SEAMAP FIELD OPERATIONS MANUAL

FOR COLLECTION OF DATA

Prepared by:

NATIONAL MARINE FISHERIES SERVICE

and

GULF STATES MARINE FISHERIES COMMISSION

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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

TABLE OF CONTENTS

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

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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.

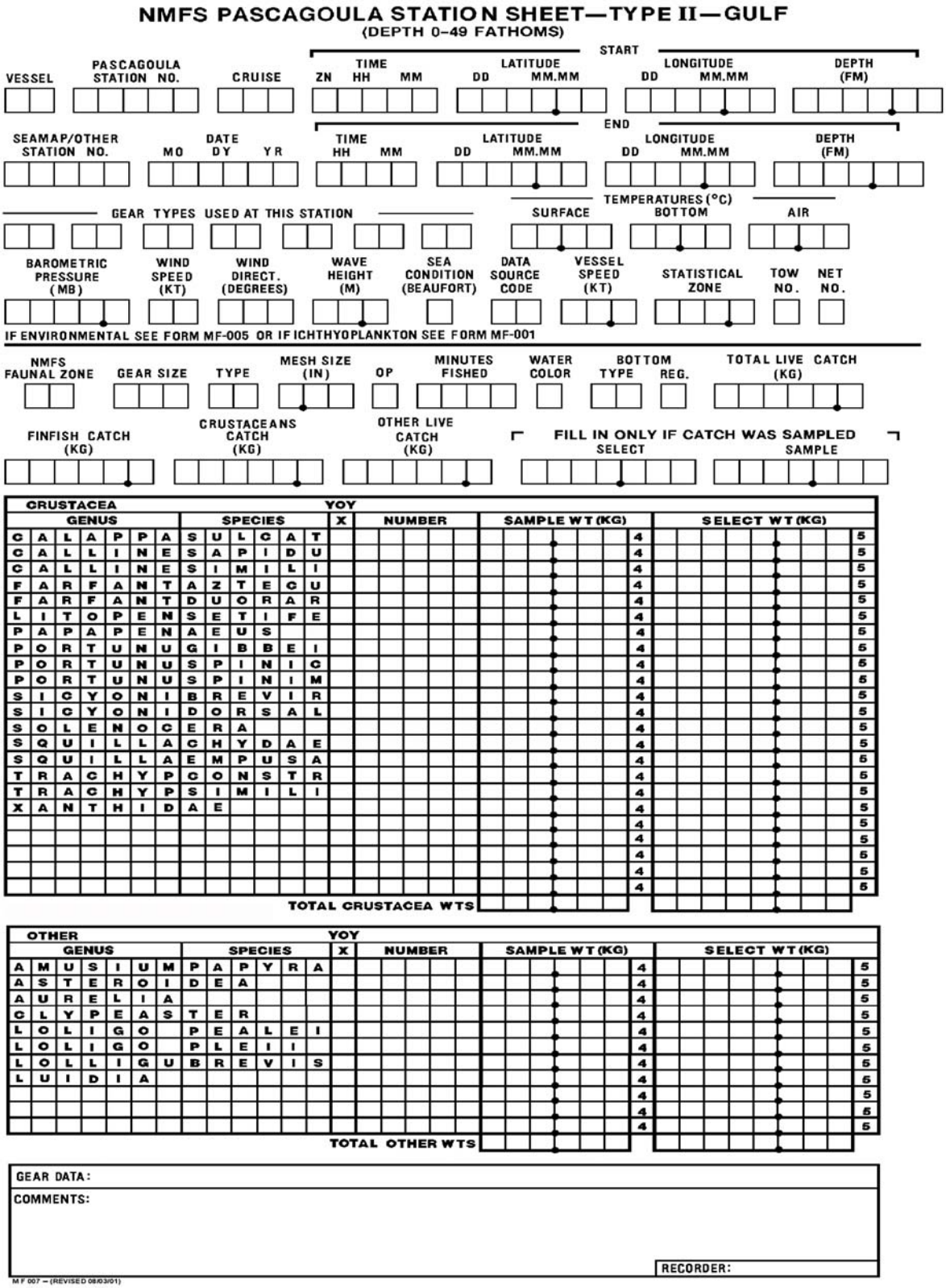
GEAR DATA - Detail gear used. If the same gear is to be used for the entire cruise, this section need be filled out only

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 GENUS	SPECIES	X	NUMBER	SAMPLE WT (KG)		SELECT WT (KG)	
CALAPPA	SULCATA			4	5		5
CALLINES	APIDU			4	5		5
CALLINES	IMILI			4	5		5
FARFANT	AZTECU			4	5		5
FARFANT	DUORAR			4	5		5
LITOPEN	SETIFE			4	5		5
PAPAPEN	AEUS			4	5		5
PORTUNU	GIBBEI			4	5		5
PORTUNU	SPINIC			4	5		5
PORTUNU	SPINIM			4	5		5
SICYONI	BREVIR			4	5		5
SICYONI	DORSAL			4	5		5
SOLENOCE	RA			4	5		5
SQUILLA	CHYDAE			4	5		5
SQUILLA	EMPUSA			4	5		5
TRACHYP	CONSTR			4	5		5
TRACHYP	SIMILI			4	5		5
XANTHID	AE			4	5		5
				4	5		5
				4	5		5
				4	5		5
				4	5		5
				4	5		5
TOTAL CRUSTACEA WTS							

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

GEAR DATA:

COMMENTS:

RECORDER:

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

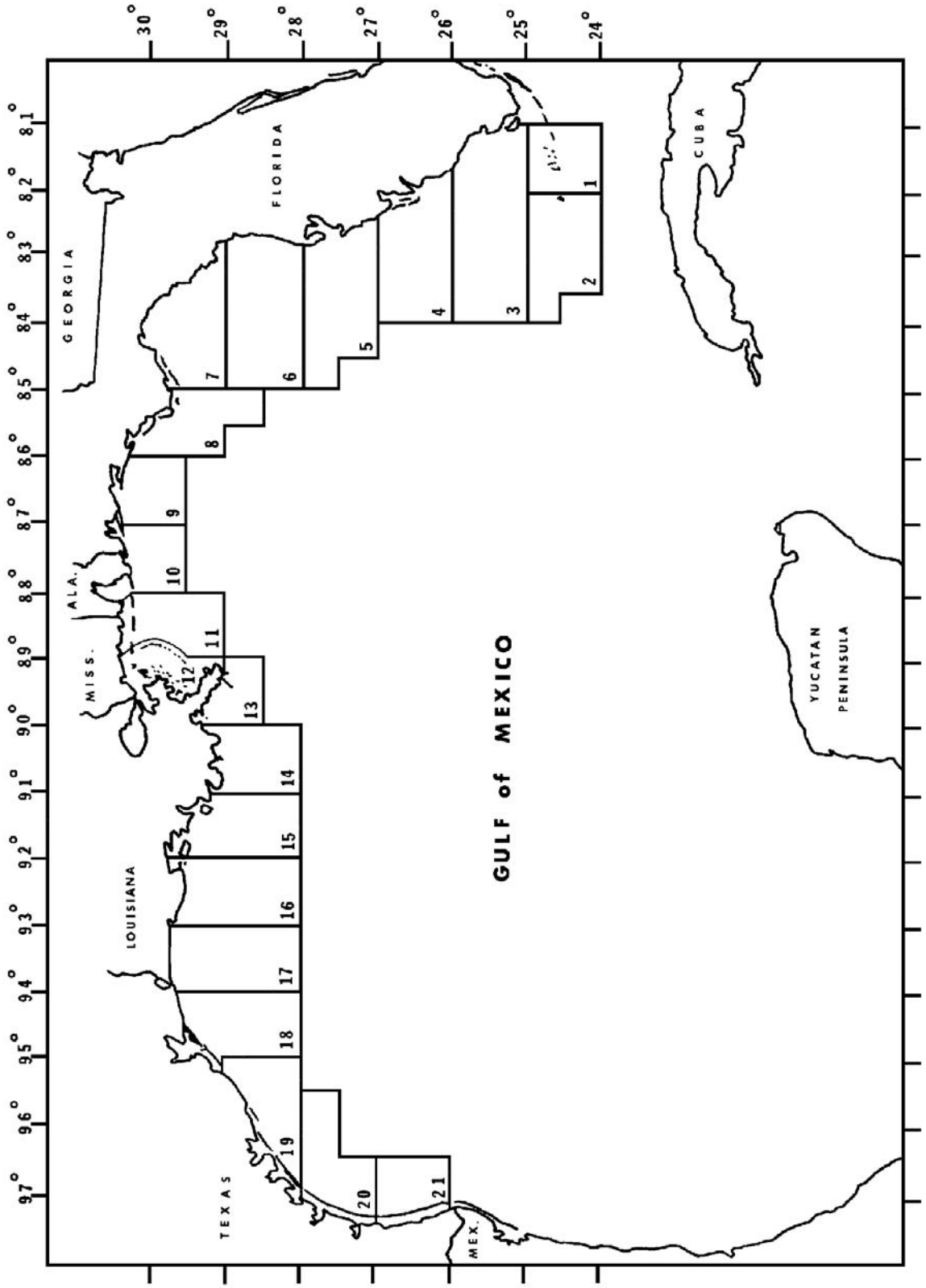
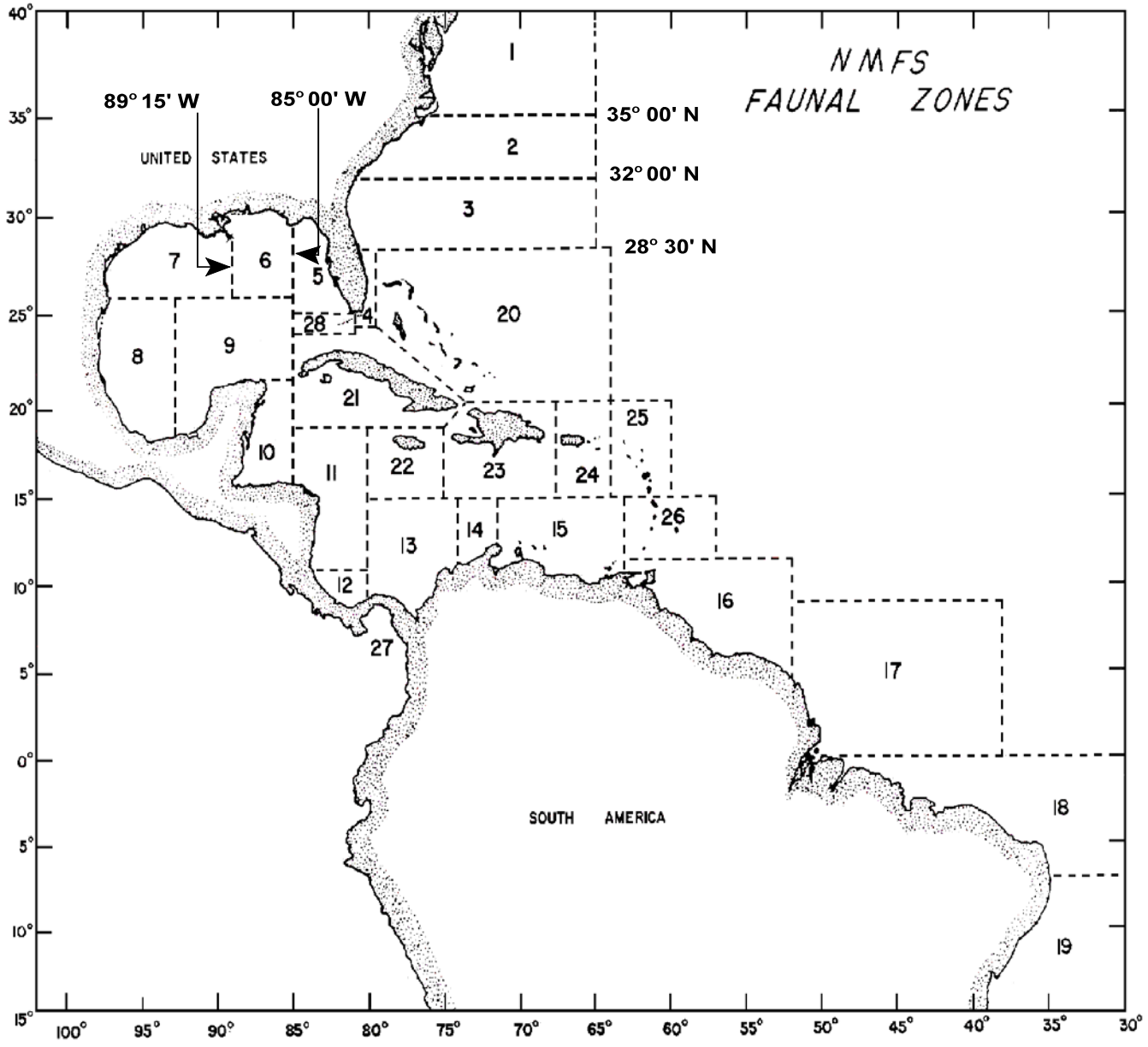


