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A BATHYTHERMOGRAPH TO SOUND VELOCITY PROFILE PROGRAM
FOR THE HP-41CV CALC.. (U) NAVAL OCEAN RESEARCH AND
DEVELOPMENT ACTIVITY NSTL STATION MS.. G A KERR JAN 83

1/1

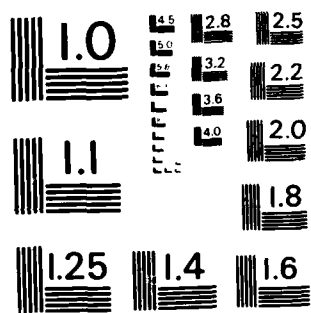
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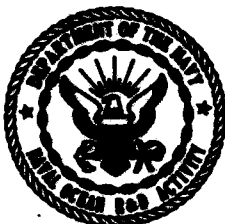


MICROCOPY RESOLUTION TEST CHART
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NORDA Technical Note 183

Naval Ocean Research
and Development Activity
NSTL Station, Mississippi 39529



A Bathythermograph to Sound Velocity Profile Program for the HP-41CV Calculator, Including a Northern Hemisphere Salinity Profile Library

ADA130761

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Distribution Unlimited

G.A. Kerr

Ocean Science and Technology Laboratory
Numerical Modeling Division

January 1983

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ABSTRACT

This technical note documents a program written specifically for the HP-41CV calculator to convert a bathythermograph profile to a sound speed profile. The format of the report follows the guidelines set forth by the Navy Tactical Support Activity, Fleet Mission Program Library.

The program documented herein differs from existing calculator programs used for a similar purpose (Kerr, 1982) in that an archival salinity profile library is included with the program.

Magnetic card copies of the program and salinity profile library may be obtained from the Naval Oceanographic Office, Code 9200.

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ACKNOWLEDGMENTS

The author wishes to thank Mr. Richard Lauer, Naval Ocean Research and Development Activity (NORDA), Code 323, for his support and most helpful suggestions during the preparation of this report. The author is grateful to Ms. Charlene Parker, NORDA Code 323, for her help during the preparation of the typed manuscript.

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NAVY TACTICAL SUPPORT ACTIVITY
FLEET MISSION PROGRAM LIBRARY
PROGRAM SUBMITTAL FORM

I. (U) SUMMARY

IDENTIFICATION NUMBER/MOD _____

A. (U) PROGRAM TYPE:

☐ TACTICS
☐ ASW TACTICS
 ☐ SEARCH
 ☐ LOCALIZATION/APPROACH
 ☐ TRACKING/ATTACK
 ☐ DIRECT SUPPORT
☐ AAW TACTICS
☐ SURFACE WARFARE TACTICS
☐ SURVEILLANCE

☐ COMMUNICATIONS
☐ SENSOR OPERATIONS
☒ ENVIRONMENT
☐ NAVIGATION
☐ LOGISTICS
☐ ENGINEERING
☐ ADMINISTRATIVE
☐ OTHER

B. (U) PROGRAM CLASSIFICATION: UNCLASSIFIED

C. (U) PROGRAM TITLE: Bathymograph+Sound Velocity Profile

D. (U) DATE: EFFECTIVE: 24 November 1982 CANCELLED: _____

E. (U) COMMAND: ORIGINATOR: G. A. Kerr, NORDA Code 323

CONTROL: _____

CONTACT: G. A. Kerr, NORDA Code 323 TEL: A/V 485-4627

F. (U) TACTICAL REFERENCES: None

1. TITLE () _____

REPORT NO. _____ ORIGINATOR _____

DATE _____ FTL ACC NO _____

2. TITLE () _____

REPORT NO. _____ ORIGINATOR _____

DATE _____ FTL ACC NO _____

G. (U) APPLICATION

EQUIPMENT HP-41CV

SOFTWARE/LANGUAGE HP-41CV

H. (U) STORAGE MEDIA: ☒ MAGNETIC CARDS ☐ MAGNETIC TAPE ☐ PAPER TAPE
☐ CASSETTE ☐ KEYPUNCH CARD ☐ OTHER

I. (U) PLATFORM:

☒ SHORE BASED PATROL AIRCRAFT ☐ TACTICAL AIRCRAFT ☐ SHORE ACTIVITIES
☒ CARRIER BASED ASW AIRCRAFT ☒ SURFACE SHIP ☐ ALL FLEET UNITS
☒ ROTARY WING AIRCRAFT ☒ SUBMARINE

CHANGE 1

IDENTIFICATION NUMBER/

II. (U) OPERATING GUIDELINES

A. (U) GENERAL GUIDELINES AND LIMITATIONS

1. When prompted for a salinity profile, "NEW SAL?", the response will be either a yes (Y) or a no (N). If a Y response is given, the program will prompt the user for magnetic cards (CARD). The cards containing the salinity profile to be entered are found in the accompanying library of salinity profiles. If an N response is given, the calculator will use the salinity profile stored from the previous program run.

2. Depth-temperature (BT) data is entered directly into the program as depth (FT) and temperature (°F). The data points may be entered in any order, i.e., depth does not have to be strictly increasing. However, entering data in order of increasing depth will reduce data entry time. If an error is made, simply reenter the same depth as the error and the correct temperature. A maximum of 20 depth-temperature pairs may be entered. The maximum depth which may be entered is 6561 feet. The message "TOO DEEP" will appear if this limit is exceeded. The initial BT data entry portion of the program is ended by entering a negative depth of any number for the temperature.

3. Additional corrections can be made to the entered BT data when the program prompts for addition corrections (CORRECTIONS?). A response of yes (Y) will result in the calculator prompting for the depth of the point to be replaced (BAD DEPTH). If the depth entered does not exactly match a depth entered during the initial data entry portion of the program, an error message (D NOT FND) will appear and the program will return with a CORRECTIONS? prompt. If the depth entered matches an initial entry depth then the initial data point is deleted and a prompt for the input of a new data (NEW PT) is generated. New depth-temperature points are entered as in the initial data entry phase. Any number of points may be replaced. If a response of no (N) is made to the CORRECTIONS? prompt the program will proceed to calculate the sound speed from the existing data set.

