protect the hands, feet and head should be worn to minimize effects of the cold. A float coat must be worn when water temperatures are below 60 degrees at any time during operations. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available • Marine based operations must cease when air and water temperatures are both below 50 degrees Fahrenheit • No operations at night, in bad visibility, bad weather, when wind speed >25 knots, when small craft advisory issued • No operations on any vessel deemed unsafe for any reason or missing any necessary equipment such as VHF radio.

TASK	**Fill in general task**
LOCATION	Fill in location
DATE PREPARED	Xx/xx/xxxx New [X] Revised [ ]

PERFORMED BY	Fill in person performing hazard analysis
REVIEWED BY	Fill in person reviewing and approving
PPE REQUIREMENTS	• PPE 1 • PPE 2 • PPE 3

Issue of Concern / Activity	Potential Hazards	Control Measures
Fill in activity	• Hazard 1 • Hazard 2 • Hazard 3 • Etc.	**PPE:** Fill in specific PPE used **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

SIMOPS & Offshore Reporting Procedures for the NRDA Scientific Fleet

All NRDA Scientific Vessels must adhere to SIMOPS Guidelines when Approaching within 5 nautical miles of the Deepwater Horizon wellhead located at 28° 44.315'N 88° 21.991'W.

All NRDA Operations Must File 48 Hour pre departure contact as well as the Daily SITREP when conducting operations.

48 Hours Prior to Departure:

1. Inform Joint NRDA Representative Chad Smith (NOAA) via e-mail of your anticipated departure time, closest point of approach to the wellhead, nature of the gear to be used and the make, model and frequency of any acoustics to be used 48 hours prior to departure. Send email with the subject line "[Vessel Name]: Pre-departure Contact" to:
    a. chad.smith@darkwatermarine.com (Joint NRDA Vessel Operations Coordinator)
    b. dwhnrdafieldops@gmail.com (NOAA Representitive)
2. Begin daily filing of the Vessel SITREP form supplied by the Joint NRDA Vessel Operations Committee 48 hours prior to departure. This is to be sent to both Vessel Operations Coordinator Chad Smith (NOAA) and Project Scientist Jodi Harney (Entrix). Send e-mails with the subject line: "[Vessel Name]: Daily Vessel SITREP" to:
    a. chad.smith@darkwatermarine.com (Joint NRDA Vessel Operations Coordinator)
    b. jodi.harney@cardno.com (BP/Cardno ENTRIX Representative)
    c. dwhnrdafieldops@gmail.com (NOAA Representative)

For the Duration of the Cruise:

1. Continue filing the Vessel SITREP form supplied by the Joint NRDA Vessel Operations Committee daily. This is to be sent to both Vessel Operations Coordinator Chad Smith (NOAA) and Project Scientist Jodi Harney (Entrix). Send e-mails with the subject line: "[Vessel Name]: Daily Vessel SITREP" to:
    a. chad.smith@darkwatermarine.com (Joint NRDA Vessel Operations Coordinator)
    b. jodi.harney@cardno.com (BP/Cardno ENTRIX Representative)
    c. dwhnrdafieldops@gmail.com (NOAA Representative)
2. On the day of departure begin calling into the daily SIMOPS conference call at 0830 central standard time. Identify yourself with your vessel's name and have the following information ready:
    a) **HSE / SIMOPS Issues**- Health, safety or traffic issues experienced in the last 24 hours.
    b) **POB** – Number of people on your vessel
    c) **Non Essentials**- This is the number of people your vessel requires BP to evacuate by helicopter in the event of a storm. This number is always 0 for scientific ships.
    d) **T-Time**- The maximum time it will take you to recover your gear in the event of a weather evacuation, given in 1 hour increments. For Scientific vessels this is typically 1 hour.
    e) **Current Operation**- Very brief statement of the vessel's current activity, location and plan for the day.

Safety Information:

- **Acoustics** – When using acoustics with in the 5 nautical mile buffer zone, permission must be granted by SIMOPS and your frequency channel assigned. This is obtained via your 48 hour pre-departure contact with Chad

Smith. This includes echo sounders, multi beam, USBL and ACDP use. The vessel must be prepared to discontinue acoustic transmission immediately if SIMOPS or any vessel in field reports an interference. VHF and SAT phone must be monitored closely for such contact. Rapid response and monitoring of communications in this situation is an **absolute safety imperative**.

- **Wellhead Access** – When approaching within 5 nautical miles of the wellhead or the vessels engaged in operations at the wellhead permission from SIMOPS must be obtained prior to departure via the 48 hour pre-departure contact. Permission must also be obtained immediately prior to entry into the 5 nautical mile zone from the infield SIMOPS representative aboard the Development Driller II (DD2) via VHF Channel 16 or 6. Approach within 1 nautical mile of the wellhead or the ships engaged in operations there is **strictly prohibited.**

Definitions:

1. **SIMOPS:** Simultaneous Operations exists as a coordination and informational medium run by BP America and based in Houston TX. It is the mission of SIMOPS to facilitate safe and coordinated operations at and around the spill site in Mississippi Canyon Block 252.
2. **Joint NRDA Vessel Operations Committee:** A group representing the offshore vessel needs and coordination of both the Trustee and BP/Cardno ENTRIX NRDA efforts.
3. **NRDA Field Ops**: Trustee NRDA Field Ops facilitates the placement of crews and assists with general logistics in addition to generating fleet reports.

Important Contacts:

Name/ Affiliation	Title	Email	Phone
	NRDA		
Chad Smith (NOAA)	Vessel Ops Coordinator	chad.smith@darkwatermarine.com	(617)-999-4163
Jodi Harney (ENTRIX)	Project Scientist	jodi.harney@cardno.com	(407)-408-3154
NOAA NRDA Field Ops	Trustee Logistics	dwhnrdafieldops@gmail.com	(504)-410-7787
Bob Mulcahy (CSA)	Operations Lead	rmulcahy@conshelf.com	(561)-758-7152
Eileen Graham (NOAA)	Project Scientist	egraham@asascience.com	(443)-745-5323
Jenna Cragan (NOAA)	Project Scientist	jcragan@asascience.com	(401)-316-5600
	SIMOPS		
SIMOPS	Director	MC252_SIMOPS@bp.com	(281)-366-4315
0830 Daily Call In	Conference call	Code 8056242962#	(866)-634-1110

Important Coordinates:

Landmark	Latitude	Longitude
MC252 Wellhead	28° 44.315' N	88° 21.991' W
Deepwater Horizon Wreckage	28° 44.483’ N	88° 22.050’ W

DWH Vessel Daily SitRep

Vessel Name: | In Port ○ | Underway ◉ | Date:

Next Port of Call: | ETA/ETD:

Current Position: | Time (24 hr):

Latitude: | Longitude:

Cruise Plan Title:

Current Operations:

Operating within 15 NM/28 km of Wellhead? YES ◉ NO ○

If yes, list acoustic instrumentation onboard and frequencies used.

Operational Issues:

Additional Comments:

Submitted by:

Email daily by 0800 to:
chad.smith@darkwatermarine.com (Vessel Ops)
dwhnrdafieldops@gmail.com (Trustee Rep)
jodi.harney@cardno.com (BP Rep)

NRDA Field Sampler Data Management Protocol

10-22-2010

MS Canyon 252 (Deepwater Horizon) Oil Spill

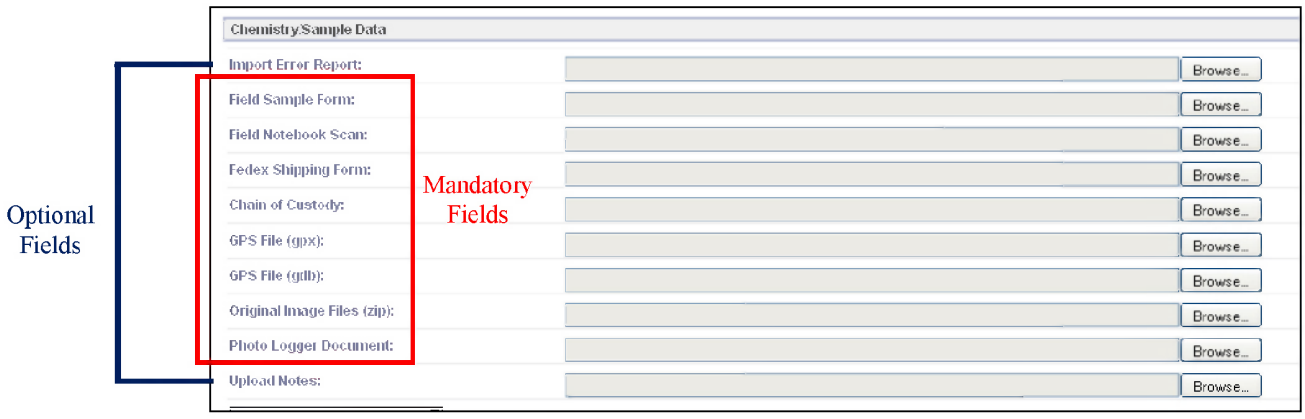
NOTE: THESE INSTRUCTIONS REPLACE ALL PREVIOUS INSTRUCTIONS.

These instructions update the protocol for preparing field sample records and uploading field sampling data into NOAA's NRDA Content Management System (www.noaanrda.org) and match the sampling forms version 16.2.1 updated in July 2010. NRDA samples submitted for chemistry must comply with the documentation requirements set forth in the NOAA field sampling form documentation and outlined below. Samples that do not meet these requirements will not be processed by the laboratory. Individuals who submit samples that do not comply with documentation requirements will be instructed on proper procedures and be given the opportunity to correct any deficiencies; however, this will delay data acquisition. This system was developed with both legal and scientific considerations. Prior to undertaking any sampling, please familiarize yourself with all of the required data elements on the forms relevant to your effort. These documentation requirements are relevant to all work groups, with the exception of the sub-surface multi-depth water sampling conducted on research cruises, which is subject to its own documentation requirements (see Cruise Data Protocol document).

A weekly Q&A session for field samplers (Wednesday at 4pm CDT) goes through the contents of this protocol. Please join the webinar if you are new to NRDA Field Sampling or if you have questions about field sampling protocol. The number to call in to the webinar is 866-763-3375 and the Participant Code is 9557764, and the webinar is presented at https://www1.gotomeeting.com/join/454999441

NRDA Sample Data Requirements

All analytical sample data must be submitted through the NOAA NRDA Content Management System. A complete file collection must include those listed as Mandatory in the graphic below. In the event that all Mandatory files are not uploaded, the sampling event will not be included the database and you will be notified by a representative from the NRDA Data Management team. The only optional fields include Import Error Report and Upload Notes.



To gain access to the NOAA NRDA Content Management Site, users must request access via support@noaanrda.org or call (866) 974-0614. Each component of a complete file collection is discussed below.

Field Sample Documentation

The NRDA Field Sample Form and related guidance documents are located on the NOAA NRDA site (*Documents* > *Field Sample Form*). When a sample is collected for chemical analysis, the following documentation is required and must be provided in order for the samples to be accepted for analysis:

- **Sample collection information**: **All** fields on the applicable NRDA Sample Collection Form (Oil-Tarball-Water, Soil-Sediment, or Tissue-Wrack) must be filled out, with the exception of those fields noted below. There are three options to record this required information:
    a. Use the matrix-specific NRDA Sample Collection Forms;
    b. Record **all** the required information on paper (e.g, other form, log book); or
    c. Record **all** the required information directly into a spreadsheet.
- **NRDA Chain of Custody (CoC) Form**: Complete all fields in the COC form with the exception of the fields noted below. NOTE: Written documentation must be in the NRDA format for this project.
- **Field log books:** If a log book is used, either the log book must be submitted for scanning or appropriate scanned pages must be delivered with the samples. Originals may be demanded in the future; they must be kept by your agency or turned in to the SIC or other NOAA representative.

All data fields on the forms are to be ***completely*** filled out. Exceptions to the data field requirements are very limited:

- NRDA CoC form
    - Analyses Requested (if uncertain, select "As per sample plan" in picklist)
    - Lab Name (if unknown, please write "Lab")
    - Waybill Number (Laboratory will fill in if coolers are sealed prior to obtaining waybill number)
    - Turn Around Time
- NRDA Sample Collection Forms
    - Resource Group Leader (Preferred, but not legally required)
    - Chain of Custody Field CoC information (Only if an intermediary delivers samples from sample site to SIC)
    - Notes sections (The notes sections are not mandatory; however samplers are encouraged to use these sections to provide additional detail.

Pre-Field Sampling Protocol

I. Before going into the field for the first time, the NRDA field sampler should watch the sample training videos and review the Field Form User Guide (Documentation > Sampling Training Session). Any outstanding questions can be addressed via email (dwhnrda@gmail.com), the **Field Sample Form helpline at (985) 746-1394**, or through attending the weekly Q&A session. This explains the official NOAA NRDA field sampling form.

II. Before going into the field *each day*, the NRDA field samplers should generally complete two tasks.

1. Print necessary field sampling forms (*Documentation > Field Sampling Form*).

2. Determine your NRDA Sampling Grid Location Code (*Documentation > NRDA Grid Location Code Maps*).

Near-Shore/Land Sampling:
a. Choose the index map for the state in which you will be sampling.
b. Find the sampling grid map corresponding to the specific area in which you will be working.
(*Documentation > NRDA Grid Location Code Maps*)

c. Use the sampling grid map to find the grid in which you will be working. The codes are noted in the center of each cell.

Water-Based Sampling:
Given the extent of the Gulf activities, for open water-based sampling please use the following convention:
- GU (for Gulf of Mexico) or EC (for East Coast, east of the Florida Keys)
- Degree Latitude
- Degree Longitude

For example, in the Gulf of Mexico sampling location 27.30 North and -88.30 West code would be GU2788.

Sample Collection Information Options

With every chemistry sampling event, the information on both the matrix-specific NRDA Sample Collection Forms and the NRDA Chain of Custody Form must be collected. For legal defensibility, original copies of all documents must be retained. Individual agencies may choose to retain custody of these documents (field forms, log books) and

provide only electronic copies to NOAA; in this case, the individual agency is responsible for providing the material in the event of a discovery request. Alternatively, the original documents may be signed over to NOAA and its contractors, and will be retained in secure document storage.

Some sampling teams may find it convenient or necessary to use formats besides the NRDA Sampling Collection Form to capture this information. There are three options to record this information. If you do multiple days of sampling, you need to fill out one electronic field form per day.

1. ***Use the NRDA Sample Collection Form for the specific matrix you are working with*** (strongly recommended option). The three NRDA Sample Collection Forms are:
   - Oil/Tarball/Water (use separate forms to track water versus oil/tarball)
   - Tissue/Wrack
   - Soil/Sediment

   The completed original NRDA Sample Collection Form is turned in with the samples when using a Sample Intake Center (SIC). If the sampling team is not using a SIC, the data from this form are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded to the NOAA NRDA site with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy via a traceable carrier (e.g. U.S. registered mail, FedEx, UPS or similar) to the NRDA document manager:

   NRDA Document Manager
   c/o Industrial Economics
   2067 Massachusetts Avenue
   Cambridge, MA 02140

2. ***Use a form other than the NRDA Sample Collection Form for recording the required information.*** The information can be recorded on another form or in a field log book. It is imperative that **all** required fields from the NRDA Sample Collection Form be recorded (see above requirements). When using a form other than the NRDA Sample Collection Form, the original form or field log book must be turned into the SIC. If the sampling team is not using a SIC, the data from the form or field log book are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy to the NRDA document manager (see address above).

3. ***Use a computer to input the information directly into a spreadsheet***. The required information from the NRDA Sample Collection Form can be recorded directly into a computer provided the following steps are followed:
   a. The computer file is recorded on a CD/DVD (non-rewritable) at the end of each field day.
   b. The following is recorded on the CD/DVD label:
      i. Name of person entering data into the computer system
      ii. Date of sample collection/data input
      iii. Make and serial number of the computer
      iv. Software used and version number
   c. A NRDA Chain of Custody is completed for transfer of the CD/DVD
   d. The files on the CD/DVD are uploaded to the NOAA NRDA website.