Figure 1-3. NMFS Faunal Zones.



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.

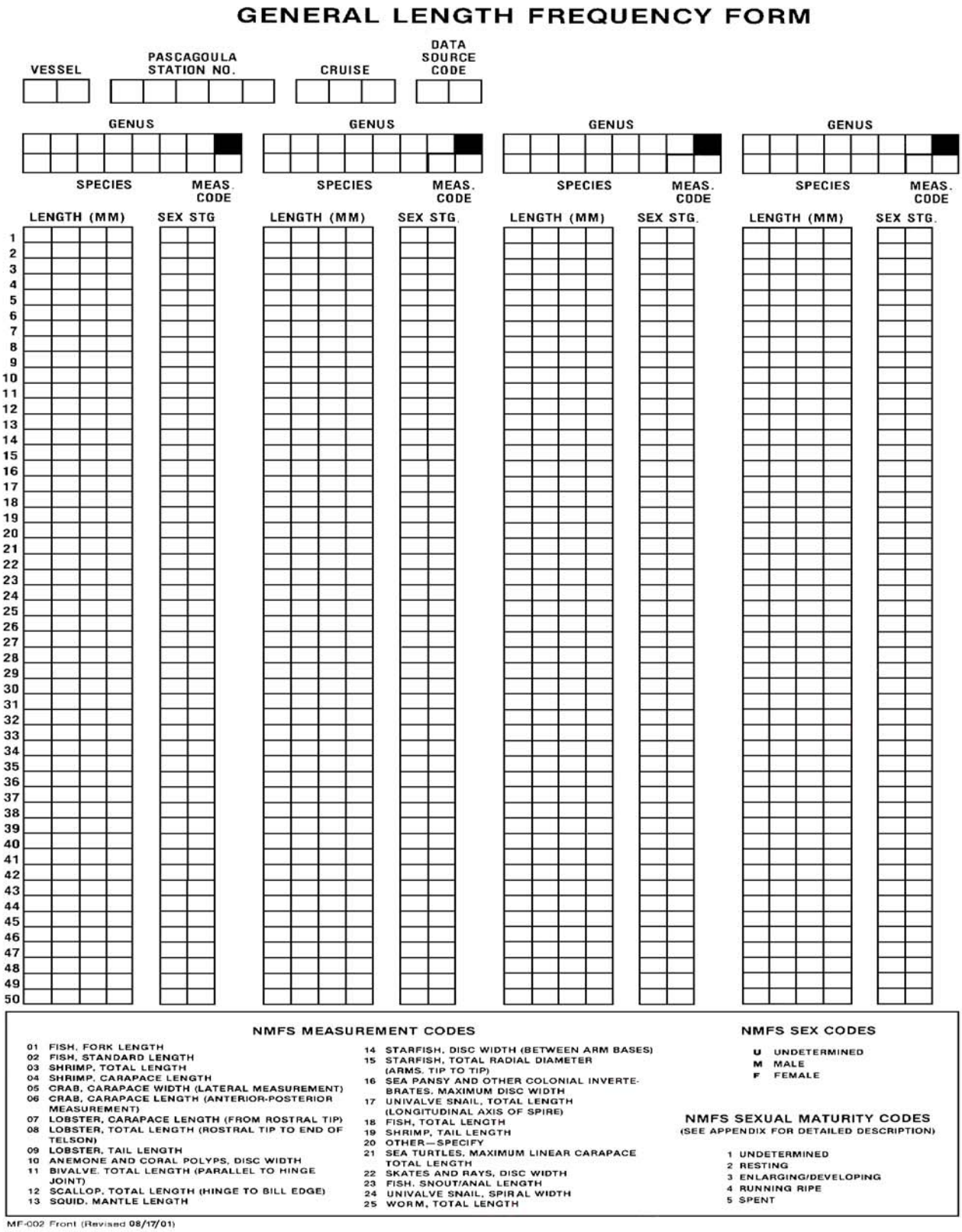
MEASUREMENT CODE - See Appendix 6, Alphabetic List of Species Length Frequency Measurement Codes, page A-8, for species length measurement codes. For species not listed refer to Appendix 7, Length Frequency Measurement Code Finder List, page A-19. Consult FPC if you are unsure of which measurement to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

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

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

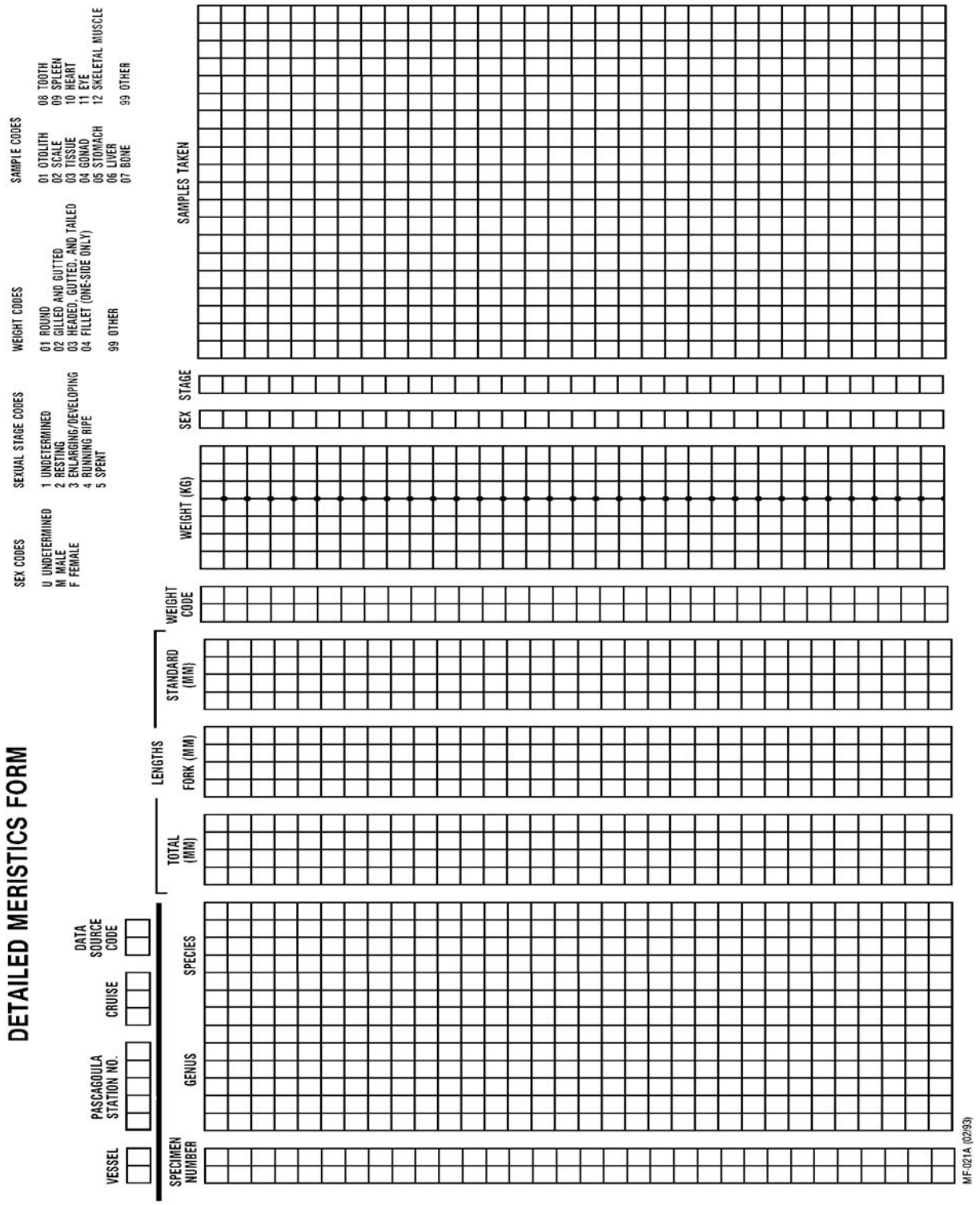
GENUS-SPECIES - Record first seven characters of the genus and the first six of the species.