4. The sound speed is output in the form depth (FT) and sound speed (FT/sec).

5. The sound speed profile in the form depth (FT) sound speed (FT/sec) can be saved on magnetic cards by responding with a yes (Y) to the prompt "SVP ON CRD." This data can be used in the "Sound Velocity Profile Propagation Loss." program written for the HP41CV.

1

Bathythermograph-Sound Speed Profile

2

3

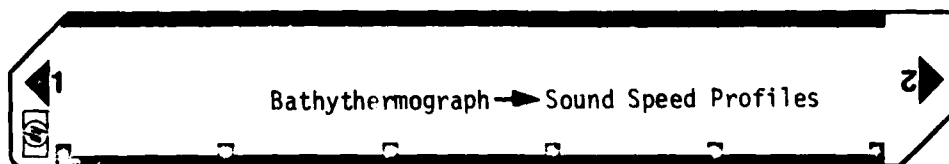
IDENTIFICATION NUMBER/MOD
B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
6	Enter Depth	Df/°FT			
7	Enter Temperature	Tf/F	R/S		Df Tf
	Enter first depth temperature point after "DTH TEMP" prompt. Repeat steps 6 and 7 for up to 20 points. Output for each entry is depth (FT) and temperature (°F).				
	To terminate input enter a negative depth any number for temperature.				
	If an incorrect temperature is entered, simply reenter the same depth as the error and the correct temperature.				
	If a 'TOO DEEP' message appears in the display the depth entered was larger than the maximum (6561 ft.) allowed. Go to step 6.				
8	Respond to "CORRECTIONS?" Prompt				
	(a) To make corrections		Y	R/S	
	or (b) To skip corrections		N	R/S	
	If corrections are to be made go to step 9, if not go to step 11.				
9	Respond to "BAD DEPTH" Prompt				
	Enter the depth of the depth-temperature point to be replaced.	Df/FT	R/S		
	If "D NOT FND" message appears in the display the depth entered in step 9 could not be matched with any of those entered in step 6. Go to step 8.				
	4				

IDENTIFICATION NUMBER/MOD
B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
10	Respond to "NEW PT" PROMPT: (a) Enter the new depth and (b) Enter the new temperature The output for each entry is depth (FT) and Temperature ($^{\circ}$ F). Return to Step 8	D_f /FT T_f / $^{\circ}$ F	$\uparrow$ R/S	D_f T_f
11	Sound Speed Profile Output For each depth - temperature point entered a depth (FT) and sound speed (FT/SEC) is output.	none		D_f SS_f
12	Respond to "SSP ON CRD" Prompt (a) To store the sound speed profile on magnetic cards or (b) To skip to the end of the program If the sound speed profile is to be stored, go to Step 13.		Y R/S N R/S	
13	Insert Blank, Unprotected Magnetic Cards as Requested. Output will be of the form depth (FT). Sound Speed (FT/SEC) NOTE: To enter a different set of data points, to Step 3.			D_f SS_f
	5			

II. C. (U) EXAMPLE AND IN-FLIGHT PAGES .



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA UNITS
1	Adjust calculator memory	153	XEQ		
			ALPHA		
			S		
			1		
			Z		
			E		
			ALPHA		
2	Load Program Cards (6)				
3	Execute Program		XEQ		
			ALPHA		
			B		
			T		
			S		
			S		
			ALPHA		
	"New Salinity" Prompt				
	Y for new salinity profile				
	N for previously loaded profile				
4	"New Salinity"		Y	R/S	
	For a "N" response go to Step 6				
	"CARD" Prompt				
5	Insert new salinity profile cards				
	Depth (Ft)/Temperature ($^{\circ}$ F)				
	Data may be entered in any order				
6	Depth	0 Ft.	↑		0.0 Ft.
7	Temperature	75.0 $^{\circ}$ F	R/S		75.0 $^{\circ}$ F
	Repeat Steps 6 and 7 for up to 20 points				
	6				

II. C. (U) EXAMPLE AND IN-FLIGHT PAGES (CONT'D)

[illegible]

II. C. (U) EXAMPLE AND IN-FLIGHT PAGES (CONT'D)

II. C. (U) EXAMPLE AND IN-FLIGHT PAGES (CONT'D)

[illegible]

IDENTIFICATION NUMBER/MOD

III. (U) PROGRAM DOCUMENTATION

A. (U) DISCUSSION/ANALYSIS

This program generates a sound speed profile from an input temperature profile. The program must be provided with a salinity profile from which interpolated salinities can be determined at input temperature depths.

The major sections within this program identified by beginning labels are:

1. LBL "C" (used to issue data entry instructions). Stores and prints instructions in the print buffer. If a printer is not attached (FLG 55 set) messages throughout the program are held in the display for one PSE.

2. LBL "B" (used to enter, and store depth-temperature points). Points are stored in order of increasing depth. Registers 5 and 6 are used for temporary storage of depth and temperature respectfully. Register 18 is used to store the total number of points entered; and register 17 is used to store the deepest depth entered. If the depth of a newly entered point is larger than the deepest stored depth, then the new point is stored in the next sequential storage register locations. If the depth entered is less than the deepest stored depth, then the point is stored in the appropriate location by depth replacing an existing point in memory. The replaced point is stored in temporary storage locations previously used by the new data point and the "fitting by depth" procedure is repeated until all data points are in the correct order. Flag 3 is clear to indicate the program is in the original data entry mode. A maximum of 20 points may be entered.

3. LBL "COR" (used to make final corrections to the entered depth-temperature data). Given the depth of the bad data point, the point is deleted from memory and the points located at deeper depths are moved up one memory location. Storage of correcting data is handled by the same procedures used to store the original data points. Flag 3 is set to indicate the program is in the correction mode.

4. LBL "DSP" (used to print input data points). Accumulates depth and temperature values to the print buffer for printing.