   The original file is kept on the computer system until it is verified that the CD/DVD recorded properly. This CD/DVD is turned in with the samples if using a SIC. If the sampling team is not using a SIC, this CD/DVD must be sent to the NRDA document manager under chain of custody (i.e., with a CoC form and using a secure carrier such as FedEx).

If you have questions or need assistance with the workbook please first look for the answer in the User Guide, then try to attend the weekly webinar. If you cannot attend the webinar, you may call the field sampling form/COC **helpline number at (985) 746-1394**. Again, general questions regarding the forms may posted to NRDA Gmail address (dwhnrda@gmail.com); inquiries are usually responded to within 24 hours.

Regardless of which reporting approach you choose, name the file using the following naming convention. The date is the **date sampled** (if multiple sampling days *on cruises only*, use the last day of samples).

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>.xls

For example:
2010_0701_SMITH_JOHN_FieldSampleForm.xls

Scanning Field Form Documents

Scans of all paper forms used in the field and any log book entries must be included in the file collection upload. All sample intake centers have scanners.

Chain of Custody (COC) Forms and Mailing Labels

Please scan your ***signed*** COC forms and mailing labels. Note that the NOAA Spreadsheet will create a custom COC form based on your inputs. NOAA NRDA samples require the use of the NOAA NRDA COC.

Photos and GPS

Photos are taken in the field for two primary reasons: to validate the field sampling effort and to provide a visual description of field conditions and operations. The GPS is required to geo-locate the photos to a particular time and place for legal reasons. Samples will be accepted without photo documentation, but any submitted photos must follow the NRDA documentation requirements.

Pre-Field Photo/GPS Protocol

I. Read through the field photo validation documents located on NOAA NRDA (*Documentation > Photos and GPS*) which include: NRDA Field Photography Guidance, Basic GPS Skills and Garmin MapSource

II. Make sure digital camera has charged batteries, is set to a high resolution, and uses JPEG file format (not RAW).

III. Set the camera to local time and date; the time should be in 24h military time.

IV. Have a back up of all past information, and clear camera and GPS before each sampling day.

V. Set the GPS to Datum - WGS 1984, 24h military time with the correct time and date, set the track log to "wrap when full", and make sure the GPS is set in decimal degrees. The batteries for the GPS should also be fully charged.

Field Photo and GPS Protocol

I. Turn on your GPS. Leave it on for the entire sampling day.

II. Take one photo of your GPS screen which displays the time (including seconds) and date clearly. Make sure the GPS screen is clear in the photo. This will be used with the GPS track log to geo-locate the photos.

III. Take photos of the field samples and sampling effort. Remember, for legal reasons, do not delete or rename photos.

Post-Field Photo and GPS Protocol

I. Download your photos from that day's sampling only. Place them in a folder called Photos to be included in the zip file. Do not open, delete or rename any of the photos. If you wish to view your photos, you may download them again to your own personal folder and view them. Sample Intake Centers can also upload your photos.

II. Download the GPS Track Log and way points using Garmin MapSource. Save the points twice from MapSource: once as a Garmin Database file (.gdb) and once as a GPS exchange file (.gpx). If you have other non-Garmin GPS/latitude longitude information, please provide GPS locations in a format (e.g., excel) that links the photo name with its coordinates. If the field locations are staffed with members of the data management team, they can assist you with this process.

III. Fill out the NRDA Photo Logger form. This is required and located on NOAA NRDA *(Documentation > Photos and GPS*). Without the form, the data management team will not be able to log your photos.

Uploading the File Collection to the NOAA NRDA Website

Naming Convention for Uploaded Files

Naming files in a consistent way will greatly speed up the processing of the sampling information. Please use the following naming convention (the date field representing the sample date):

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>

For example:
2010_0505_SMITH_JOHN_PhotologgerForm.PDF

Uploading Sample Information and Notifying Data Management

To upload all associated with a sample and/or observation event, go to the NOAA NRDA site at: www.noaanrda.org

On the left-hand navigation columns, click on "Data Entry/Data Exports" under the **Access/Post Data** heading. From here, users will notice a link to the Uploading Tool. Under the **Workgroup:** dropdown menu, choose "-All Sample Data/Chemistry" and click on the **Upload** control button in the upper right-hand corner. This will navigate the user to the actual page for file collection uploads.

Choose the Workgroup and Workplan related to your sample team (if you do not know this, contact your Technical Workgroup lead). From here you will be asked whether observational data was also collected during the sampling event. If you have observational data, you will be prompted to enter this information in a portion of the NOAA NRDA site dedicated to observation data (from there, users can also upload sample data). Otherwise, if a user does not have observational data, a series of data entry prompts will appear. This includes prompts to enter general information about the sampling event and places to upload specific files. Note that the NOAA NRDA site currently has a limit of 1 GB *per file.* If you have files that are larger than 1 GB, please split into multiple files, label appropriately, and enter in the additional files using the dropdown that the bottom of the Sample/Chemistry Data section. Here, users can specify the type of auxiliary document associated with the file collection.

Also, please do not scan documents at a resolution higher than 300 DPI. This will help keep file size down.

*******IMPORTANT*******

Once you have uploaded the file collection to NOAA NRDA, you must alert the data management staff. Please send an email to the Gmail account (dwhnrda@gmail.com) as notification. Specifically, please use the following subject heading: SAMPLE TO NOAA NRDA<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>> For example: SAMPLE TO NOAA NRDA 2010_0505_SMITH_JOHN

Once again, thank you very much for following these procedures. Assistance from all sampling teams will improve efficiency and reduce our need to call you back for missing information.

Transfer of Personnel and Material at Sea

Purpose

This protocol applies to vessel operations involving the joint research being conducted aboard the Entrix/CSA research vessels in conjunction with the MC -252 Deepwater Horizon Spill Response efforts.

The type of water sampling being conducted on this mission requires lab analysis ashore of samples within 7 days from the time they are taken. Sample degradation occurs rapidly, necessitating supply vessels to recover these samples within 72 to 96 hours of collection from the sampling vessels or at other regular intervals on extended missions. Other supplies including food, equipment or spare parts may be transferred also. In addition to samples and supplies, personnel issues may require transfer of personnel from one vessel to another. These circumstances may arise from a medical emergency or other significant personal issue. This protocol is to provide safety guidance when conducting these operations at sea. This protocol is designed to apply to operations where the following conditions are true:

1. A vessel or vessels need supplies, equipment or spare parts,
2. A vessel or vessels need to discharge samples
3. Items to be transferred consist of scientific supplies to support the mission.
4. Personnel emergencies

For the purposes of this mission, all materials to be transferred are items that can be carried by 1 or 2 people. The bulk of these supplies include scientific equipment, water samples and personal effects. These rules do not apply to visitors to the ship including press, family members and USCG boarding personnel.

Application

It is the ultimate responsibility of the Master of each vessel involved to ensure the safety of all personnel involved in the operation. The Master of either vessel shall call off the operations if he or she believes it to be unsafe for any reason. Nothing in this protocol relieves the Master of this responsibility. The Master's judgment shall take into account (but is not limited to) the following factors:

1. Sea conditions
2. Weather conditions
3. Vessels involved
4. Crew fatigue
5. Crew experience
6. Equipment
7. Type and quantity of material to be transferred

This operation, except in the event of an emergency, shall not be conducted in the following conditions:

1. Night,

2. Restricted visibility,
3. Where traffic proximity is cause for concern and may involve a risk of collision,
4. Over a World Meteorological Organization (WMO) sea state of 3,
5. Where transferring goods at the dock is possible and practical,
6. Communications between the 2 vessels has not been established,
7. Where the Master of either vessel has any doubt.

Procedure

All at sea transfers shall be conducted only in daylight and at the discretion of the Master.

The method of approach shall be agreed upon by the Masters of both vessels. It is the choice of the Master to select the approach that is safest with regard to vessel type, configuration, fendering, deck height, vessel maneuverability as well as any other factors which may affect the operation. The operation described herein is common practice for such operations and shall be regarded as the default plan for all such operations.

Communication via VHF radio will be established and maintained throughout the entire operation.

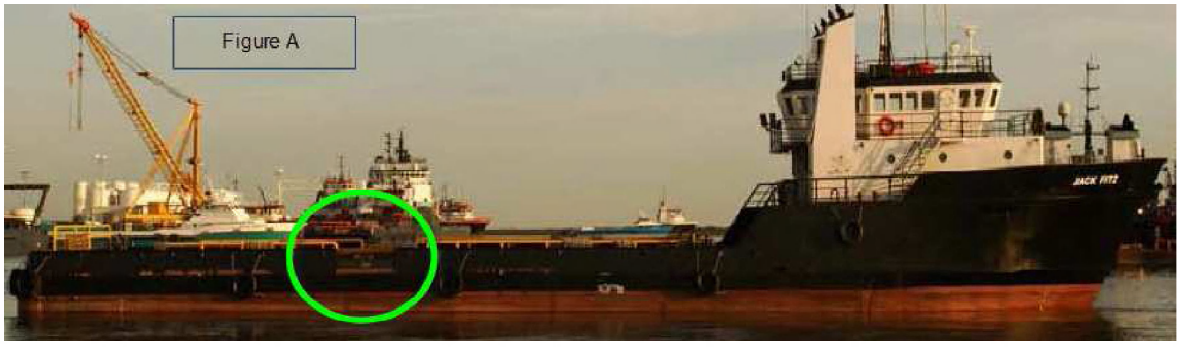
The wheelhouses of both vessels shall be manned during the entire operation.

One individual aboard the Vessel other than the person(s) manning the wheelhouse shall supervise the operation on site and be in communication with the Vessel wheelhouse.

One individual on the Vessel shall be designated to stand by the transfer site with a life ring at the ready in the event of a man overboard. This individual will also be equipped with a radio.

The Vessel shall, where practicable, be positioned in such a manner as to provide a lee and shelter the pilot boat from wind and waves.

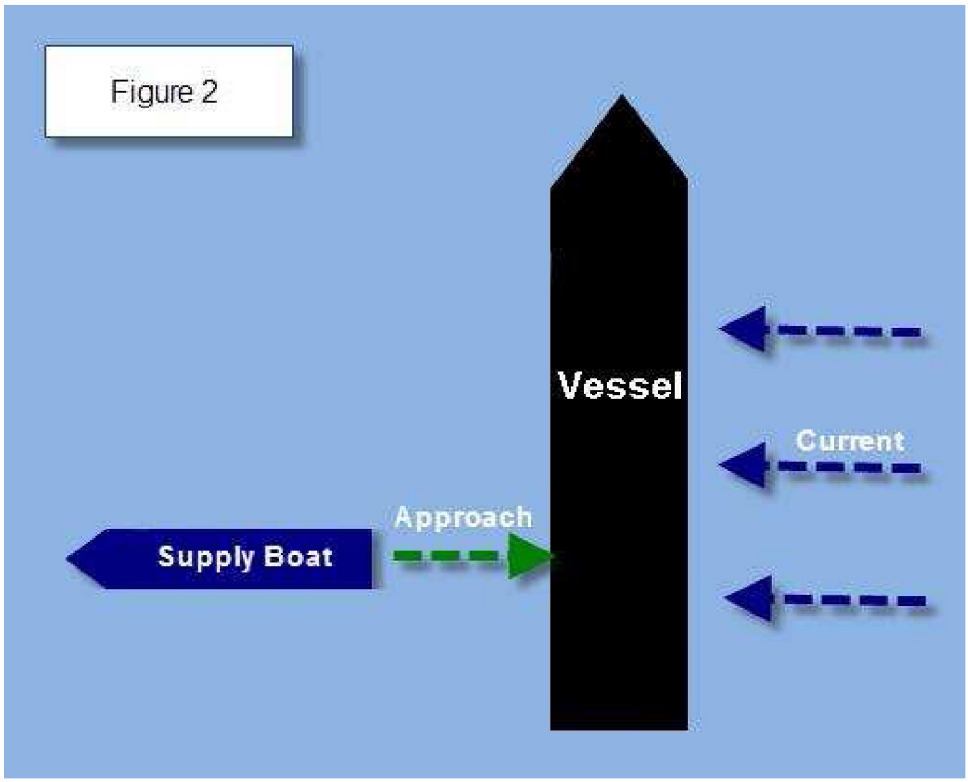
The Vessel shall load from her aft deck either port or starboard side where the break in the gunwale provides the best access to the waterline with the least freeboard to the deck as shown in Figure A.



The vessel shall make no way as the supply vessel approaches.

The supply vessel will make contact with her centerline perpendicular to the hull of the Vessel (see fig. 2).

The supply vessel, where properly fendered, shall approach the Vessel down current and stern to (see fig 2).



Contact between the vessels shall be made while coasting at a safe and minimal speed. Forward propulsion by the supply boat may be used to slow the approach. If during the approach the docking angle is lost, the vessels shall reposition where safe and appropriate for another attempt.

No lines or entanglements shall make fast one vessel to the other.

If the vertical distance between the 2 decks used in the operation on either vessel is greater than 12 inches, then a pilot ladder or other approved boarding equipment shall be used.

Material shall be transferred in a slow and deliberate manner.

If a crane is available, all materials shall be handed across using the crane to move materials from one vessel to another.

Other than in an emergency, vessels will break contact only under the following conditions:

1. The supervisor has ensured all personnel are in a safe position to break contact,
2. The pilot ladder has been recovered,
3. The Masters of both vessels involved agree to end the operation,
4. It is safe to do so.

PPE

All personnel on deck must wear an approved buoyant work vest.

All personnel involved in the operation on deck shall wear an approved hard hat, safety glasses, long pants and closed toe shoes/steel toe shoes where company safety regulations apply.

Requisition

At sea transfer missions shall be requested prior to the Vessel's departure from the port and incorporated into the vessel's mission planning.

Emergency

Nothing in this protocol shall prevent the master of either vessel from taking action in an emergency. This protocol governs only routine scientific supply transfers. The ability of the master to transfer personnel, stores or equipment in a safety or medical emergency shall not be infringed.

MC 252 Standing Order		
TO: All Personnel assigned to MC252 Response		
FROM: Tad Lynch	POSITION: Houston IC Safety Officer	
SUBJECT: Incident Reporting	DATE: 02 May 2010	Time: 1630 hrs

1.0 PURPOSE AND SCOPE

The purpose of this Standing Order is to establish a consistent HSSE incident reporting process for MC252 response personnel. Response personnel include all Federal employees, BP employees, Contractors, Visitors, and other third parties. These minimum reporting requirements are for response operations and are not intended to replace site or project-specific incident and emergency response procedures and policies. The ultimate purpose is to enable and foster a culture of sharing and continuous improvement through identifying trends, special focus needs, case management, HSSE performance and sharing lessons learned.

2.0 RESPONSIBILITIES

All personnel involved in the MC 252 response who are personally involved in, or witness an incident or near miss; are required to immediately notify the person in charge or BP Supervisor who is responsible for the work being conducted. The person in charge or BP Supervisor is responsible for making timely notifications to the appropriate Incident Command or Unified Area Command - Safety Officer (currently Houma, Houston, Mobile, and Robert).

Robert SO (985) 709-5522 **Houma SO (985) 493-7812**
Houston SO (281) 366-6916 **Mobile SO (251) 445-8690**

3.0 NOTIFICATION REQUIREMENTS

Incident Classification	**Notification Time**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Immediately
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment), First Aids, or Near Miss	Within 2 hours

4.0 REPORTING STRUCTURE

Safety Officers and/or Health & Safety Unit Leaders are required to report all incidents and near misses to the Safety Officer in Robert, La. - **(985) 709-5522.** After verbal notification has been made, send written incident reports and associated documentation to *MC252Safety@bp.com*.

Input into Traction will be completed by an HSSE Technician in Houston. The Tech will access information via the above e-mail location.

NOTE: If you are a Safety Officer and are not on the MC252Safety@bp.com distribution list, contact the number above and they will submit your information to IT&S to get you set up.

5.0 REQUIRED INFORMATION

Instructions: The Initial Incident Report should be completed using the attached GoM Preliminary HSSE Incident Report "Short Form", or an equivalent contractor supplied form. At a minimum, information should include the following and sent to *MC252Safety@bp.com*.