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 L mm		TOTAL L mm		TOTAL L mm		TOTAL L mm		TOTAL L mm		TOTAL 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

MF-004 Front (Revised 01/4/89)

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).

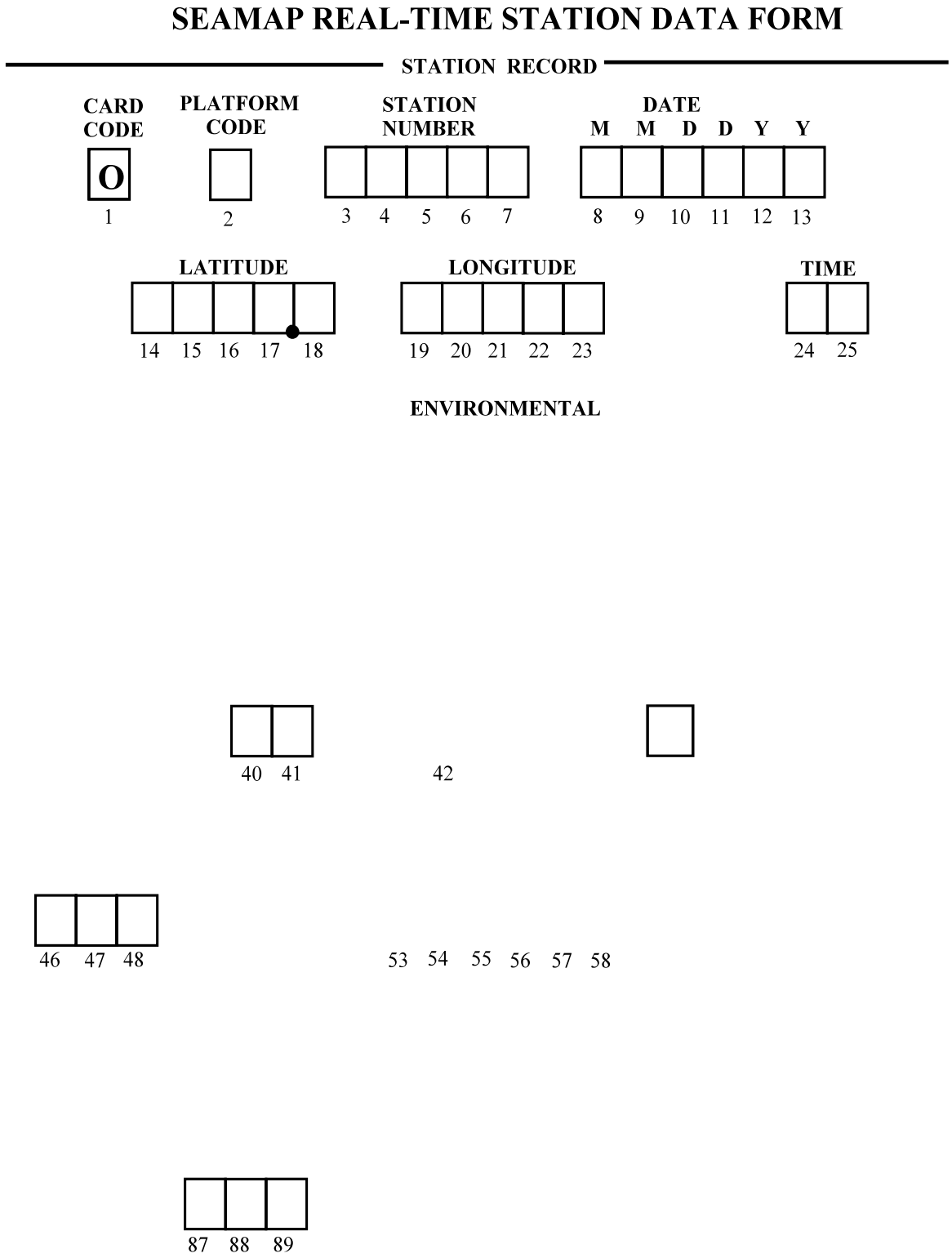
80-86 Catfish - same as above.

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.

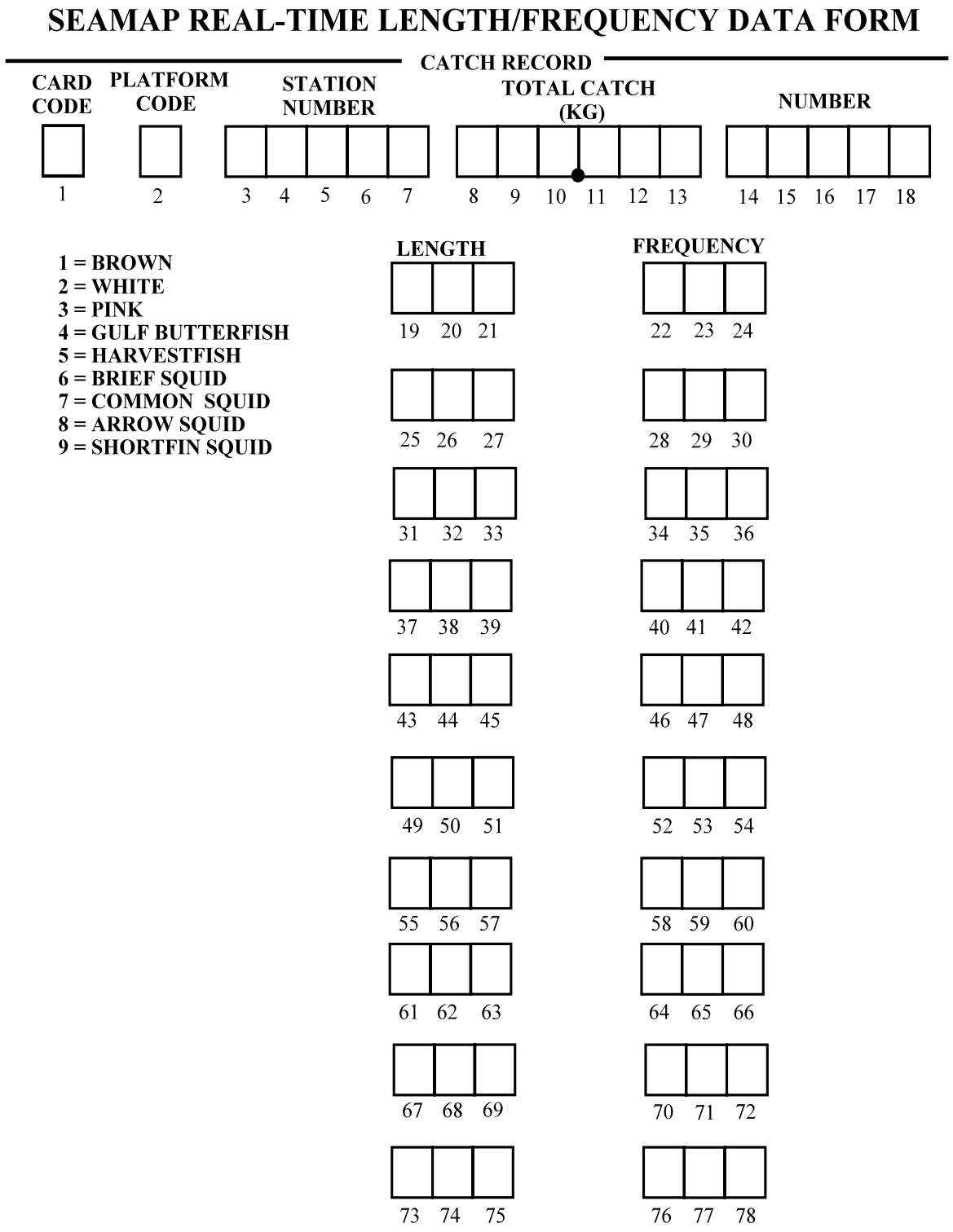


Table A. SEAMAP Real-Time Alphabetic List of Species Codes.

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.

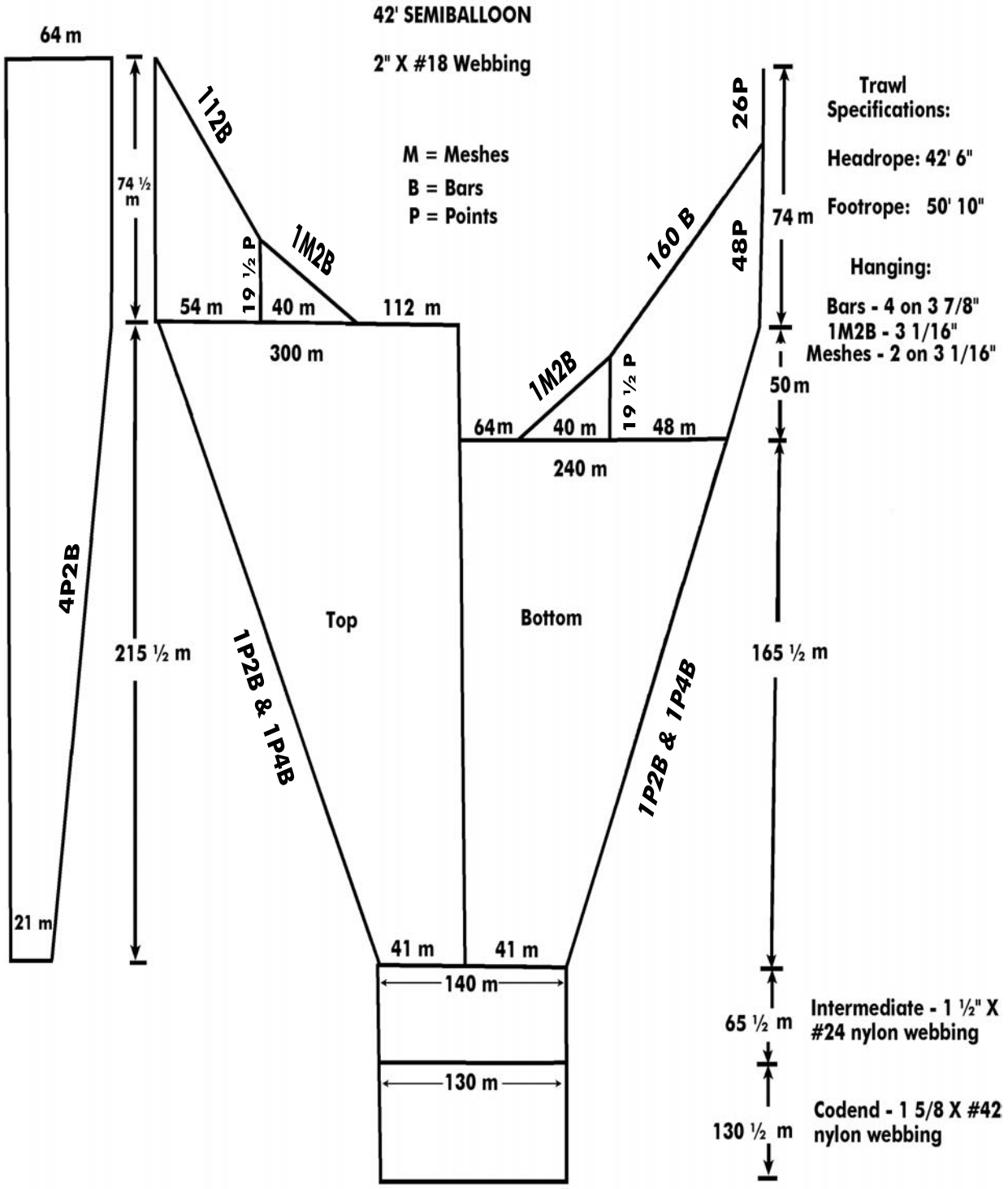
Mud Rollers:
17 mud rollers on a separate line (1/2" polypropylene) tied every 3 feet, with 3" of slack (top of roller to bottom of footrope).