5. LBL "INTR" (used to calculate, through linear interpolation, the salinity at each entered depth). Register 15 is used to store the location of the temperature profile depth (d_T). Register 16 is used to store the location of the salinity profile depth (d_2) deeper than d_T . Register 7 is used to store the location of the salinity profile depth (d_1) shallower than d_T . Register 12 is used to store relative location of the interpolated salinity (S_T). Register 18 is used to store the location of salinity (S_1) corresponding to d_1 . Register 19 is used to store the location of the salinity (S_2) corresponding to d_2 . S_T is found from:

$$S_T = \frac{d_T - d_1}{d_2 - d_1} (S_2 - S_1) + S_1$$

IDENTIFICATION NUMBER/MOD

III. (U) PROGRAM DOCUMENTATION

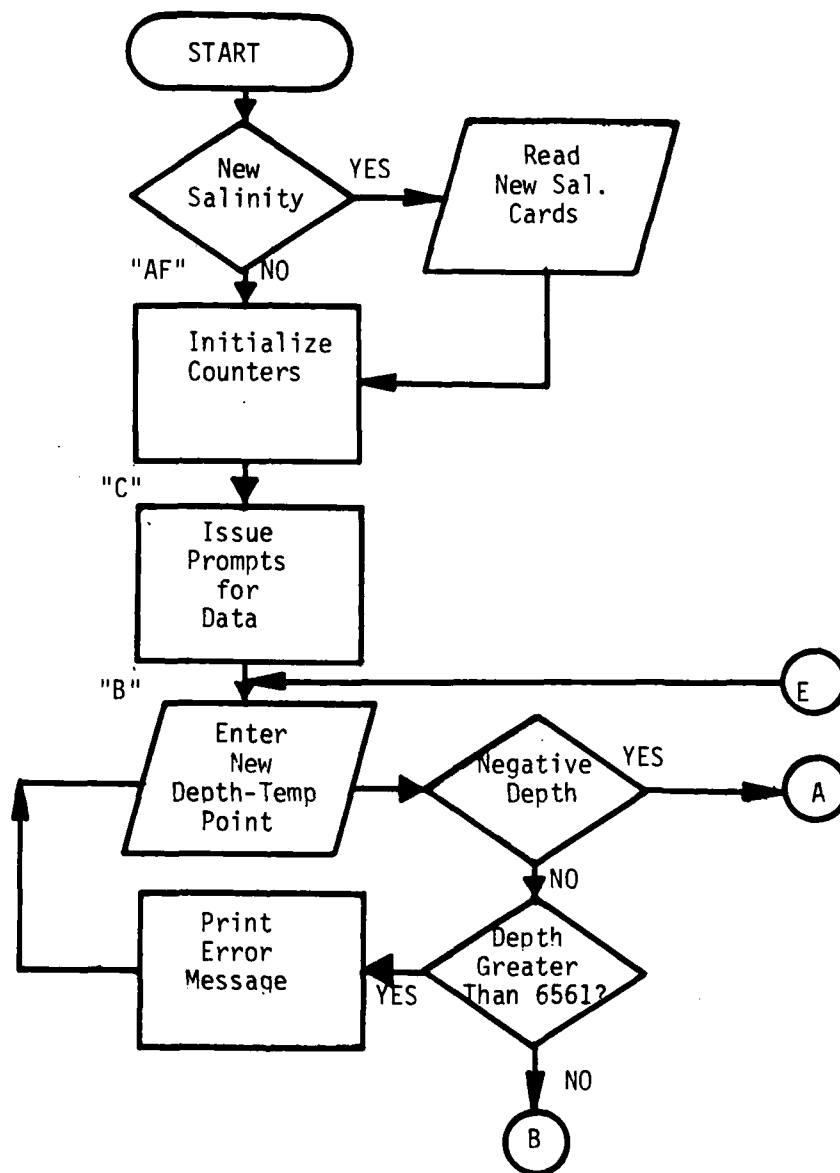
A. (U) DISCUSSION/ANALYSIS (Cont'd)

6. LBL "SSPD" (used to calculate the sound speed from temperature (T), salinity (S), and depth (D).) For each input D the following data are calculated and stored (storage register): T(0), T²(1), T³(2), S(3), D(4), and D²(5). The speed of sound (S) is calculated using Mackenzie's (1981) equation modified for English units. the modified equation is:

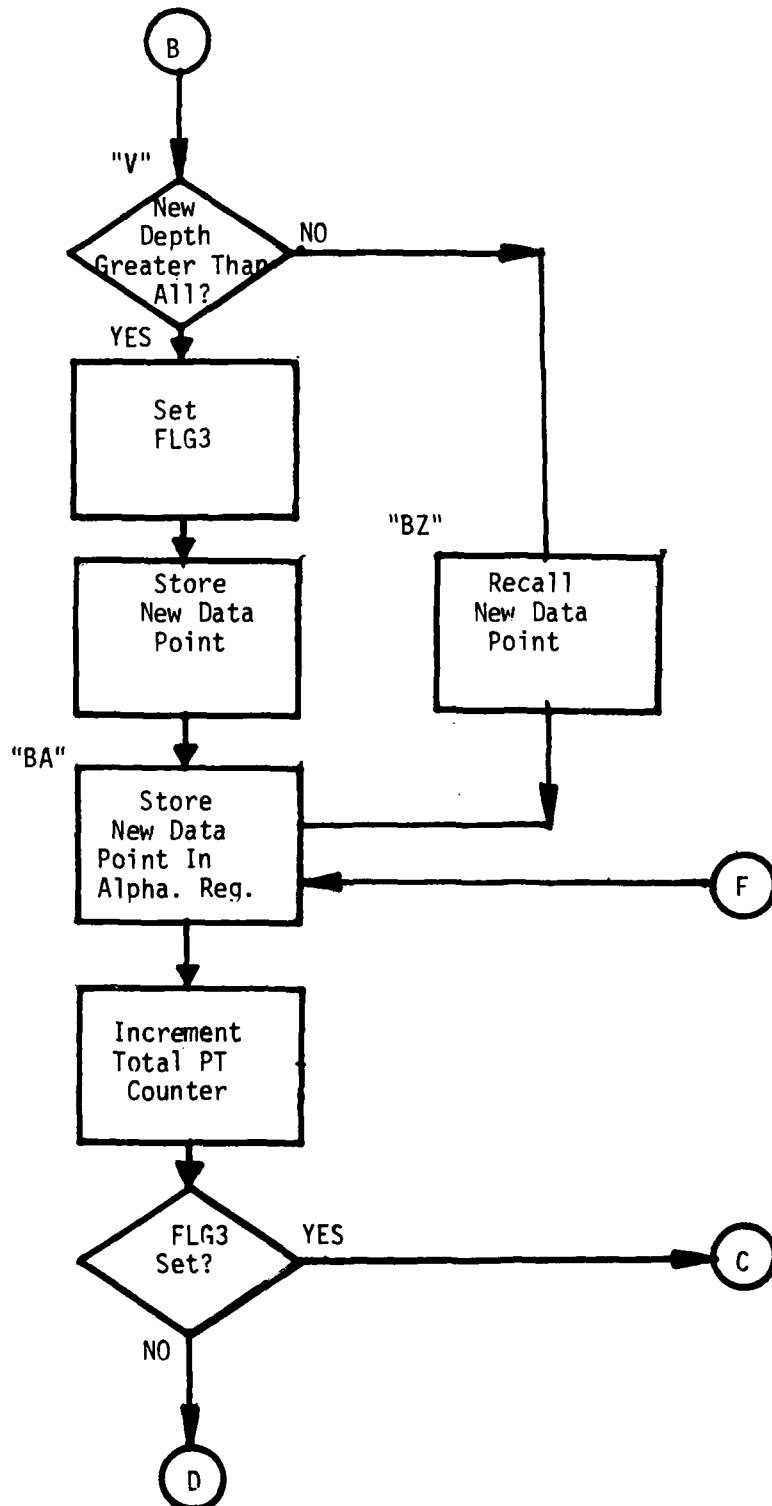
$$\begin{aligned} S = & 3.2808 (1295.97 + 3.9229T - 2.0278T^2 \times 10^{-2} \\ & + 4.071 \times 10^{-5} T^3 + 4.9683 \times 10^{-3}D \\ & + 1.5562 \times 10^{-8} D^2 + 1.522 S \\ & - 5.6944 \times 10^{-3} TS \end{aligned}$$