C:\Documents and Settings\churchtr\My

Minimum information to include:

Report Date:
Date / Time Occurred:
Date / Time Reported:
Type of Incident: First Aid, Recordable, Near Miss, Spill, HIPO, MIA
Location (Circle One): Offshore or Onshore
Site / Vessel:
Company/Agency/Volunteer Group involved:
Event Description:
Completed by:
Contact Phone #:

6.0 INCIDENT INVESTIGATION

The level of investigation performed will depend on the actual and potential severity outcomes. The level of investigation and responsible organization are listed below.

Incident Classification	**Investigation Requirements**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Houston Safety Officer and Tim Church will determine level of investigation and team make-up.
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment),	Local investigation. One-page Lessons Learned document will be developed by Tim Church from local investigation report.
First Aids, or Near Miss	Local investigation. Incident report containing information outlined in Section 5.

7.0 HSSE PERFROMANCE SCORECARD

The Safety Officer in Robert will report incidents to the Unified Area Command BP Liaison and BP Aide de Camp. They will also update and distribute the HSSE Performance summary and scorecard daily by 1100 hrs. It is responsibility of each IC Safety Officer to distribute the information to appropriate command and planning staff.

Safety Officer Name:	Date:
Signature:	Approval Signature:

ANALYTICAL QUALITY ASSURANCE PLAN

MISSISSIPPI CANYON 252 (DEEPWATER HORIZON) NATURAL RESOURCE DAMAGE ASSESSMENT

Version 2.2

Prepared for:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

January 20, 2011

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VERSION 2.2 CHANGES FROM VERSION 2.1:

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<tr><td>Cover</td><td>Updated version # & date</td></tr>
<tr><td>Acronyms</td><td>Inserted DOSS</td></tr>
<tr><td>4</td><td>Inserted discussion re: Corexit Indicator Compound analysis (see below)
• Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in Table 1.1.g. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.</td></tr>
<tr><td>4</td><td>Corrected table reference – Table 1.1g to Table 6.1g</td></tr>
<tr><td>5</td><td>In table removed X from SHC/TEH for Tissue</td></tr>
<tr><td>7</td><td>Removed Water (TEH) from Target MDL</td></tr>
<tr><td>7</td><td>Added Target Reporting Limit for Water (TEH/TEM) at 200 ug/L</td></tr>
<tr><td>10</td><td>Added T22a-Gammacerane/C32-diahopane to Table 1.1e –Petroleum Biomarkers</td></tr>
<tr><td>11</td><td>Added Corexit Indicator Compounds table (Table 1.1g)
TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only (monitoring mass/charge ion)
<table>
<tr><td>2-Butoxyethanol (m/z 87, 75)</td></tr>
<tr><td>Glycol ether Isomers (m/z 59, 103)</td></tr>
<tr><td>Bis-(2-ethylhexyl) fumarate (m/z 112, 211)</td></tr>
</table></td></tr>
<tr><td>13</td><td>Corrected Greg Salata email address to gsalata@caslab.com</td></tr>
<tr><td>14</td><td>Added two rows to preservation and holding time table – Sediment for VOC, and Water for DOSS
<table>
<tr><td>Section 3.1</td><td></td><td></td><td></td></tr>
<tr><td>Sediment for VOC</td><td>Refrigeration 4°± 2C</td><td>14 days</td><td>Not Applicable</td></tr>
<tr><td>Water for DOSS</td><td>Frozen, 15mL plastic centrifuge tubes so entire container can be solvent rinsed</td><td>Not established</td><td>Not established</td></tr>
</table></td></tr>
<tr><td>14</td><td>Table under Section 3.1: Changed header “Holding Time for Extracts” to read “Holding Time to Analysis”</td></tr>
<tr><td>14</td><td>For VOC stated Not Applicable in “Holding Time to Extraction” and moved holding times to last column (Holding Time to Analysis)</td></tr>
<tr><td>14</td><td>In last column – changed the footnote numbers from “9” to “12”</td></tr>
</table>

<table>
<tr><th>Page</th><th>Change</th></tr>
<tr><td>14</td><td>Replaced the rows for Sediment and Tissue matrices with the rows below.
<table>
<tr><th>Matrix</th><th>Storage for Samples</th><th>Holding Time to Extraction</th><th>Holding Time to Analysis</th></tr>
<tr><td>Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC</td><td>Frozen; except Grain Size should not be frozen - store at 4°C ±2°</td><td>1 Year; except not applicable for grain size, total solids and TOC.</td><td>40 days from extraction[12]; except biomarkers grain size and TOC no holding time.</td></tr>
<tr><td>Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)</td><td>Frozen</td><td>1 Year</td><td>40 days from extraction[12]; except biomarkers and TEO no holding time.</td></tr>
</table></td></tr>
<tr><td>20</td><td>First line: changed 10X to 5X, removed "(whichever is lower)"</td></tr>
<tr><td>21</td><td>Changed Mass Discrimination MQO to read Ratio for the “concentration” (rather than raw area)</td></tr>
<tr><td>24, 25</td><td>Removed "Draft" from table titles</td></tr>
<tr><td>26</td><td>Table 6.1f: Changed “Grain Size” method description to the following:
Grain Size (apparent): ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.</td></tr>
<tr><td>26</td><td>Added web address for Plumb method reference;
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf</td></tr>
</table>

Acronyms and Abbreviations

%D	Percent difference
%R	Percent recovery
ASTM	American Society for Testing and Materials
BS/BSD	Blank spike/blank spike duplicate
CCV	Continuing calibration verification
CRM	Certified reference material
DISP	Dispersant
DOSS	Dioctylsulfosuccinate salt
DOT	U.S. Department of Transportation
DQO	Data quality objectives
EDD	Electronic data deliverable
EIP	Extracted ion Profile
EPA	U.S. Environmental Protection Agency
GC/MS-SIM	Gas chromatography with low resolution mass spectrometry using selected ion monitoring
GC-FID	Gas chromatography with flame ionization detection
LC	Liquid chromatography
MC 252	Mississippi Canyon 252 (Deepwater Horizon)
MDL	Method detection limit
MQO	Measurement quality objectives
MS/MSD	Matrix spike/matrix spike duplicate
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural resource damage assessment
OPA	Oil Pollution Act
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbons
PIANO	Paraffins, isoparafins, aromatics, napthenes, olefins
QA	Quality assurance
QAP	Quality assurance plan
QC	Quality control
RM	Reference material
RPD	Relative percent difference
RSD	Relative standard deviation
SHC	Saturated hydrocarbons
SOP	Standard Operating Procedures
TEH	Total extractable hydrocarbons
TEM	Total extractable matter
TEO	Total extractable organics
TOC	Total organic carbon
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compounds

INTRODUCTION

On April 20, 2010, a fatal explosion struck the Deepwater Horizon offshore oil platform approximately 50 miles off the Louisiana coast in the Gulf of Mexico, ultimately leading to the destruction of the platform and the connecting riser pipe to the seafloor a mile below the water surface, and the ongoing release of thousands of barrels of crude oil from the seafloor per day. The incident has been declared a Spill of National Significance by the U.S. Secretary of Homeland Security and a major spill response effort is in progress. The spill threatens a broad expanse of the U.S. Gulf Coast in addition to the natural resources in the path of the oil slick which has spread across thousands of square miles at sea. Federal and state natural resource trustees have begun collecting ephemeral data to support a natural resource damage assessment (NRDA). Currently, NOAA is the lead administrative trustee. Although a formal agreement has not yet been reached, BP America has indicated an interest in cooperating with the natural resource trustees in the damage assessment.

This Analytical Quality Assurance (QA) Plan describes the minimum requirements for the chemical analysis of the environmental samples that are collected in support of this NRDA. This plan does not address the actual field collection or generation of these samples. The scope of the laboratory work is twofold: (1) generate concentrations for key chemicals used in injury determinations for crude oil releases, and (2) produce more extensive chemical data to use in fingerprinting for source identification. The applicable chemicals, need and frequency of environmental sample analyses, quality control requirements, and data usage vary for these two purposes, although implementation of this plan enables both to be achieved. In recognition of these differences, sampling plans may reference the Analytical QA Plan and cite to specific tables of chemical analyses that are appropriate to the needs of the particular sampling effort.

The requirements specified in this plan are designed to: (1) monitor the performance of the measurement systems to maintain statistical control over the reported concentrations of target analytes and provide rapid feedback so that corrective measures can be taken before data quality is compromised and; (2) verify that reported data are sufficiently complete, comparable, representative, unbiased and precise so as to be suitable for their intended use.

The analytes of concern addressed in this QA Plan are polycyclic aromatic hydrocarbons (PAHs) including alkyl homologues, saturated hydrocarbons (SHC), total extractable hydrocarbons (TEH)[1], and volatile organic compounds (VOCs) and petroleum biomarkers. Additional analytes of concern are potentially toxic polar and non-polar components found within or formed from the dispersant agents utilized during the response to the incident, although the appropriate target analytes and methods are not yet established. A variety of matrices may be analyzed including water, filters, sediment/soil, tissues, vegetation, absorbent materials (e.g. Teflon nets, etc.), oils and oil debris. In addition to the primary analytes of concern, ancillary tests may include: percent moisture, total organic carbon (TOC) and grain size for sediment samples, and total extractable organics (TEO) for tissues. Additional tests not

[1] TEH is the total aromatic and aliphatic content as determined by GC-FID. If the sample extract is not "cleaned up" to remove biogenic material prior to the GC-FID analysis, then the result from the GC-FID analysis is termed Total Extractable Matter (TEM).

currently addressed in the QAP but may be of interest are: SARA (%Saturate, %Aromatic, %Resin, %Asphaltene) content in oil[2]; carbon, hydrogen, and nitrogen (CHN)[3] for sediments and particulate material in water. Performance criteria will be added to the QAP for additional tests when requested under the NRDA program.

The work plans and associated QA plans under which these samples were generated or collected are independent documents and not included or considered herein. This Analytical QA Plan describes the minimum requirements to be taken to provide for the chemical analyses (and associated physical normalizing parameters) of the previously generated or collected samples in a technically sound and legally defensible manner.

This Analytical QA Plan is consistent with the intent of NRDA regulations under OPA (33 U.S.C. §§ 2701 *et seq.)* and satisfies the requirements listed in the relevant EPA guidance for QA plans (USEPA 2002 and USEPA 2001) as far as the documents relate to analytical testing services. This QA plan will be revised as appropriate, as changes are made to the NRDA and the QA program.

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[2] SARA according to method published by Zumberge et al (2005) or equivalent. [Zumberge, J., J.A. Russell, and S.A. Reid . 2005. Charging of Elk Hills reservoirs as determined by oil geochemistry AAPG Bull. v. 89, pp. 1347-1371]

[3] CHN by micro elemental analyzer using the Dumas method of complete and instantaneous oxidation (flash dynamic combustion) at >1,000 °C following exposure of the sample to HCl fumes to remove inorganic carbon.

1.0 PROJECT DESCRIPTION

A number of laboratories will be analyzing samples associated with this NRDA. The intent of this plan is to present the minimum requirements for the performance criteria for the laboratories providing data in support of this investigation. The analytes of specific interest and brief descriptions of the analytical methods are as follows:

- PAHs including alkyl homologues by gas chromatography with low resolution mass spectrometry using selected ion monitoring (GC/MS-SIM). The analytical procedure is based on EPA Method 8270D with the GC and MS operating conditions optimized for separation and sensitivity of the target analytes. Alkyl PAH homologues are quantified using a response factor assigned from the parent PAH compound. Analytes, associated response factors and target detection limits are listed in **Table 1.1a.** The following references discuss the method options in further detail:

  Federal Register 40CFR300, Subchapter J, Part 300, Appendix C, 4-6-3 to 4-6-5 pp. 234-237.

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Page, D.S., P.D. Boehm, G.S. Douglas, and A.E. Bence. 1995. Identification of hydrocarbon sources in the benthic sediments of Prince William Sound and the Gulf of Alaska following the *Exxon Valdez* oil spill. *In*: *Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219*, P.G. Wells, J.N. Bulter, and J.S. Hughes, Eds, American Society for Testing and Materials, Philadelphia. pp 44-83.

  Kimbrough, K.L., G.G. Lauenstein and W.E. Johnson (Editors). 2006. *Organic Contaminant Analytical methods of the National Status and Trends Program: Update 2000-2006*. NOAA Technical Memorandum NOS NCCOS 30. p. 25- 37.

  Sauer, T.C. and P.D. Boehm. 1995. *Hydrocarbon Chemistry Analytical Methods for Oil Spill Assessments*. MSRC Technical Report Series 95-032, Marine Spill Response Corporation, Washington, D.C. 114 p.

  USEPA. 2008. *Test Methods for Evaluating Solid Waste, Physical/Chemical Method* (SW846).

  Wang, Z. and S.A. Stout. 2007. Chemical fingerprinting of spilled or discharged petroleum – methods and factors affecting petroleum fingerprints in the environment. In: *Oil Spill Environmental Forensics: Fingerprinting and Source Identification*. Z. Wang and S.A. Stout, Eds, Elsevier Publishing Co., Boston, MA, pp. 1-53.

- Saturate hydrocarbons by gas chromatography with flame ionization detection (GC/FID) based on EPA Method 8015. Analytes and target detection limits are listed in **Table 1.1b**.

- Total Extractable Hydrocarbons (TEH[4]) representing the total aromatic and aliphatic hydrocarbon content of sample extracts after silica gel clean-up and analysis by GC/FID (**Table 1.1b**). The result is reported based on integration of the FID signal over the entire hydrocarbon range from *n*-C9 to n-C44 and calibrated against the average alkane hydrocarbon response factor.

  If the sample extract does not receive any clean-up then the result will be reported as Total Extractable Matter (TEM) because the extract may contain non-hydrocarbon compounds. . Either TEH or TEM may reported by the laboratory depending on the handling of the extract.

- Standard volatile organic compounds (VOC) by GC/MS based on EPA Method 8260B but for aromatics hydrocarbons only. Analytes and target detection limits are listed in **Table 1.1c.**

- Extended list of VOCs for a specialized fingerprinting analysis of paraffins, isoparaffins, aromatics, napthenes, and olefins (PIANO) by GC/MS. Analytes and target detection limits are provided in **Table 1.1d** for this source identification list.

- Petroleum biomarkers by GC/MS-SIM. Two methods for the analysis of petroleum biomarkers are contained herein, viz., quantitative and qualitative. The difference between these two analyses is that quantitative analysis produces absolute concentrations of target analytes whereas qualitative analysis produced pattern, or fingerprints, only. The proposed target analyte list for quantitative biomarkers is provided in **Table 1.1e.** This list may be expanded if warranted. This method is discussed in further detail in:

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Wang, Z.. Stout, S.A., and Fingas, M. (2006) Forensic fingerprinting of biomarkers for oil spill characterization and source identification (Review). *Environ. Forensics* **7(2)**: 105-146.

- Qualitative biomarker patterns may also be acquired using GC/MS-SIM with monitoring of selected ions (m/z) as provided in **Table 1.1f**. Since no concentration data are generated by qualitative analysis the results are reported as hardcopy PDF files of each ion over the appropriate retention time(s) and scale and included in the hardcopy data package produced by the laboratory.

- Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and

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[4] Note that the term TEH is being used for the total hydrocarbon analysis. The term "Total Petroleum Hydrocarbon" (TPH) may be used to refer to TEH, in some instances. For this QAP, the term TEH is used to avoid confusion with state-regulated gasoline or diesel determinations, rather TEH is used to refer to the sum of hydrocarbons from C_9 to C_{44}.

bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in **Table 1.1.g**. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.

- Corexit 9500/9527 dispersant (DISP) by liquid chromatography (LC)/MS for quantitative assessment, particularly dioctylsulfosuccinate sodium salt (DOSS). Proposed measurement performance criteria are presented in **Table 6.1g**. Because the method is under development the laboratory may develop appropriate performance criteria based on past method performance.

- GC/MS may have use for qualitative assessments of solvent package components (e.g. glycol ethers) or primary degradation products of DOSS (alkyl diesters), pending further method development. Standard methods are not available for either technique but provisional analytical criteria and detection limits are under development.