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.

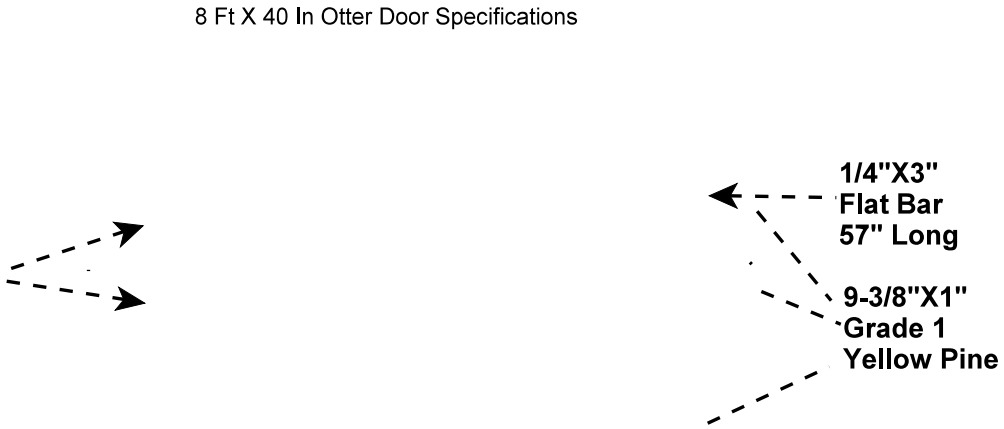
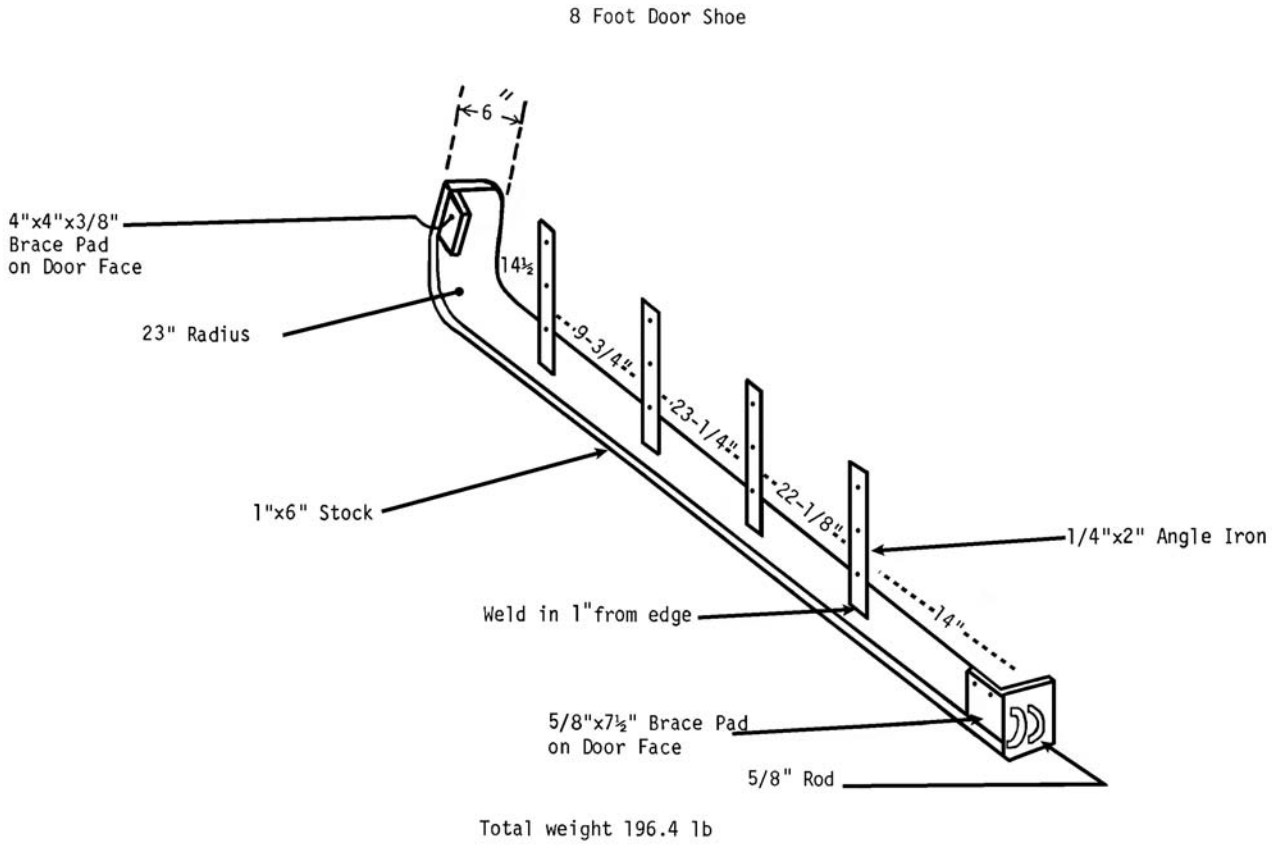


Figure 3-3. SEAMAP 8 Foot Door Shoe Design.



D. <u>Recommended Towing Warp Scope Ratio Table</u>

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.

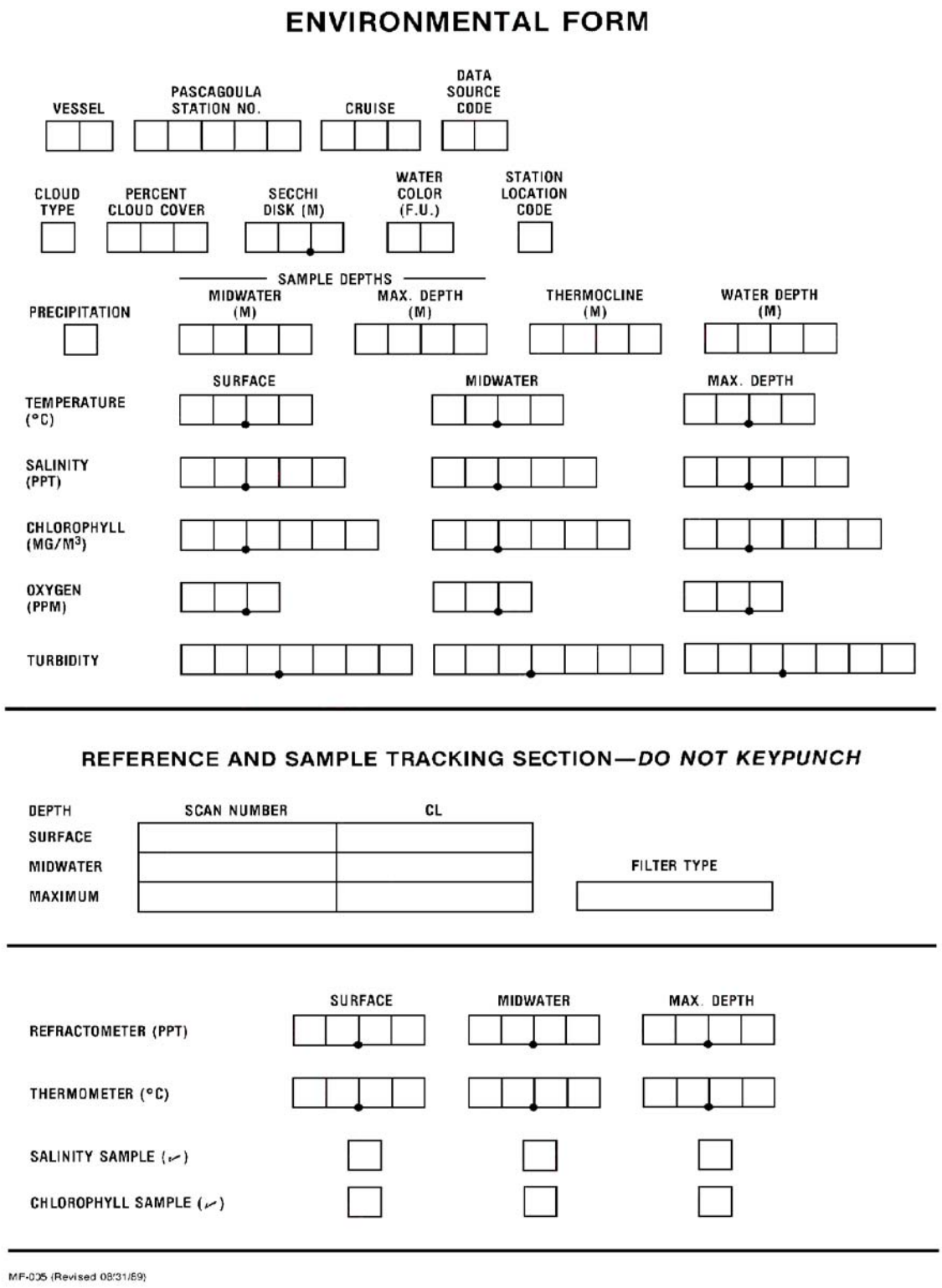
REFRACTOMETER (PPT) - Enter refractometer readings in ppt. Refractometer readings are not recorded if you are saving a salinity sample or have recorded other salinity measurements.