The $10^{-13}TD^3$ term of the original equation was omitted since this term would be insignificant for the depths considered in the program (≤ 6561 FT).

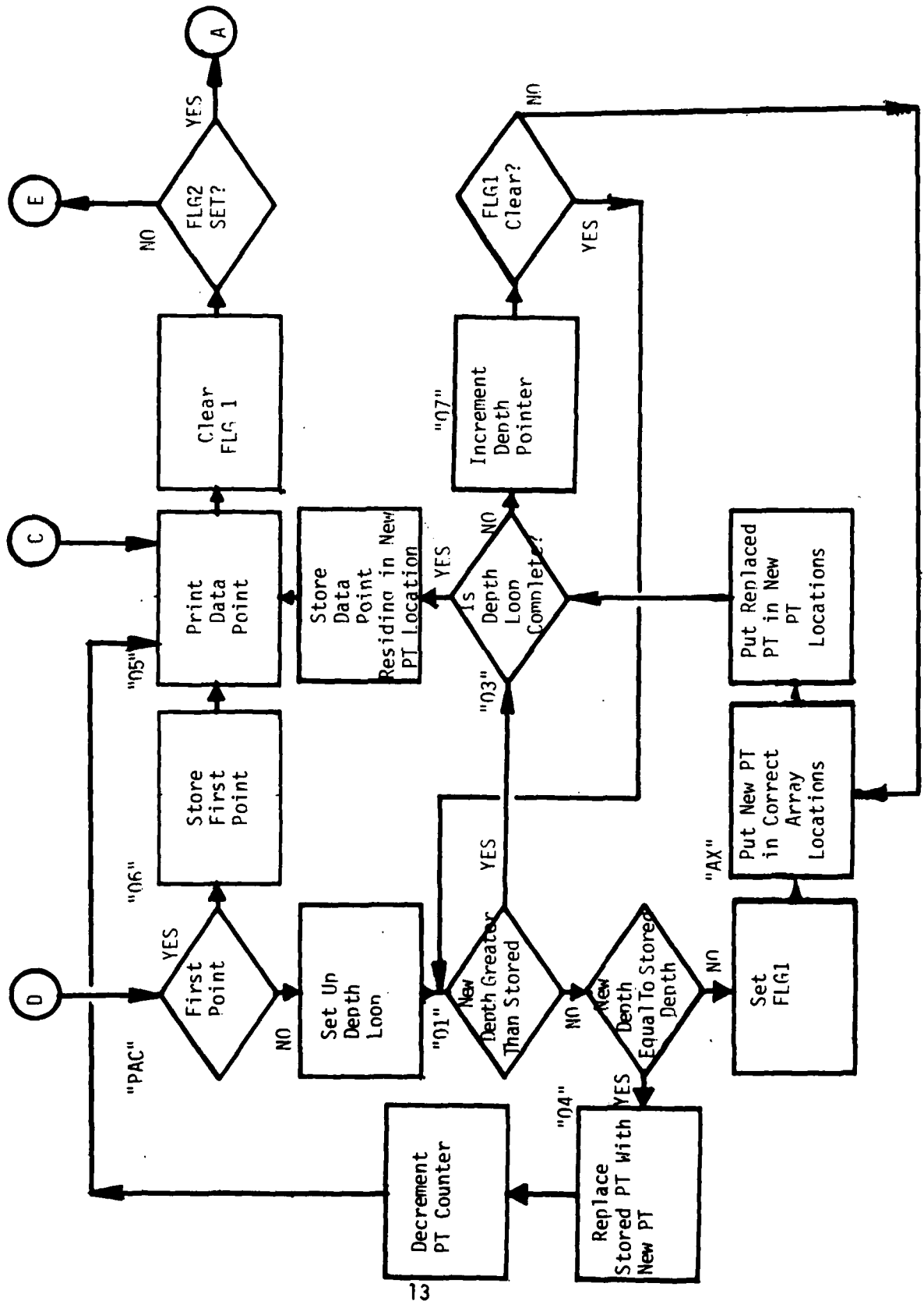
IDENTIFICATION NUMBER/MOD
A. DISCUSSION/ANALYSIS (CONT'D)
The Flow of the Main Program is as follows:



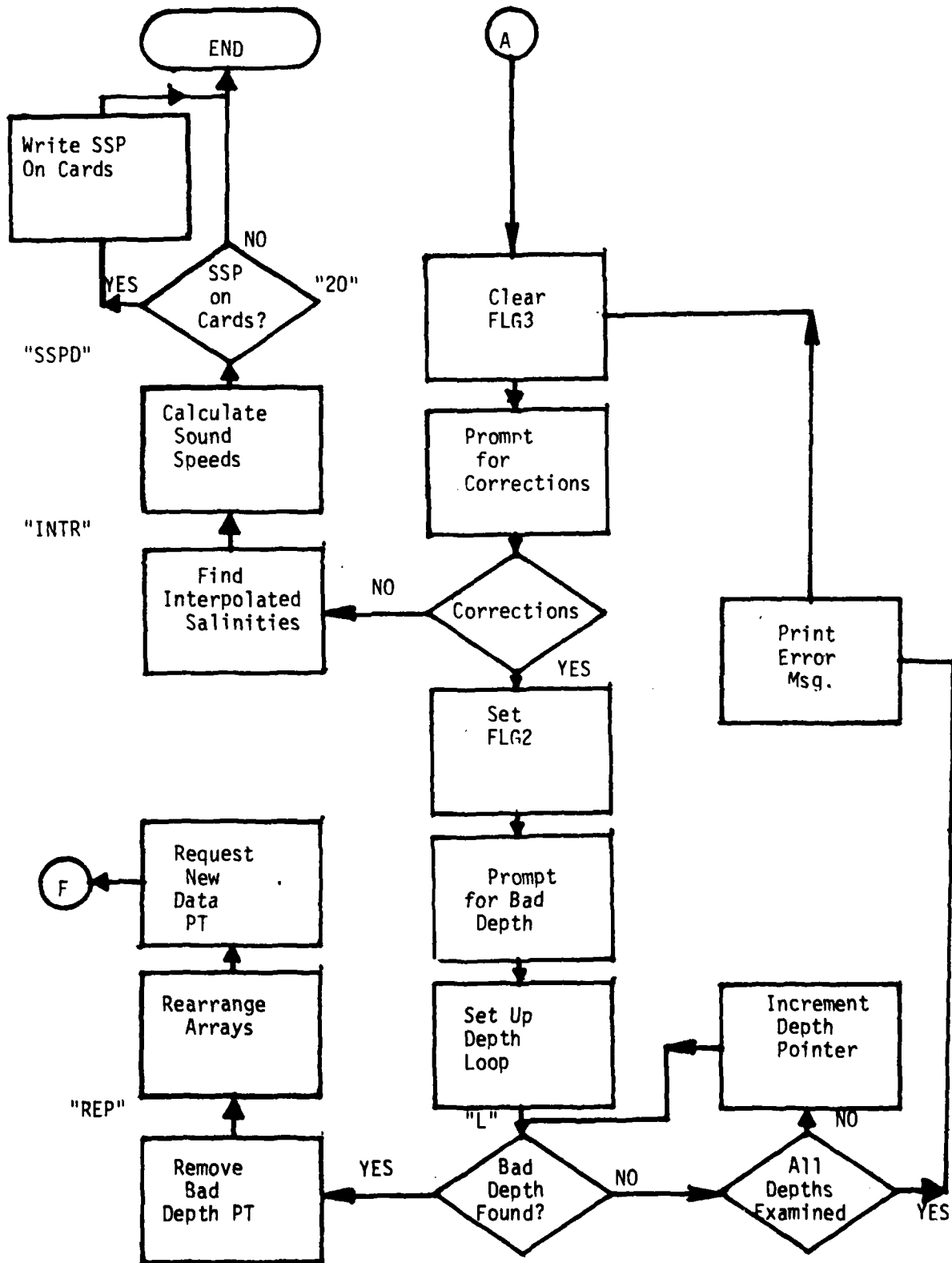
IDENTIFICATION NUMBER/MOD
A. DISCUSSION/ANALYSIS (CONT'D)
Flow of Main Program Cont'd:



IDENTIFICATION NUMBER/MOD
A. DISCUSSION/ANALYSIS (Cont'd)
Flow of Main Program Cont'd



IDENTIFICATION NUMBER/MOD
A. DISCUSSION/ANALYSIS (CONT'D)
Flow of Main Program Cont'd



IDENTIFICATION NUMBER/MOD

B. (U) REFERENCES

1. Nine-term Equation for Sound Speed in the Oceans, Mackenzie, K. V., The Journal of the Acoustical Society of America, 1981, Vol. 70, Number 3, p. 807-812.
2. An Evaluation of Fleet Mission Program Library Program V10011/B (Bathymograph Sound Velocity Profile, Kerr, G. A., Naval Ocean Research and Development Activity. Technical Note 192, 1983.

C. (U) PROGRAM DATA

DATA REGISTERS

(0) through (19)	USED
(20) through (30)	BT DEPTH (OUTPUT SSP)
(40) through (59)	BT TEMPERATURE
(60) through (79)	INTERPOLATED SALINITY
(80) through (99)	CALCULATED SOUND SPEED
(100) through (125)	SALINITY PROFILE DEPTH
(126) through (151)	SALINITY PROFILE SALINITY
(152)	NO. OF POINTS IN SAL. PROF.

FLAGS

- 01) SET WHEN NEW DATA HAS BEEN STORED
- 02) SET WHEN IN CORRECTION MODE
- 03) SET WHEN ENTERED DEPTH IS LARGER THAN ALL DEPTHS ENTERED PREVIOUSLY

LABELS

(SUBROUTINES)

(OTHER)