Analyses will include a number of different sample matrices. Matrices that will be analyzed will be determined in sampling plans and may not include all analyses for each matrix. The following table provides a summary of which analyses may be applicable to each matrix (analyses may be added or deleted as warranted over time).

Matrix	PAH	SHC/TEH	BIOMARK	DISP	VOC
Water	X	X	X	X	X
Filters	X	X	X		
Sediment/Soil	X	X	X	X	X
Tissue	X		X	X	
Vegetation	X	X	X	X	
Inert Sorbent Materials	X	X	X	X	X
Oil/Oily Debris	X	X	X	X	X

TABLE 1.1a
Extended PAH (Parent and Alkyl Homologs) and Related Compounds

	Compound	RF Source[5]
D0	cis/trans-Decalin	
D1	C1-Decalins	D0 or tD0[6]
D2	C2-Decalins	D0 or tD0
D3	C3-Decalins	D0 or tD0
D4	C4-Decalins	D0 or tD0
BT0	Benzothiophene	
BT1	C1-Benzo(b)thiophenes	BT0
BT2	C2-Benzo(b)thiophenes	BT0
BT3	C3-Benzo(b)thiophenes	BT0
BT4	C4-Benzo(b)thiophenes	BT0
N0	Naphthalene	
N1	C1-Naphthalenes	N0
N2	C2-Naphthalenes	N0
N3	C3-Naphthalenes	N0
N4	C4-Naphthalenes	N0
B	Biphenyl	
DF	Dibenzofuran	
AY	Acenaphthylene	
AE	Acenaphthene	
F0	Fluorene	
F1	C1-Fluorenes	F0
F2	C2-Fluorenes	F0
F3	C3-Fluorenes	F0
A0	Anthracene	
P0	Phenanthrene	
PA1	C1-Phenanthrenes/Anthracenes	P0
PA2	C2-Phenanthrenes/Anthracenes	P0
PA3	C3-Phenanthrenes/Anthracenes	P0

	Compound	RF Source
PA4	C4-Phenanthrenes/Anthracenes	P0
RET	Retene	RET or P0
DBT0	Dibenzothiophene	
DBT1	C1-Dibenzothiophenes	DBT0
DBT2	C2-Dibenzothiophenes	DBT0
DBT3	C3-Dibenzothiophenes	DBT0
DBT4	C4-Dibenzothiophenes	DBT0
BF	Benzo(b)fluorene	BF or FL0
FL0	Fluoranthene	
PY0	Pyrene	
FP1	C1-Fluoranthenes/Pyrenes	FL0 or PY0
FP2	C2-Fluoranthenes/Pyrenes	FL0 or PY0
FP3	C3-Fluoranthenes/Pyrenes	FL0 or PY0
FP4	C4-Fluoranthenes/Pyrenes	FL0 or PY0
NBT0	Naphthobenzothiophenes	
NBT1	C1-Naphthobenzothiophenes	NBT0
NBT2	C2-Naphthobenzothiophenes	NBT0
NBT3	C3-Naphthobenzothiophenes	NBT0
NBT4	C4-Naphthobenzothiophenes	NBT0
BA0	Benz[a]anthracene	
C0	Chrysene/Triphenylene	
BC1	C1-Chrysenes	C0
BC2	C2-Chrysenes	C0
BC3	C3-Chrysenes	C0
BC4	C4-Chrysenes	C0
BBF	Benzo[b]fluoranthene	
BJKF	Benzo[j,k]fluoranthene	BKF[8]
BAF	Benzo[a]fluoranthene	BKF or BAF

	Compound	RF Source
BEP	Benzo[e]pyrene	
BAP	Benzo[a]pyrene	
PER	Perylene	
IND	Indeno[1,2,3-cd]pyrene	
DA	Dibenz[a,h]anthracene	
GHI	Benzo[g,h,i]perylene	
4MDT	4-Methyldibenzothiophene	DBT0
2MDT	2/3-Methyldibenzothiophene	DBT0
1MDT	1-Methyldibenzothiophene	DBT0
3MP	3-Methylphenanthrene	P0
2MP	2/4-Methylphenanthrene	P0
2MA	2-Methylanthracene	P0
9MP	9-Methylphenanthrene	P0
1MP	1-Methylphenanthrene	P0
	2-Methylnaphthalene	
	1-Methylnaphthalene	
	2,6-Dimethylnaphthalene	
	1,6,7-Trimethylnaphthalene	
	Other	
	Carbazole	
	C30-Hopane[7]	

Target Method Detection Limit Range

Sediment/Soil = 0.1 – 0.5 ng/g dry weight
Tissue = 0.2 – 1.0 ng/g wet weight
Water = 1 – 5 ng/L

Target Reporting Limit

Oil = 2.0 mg/kg

[5] Response factor (RF) to be used for quantitation. If blank, compound is included in the calibration mix

[6] tD0 = transD0 (used if cis/trans in separate standards)

[7] Quantitative concentrations of C29-hopane and 18α-oleanane may be provided if laboratories are calibrated to do so; the C30-hopane is a minimum requirement.

[8] BKF = Benzo(k)fluoranthene. Benzo(j)fluoranthene and Benzo(k)fluoranthene coelute and will be reported as Benzo(j,k)fluoranthene (BJKF)

TABLE 1.1b
Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons

Abbr.	Analyte
nC9	n-Nonane
nC10	n-Decane
nC11	n-Undecane
nC12	n-Dodecane
nC13	n-Tridecane
1380	2,6,10 Trimethyldodecane
nC14	n-Tetradecane
1470	2,6,10 Trimethyltridecane
nC15	n-Pentadecane
nC16	n-Hexadecane
nPr	Norpristane
nC17	n-Heptadecane
Pr	Pristane
nC18	n-Octadecane
Ph	Phytane
nC19	n-Nonadecane
nC20	n-Eicosane
nC21	n-Heneicosane
nC22	n-Docosane

Abbr.	Analyte
nC23	n-Tricosane
nC24	n-Tetracosane
nC25	n-Pentacosane
nC26	n-Hexacosane
nC27	n-Heptacosane
nC28	n-Octacosane
nC29	n-Nonacosane
nC30	n-Triacontane
nC31	n-Hentriacontane
nC32	n-Dotriacontane
nC33	n-Tritriacontane
nC34	n-Tetratriacontane
nC35	n-Pentatriacontane
nC36	n-Hexatriacontane
nC37	n-Heptatriacontane
nC38	n-Octatriacontane
nC39	n-Nonatriacontane
nC40	n-Tetracontane

TEH	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 after silica gel cleanup.
TEM	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 no silica gel cleanup.

Target Method Detection Limit

Sediment (Alkanes) =	0.01 µg/g dry weight
Sediment (TEH) =	1 µg/g dry weight
Water (Alkanes) =	0.8 µg/L

Target Reporting Limit

Oil (Alkanes) =	200 mg/kg
Oil (TEH) =	200 mg/kg
Water (TEH/TEM) =	200 µg/L

TEH = Total Extractable Hydrocarbons with silica gel "clean-up"
TEM = Total Extractable Matter with no extract "clean-up"

TABLE 1.1c
Standard Volatile Organic Compounds

Analyte
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
4-Isopropyltoluene
Benzene
Ethylbenzene
Isopropylbenzene
m,p-Xylenes
Naphthalene[9]
n-Butylbenzene
n-Propylbenzene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Toluene

	Target Method Detection Limit Range
Sediment/Soil =	0.1 – 1 ng/g
Water =	0.05 – 0.5 µg/L
	Target Reporting Limit
Oil =	2 mg/kg

[9] Naphthalene is also included on the **Table 1.1a** target analyte list of PAH compounds. The PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1d
C5-C13 Volatile Compounds for PIANO Forensic Assessment

Abbrev.	Analyte
IP	Isopentane
1P	1-Pentene
2M1B	2-Methyl-1-butene
C5	Pentane
T2P	2-Pentene (trans)
C2P	2-Pentene (cis)
TBA	Tertiary butanol
CYP	Cyclopentane
23DMB	2,3-Dimethylbutane
2MP	2-Methylpentane
MTBE	MTBE
3MP	3-Methylpentane
1HEX	1-Hexene
C6	Hexane
DIPE	Diisopropyl Ether (DIPE)
ETBE	Ethyl Tertiary Butyl Ether (ETBE)
22DMP	2,2-Dimethylpentane
MCYP	Methylcyclopentane
24DMP	2,4-Dimethylpentane
12DCA	1,2-Dichloroethane
CH	Cyclohexane
2MH	2-Methylhexane
B	Benzene
23DMP	2,3-Dimethylpentane
THIO	Thiophene
3MH	3-Methylhexane
TAME	TAME
1H	1-Heptene/1,2-DMCP (trans)
ISO	Isooctane
C7	Heptane

Abbrev.	Analyte
MCYH	Methylcyclohexane
25DMH	2,5-Dimethylhexane
24DMH	2,4-Dimethylhexane
223TMP	2,2,3-Trimethylpentane
234TMP	2,3,4-Trimethylpentane
233TMP	2,3,3-Trimethylpentane
23DMH	2,3-Dimethylhexane
3EH	3-Ethylhexane
2MHEP	2-Methylheptane
3MHEP	3-Methylheptane
T	Toluene
2MTHIO	2-Methylthiophene
3MTHIO	3-Methylthiophene
1O	1-Octene
C8	Octane
12DBE	1,2-Dibromoethane
EB	Ethylbenzene
2ETHIO	2-Ethylthiophene
MPX	p/m-Xylene
1N	1-Nonene
C9	Nonane[10]
STY	Styrene
OX	o-Xylene
IPB	Isopropylbenzene
PROPB	n-Propylbenzene
1M3EB	1-Methyl-3-ethylbenzene
1M4EB	1-Methyl-4-ethylbenzene
135TMB	1,3,5-Trimethylbenzene
1D	1-Decene
1M2EB	1-Methyl-3-isopropylbenzene

Abbrev.	Analyte
C10	Decane[10]
124TMB	1,2,4-Trimethylbenzene
SECBUT	sec-Butylbenzene
1M3IPB	1-Methyl-3-isopropylbenzene
1M4IPB	1-Methyl-4-isopropylbenzene
1M2IPB	1-Methyl-2-isopropylbenzene
IN	Indan
1M3PB	1-Methyl-3-propylbenzene
1M4PB	1-Methyl-4-propylbenzene
BUTB	n-Butylbenzene
12DM4EB	1,2-Dimethyl-4-ethylbenzene
12DEB	1,2-Diethylbenzene
1M2PB	1-Methyl-2-propylbenzene
14DM2EB	1,4-Dimethyl-2-ethylbenzene
C11	Undecane[10]
13DM4EB	1,3-Dimethyl-4-ethylbenzene
13DM5EB	1,3-Dimethyl-5-ethylbenzene
13DM2EB	1,3-Dimethyl-2-ethylbenzene
12DM3EB	1,2-Dimethyl-3-ethylbenzene
1245TMP	1,2,4,5-Tetramethylbenzene
PENTB	Pentylbenzene
C12	Dodecane[10]
N0	Naphthalene[11]
BT0	Benzothiophene[11]
MMT	MMT
C13	Tridecane[10]
2MN	2-Methylnaphthalene[11]
1MN	1-Methylnaphthalene[11]

Target Detection Limit

Sediment/Soil = 0.1 – 10 ng/g

Water = 0.2 - 2.0 µg/L

Target Reporting Limit

Oil = 2 mg/kg

[10] These compounds are also included on the **Table 1.1b** target analyte list of saturate hydrocarbons. Because of the extraction technique, the GC-FID method for hydrocarbons is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both saturate hydrocarbons by GC-FID and VOC the result from the GC-FID analysis will be noted in the database as the preferred result.

[11] These compounds are also included on the **Table 1.1a** target analyte list of PAH compounds. Because of the extraction technique, the PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1e
Petroleum Biomarkers for Quantitative Analysis

Compound *	Quant Ion m/z
C23 Tricyclic Terpane (T4)	191
C24 Tricyclic Terpane (T5)	191
C25 Tricyclic Terpane (T6)	191
C24 Tetracyclic Terpane (T6a)	191
C26 Tricyclic Terpane-22S (T6b)	191
C26 Tricyclic Terpane-22R (T6c)	191
C28 Tricyclic Terpane-22S (T7)	191
C28 Tricyclic Terpane-22R (T8)	191
C29 Tricyclic Terpane-22S (T9)	191
C29 Tricyclic Terpane-22R (T10)	191
18a-22,29,30-Trisnorneohopane-Ts (T11)	191
C30 Tricyclic Terpane-22S (T11a)	191
C30 Tricyclic Terpane-22R (T11b)	191
17a(H)-22,29,30-Trisnorhopane-Tm (T12)	191
17a/b,21b/a 28,30-Bisnorhopane (T14a)	191
17a(H),21b(H)-25-Norhopane (T14b)	191
30-Norhopane (T15)	191
18a(H)-30-Norneohopane-C29Ts (T16)	191
17a(H)-Diahopane (X)	191
30-Normoretane (T17)	191
18a(H)&18b(H)-Oleananes (T18)	191
Hopane (T19)	191
Moretane (T20)	191
30-Homohopane-22S (T21)	191
30-Homohopane-22R (T22)	191
T22a-Gammacerane/C32-diahopane	191
30,31-Bishomohopane-22S (T26)	191
30,31-Bishomohopane-22R (T27)	191
30,31-Trishomohopane-22S (T30)	191

Compound	Quant ion m/z
30,31-Trishomohopane-22R (T31)	191
Tetrakishomohopane-22S (T32)	191
Tetrakishomohopane-22R (T33)e	191
Pentakishomohopane-22S (T34)	191
Pentakishomohopane-22R (T35)	191
13b(H),17a(H)-20S-Diacholestane (S4)	217
13b(H),17a(H)-20R-Diacholestane (S5)	217
13b,17a-20S-Methyldiacholestane (S8)	217
14a(H),17a(H)-20S-Cholestane (S12)	217
14a(H),17a(H)-20R-Cholestane (S17)	217
13b,17a-20R-Ethyldiacholestane (S18)	217
13a,17b-20S-Ethyldiacholestane (S19)	217
14a,17a-20S-Methylcholestane (S20)	217
14a,17a-20R-Methylcholestane (S24)	217
14a(H),17a(H)-20S-Ethylcholestane (S25)	217
14a(H),17a(H)-20R-Ethylcholestane (S28)	217
14b(H),17b(H)-20R-Cholestane (S14)	217
14b(H),17b(H)-20S-Cholestane (S15)	217
14b,17b-20R-Methylcholestane (S22)	217
14b,17b-20S-Methylcholestane (S23)	217
14b(H),17b(H)-20R-Ethylcholestane (S26)	217
14b(H),17b(H)-20S-Ethylcholestane (S27)	217
C26,20R- +C27,20S- triaromatic steroid	231
C28,20S-triaromatic steroid	231
C27,20R-triaromatic steroid	231
C28,20R-triaromatic steroid	231

* Peak identification provided in parentheses.

Target Reporting Limit

Sediments/Soil = 2 ug/Kg dry weight
Waters = 10 ng/L

Target Reporting Limit

Oil = 2 mg/Kg

TABLE 1.1f
Suggested Hydrocarbon Groups and Petroleum Biomarkers for Qualitative Analysis

n-Alkycyclohexanes (m/z 83)
n-Alkanes (m/z 85)
Diamondoids (m/z 135, 187)
Sesquiterpanes (m/z 109, 123)
Isoprenoids (m/z 183)
Triterpanes (m/z 191)
Regular Steranes (m/z 217)
Rearranged β,β-steranes (m/z 218)
Methyl steranes (m/z 232, 245)
Methyl and triaromatic steroids (m/z 231)
Monoaromatic steroids (m/z 253)
Diasteranes (m/z 259)

TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only
(monitoring mass/charge ion)

2-Butoxyethanol (m/z 87, 75)
Glycol ether Isomers (m/z 59, 103)
Bis-(2-ethylhexyl) fumarate (m/z 112, 211)

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Assessment Manager

Greg Baker
Office of Response and Restoration
NOAA
345 Middlefield Road, MS-999
Menlo Park, CA 94025
(650)329-5048 FAX (650)329-5198
greg.baker@noaa.gov

The Assessment Manager is the designated natural resource trustee representative who is responsible for the review and acceptance of specific work plans and associated QA plans.