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

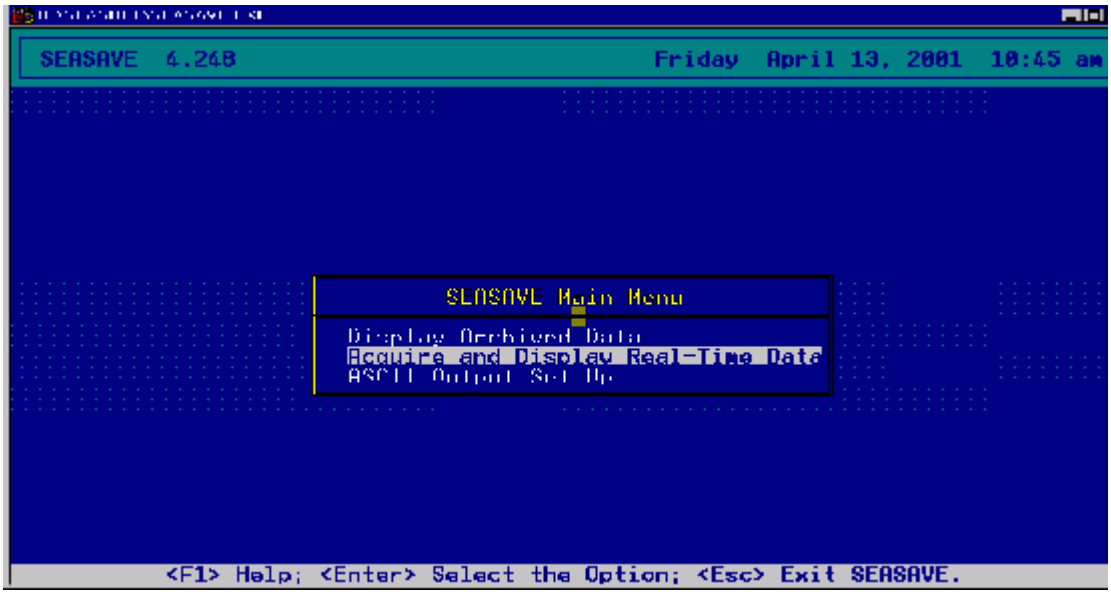
the frame.

e. Test fire the Rosette.

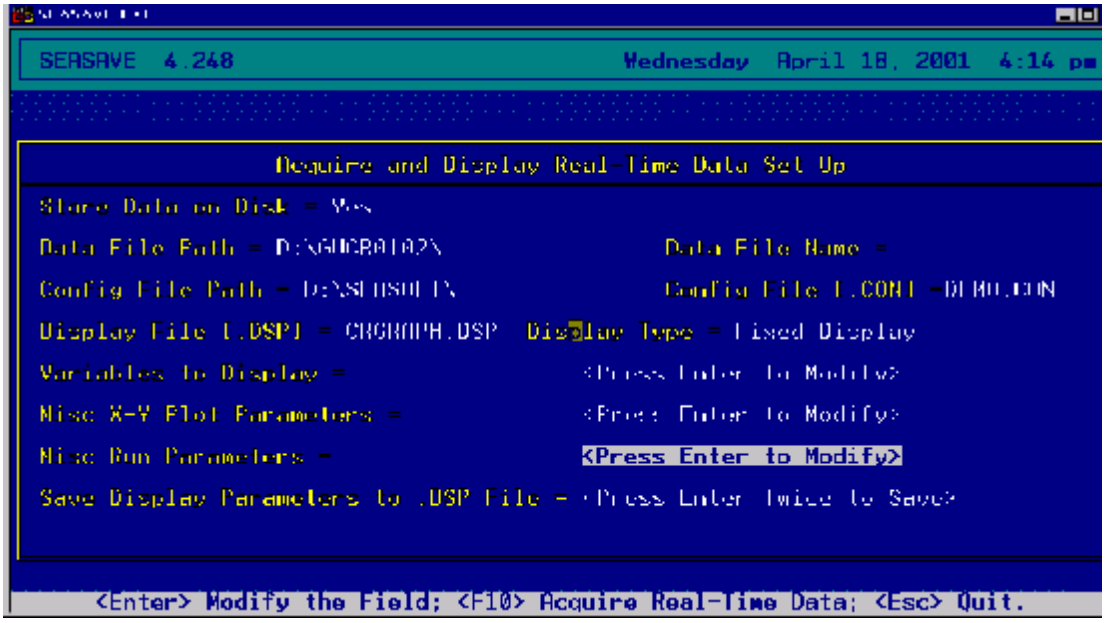
3. PRECRUISE SEASAVE SOFTWARE SETUP

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:

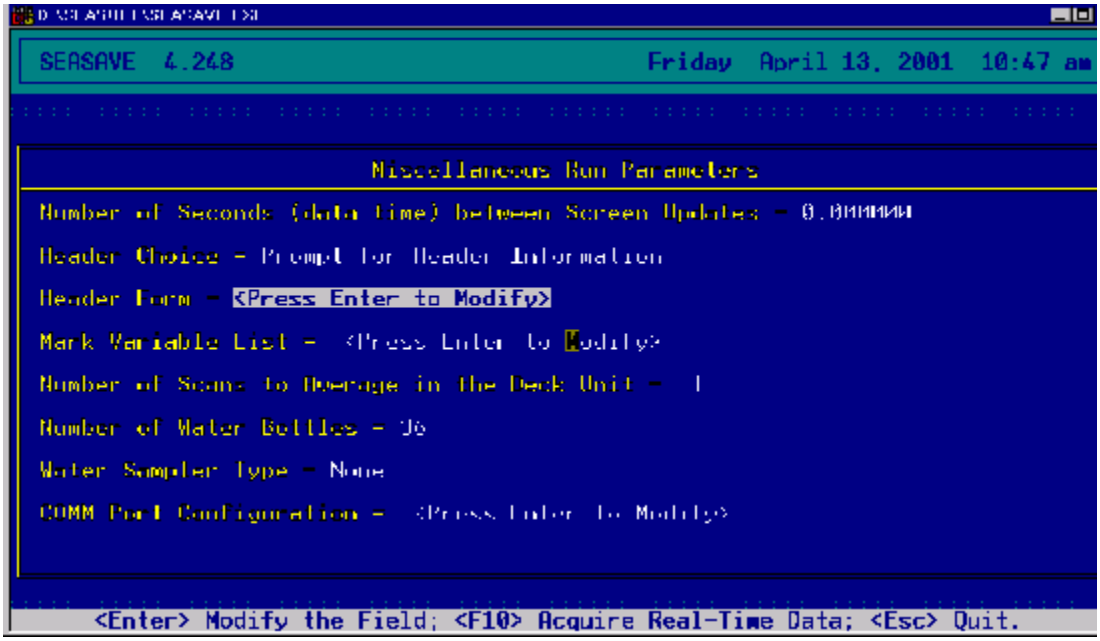
In the SEASAVE Main Menu window, scroll down and select Acquire and Display Real-Time Data.



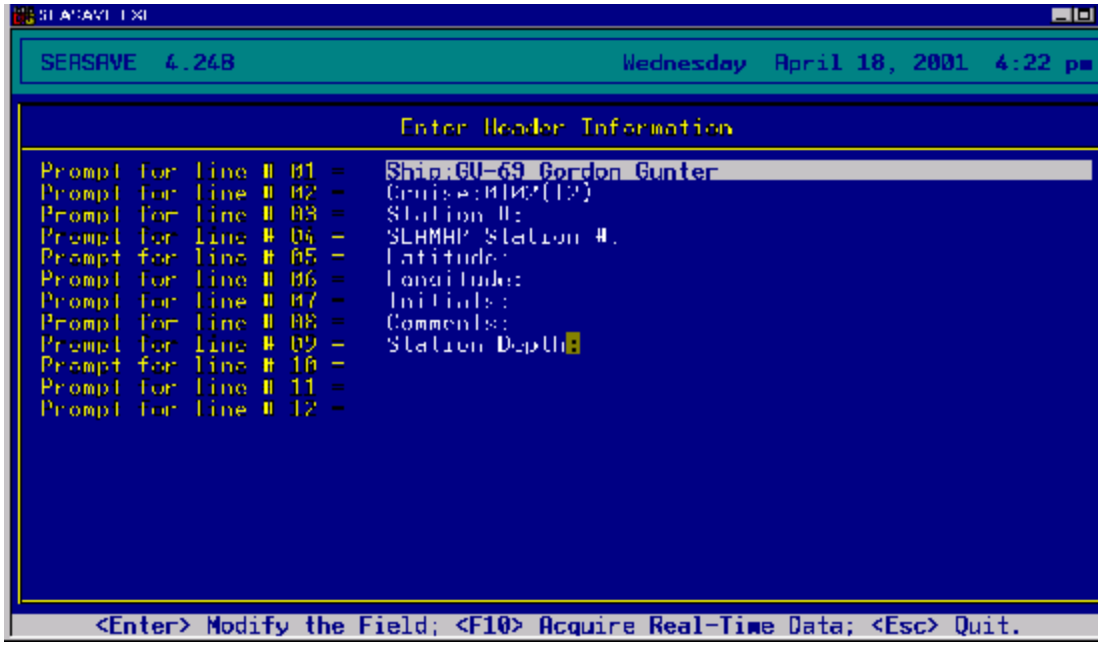
In the Acquire and Display Real-Time Data Set Up window, scroll down and select Misc Run Parameters.