DSP
PAC

01	L
03 through 09	REP
20	AX
30	INTR
BTSS	BEG
AF	XAC
V	AJ
BZ	INTP
BA	SSPD
COR	

IDENTIFICATION NUMBER/NO

D. (U) PROGRAM LISTING

STEP/KEY ENTRY	COMMENT	STEP/KEY ENTRY	COMMENT
02 ST 11		58 FC 55	
03 FC 1		59 PSE	
04 "K"		60 CLR	
05 ASTO Y		61 "ANY NO RS"	
06 "NEW SAL?"	New Salinity	62 AVIEW	
07 ADV	Profile Prompt	63 FC 55	
08 PROMPT		64 PSE	
09 ASTO X		65 CLR	
10 AOFF		66 ADV	
11 "Y?"		67 "DTA TEMP"	
12 GTO "AF"		68 AVIEW	
13 CLR		69 CLR	
14 100.152	Read New Salinity	70 LBL E	Enter Depth-
15 ST X	Profile Cards	71 STOP	Temperature
16 RTAX		72 XCV	
17 LBL "AF"		73 0	Check for End
18 AOFF		74 XCV	of Input Data
19 20	Initialize	75 GTO "COR"	Make Corrections
20 ST 11	Registers	76 ADV	Check for
21 0		77 650	Too Large A
22 ST 16		78 ADV	Depth
23 ST 19		79 GTO "	
24 CLR		80 "TOO DEEP"	
25 CLR		81 AVIEW	
26 LBL C		82 CLR	
27 "TO ENTER"		83 GTO E	
28 AVIEW		84 LBL "V"	
29 FC 55		85 CF 03	
30 PSE		86 FC 12	
31 CLR		87 ST 06	Store Temp.
32 "TEMP PROP"	Print Data	88 FC 1	
33 AVIEW	Entry	89 ST 25	Store Depth
34 FC 55	Instructions	90 RCL 11	No. PT Entered
35 PSE		91 RCL 16	
36 CLR		92 +	Find Deepest
37 ADV		93 1	Depth Entered
38 "DEPTH ENTER."		94 -	
39 AVIEW		95 ST 17	
40 FC 55		96 RCL IND 17	
41 PSE		97 FC 05	Compare Depth
42 CLR		98 XCV	Against
43 "TEMP RS"		99 GTO "62"	Deepest
44 AVIEW		100 RCL 17	Store Depth
45 FC 55		101 1	
46 PSE		102 +	
47 CLR		103 ST 17	
48 ADV		104 FC 25	
49 "IF DONE"		105 ST IND 17	
50 AVIEW		106 RCL 17	
51 FC 55		107 20	Store
52 PSE		108 +	Temperature
53 CLR		109 ST 17	
54 "NEG"		110 RCL 06	
55 CLR		111 ST IND 17	
56 "NEG & ENTER"			
57 AVIEW			

IDENTIFICATION NUMBER/MOD _____

E. (U) PROGRAM LISTING (CONT'D)

STEP/KEY ENTRY	COMMENT	STEP/KEY ENTRY	COMMENT
112 STG 05	Data Has Been Stored	167 20	Find Temp. Location for Bad Depth
113 LBL "REP"	Recall Data	168 +	
114 RCL 05		169 STG 04	
115 RCL 06		170 RCL 02	Replace Depth With Next Deepest
116 LBL "BA"	Go Store Point in Alpha Registers	171 1	
117 XEQ "DSP"		172 +	
118 FST 05	Data in Array?	173 STG 03	
119 GTD 05		174 RCL IND 03	
120 LBL "PAC"	Place Out of Seq. Data In Correction Mode?	175 STG IND 02	
121 FST 02		176 RCL 04	Replace Temp. With Next Deepest
122 GTD "COR"	Go to Corrections Section	177 1	
123 RTN		178 +	
124 LBL "COR"	Beginning of Corrections Section	179 STG 05	
125 FCL 55		180 RCL IND 05	
126 PSE		181 STG IND 04	
127 CL 03		182 RCL 02	Increment Depth Pointer
128 "N"		183 1	
129 ASTO Y		184 +	
130 "CORRECTIONS?"	Are Corrections Required	185 STG 02	
131 AGN		186 RCL 04	Increment Temperature Pointer
132 PROMPT		187 1	
133 ASTO Y		188 -	
134 POFF		189 STG 04	
135 "Y?"		190 ISG 01	Enter Array Bumped?
136 STG "INTP"	Go Perform Interpolation Corrections Being Made	191 GTD "REP"	Go to Rep. Rec
137 SF 02		192 RCL 18	
138 "BAD DEPTH"	Enter Depth of Bad Data Point	193 1	Decrement No. of Pts.
139 PROMPT		194 -	
140 STG 02		195 STG 18	
141 RCL 18	Recall Number of Points Entered and Set Up Loop	196 "NEW PT"	Get Replace- ment Point
142 1000		197 WYIE	
143 1		198 STOP	
144 +		199 GTD "BA"	Put PT. in Arrays
145 STG 01		200 STOP	
146 19	Set Up Pointer to Depth	201 LBL "DSP"	
147 STG 02		202 CLR	
148 LBL "L"	Increment Pointer to Depth	203 ARCL Y	
149 RCL 02		204 ASTO 01	
150 1		205 CLR	
151 +		206 ARCL X	
152 STG 02		207 ASTO 02	
153 RCL 02		208 CLR	
154 RCL 02	Recall Bad Depth and Array Depth and Compare	209 RCL 18	
155 RCL IND 02		210 1	
156 "N=?"		211 +	
157 GTD "REP"	Go Make Replacement	212 STG 18	
158 ISG 01	All Depths Checked?	213 " "	
159 GTD "L"	Go Get Next Depth	214 ASTO 04	
160 "NOT FND"	Print Error Message and Return to Correction Beginning	215 CLR	
161 WYIE		216 RCL	
162 FCL 55		217 "N=?"	
163 PSE		218 RTN	
164 GTD "COR"		219 LBL "PAC"	Place out of Seq. Pts
165 LBL "REP"	Beginning of Replacement	220 STG 05	Store Depth
166 RCL 02		221 RCL Y	