2.2 Project Coordinator

Mark Curry
Industrial Economics, Inc. (IEc)
2067 Massachusetts Avenue
Cambridge, MA 02140
(617) 354-0074 FAX (617) 354-0463
curry@indecon.com

The Project Coordinator is responsible for administration of the contracts with the laboratory(ies). The Project Coordinator will oversee the proper scheduling and transmittal of the data from the time of sampling to data reporting.

2.3 Quality Assurance

Ann Bailey is the QA Coordinator reporting directly to the Assessment Manager. Ms. Bailey is responsible for the implementation of this Analytical QA Plan. She will receive assistance in the coordination and performance of laboratory technical audits and independent data validation from the QA Contractor (EcoChem). The QA Coordinator has the authority and responsibility to cease or temporarily halt activities not in keeping with this QA Plan. The QA Coordinator will work closely with laboratory representatives and the project team to assure that project and data quality objectives are met. The QA Coordinator may be reached at:

Ann Bailey
EcoChem, Inc.
710 Second Avenue Suite 660
Seattle, WA 98104
(206)233-9332 x106 FAX (206)233-0114
abailey@ecochem.net

Cheryl Randle is a QA Reviewer conducting data validation on behalf of BP America. Ms. Randle is responsible for working closely with the Assessment Manager's QA Coordinator to assure the validity of the final data in accordance with this Analytical QA Plan. The QA Reviewer will conduct spot

validation of up to 25 percent of the reported data, unless substantial problems are discovered in which case up to 100 percent validation may be performed. The QA Reviewer may be reached at:

Cheryl Randle
ENTRIX, Inc.
1000 Hart Road, Suite 130
Barrington, IL 60010
(847)277-2865 FAX (847)381-6679
crandle@entrix.com

2.4 Analytical Laboratories

The laboratories planned to be contracted at this time for analytical work in support of the NRDA are TDI-Brooks B&B Laboratories (B&B), Newfields/Alpha Analytical (Alpha), and Columbia Analytical Services (CAS). The laboratory project managers are responsible for assuring that all analyses performed meet project and measurement quality objectives. The Laboratory Project Managers are:

Juan Ramirez
TDI-Brooks B&B Laboratories
1902 Pinon
College Station, TX 77845-5816
(979)693-3446 FAX: (979)693-6389
juanramirez@TDI-BI.com

Liz Porta
Alpha Analytical
320 Forbes Boulevard
Mansfield, MA 02048
508-844-4114:
eporta@alphalab.com

Greg Salata, PhD.
Columbia Analytical Services (CAS)
1317 S. 13th Ave.
Kelso, WA 98626
(360)577-7222
gsalata@caslab.com

As additional analytical laboratories are brought under contract this QAP will be updated to include their names and project managers.

3.0 SAMPLE HANDLING AND CHAIN OF CUSTODY PROCEDURES

Chain of custody procedures will be used for all samples throughout the analytical process and for all data and data documentation, whether in hard copy or electronic format. Sampling procedures, including sample collection and documentation, are part of the work plans of the individual projects and as such, are not considered here.

3.1 Sample Preservation and Holding Times

Sample preservation and field treatment of samples for analyses should be described in relevant field work plans. Based on EPA guidance, "advisory" sample holding times prior to analysis and holding times for the extracts are presented below. These holding times may be extended or preservation guidance changed, as options are assessed.

Matrix	Storage for Samples	Holding Time to Extraction	Holding Time to Analysis
Water for PAH, SHC/TEH, Biomarkers	Refrigeration 4°C ±2°; Optional: Preserved with 1:1 HCl to pH<2	7 days if not acid preserved; 14 days if acid preserved	40 days from extraction[12]; except biomarkers no holding time
Water for VOC	Refrigeration 4°C ±2° with no headspace; Optional: Preserved with HCl in the field in VOA vial.	Not applicable	7 days if not acid preserved; 14 days if acid preserved
Sediment for VOC	Refrigeration 4°C ±2°	Not applicable	14 days
Filters for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC	Frozen, except Grain Size should not be frozen – store at at 4°C ±2°	1 Year, except not applicable for Grain Size, Total Solids, and TOC	40 days from extraction[12]; except biomarkers grain size and TOC no holding time.
Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)	Frozen	1 Year	40 days from extraction[12]; except biomarkers and TEO no holding time.
Vegetation for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Inert Sorbent Material for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Oil/Oily Debris for PAH, SHC/TEH, Biomarkers, VOC	Refrigeration <6°C	No holding time	40 days from extraction[12]; except biomarkers no holding time
Water for DOSS	Frozen, 15mL plastic centrifuge tubes	Not established	Not established

[12] 40 days is an advisory extraction holding time. Extracts should be held at -20C in the dark, and may be analyzed past 40 days and results not qualified if surrogates are within criteria.

3.2 Chain of Custody

Chain of custody records will be completed in ink.

A sample is considered in "custody" if:

- it is in the custodian's actual possession or view, or
- it is retained in a secured place (under lock) with restricted access, or
- it is placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

Samples are kept in the custody of designated sampling and/or field personnel until shipment.

3.4 Sample Shipping

Any transfer or movement of samples will use chain of custody procedures. The original signed and dated chain of custody record accompanies the sample(s); a copy is retained by the sample shipper. All shipments will comply with DOT regulations (*49CFR, Parts 172 and 173*).

3.5 Sample Receipt

Immediately upon receipt of samples, the recipient will review the shipment for consistency with the accompanying chain of custody record and sample condition, before signing and dating the chain of custody record. Sample condition(s) will be noted on the laboratory's sample receipt form and maintained with the chain of custody records. If there are any discrepancies between the chain of custody record and the sample shipment, the recipient will contact the sample shipper immediately in an attempt to reconcile these differences. Reconciliation of sample receipt differences will be maintained with the chain of custody records and discussed in the laboratory narrative which accompanies the data report.

3.6 Intra-Laboratory Sample Transfer

The laboratory sample custodian or designee will maintain a laboratory sample-tracking record, similar to the chain of custody record that will follow each sample through all stages of laboratory processing. The sample-tracking record will show the name or initials of responsible individuals, date of sample extraction or preparation, and sample analysis.

3.7 Inter-Laboratory Sample Transfer

Transfer of samples from one analytical laboratory to another, e.g. for grain size or TOC analysis, will follow chain of custody, sample shipping and receipt procedures described above. Transfer of samples between laboratories will be noted in the laboratory case narrative which accompanies the data report.

3.8 Sample Archival

All unanalyzed samples and unutilized sample aliquots or extracts will be held by the laboratory in a manner to preserve sample integrity at a secure location with chain of custody procedures for one (1) year after the QA Contractor has validated the data package for that particular set of samples. All archived materials will be accessible for review upon request. At the end of the archival period, the laboratory shall contact the QA Coordinator to obtain directions for handling remaining samples. The samples will not be disposed of by the laboratory unless provided with written approval from the Assessment Manager.

3.9 Data and Data Documentation

The laboratories will provide the QA Contractor with hardcopy data tables, QC documentation and instrument printouts suitable for QA assessment/data validation. Required laboratory deliverables are listed in **Table 7.1**. Data packages will include all related instrument print-outs ("raw data") and bench sheets. A copy of the data and data documentation developed by the laboratory for a given data package will be kept by the laboratory in a secure location using chain of custody procedures for five (5) years after the QA Contractor has validated that data package. All archived data and documentation will be accessible for review upon request. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

The original data will be transferred from the laboratory to the QA Contractor by means such that a signature is required at the time of document delivery. The QA Contractor will document receipt of packages and maintain a record of the method and date of data submittal with the complete data package. The QA Contractor will maintain the copy of the data packages and related validation documentation in a secure location for a period of one (1) year from the date of validation. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

4.0 LABORATORY OPERATIONS

All laboratories providing analytical support for the MC252 Damage Assessment must have the appropriate facilities to store and prepare samples, and appropriate instrumentation and staff to provide data of the required quality within the time period dictated. Laboratories are expected to conduct operations using good laboratory practices, including:

- Training and appropriate certification of personnel.
- A program of scheduled maintenance of analytical balances, laboratory equipment and instrumentation.
- Routine checking of analytical balances using a set of standard reference weights (ASTM class, NIST Class S-1, or equivalents).
- Recording all analytical data in secure electronic system with date and associated analyst identification, and/or logbooks with each entry signed and dated by the analyst.
- Monitoring and documenting the temperatures of cold storage areas and freezer units.

Laboratory operations may be evaluated by the QA Coordinator through technical systems audits, performance evaluation studies, and performance in a NIST-managed intercomparison program. Personnel in any laboratory performing analyses for this damage assessment should be well versed in good laboratory practices, including standard safety procedures. It is the responsibility of the laboratory manager and /or supervisor to ensure that safety training is mandatory for all laboratory personnel. The laboratory is responsible for maintaining a current safety manual in compliance with the Occupational Safety and Health Administration (OSHA) or equivalent state or local regulations. Proper procedures for safe storage, handling and disposal of chemicals should be followed at all times; each chemical should be treated as a potential health hazard and good laboratory practices should be implemented accordingly.

4.1 Quality Assurance Documentation

All laboratories must have the latest revision of the MC 252 NRDA Analytical QA Plan. In addition, the following documents and information must be current and available to all laboratory personnel participating in the processing of MC 252 samples:

- Laboratory Quality Assurance Management Plan
- Laboratory Standard Operating Procedures (SOPs) – Detailed instructions for performing routine laboratory procedures.
- Control charts or data tables – These must be developed and maintained throughout the project for appropriate analyses and measurements, including:
    - Alkyl PAH pattern book for MC252 reference oil.

4.2 Laboratory Systems Audits

Prior to or during sample analysis, QA systems audits will be performed. The laboratory audits will be conducted by the QA Coordinator or designee. The checklists used for the laboratory audits are based on requirements outlined in "Good Laboratory Practice Standards" (*40 CFR Part 792*) and audit procedures of the EPA National Enforcement Investigations Center, "NEIC Procedures Manual for the Contract Evidence Audit and Litigation Support for EPA Enforcement Case Development" (*EPA 330/9-89-002*). The Laboratory Project Managers will be informed of the findings and recommendations of the audit before the auditors leave the facility. A written report discussing the audits will be submitted to the Assessment Manager.

Additional laboratory audits may be performed at any time throughout the duration of the NRDA.

4.3 Participation in Intercomparison Exercises

Each analytical laboratory performing analysis will be required to participate in potential intercomparison exercises that may be organized by NS&T and/ or NIST during the duration of the laboratory's participation in this NRDA analytical program. A variety of samples including sample extracts and representative matrices (e.g., sediment or tissue samples) may be utilized in these exercises. Laboratories are required to analyze only those matrices or analytes that they are providing in like manner for the NRDA analytical program. When participating in the intercomparison exercise, the

laboratory should analyze the sample(s) in the same manner as routinely performed for this NRDA and as specified in this Analytical QA Plan. Laboratories which fail to achieve acceptable performance will be required to provide an explanation to the QA Coordinator and/or undertake appropriate corrective actions.

5.0 ASSESSMENT OF DATA QUALITY

The purpose of this Analytical QA Plan is to develop and document analytical data of known, acceptable, and defensible quality. The quality of the data is presented as a set of statements that describe in precise quantitative terms the level of uncertainty that can be associated with the data without compromising their intended use. These statements are referred to as Data Quality Objectives (DQOs) and are usually expressed in terms of precision, bias, sensitivity, completeness, and comparability.

5.1 Precision

Precision is the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions, such as replicate measurements of the same sample. Precision is concerned with the "closeness" of the results. Where suitable reference materials (RMs) are available, precision will be expressed as the relative standard deviation (RSD) for the repeated measurements. This use of RMs allows for the long-term measurement of precision but does not include homogenization as a source of analytical variability.

In addition to the tracking precision of replicate RM analyses, precision will be expressed as the relative percent difference (RPD) between a pair of replicate data from environmental samples prepared and analyzed in duplicate.

5.2 Bias

Bias is the degree of agreement of a measurement with an accepted reference value and may be expressed as the difference between the two measured values or as a percentage of the reference value.

The primary evaluation of bias will be through the use of RMs. RMs with certified values (from NIST or a similar source) will be used if they are available. The laboratory will maintain control charts to track the RM performance. Spiked matrix samples will also be analyzed to assess bias for those analytes that are not available in suitable reference materials.

5.3 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relationship to another data set. Comparability of the chemical analytical data is established through the use of:

- Program-defined general analytical methodology (e.g., low resolution MS), detection limits, bias and precision requirements and reporting formats;

- NIST-traceable calibration materials;
- Reference material with each sample batch;
- Analysis of a common "reference oil".

5.4 Completeness

Completeness is a measure of the proportion of data specified in the sampling plan which is determined to be valid. Completeness will be assessed by comparing the number of valid sample results to the total number of potential results planned to be generated. The DQO for completeness is 95%, i.e. no more than 5% of the analytical data missing or qualified as unreliable (rejected).

6.0 QUALITY CONTROL PROCEDURES

No particular analytical methods are specified for this project, but the QA/QC requirements will provide a common foundation for each laboratory's protocols. This "common foundation" includes: (1) the specification of the analytes to be identified and quantified and the minimum sensitivity of the analytical methods and (2) the use of NIST reference materials, and (3) the use of a common MC252 Reference Oil.

Prior to the analysis of samples, each laboratory must provide written protocols for the analytical methods to be used; calculate detection limits for each analyte in each matrix of interest and establish an initial calibration curve in the appropriate concentration range for each analyte. The laboratory must demonstrate its continued proficiency by participation in refereed intercomparison exercises (as available) and repeated analyses of reference materials, calibration checks, and laboratory method blanks. Laboratories will be expected to take corrective actions promptly if measurement quality objectives described in this plan are not met.

A laboratory may be audited at any time to determine and document that they have the capability to analyze the samples and can perform the analyses in compliance with the QA plan. Independent data validation will be undertaken promptly after analyses of each sample batch to verify that measurement quality objectives are met. The data validator will discuss any unacceptable findings with the laboratory as soon as possible, and assist the laboratory in developing a satisfactory solution to the problem.

6.1 Standard Operating Procedures for Analytical Methods

Prior to the analysis of field samples, each laboratory is required to submit to the QA Coordinator for review and approval, written Standard Operating Procedures (SOPs) detailing the procedures used in sample receipt and handling, sample preparation and analysis, data reduction and reporting. Once approved, the SOPs for each analytical method and from each analytical laboratory will be archived with this plan as part of the QA documentation.

6.2 Determination of Method Detection Limit, Quantitation Range, and Reporting Limits

The analytical laboratory will establish and report a method detection limit (MDL) for each analyte of interest in each matrix, with the exception of oil for which MDLs cannot be accurately determined. The target detection ranges or limits are specified in **Tables 1.1a – 1.1e**. The actual MDLs will be established by following the method in *40CFR part 136*. Results that are less than 5X the MDL or less than the lowest calibration standard will not be required to meet the measurement quality objectives (MQOs) for precision and bias, because these results may be outside the "quantitation range". Thus, these results may be flagged by the laboratory with a J, to indicate the results are possibly an estimate and have not been required to meet the MQOs. If the analyte is not detected in a sample, the result will be reported as non-detected at the MDL and flagged with a "U".

Reporting limits for the supporting analyses (percent moisture, percent total extractable organics [TEO], total organic carbon, and grain size) will be 0.01%. The reporting limit will be demonstrated by the laboratory to be greater than 5X the detection limit.

Target detection limits, as shown at the bottom of **Tables 1.1a through 1.1e**, may not be met due to required dilutions, interferences, and/or limited sample size. If a laboratory MDL does not meet the target detection limit, the reason for the elevated detection limits should be discussed in the laboratory case narrative.