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



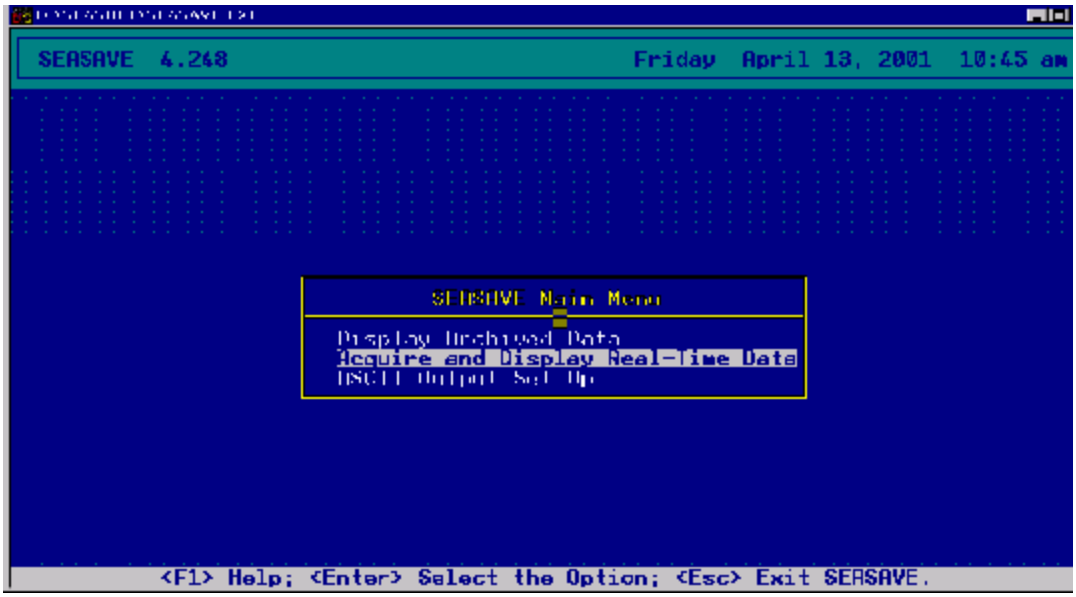
In the Enter Header Information window enter the information appropriate for your organization and vessel on each line.



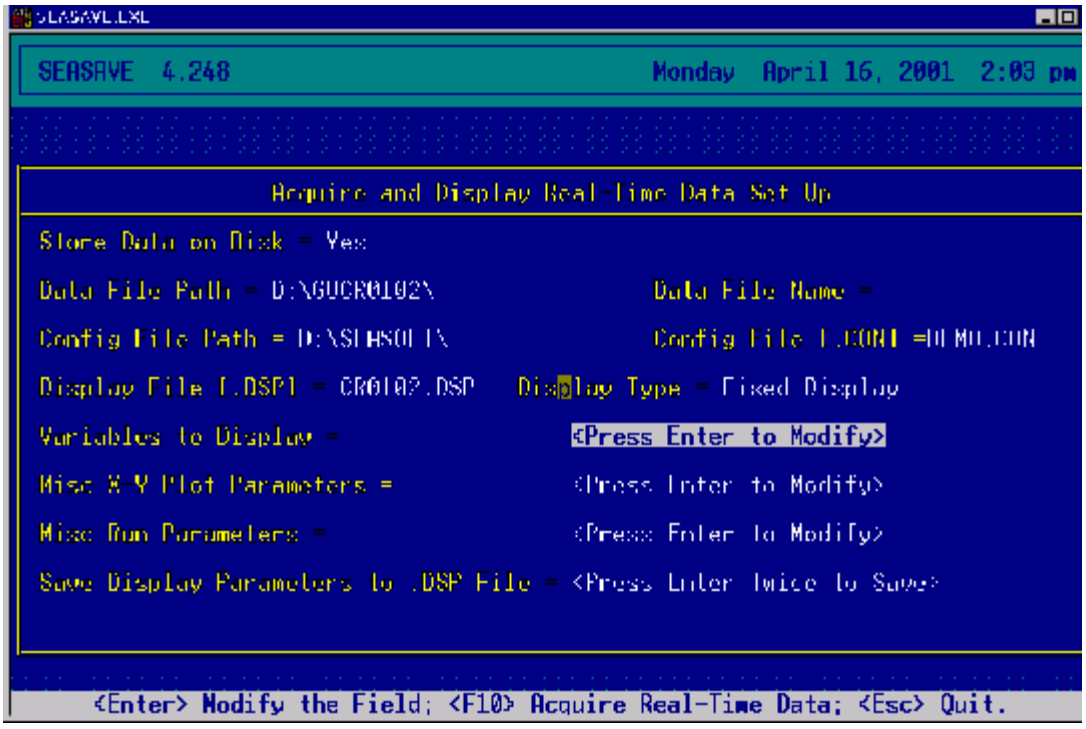
b. SEASAVE Display Forms While dockside and making a wet test of the CTD unit before the ship sails, a Data Display Form and Graph Display Form must be edited to conform with

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:

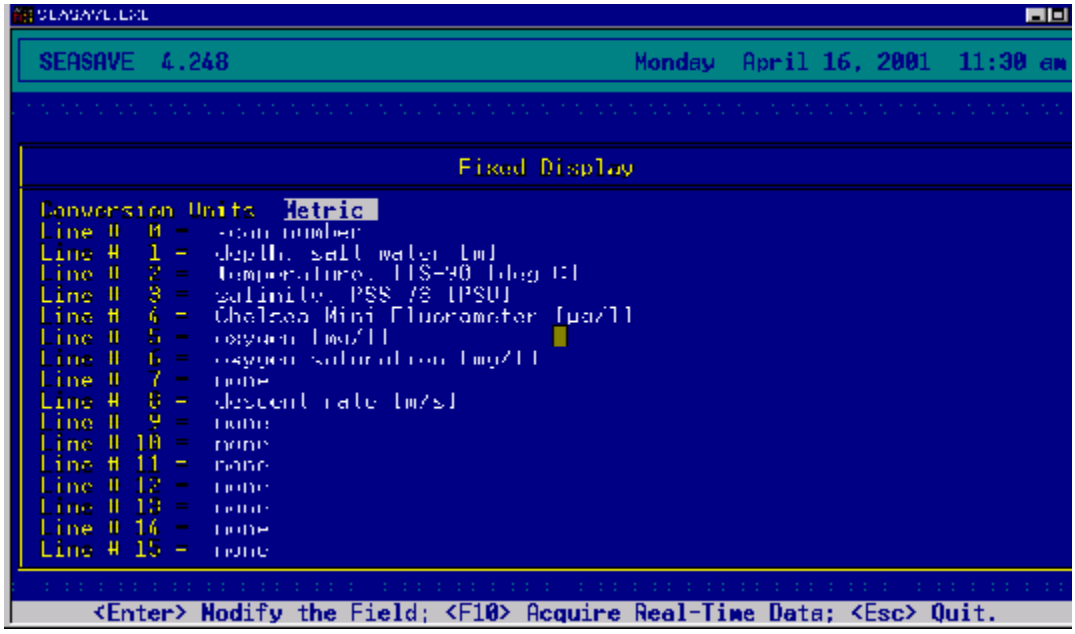
(1) Fixed Display Form In the SEASAVE Main Menu window, scroll down and select Acquire and Display Real-Time Data.



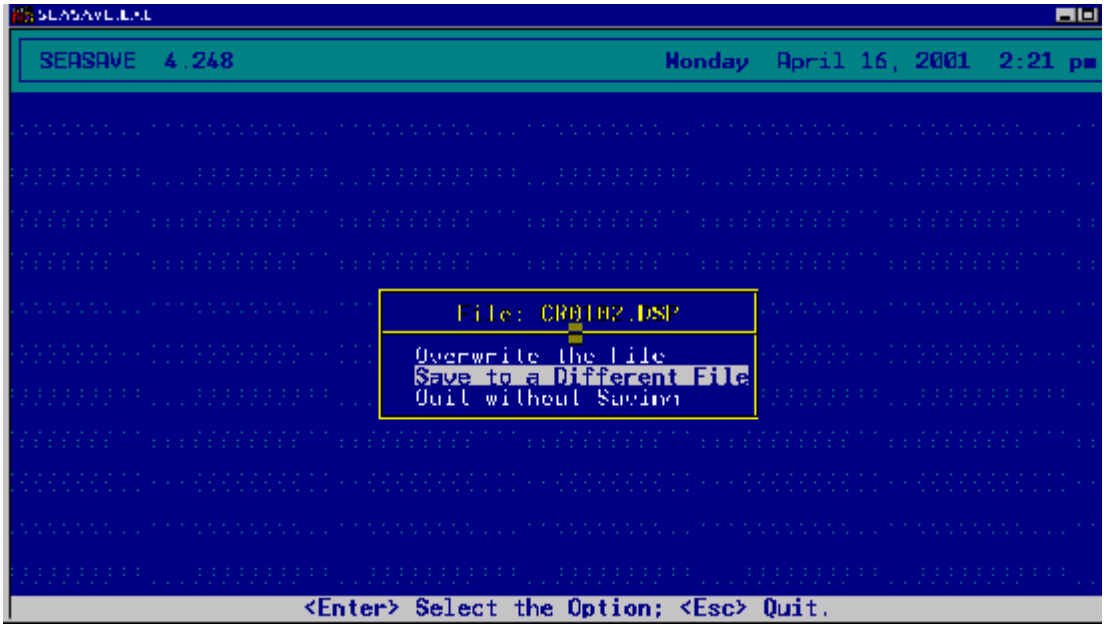
In the Acquire and Display Real-Time Data Set Up window, scroll down to Display Type and select Fixed Display, then select Variables to Display.



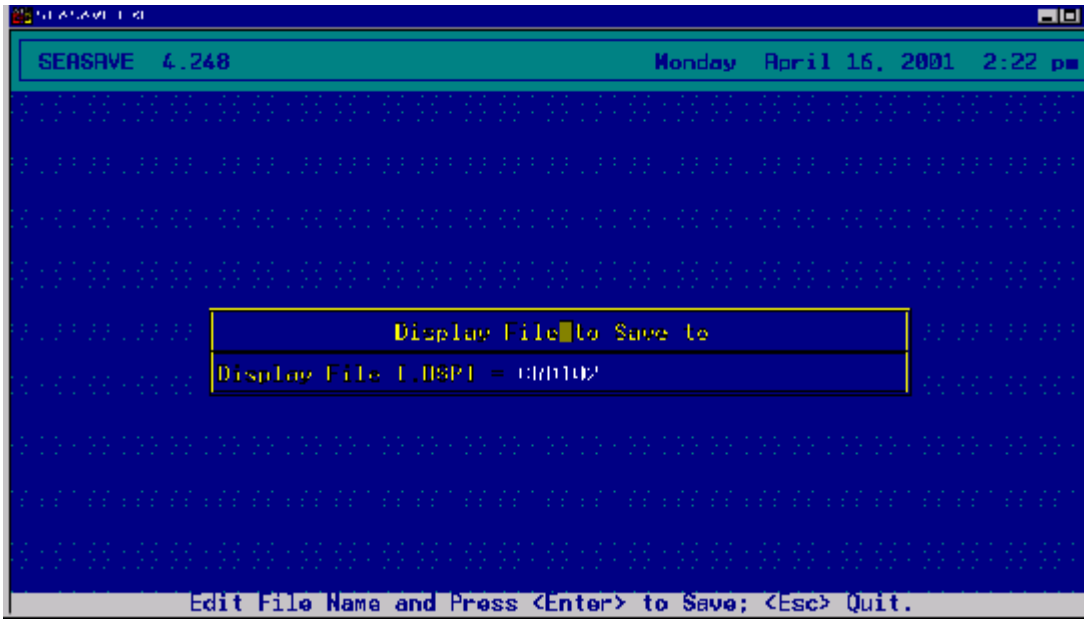
In the Fixed Display window, enter in each line the data parameters to display.