IDENTIFICATION NUMBER/MOD _____

E. (U) PROGRAM LISTING (CONT'D)

STEP/KEY ENTRY	COMMENT	STEP/KEY ENTRY	COMMENT
222 STO 06	Store Temp. to be	277 STO 03	
223 RCL 16	Placed in Array	278 RCL 06	
224 1	Find No. of Pts.	279 STO IND 08	
225 -	Entered	280 GTO 05	
226 ENTER		281 LBL 04	For Exact
227 X=Y?	First Point Treat	282 STO IND 08	Depth Match
228 GTO 06	as First Pt.	283 RCL 2	Replace Data
229 1 EQ		284 20	PT with New
230 /	Set Up Loop	285 +	PT
231 1		286 STO 06	
232 +		287 RCL 06	
233 STO 07		288 STO IND 08	
234 RCL 11		289 RCL 16	
235 LBL 01	Recall Depth from Array	290 1	
236 STO 08		291 -	
237 RCL IND 03		292 STO 18	
238 RCL 05	Recall New Depth and	293 LBL 05	
239 X-Y?	Compare	294 CLA	Print New
240 GTO 03		295 CLA	Point
241 X=Y?		296 ARCL 01	
242 GTO 04		297 ARCL 04	
243 SF 01	Location for New Data Found	298 ARCL 02	
244 LBL "BX"		299 AVIEW	
245 RCL IND 06		300 CF 01	
246 STO 08	Place Depth and Temp.	301 FS 02	In Correction
247 RCL 05	in Arrays and Store	302 GTO "COR"	Mode?
248 STO IND 06	Replaced Data in Depth	303 GTO 8	
249 RCL 06	and Temp. Temporary	304 LBL 06	Store First
250 STO 05	Locations	305 RCL 05	Data Point
251 RCL 08		306 STO 20	
252 20		307 RCL 06	
253 +		308 STO 40	
254 STO 05		309 GTO 05	
255 RCL IND 08		310 LBL 07	Increment
256 STO 08		311 RCL 08	Depth Counter
257 RCL 06		312 1	Check Mode and
258 STO IND 08		313 +	Go Accordingly
259 RCL 08		314 FC? 01	
260 STO 06		315 GTO 01	
261 RCL 08		316 STO 08	
262 20		317 GTO "BX"	
263 -		318 LBL "INT"	
264 STO 08		319 ADV	Begin Inter-
265 LBL 03		320 CF 02	polation of
266 ISG 07	Have Arrays Been	321 CLA	Salinity
267 GTO 07	Exhausted?	322 "INTERPOLATED"	Profile for
268 RCL 08		323 AVIEW	Entered Depth
269 1		324 CLA	
270 +	Store Last Array	325 "SALINITY"	
271 STO 08	Points	326 AVIEW	
272 RCL 05		327 0	
273 STO IND 08		328 STO 13	
274 RDN		329 20	
275 20		330 STO 15	
276 +		331 100	

IDENTIFICATION NUMBER/MOD _____

E. (U) PROGRAM LISTING (CONT'D)

STEP/KEY ENTRY	COMMENT	STEP/KEY ENTRY	COMMENT
332 ST 16	Store Location of	397 RDN	
333 LBL "DEP"	First Depth of Sal.Prof.	398 XNY	
334 RCL IND 16	Compare Entered Depths w/	399 RCL 2	
335 RCL IND 15	Sal.Prof. Depths	399 -	
336 XNY?		399 RCL Y	
337 GTO "AJ"	Interp. Possible	399 RCL T	
338 X=1?	Exact Match?	399 -	
339 GTO "XAC"		399 /	
340 RCL 16	Decrement Sal. Depth	399 RCL 16	Perform Linear
341 1		399 28	Interpolation
342 -		399 +	Between Sal.
343 STG 16		399 STG 28	Profile Depths
344 GTO "BEG"		399 RCL 27	
345 LBL "XAC"	For Exact Match Find	400 26	
346 RCL 16	Salinity Location and	401 +	
347 26	Store	402 STG 15	
348 +		403 RDN	
349 STG 28		404 RDN	
350 RCL IND 05		405 RCL IND 05	
351 LBL 06	Find Location for Inter-	406 RCL IND 15	
352 RCL 15	polated Salinity and	407 -	
353 40	Store	408 +	
354 +		409 RCL IND 19	
355 STG 16		410 +	
356 XNY	Store Int. Sal.	411 GTO 05	
357 STG IND 12		412 LBL "SSPD"	
358 RCL 16	Keep Track of the Number	413 CLR	Get Ready to
359 RCL 13	of Pts for which Sal.	414 +	Calculate the
360 1	was Calculated	415 RSTG 10	Sound Speed
361 +		416 OF 29	
362 STG 13		417 CLR	
363 XNY?	Go Calculate Sound Speed	418 "SOUND SPD"	
364 GTO "SSPD"	If all Depths Have Salinity,	419 RVIEW	
365 RCL 15	if not continue Interp.	420 "PROFILE"	
366 1		421 RVIEW	
367 +		422 CLR	
368 STG 15		423 RDN	
369 GTO "BEG"		424 "BTH SSPD"	
370 LBL "AJ"	Make Sure Entered Depth	425 RVIEW	
371 RCL 16	is Between Salinity	426 CLR	
372 1	Depths	427 RCL 16	Set Up Loop
373 +		428 1 E2	and Pointer
374 STG 16		429 /	
375 RDN		430 1	
376 RCL IND 16		431 +	
377 XNY?		432 STG 05	
378 GTO "INTP"	Go Perform Interp.	433 15	
379 GTO "BEG"	Go to Beginning of Proc.	434 STG 05	
380 LBL "INTP"		435 LBL 09	Increment
381 RCL 16		436 CLR	Pointer
382 1		437 RCL 09	
383 -		438 1	
384 STG 07		439 +	
385 RCL IND 07		440 STG 05	
386 RDN		441 RCL IND 05	