6.3 Quality Control Criteria

MQOs and required minimum frequency of analysis for each QC element or sample type are summarized in **Tables 6.1a – 6.1g**. The analytical laboratory will determine when MQOs have not been met, and perform appropriate corrective actions before continuing the analyses or reporting of the data. If the "Corrective Action" in the Method Performance Criteria table states "Resolve before proceeding", the laboratory must perform an adjustment to the analytical process and subsequently demonstrate the criteria will be met before proceeding with analysis for project samples. In addition, if results associated with a non-compliant QC element have been obtained, the laboratory must repeat those analyses until acceptable QC results are obtained. If the laboratory determines the non-compliance does not affect the quality of the data, the laboratory will discuss the non-compliance and the rationale, used to conclude the data are not affected, in the case narrative which accompanies the data report. If the laboratory determines the non-compliance is due to interferences or circumstances outside the laboratory's control, the laboratory will discuss the reason for the non-compliance in the case narrative and the results reported.

At this time, no criteria for evaluating the target analyte concentrations in the MC252 Reference Oil have been established. Chromatographic resolution criteria for specific compound (peaks) are specified in **Tables 6.1a through 6.1e** and **Table 6.1g** below. When additional criteria are developed they will be added to this Analytical QAP.

TABLE 6.1a
Method Performance Criteria for Extended PAH (Parent and Alkyl Homologs) and Related Compounds

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration (All parent PAH and selected alkyl homologue PAH)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
Matrix SRM 1941b for sediment; SRM 1974b for tissue	One per batch/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of 9-methylphenanthrene from 1-methylphenanthrene (m/z 192). Plus additional criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the concentration of Benzo[g,h,i]perylene to phenanthrene ≥0.70	Resolve before proceeding.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120% except d12-perylene which is 10-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1b
Method Performance Criteria for Alkanes/Isoprenoids Compounds and Total Extractable Hydrocarbons

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration (Standard solution - all target analytes, except phytane, and C_{31}, C_{33}, C_{35}, and C_{39} n-alkanes)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 15 for 90% of analytes %D ≤ 20 for 10% of analytes	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
SRMs - no SRMs for SHC or TPH are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of n-C17 from pristane; Add'l criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Duplicate Sample Analysis (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the raw areas of n-C36 / n-C20 ≥0.70	Resolve before proceeding.
Surrogates	Every sample	%R 40-125%	Re-extract affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1c
Method Performance Criteria for VOCs

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Per SW846 8260B	Resolve before proceeding
Initial Calibration (ICAL)	Prior to every sequence, or as needed based on continuing calibration/verification check.	Minimum of 5 concentration levels %RSD ≤ 25% for 90% of analytes %RSD ≤ 35% for all analytes >C6	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25% for 90% of analytes %D ≤ 35% for all analytes >C6 Except t-butanol <50%	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%. Except 2 analytes can be at 60 - 140%	Resolve before proceeding.
SRMs – No SRMs are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	To Be Determined	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils)	One per batch/every 20 field samples	%R 50% - 130% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 130% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 70-130%	Re-extract or re-analyze affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1d
Method Performance Criteria for Quantitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Biomarker concentrations are not certified; Peak resolution (*m/z* 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogate	Every sample	%R 50-130%	Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1e
Method Performance Criteria for Qualitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quaiity Objective/ Acceptance Criteria	Corrective Action
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Peak resolution (m/z 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No interference with biomarker patterns	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	Qualitative comparison meets laboratory SOP	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.

TABLE 6.1f
Method Performance Criteria for General/Conventional Chemistry

Conventional Sediment Parameters: Total Organic Carbon (TOC), Grain Size, Total Solids
Tissues: Total Extractable Organics (TEO)

QC Element or Sample Type	Minimum Frequency	Acceptance Criteria	Relevant Parameter(s) Reference Methods*
Initial Calibration	Prior to analysis (method and instrument specific procedures & number of standards)	For multipoint calibration, Correlation coefficient (r) >0.995	TOC
Continuing Calibration	Must start and end analytical sequence and every 10 samples	%R 90%-110%	TOC
Method Blanks	One per batch/every 20 field samples	Not to exceed QL	TOC, TEO
Blank Spike Samples	One per batch/every 20 field samples	%R 75% - 125%	TOC
Matrix Spike Samples	One per batch/every 20 field samples	%R 75% - 125% If MS/MSD analyzed, RPD ≤ 25%	TOC
Replicate Analyses[13]	Each sample must be analyzed at least in duplicate. The average of the replicates shall be reported.	RPD or %RSD < 20% for concentrations > QL	TOC
Sample Duplicates[14]	One per batch/every 20 field samples	RPD ≤ 25% for analyte concentrations greater than QL	TOC, Grain Size, TS, TEO
Reference Materials TOC NIST 1941B TEO NIST 1974B	One per batch/every 20 field samples	Values must be within ±20% of NIST uncertainty range	TOC, TEO

* Reference Methods

TOC	Plumb 1981/SW 846 Method 9060A
Grain Size	ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.
TS (percent)	EPA 160.3

Method 9000 series - analytical methods from SW-846 (U.S. EPA 1986) and updates
The SW-846 and updates are available from the web site at: http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm
Plumb (1981) - U.S. EPA/U.S. Army Corps of Engineers Technical Report EPA/CE-81-1 :
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf

[13] Method SW9060 requires quadruplicate analyses, however duplicate or triplicate analyses are acceptable.

[14] Method SW9060 requires a duplicate spike. A matrix spike and sample duplicate are acceptable in lieu of matrix spike/matrix spike duplicates. For grain size, RPD criteria only applied if fraction is greater than 5%.

TABLE 6.1g
Draft Method Performance Criteria for Analysis of Dioctylsulfosuccinate sodium salt (DOSS)

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours	%D ≤ 30	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 70-130%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Criteria to be developed	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% if sample concentration detected at >5X the spiked amount; RPD ≤30%	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125; RPD ≤30%	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	Not to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

6.3.1 Initial Calibration

Acceptable calibration (initial and continuing) must be established and documented before sample analyses may begin. NIST-traceable calibration materials must be used where available in establishing calibration. Initial calibrations will be established according to the criteria in **Tables 6.1a – 6.1d , 6.1f and 6.1g**. A specific requirement for this project is to use methodology (and tune instrumentation) for low detection limits, therefore, samples with analytes above the calibration range will be diluted and reanalyzed. If samples require a dilution, results from the initial analytical run that were within the calibration range should be reported. Results from the diluted analyses should be reported for only those analytes which exceeded the calibration. .

6.3.2 Continuing Calibration Verification

Continuing calibration verification (CCV) standards will be run at the frequencies indicated in **Tables 6.1a – 6.1d, 6.1f and 6.1g**. If CCV results do not meet the specified criteria, then the instrument must be re-calibrated and all samples analyzed since the last acceptable CCV must be re-analyzed.

6.3.3 Reference Materials

Reference materials of a matrix appropriate to the samples being analyzed, will be analyzed every 20 samples throughout the analytical program, if available. The data resulting from the analysis of these samples will be reported in the same manner as that from the field samples. These data will be the prime materials used to determine and document the accuracy and precision of the associated field sample data. The reference materials to be used are listed in the criteria tables.

Accuracy is computed by comparing the laboratory's value for each analyte against either end of the range of values reported by the certifying agency. The laboratory's value must be within 20% of either the upper or lower end of NIST's 95% uncertainty range. For oil, water, filters, and inert sorbent materials analyses, the SRM is not extracted, but analyzed only on the instrument. The MC252 Reference Oil will be run with each batch of samples (e.g., GU2988-A0521-O9805 or equivalent as approved by the QA Coordinator). Chromatographic resolution criteria of selected peak pairs in the Reference Oil are indicated in **Tables 6.1a-6.1e**. After initial data sets are acquired, additional criteria for the Reference Oil will be determined.

6.3.4 Method Blanks

Method blanks are laboratory derived samples which have been subjected to the same preparation or extraction procedures and analytical protocols as project samples. A method blank will be analyzed with every 20 field samples analyzed. Acceptance criteria are provided in **Tables 6.1a – 6.1g**. Failure to meet acceptance criteria requires definitive corrective action to identify and eliminate the source(s) of contamination before the subsequent reanalysis and re-extraction of the blank and affected samples. Sample results will not be blank corrected.

6.3.5 Sample Duplicates

A duplicate sample aliquot from a representative matrix will be prepared and analyzed with every 20 field samples, except for water samples, filters, and inert sorbent materials for SHC/TEH and PAH. Water samples, filters and inert sorbent materials for SHC/TEH and PAH will not be analyzed in

duplicate because of the difficulty in subsampling representative aliquots. If duplicate VOA vials are collected, then volatile organic analyses may be performed in duplicate. Acceptance criteria the other matrices are provided in **Tables 6.1a – 6.1g**.

6.3.6 Matrix Spike/Matrix Spike Duplicates or Blank Spike/Blank Spike Duplicate

Matrix spike/matrix spike duplicates (MS/MSDs) will be analyzed every 20 samples, except for water samples, filters and inert sorbent materials. MS/MSDs will not be analyzed with the water sample batches because of the difficulty in subsampling representative aliquots from a sample container. Instead, blank spike/blank spike duplicates (BS/BSDs) will be analyzed with each batch of water samples. Samples will be spiked prior to extraction. Spike solution concentrations for the MS must be appropriate to the matrix and anticipated range of contaminants in the sample; that is 2 to 10 times analyte concentration. However, because it is not possible to know the concentration of contaminants prior to analysis, professional judgment may be exercised in choosing concentrations that are reasonable under the circumstances.

6.3.7 Internal Standards

All samples will be spiked with internal standards prior to analysis, when required by the analytical method. Control criteria for internal standard recovery are listed in **Tables 6.1a – 6.1d, and 6.1g**.

7.0 DATA REDUCTION, VALIDATION AND REPORTING

7.1 Data Reduction

Data reduction is the process whereby raw data (analytical measurements) are converted or reduced into meaningful results (analyte concentrations). This process may be either manual or electronic. Primary data reduction requires accounting for specific sample preparations, sample volume (or weight) analyzed, and any concentrations or dilutions required.

Primary data reduction is the responsibility of the analyst conducting the analytical measurement and is subject to further review by laboratory staff, the Laboratory Project Manager and finally, independent reviewers. All data reduction procedures will be described in the laboratory SOPs. Any deviations from the laboratory SOPs will be discussed in the laboratory case narratives.

- Concentrations will be reported as if three figures were significant.
- Data generated from the analysis of blank samples will not be utilized for correction of analyte data.
- Surrogate compounds, matrix spikes, and spike blanks will be evaluated as %R.
- Reference materials will be reported in units indicated on the certificate of analysis.
- Continuing calibration factors will be presented as %D
- Duplicate sample results will be expressed as RPD.

7.2 Data Review and Validation

Data review is an internal review process where data are reviewed and evaluated by personnel within the laboratory. Data validation is an independent review process conducted by personnel not associated with data collection and generation activities.

Data review is initiated at the bench level by the analyst, who is responsible for ensuring that the analytical data are correct and complete, the appropriate SOPs have been followed, and the QC results are within the acceptable limits. The Laboratory Project Manager has final review authority. It is the Laboratory Project Manager's responsibility to ensure that all analyses performed by that laboratory are correct, complete, and meet project data quality objectives.

External and independent data validation will be performed for all samples by the QA Contractor using a full data package containing sufficient information to allow the independent validation of the sample identity and integrity, the laboratory measurement system, and resulting quantitative and qualitative data. The required information with associated instrument print-outs are listed in **Table 7.1**.

TABLE 7.1 Laboratory Data Deliverables Per Sample Batch

Chain-of-Custody/ Sample Receipt Checklist	
Sample Data:	Result summaries including surrogate recoveries, percent total solids, dilutions, etc
Standards Data:	Target MDL data based on the method in *40 CFR, 136* Calibration summaries: Initial calibration data, standard curve equation, correlation coefficient or %RSD, continuing calibration %D.
Quality Control Data (Method Blanks, CRMs, Duplicates, Matrix Spikes, Spike Blanks):	Results summaries including surrogate recoveries, plus %R and RPD, as applicable.
Case Narrative:	Special handling or analysis conditions. Any circumstance that requires special explanation such as an exception to QA/QC conditions or control criteria, dilutions, reanalysis, etc. Corrective actions/procedure alterations
Chromatograms and Extracted Ion Profiles	Appropriately scaled (1) GC/FID chromatograms for samples and associated QC analyzed for extractable hydrocarbons; (2) GC/MS EIPs for samples and associated QC analyzed for qualitative biomarkers
Electronic Data Deliverable:	As specified in laboratory contract.

Three levels of data validation will be performed (see USEPA, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. EPA-540-R-08-005. January 2009 for definitions): full (stage 4), summary (stage 2B), or cursory (stage 2A) validation. Full validation will consist of a review of the entire data package for compliance with documentation and quality control criteria for all the following items, plus recalculations of instrument calibration curves, sample and QC results. Summary validation will consist of a review of all the following items, but without recalculations. Cursory validation will consist of a review of only the starred (*) items:

- Package completeness*
- Holding times from extraction to analysis*
- Instrument calibration, initial and continuing
- Blank results*
- Instrument performance
- Spike recoveries*
- Standard reference material results*
- Laboratory duplicate results*
- Reported detection limits*
- Compound quantitation
- Compound identification
- Verification of electronic data deliverable (EDD) against hardcopy (10% verification)*

As the project proceeds and the quality of the data is verified and documented, the level of validation will decrease at the discretion of the QA Coordinator. At a minimum, cursory validation will be performed on all data packages, i.e., only the starred items will be reviewed.

Qualifiers (**Table 7.2**) may be assigned to individual data points by the QA Contractor. These validation qualifiers will not replace qualifiers or footnotes provided by the laboratory, but will be added to the data summary tables to inform the data user whether or not the data met all project quality objectives. Both sets of qualifiers will be maintained in the database.

TABLE 7.2 Data Validation Qualifier Codes

U	Analyte concentration is not significantly greater than the associated blank result. The result is judged to be the detection limit.
R	Unreliable result. Data should not be used.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
J	Reported concentration is an estimate with potentially more bias, or less precision than an unqualified concentration, as judged by associated calibration and/or reference material results.
UJ	Not detected. Detection limit is an estimate with potentially more bias or less precision than an unqualified detection limit as judged by the associated quality control results
DNR	Do not report; A more appropriate result is reported from another analysis or dilution.
F	Found. Analyte detected at less than the MDL, however, peak height is greater than 3 times the noise level and ID criteria are met.

All discrepancies and requests for additional corrected data will be discussed with the laboratory prior to issuing the formal data validation report. Review procedures and findings during data validation will be documented on worksheets. A validation report will be prepared for each data group/data package summarizing QC results, qualifiers, and possible data limitations. Only validated data with appropriate qualifiers will be released for general use. Data are not considered final until QA Coordinator has performed assessment and accepted the data.

In addition, the validated data will be reviewed by the QA Reviewer on behalf of BP America. The following process shall be used should the independent validation of the laboratory data results in a material difference in how qualifiers have been assigned or in the actual value itself:

- The QA Coordinator and QA Reviewer will meet to determine the source of the difference, and resolve. No changes to validated results will be made if the differences are considered immaterial to both the QA Coordinator and QA Reviewer.
- If the validated data have already been released by the QA Coordinator, then the data will be updated in accordance with the resolution and reposted.
- Should there be no agreement on how to resolve the difference, the QA Coordinator and QA Reviewer shall request further assistance from the Assessment Managers and BP America, respectively.
- The basis for all material changes to validated results will be documented along with the resubmitted validated data.

8.0 CORRECTIVE ACTION AND PROCEDURE ALTERATION

The analytical laboratories are required to adhere to the SOPs submitted by them to the QA Coordinator for this project. When the data from the analyses of any quality control sample exceeds the project specified control limits or indicates that the analytical method is drifting out of control, it is the

immediate responsibility of the analyst to identify and correct the situation before continuing with sample analysis.

A narrative describing the problem noted, the steps taken to identify and correct the problem and the treatment of the relevant sample batches must be prepared and submitted with the relevant data package. If the action indicates a revision to the accepted SOP is warranted, the laboratory will revise the SOP and resubmit the SOP to the QA Coordinator within 30 working days after the problem was noted. Until the revised SOP is approved, any data sets reported with the revised method will have the any changes to the method noted in the laboratory's case narrative.