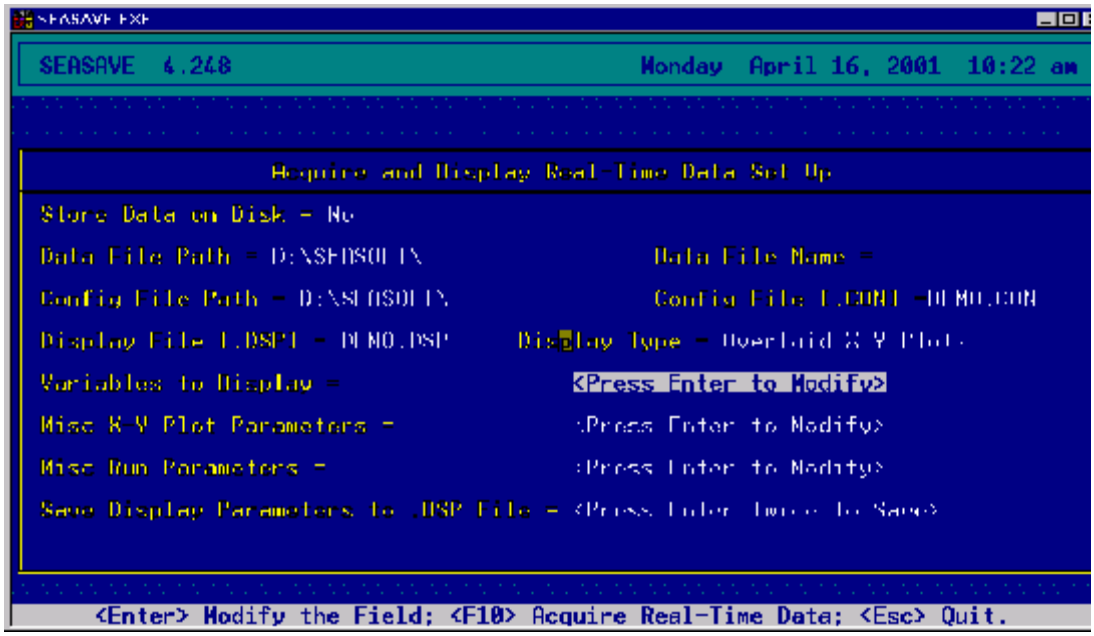
Press the 'ESC' key to return to the previous window. Return to the Acquire and Display Real Time Data Acquisition window. Press the 'ESC' key again to open a window that gives you an opportunity to save this Display file as a uniquely named file for this cruise. Scroll to select 'Save to a Different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



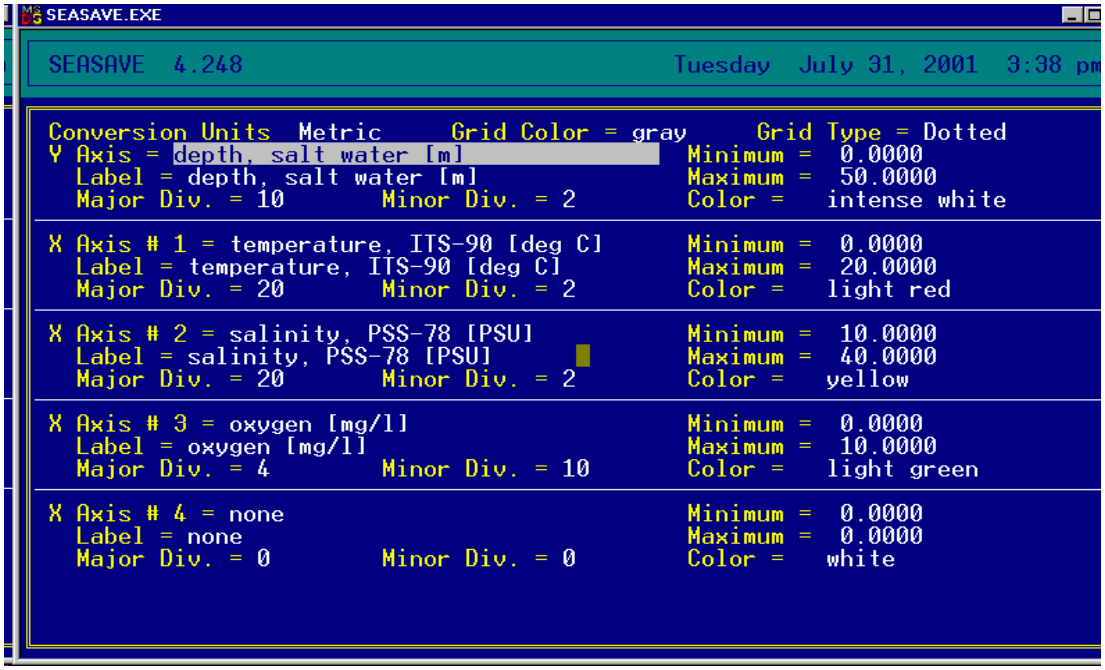
In the 'Display File to Save to' window, name the file appropriate for your cruise. Exit the window, but do not exit SEASAVE.



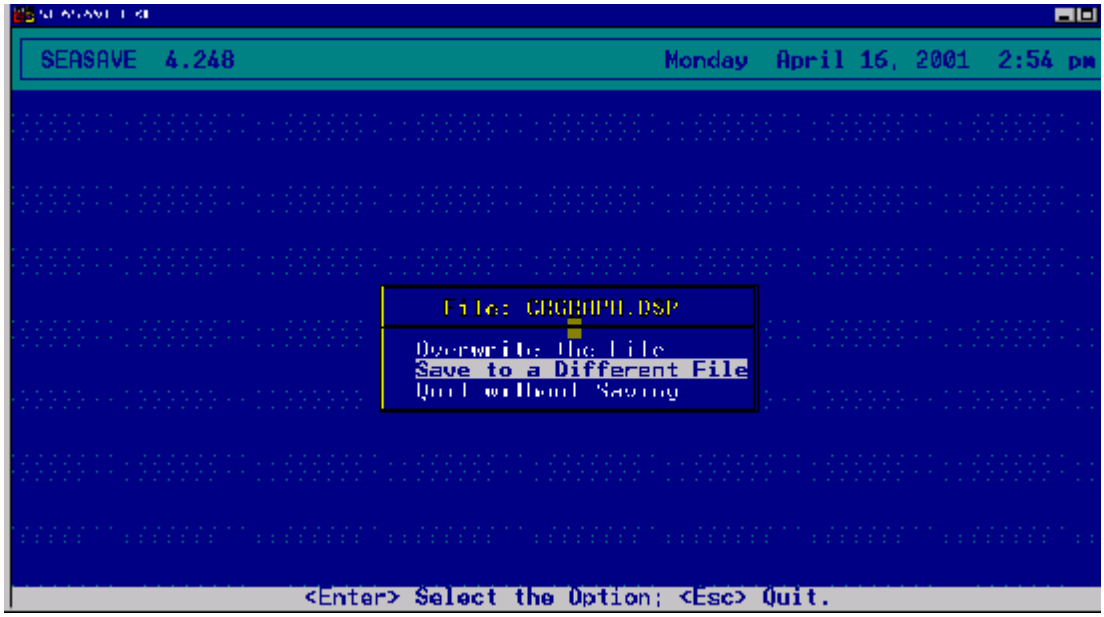
(2) Graph Display Form Return to the Acquire and Display Real Time Data Acquisition window. Scroll down to Display Type and select Overlaid X-Y Plots.



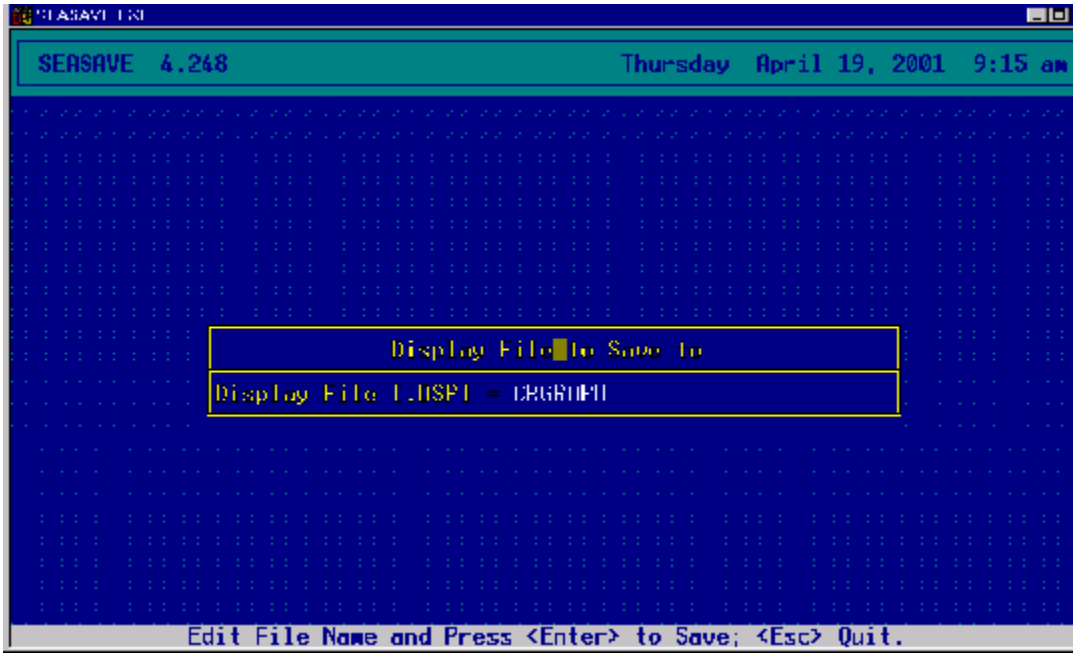
Then select Variables to Display. Fill in depth (M) on the 'Y' axis. Be sure to select saltwater and 29^0 Latitude. On the 'X' axis, fill in water temperature (°C), salinity (PSU), and dissolved oxygen (mg/l).