9.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance/Quality Control (QA/QC) reports will be submitted periodically to the Assessment Manager(s) by the QA Coordinator. These reports may be either formal or informal in response to the Assessment Manager's request. Upon termination of the analytical work for this damage assessment, a formal QA report will be submitted. This report will include:

- General compliance with QA objectives
- Summary of technical and performance evaluation audits
- Summary of data validation reports
- Summary of laboratory control charts

10.0 REFERENCES

Bence, A.E., K.A. Kvenvolden, and M.C. Kennicutt, II. 2006. Organic geochemistry applied to environmental assessments of Prince William Sound, Alaska, after the Exxon Valdez oil spill--a review. *Org. Geochem.* 24(1):7-42.

Pu, F., R.P. Philp, L. Zhenxi and Y. Guangguo. 1990. Geochemical characteristics of aromatic hydrocarbons of crude oils and source rocks from different sedimentary environments. *Org. Geochem.* 16(1-3):427-443.

USEPA, 2002. *Guidance for Quality Assurance Project Plans*, (EPA QA/G-5) EPA/240/R-02/009, December 2002. http://www.epa.gov/quality/qs-docs/r5-final.pdf

USEPA, 2001. *EPA Requirements for Quality Assurance Project Plans*, (EPA QA/R-5) EPA/240/B-01/003, March, 2001. http://www.epa.gov/quality/qs-docs/q5-final.pdf

Deepwater Horizon Oil Spill (DWHOS)

NRDA SEAMAP Plankton Sampling Plan

Attachment 11. Winter2011 SEAMAP Stations Maps and Coordinates

February 3, 2011

This attachment contains maps of the stations included in the winter 2011 SEAMAP bongo-neuston sampling plan. The list of coordinates for the stations is in Table 1.

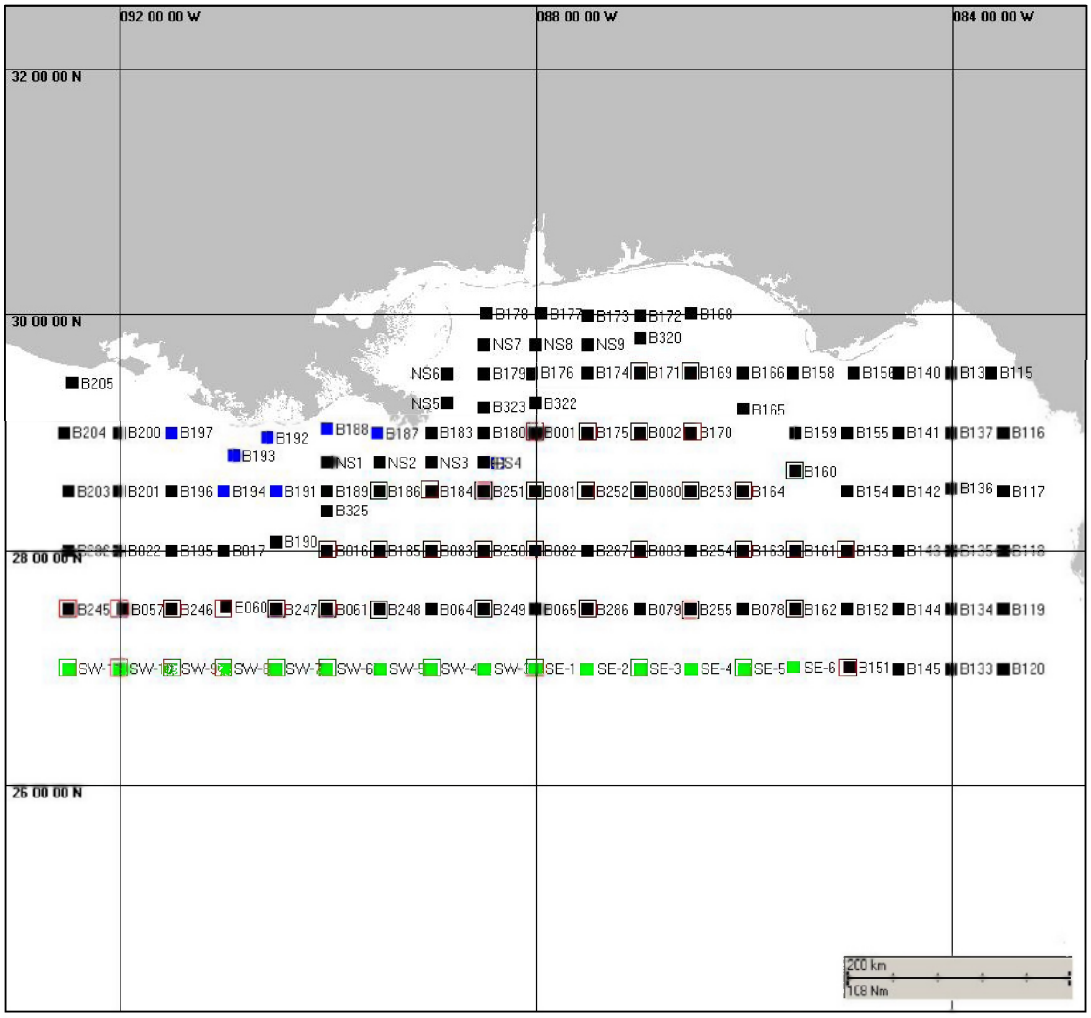

Figure 1. 2011 NRDA winter plankton stations. Black squares and green represent *Oregon* II stations for bongo-neuston sampling. (Black squares are part of the regular SEAMAP program; green squares were added for the DWHOS plankton program in fall 2010.) Red outlined stations are those where a MOCNESS tow will also be attempted (time and weather permitting). Light blue squares are stations that Louisiana is going to sample.

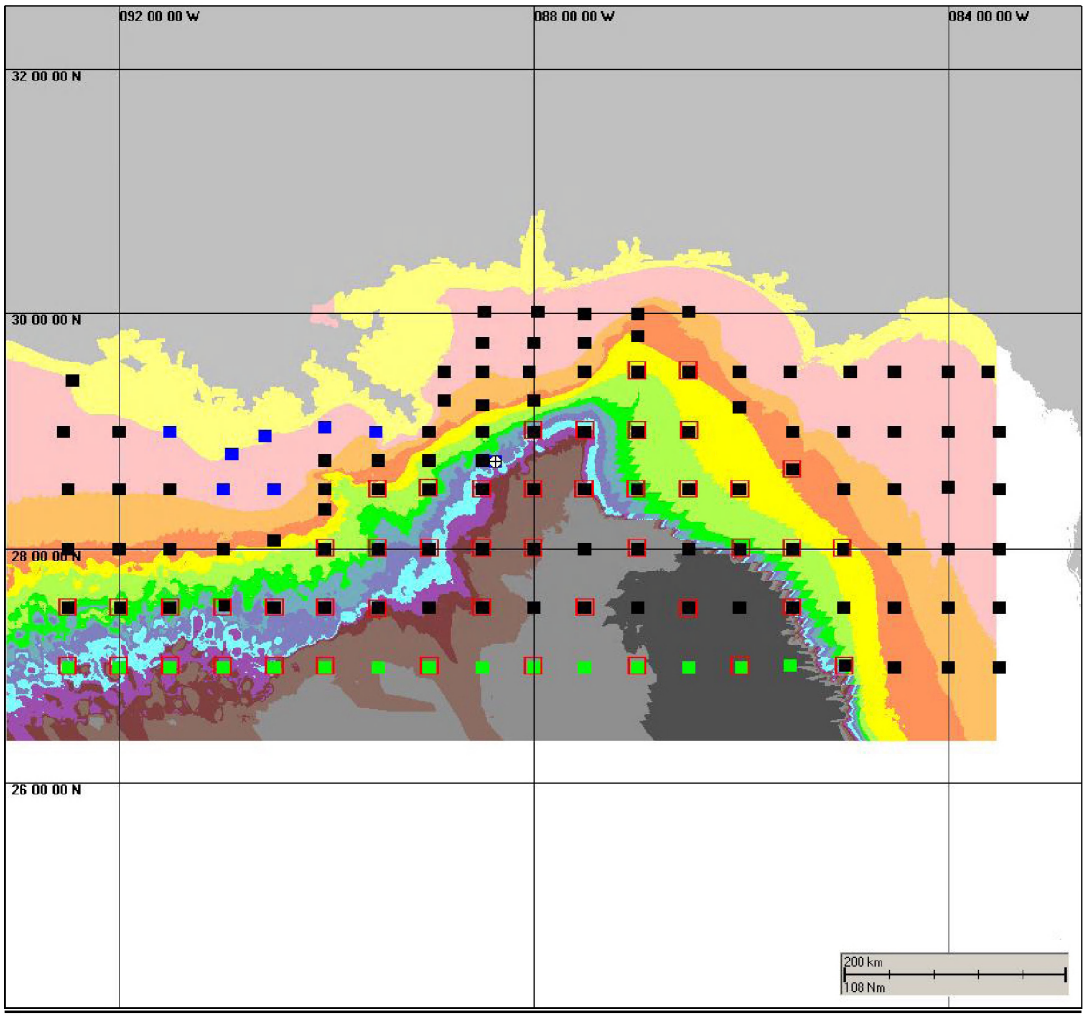

Figure 2. 2011 NRDA winter plankton stations with bathymetry. Black squares and green represent *Oregon* II stations for bongo-neuston sampling. (Black squares are part of the regular SEAMAP program; green squares were added for the DWHOS plankton program in fall 2010.) Red outlined stations are those where a MOCNESS tow will also be attempted (time and weather permitting). Light blue squares are stations that Louisiana is going to sample.

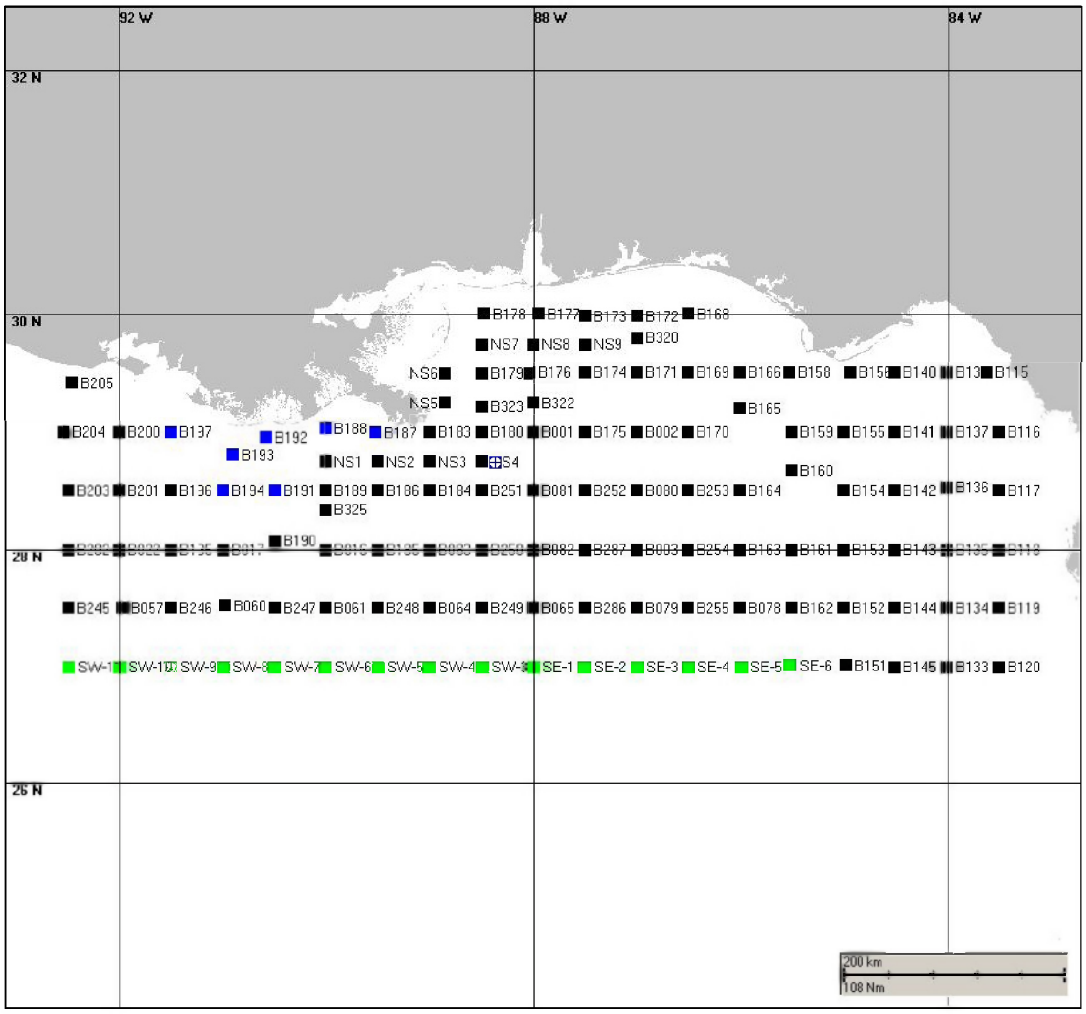

Figure 3. 2011 NRDA winter plankton stations. Black squares and green represent *Oregon* II stations for bongo-neuston sampling. (Black squares are part of the regular SEAMAP program; green squares were added for the DWHOS plankton program in fall 2010.) Light blue squares are stations that Louisiana is going to sample.

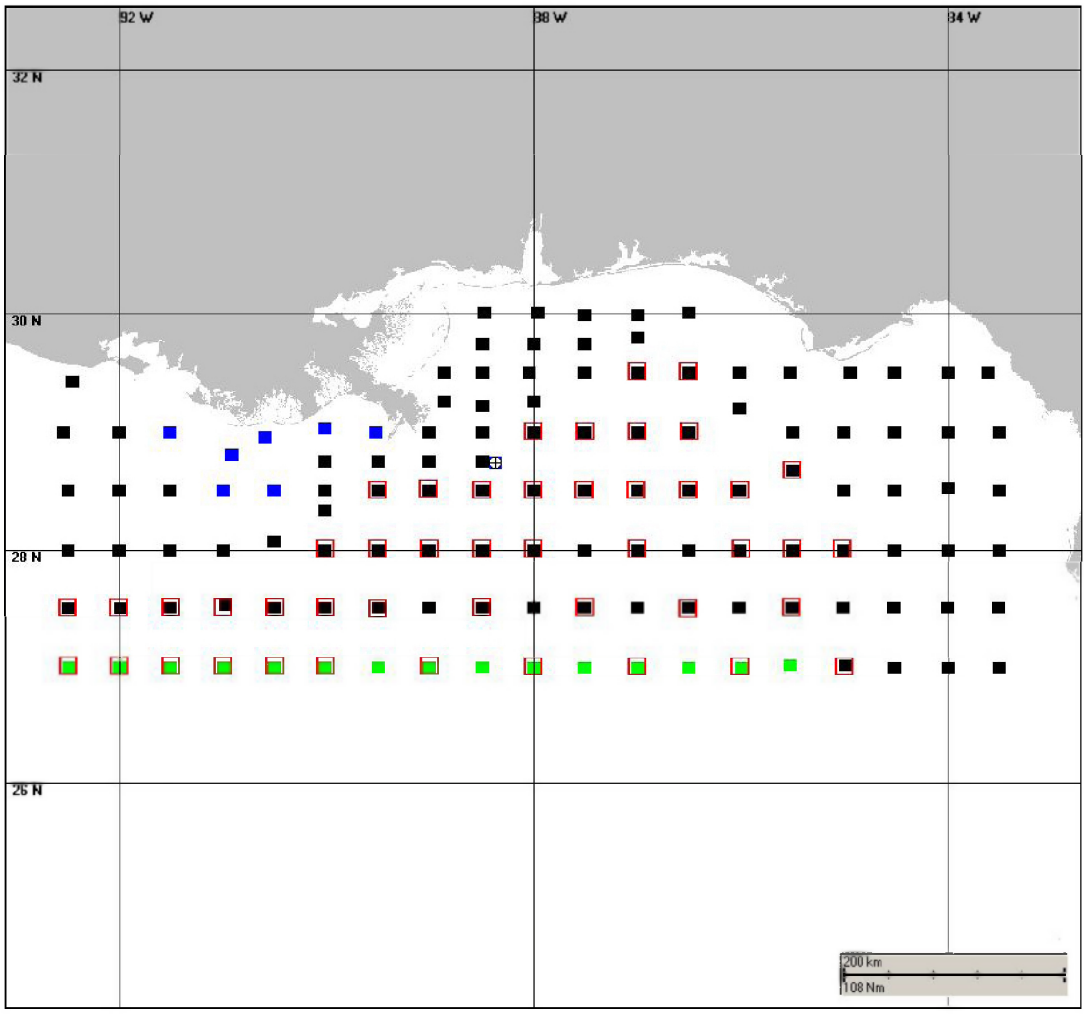

Figure 4. 2011 NRDA winter plankton stations. Black and green squares represent *Oregon* II stations for bongo-neuston sampling. (Black squares are part of the regular SEAMAP program; green squares were added for the DWHOS plankton program in fall 2010.) Red outlined stations are those where a MOCNESS tow will also be attempted (time and weather permitting). Light blue squares are stations that Louisiana is going to sample.