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

VESSEL | PASCAGOULA STATION NO. | CRUISE

START: TIME (ZN, HH, MM) | LATITUDE (DD, MM.MM) | LONGITUDE (DD, MM.MM) | DEPTH (FM)

SEAMAP/OTHER STATION NO. | DATE (MO, DY, YR)

END: 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
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
				4	5
TOTAL CRUSTACEA WTS				4	5

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

GEAR DATA:

COMMENTS:

RECORDER:

MF-006 (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).

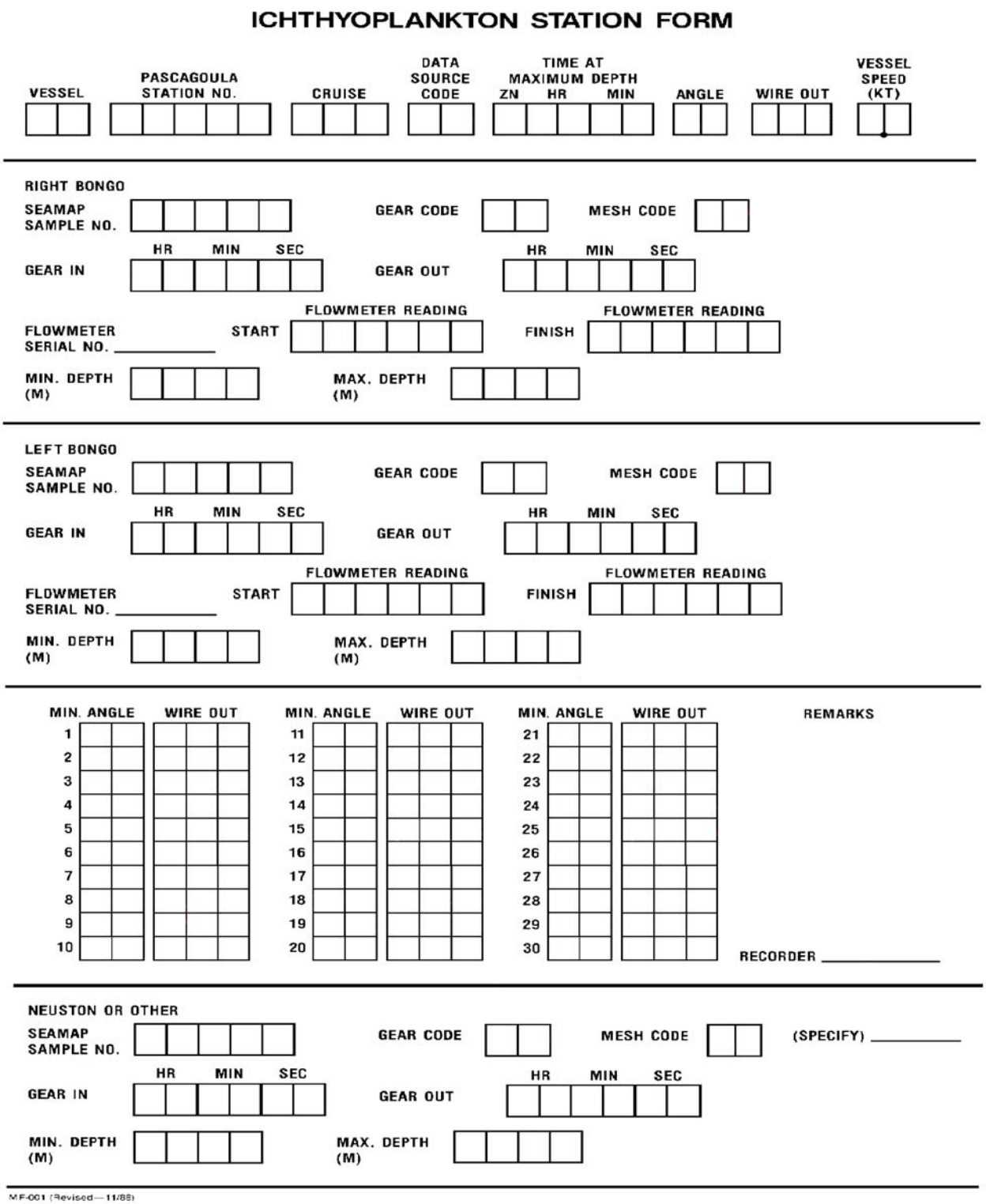
GEAR IN (neuston)- Enter military time down to seconds when **the gear is in the water half submerged and is fishing properly**. If there is only a neuston tow conducted at a station, record that value in the time at max depth field at top of station sheet.

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
CD	DREDGE, CLAM	PS	SEINE, PURSE
CM	CURRENT DOPPLER	PT	TRAWL, SCALLOP
CR	CORAL REEF MODUAL	QD	DREDGE, QUAHOG
CS	CONTINUOUS FLOW SYSTEM	RE	SALINITY, REFRACTOMETER
CT	TRAP, CRAB	RF	RECORDING FATHOMETER
DL	DEEP LINE	RG	PLANKTON, RING NET
DN	PLANKTON, DOUBLE NEUSTON OR NEKTON	RL	TAG RELEASE
DR	SURFACE DRIFTER	RN	ROUND NET
DV	DIVING	RR	ROD AND REEL
EF	TRAWL, FISH, EXPERIMENTAL	RS	TRAWL, NON-STANDARD
ES	TRAWL, SHRIMP, EXPERIMENTAL	RT	ROTENONE
FD	TRAWL, FISH DEFLECTOR	RV	REMOTELY OPERATED VEHICLE (ROV)
FE	TRAWL, FISH EXCLUDER	S5	TRAWL, MONGOOSE
FL	FLUORESCENCE, CONTINUOUS FLOW SYSTEM	S6	TRAWL MONGOOSE
FM	FATHOMETER	SA	SALINITY, AUTOSAL
FP	FISH PUMP	SB	SALINITY, BECKMAN RS5
FT	TRAWL, FISH	SC	CAMERA, STILL
FX	FLUORESCENCE, IN SITU	SD	DREDGE, SCALLOP
GN	GILL NET	SE	SECCHI DISC
GR	BOTTOM GRAB OR CORE SAMPLER	SF	SALINITY, CONTINUOUS FLOW SYSTEM
HL	HANDLINE	SH	TRAWL, SHUMAN
HO	TRAWL, HIGH OPENING BOTTOM	SI	SALINITY, SENSOR, IN SITU
IT	TRAP, ICHTHYOPLANKTON, ILLUMINATED	SL	SALINITY, BENCH TOP/LABORATORY
JP	JACKPOLE	SJ	SQUID JIG
KP	LONGLINE, KALI POLE	SM	TRAWL, STANDARD MONGOOSE
KT	TRAWL, WING	SN	TRAWL, SEPARATOR
LL	LONGLINE, SURFACE	SO	SONAR
LN	LIFT NET	SS	SONAR, SIDE SCAN
LP	SEINE, LAMPARA	ST	TRAWL, SHRIMP
LR	TRAP, LOBSTER, REED	SX	SALINITY, CTD
LT	NIGHT LIGHT	SY	SALINITY,YSI
LW	TRAP, LOBSTER, WIRE	T3	TEMPERATURE SCS
MC	CAMERA, MOVIE	TA	TEMPERATURE, CONTINUOUS FLOW SYSTEM
ML	MISCELLANEOUS- DETAIL IN COMMENTS	TB	TEMPERATURE, BECKMAN RS5
MN	MICROPEKTON	TC	TEMPERATURE, CTD
		TD	DREDGE, TUMBLER
		TE	TRAWL, TURTLE EXCLUDER
		TF	TEMPERATURE, FLUKE
		TG	TROLLING GEAR
		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
ALUTERUHEUDEL		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
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
EPIGONUPANDIO		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
EUCRASSSPECIO		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
GYMNOTHVICINU		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
ILIACANLIODAC		6	389	229070202
ILLEX	COINDE	13		348100102
ILLEX	ILLECE	13		348100101
KATHETOALBIGU		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
LEIOLAMNITIDU		5	215	229400101
LEIOSTOXANTHU		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
LOPHIODRETICU		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
MACROCOCAMPTO		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
NIBILIAANTILO		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
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
PILUMNUDASYPO		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
PONTINURATHBU		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
RACHYCECANADU		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
SPEOCARLOBATU		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
SYNODUSSYNODU		1		129040306
TAGELUSPLEBEI		11		335460403
TAMOYA HAPLON		16		616040201
TELLINAALTERN		11	311	335441403
TEREBRAFLORID		17		308200104
TETHYASGRANDI		15		691010901
TETRAXABIDENT		5	400	229101002
TETRAXARATHBU		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
TRICHIULEPTUR		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
SICYONIDORSAL	43	3
SICYONIBURKEN	160	3
SICYONISTIMPS	182	3
SINUM PERSPE	34	17
SOLENOCNECOPI	316	3
SOLENOCVIOSCA	134	3
SPHOERODORSAL	119	18
SPHOEROSPENGL	172	18
SPHOEROPARVUS	33	18
SPHOEROTESTUD	243	18
SPHOERONEPHEL	383	18
SPHYRAEBOREAL	279	1
SPHYRAEGUACHA	71	1
SPHYRAEPICUDI	322	1
SPHYRNALEWINI	209	18
SPHYRNATIBURO	133	18
SQUATINDUMERI	161	18
SQUILLACHYDAE	72	3
SQUILLAEMPUSA	16	3
SQUILLANEGLEC	245	3
SQUILLALIJDIN	276	3
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
TETRAXABIDENT	400	5
TETRAXARATHBU	421	5
TRACHINCAROLI	202	1
TRACHINFALCAT	412	1
TRACHINMYOPS	135	1
TRACHURLATHAM	18	1
TRACHYPCONSTR	128	3
TRACHYPSIMILI	67	3
TRICHIULEPTUR	21	23
TRICHOPVENTRA	53	18
TRINECTINSCRI	266	18
TRINECTMACULA	167	18
UMBRINACOROID	410	18
UPENEUSPARVUS	11	1
UROPHYCCIRRAT	105	18
UROPHYCFLORID	74	18
UROPHYCREGIUS	278	18
VENTRICRIGIDA	355	11
VESICOMVENUST	354	11
XIPHOPEKROYER	168	3
ZALIEUTMCGINT	318	18

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**