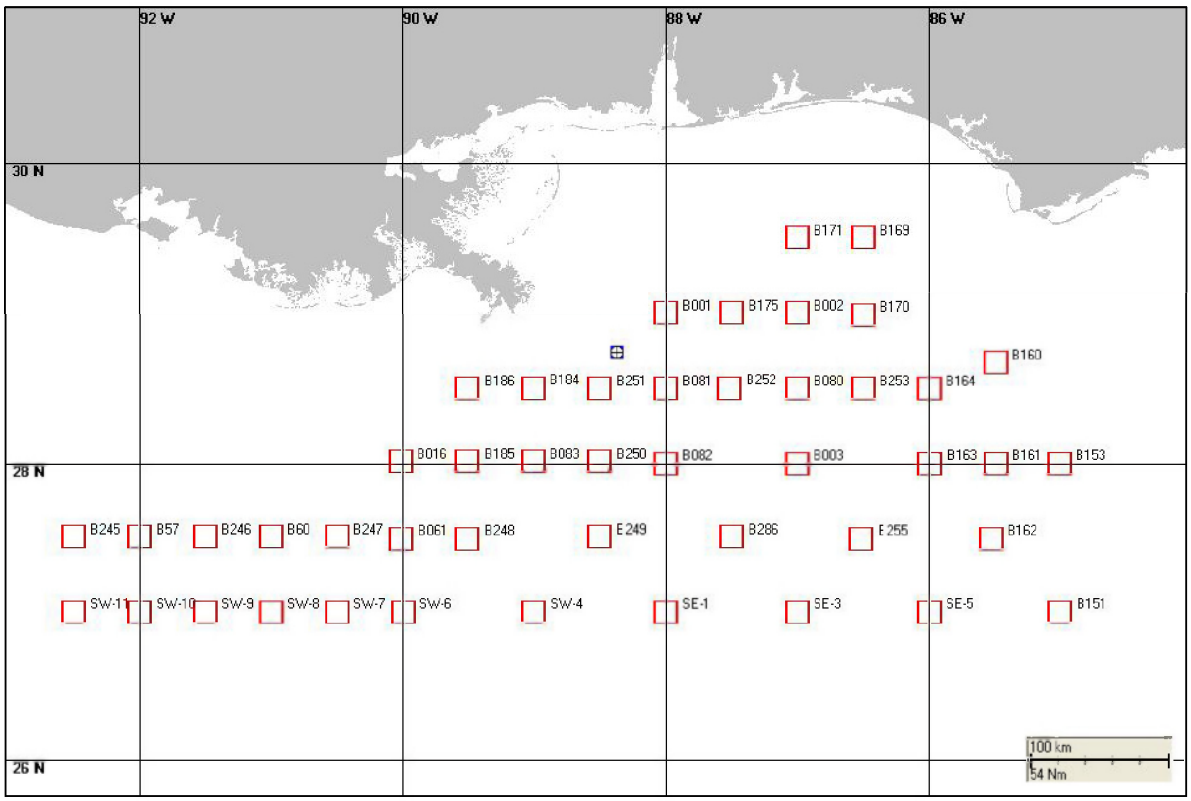

Figure 5. 2011 NRDA winter plankton stations where a MOCNESS tow will also be attempted (time and weather permitting).

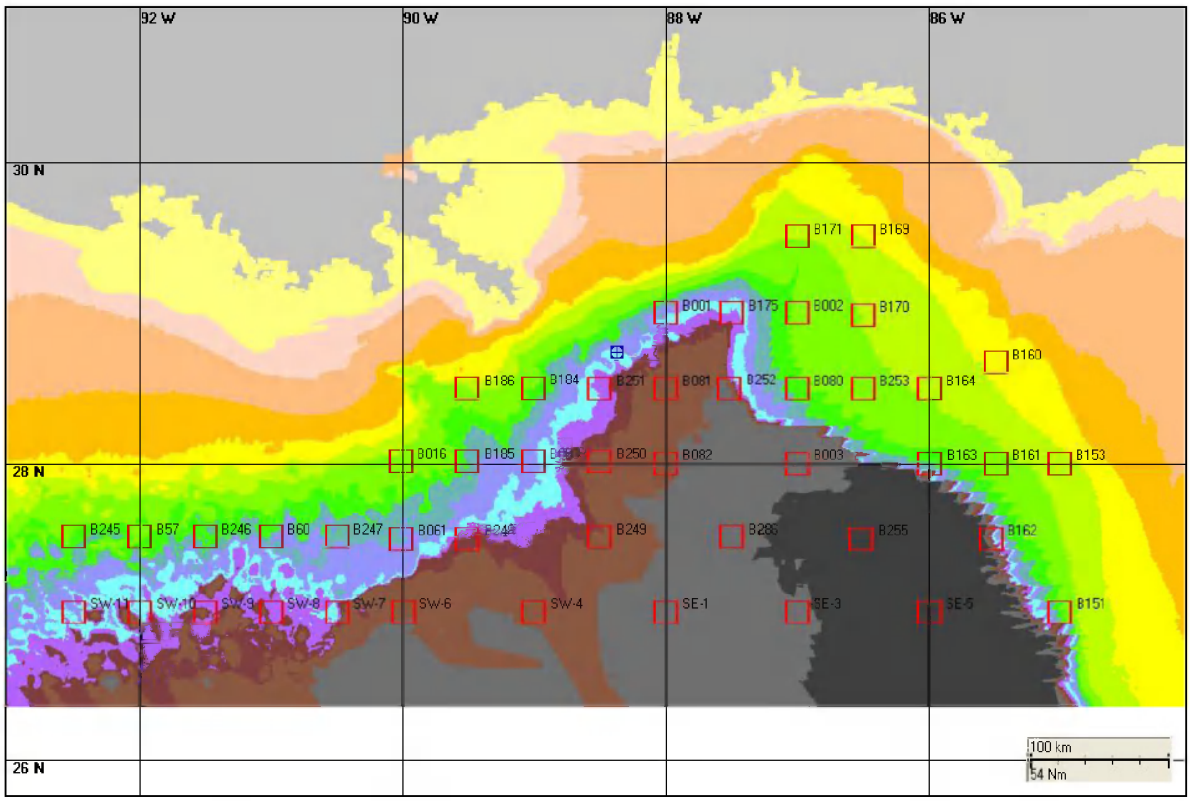

Figure 6. 2011 NRDA winter plankton stations (over bathymetry) where a MOCNESS tow will also be attempted (time and weather permitting).

Table 1. 2011 NRDA winter plankton station locations to be sampled with bongo and neuston nets on the *Oregon* II. Those stations where MOCNESS sampling will be attempted are noted with an M.

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
B001	-88.00	29.00	M
B002	-87.00	29.00	M
B003	-87.00	28.00	M
B016	-90.00	28.00	M
B017	-91.00	28.00	
B022	-92.00	28.00	
B057	-92.00	27.50	M

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
B060	-91.00	27.50	M
B061	-90.00	27.50	M
B064	-89.00	27.50	
B065	-88.00	27.50	
B078	-86.00	27.50	
B079	-87.00	27.50	
B080	-87.00	28.50	M
B081	-88.00	28.50	M
B082	-88.00	28.00	M
B083	-89.00	28.00	M
B115	-83.62	29.50	
B116	-83.50	29.00	
B117	-83.50	28.50	
B118	-83.50	28.00	
B119	-83.50	27.50	
B120	-83.50	27.00	
B133	-84.00	27.00	
B134	-84.00	27.50	
B135	-84.00	28.00	
B136	-84.00	28.53	
B137	-84.00	29.00	
B138	-84.00	29.50	
B140	-84.50	29.50	

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
B141	-84.50	29.00	
B142	-84.50	28.50	
B143	-84.50	28.00	
B144	-84.50	27.50	
B145	-84.50	27.00	
B151	-85.00	27.00	M
B152	-85.00	27.50	
B153	-85.00	28.00	M
B154	-85.00	28.50	
B155	-85.00	29.00	
B156	-84.93	29.50	
B158	-85.52	29.50	
B159	-85.50	29.00	
B160	-85.50	28.67	M
B161	-85.50	28.00	M
B162	-85.50	27.50	M
B163	-86.00	28.00	M
B164	-86.00	28.50	M
B165	-86.00	29.20	
B166	-86.00	29.50	
B168	-86.50	30.00	
B169	-86.50	29.50	M
B170	-86.50	29.00	M

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
B171	-87.00	29.50	M
B172	-87.00	29.98	
B173	-87.50	30.00	
B174	-87.50	29.50	
B175	-87.50	29.00	M
B176	-88.04	29.50	
B177	-88.00	30.00	
B178	-88.50	30.00	
B179	-88.50	29.50	
B180	-88.50	29.00	
B183	-89.00	29.00	
B184	-89.00	28.50	M
B185	-89.50	28.00	M
B186	-89.50	28.50	M
B189	-90.00	28.50	
B190	-90.50	28.08	
B195	-91.50	28.00	
B196	-91.50	28.50	
B200	-92.00	29.00	
B201	-92.00	28.50	
B202	-92.50	28.00	
B203	-92.50	28.50	
B204	-92.54	29.00	

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
B205	-92.45	29.42	
B245	-92.50	27.50	M
B246	-91.50	27.50	M
B247	-90.50	27.50	M
B248	-89.50	27.50	M
B249	-88.50	27.50	M
B250	-88.50	28.00	M
B251	-88.50	28.50	M
B252	-87.50	28.50	M
B253	-86.50	28.50	M
B254	-86.50	28.00	
B255	-86.50	27.50	M
B286	-87.50	27.50	M
B287	-87.50	28.00	
B320	-87.00	29.80	
B322	-88.00	29.25	
B323	-88.50	29.22	
B325	-90.00	28.34	
SE-6	-85.50	27.00	
SE-5	-86.00	27.00	M
SE-4	-86.50	27.00	
SE-3	-87.00	27.00	M
SE-2	-87.50	27.00	

Station Number	Longitude (W)	Latitude (N)	MOCNESS Tow
SE-1	-88.00	27.00	M
SW-3	-88.50	27.00	
SW-4	-89.00	27.00	M
SW-5	-89.50	27.00	
SW-6	-90.00	27.00	M
SW-7	-90.50	27.00	M
SW-8	-91.00	27.00	M
SW-9	-91.50	27.00	M
SW-10	-92.00	27.00	M
SW-11	-92.50	27.00	M
NS-1	-90.00	28.75	
NS-2	-89.50	28.75	
NS-3	-89.00	28.75	
NS-4	-88.50	28.75	
NS-5	-88.85	29.25	
NS-6	-88.85	29.50	
NS-7	-88.50	29.75	
NS-8	-88.00	29.75	
NS-9	-87.50	29.75	M

Deepwater Horizon Oil Spill (DWHOS)

NRDA Plankton Sampling Plans:
1-m MOCNESS Sample Handling and Preservation Protocol

March 28, 2011

Overall Sample Handling Procedure

Upon recovery of the MOCNESS, each net will be washed down with salt water and the contents of the cod ends rinsed into buckets with icepacks. The samples from **nets 1-9** will then be preserved in the following manner: collect each sample on a sieve, rinse into a collection jar with sea water, and preserve in 10% buffered formalin (37% formaldehyde solution). The sample from **net 0** will be preserved in the following manner: collect each sample on a sieve, rinse into a collection jar with 70% ethanol (95% ethanol stock diluted with seawater to 70%), and fill the jar completely with the 70% ethanol solution. In the event that the sample contains any large organisms that will not fit in the sample jar or requires a more concentrated preservative, the large organisms will be rinsed with sea water (back into the sample to ensure none of the smaller organisms are removed), and then preserved in a separate container with the appropriate mixture of buffered formalin. If the total biomass takes up more than 50% of the jar the sample should be moved to a larger jar or split into two jars – maintaining the preservation percentages.

For samples where the volumes of gelatinous zooplankton exceed the capacity to save, the whole sample will be rinsed with sea water to separate the larger jellies and ensure the smaller organisms are not caught. The smaller size fraction will be preserved as described above and the volume and species composition of sieved jellies will be recorded using a calibrated large volume measuring device and photography. These techniques do not constitute a quantitative measure, but can be used qualitatively.

All samples will be held under NOAA NRDA chain of custody. All samples will be sent to Malinda Sutor's laboratory at Louisiana State University (or her designee).

Chemicals

Buffered Formalin: Buffered formalin is created by adding sodium borate (Borax can also be used) to the stock 37% Formaldehyde Solution. Sodium borate should be added in small quantities until the formalin cannot hold any more and the borate begins to precipitate out of the solution. When this is reached, the buffered formalin should be tested with a pH strip to ensure it at neutral pH (8). The buffered formalin is then ready to add to samples.

70% Ethanol: 70% ethanol is created by diluting the 95% non-denatured ethanol stock with sea water. This solution is then ready to be used to rinse the sample from the sieves into the sample jar, and then fill the rest of the way to avoid evaporation.

Storage: Store unopened formalin and ethanol inside Flammable Liquid Storage Cabinet outside of wet lab or in the fume hood.

Laboratory Standard Operating Procedures – 1-m MOCNESS

1. Wash down the net with sea water from the highest possible point, rinsing any specimens into the secured cod end
2. Empty the cod end of the net into the respectively numbered buckets with icepack in the bottom. Rinse the cod end and collar of the net thoroughly into the bucket.
    - Repeat for the remaining 9 nets/cod ends
3. For each sample, strain the sample on a sieve to remove excess water
4. Rinse the sample into a sample jar
    - This should be done with sea water for nets 1-9 and 70% ethanol for net 0
    - If 50% or more of the sample (once water is added) is biomass the sample needs to be split into 2 separate jars
5. When sample is ready for preservation, add the internal label
6. Preserve the samples
    - Nets 1-9 should be preserved with 10% buffered formalin
    - Net 0 should be preserved with 70% ethanol
7. Dry the outside of the sample jars and apply the external labels
    - Once labeled, wrap the entire jar in clear tape to ensure labels do not come off

Sample Preservation

NET 0 (70% ETHANOL)

- Strain all seawater from sample using 70% ethanol in sea water solution
- Fill jar with 70% ethanol and cap with correct lid
- Place preserved sample jar into fume hood or staging area and note on Ethanol data sheet awaiting second preservation
- 24 hours following initial preservation, strain sample and refill with fresh ethanol
- Move waste ethanol into waste container

NETS 1-9 (BUFFERED FORMALIN)

- Ensure the sample jar has adequate space (i.e. 1/3 volume) for formalin
- Measure 10 parts formalin per volume of sample container with graduated cylinder and pour into sample jar
    - 500 ml sample jar = 50 ml formalin
    - 1000 mL sample jar = 100ml formalin
- Fill any remaining samples jar head space with seawater and secure jar lid

Safety Measures

- Wear proper PPE (i.e. hard hat, steel toe boots, and PFD)
- Wear gloves, goggles when handling hazardous chemicals
- Work in a well-ventilated area (i.e. outside or in fume hood) with proper lighting
- Watch for slips, trip and falls when entering/exiting science lab and while working on back deck
- Make sure channels of communication are properly used and everybody is following same procedures of collecting, analyzing and preserving samples
- If you are unsure, as your watch lead or chief scientist