IDENTIFICATION NUMBER/MOD _____

E. (U) PROGRAM LISTING (CONT'D)

STEP/KEY ENTRY	COMMENT	STEP/KEY ENTRY	COMMENT
442 ARCL 10		497 3.2600	
443 RCL IND 09		498 *	
444 STO 04	Store Depth	499 RCL 09	
445 RCL IND 09		500 20	
446 *		501 +	
447 STO 05	Store Depth **2	502 STO 09	Calculate
448 RCL 09		503 RCL Y	Card Output
449 20		504 STO IND 09	Form for SSP
450 +		505 1 E4	Point
451 STO 09		506 /	
452 RCL IND 09		507 RCL 04	
453 STO 00	Store Temperature	508 INT	
454 RCL IND 09		509 +	
455 *		510 STO 11	
456 STO 01	Store Temp **2	511 ARCL IND 09	Print Depth
457 RCL IND 09		512 RTIE*	and SS
458 *		513 FC2 55	
459 STO 02		514 PSE	
460 RCL 09		515 RCL 09	Store Card
461 20		516 60	Format Profile
462 +		517 -	Point in Depth
463 STO 09		518 STO 09	Locations
464 RCL IND 09		519 FIA 4	
465 STO 03	Store Salinity	520 RCL 11	
466 RCL 00		521 STO IND 09	Have Sound
467 3.9229		522 FIX 1	Speeds Been
468 *		523 ISG 00	Calculated for
469 RCL 01		524 GT0 09	All Depths?
470 2.6276 E-2		525 LBL 20	
471 *		526 ADV	
472 -		527 ADV	
473 RCL 02		528 ADV	SSP on Cards?
474 4.071 E-5		529 "M"	
475 *		530 ASTO Y	
476 +		531 "SSF ON CRD"	
477 RCL 04		532 AGN	
478 4.9603 E-3	Calculate Sound Speed	533 PRONFT	
479 *		534 ASTG X	
480 +		535 AOFF	
481 RCL 05		536 X=Y?	
482 1.5562 E-6		537 GT0 30	
483 *		538 RCL 18	Output SSP
484 +		539 19	to Cards
485 RCL 03		540 +	
486 1.522		541 1 E3	
487 *		542 /	
488 +		543 20	
489 5.6944 E-3		544 +	
490 RCL 00		545 STO 2	
491 *		546 RTIE*	
492 RCL 03		547 LBL 30	End of Progr
493 *		548 CLX	
494 -		549 RTA	
495 1295.97		550 .END.	
496 *			

Appendix A. HP-41CV BT Sound Speed Profile Program
Areas of Salinity Profile Coverage.

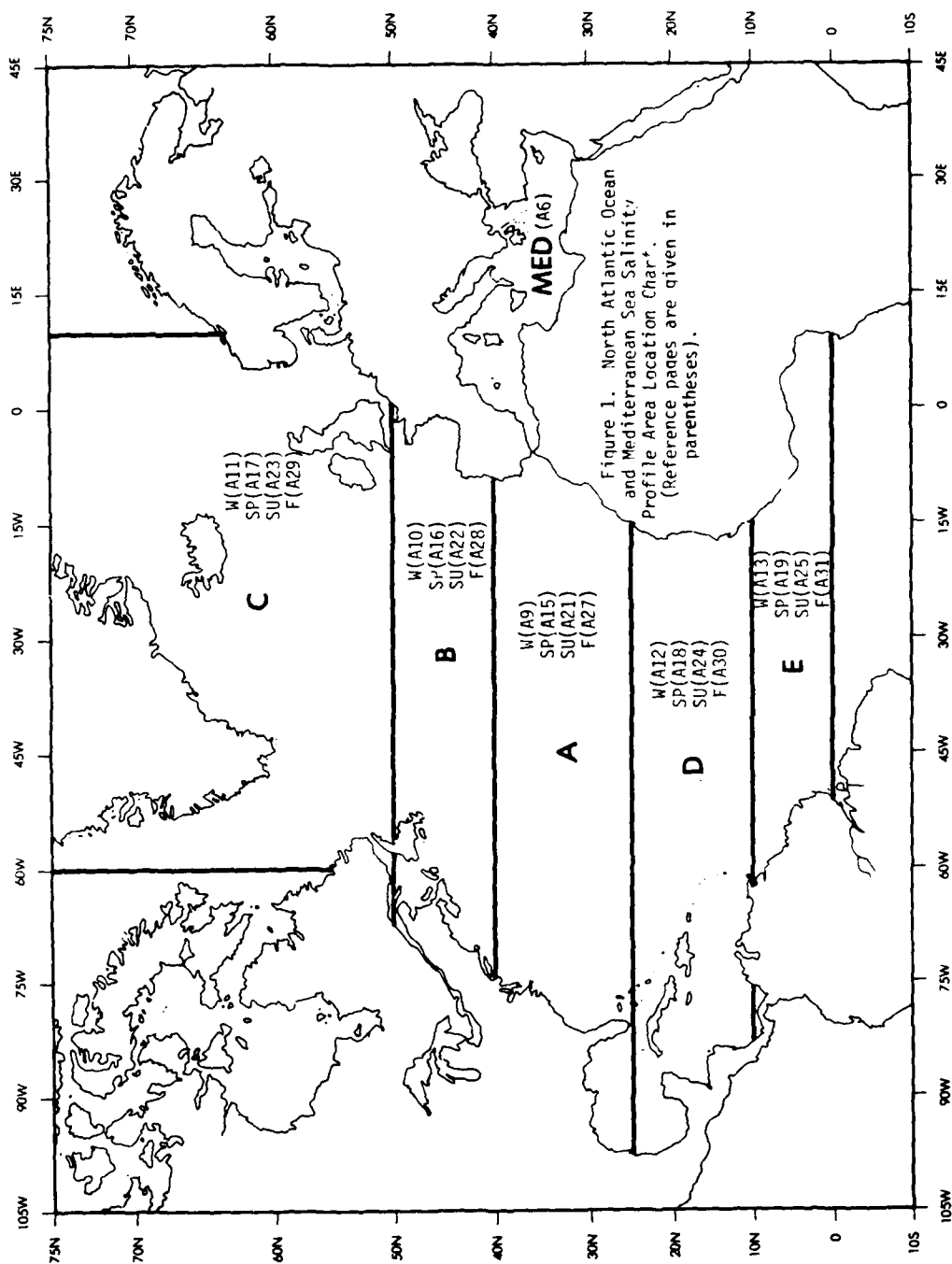
I. Discussion

Contained within this Appendix are figures illustrating the areas of coverage of selected (ICAPS) salinity profiles for the North Atlantic, North Pacific, and North Indian Oceans, and the Mediterranean Sea. The method used to select these representative profiles and listings of the profiles selected may be found in Appendix B.

The profile number to be used in an area of interest corresponds to the number of lines used to crosshatch that area in the figures which follow. Areas without crosshatching are represented by profile zero; areas with single line crosshatching by profile one; etc.

Areas of coverage for the North Atlantic Ocean are seasonally dependent, i.e., a specific area may be represented by a different profile number in each season. Areas of coverage for all other bodies of water are presented on an annual basis. Profile number two in the Mediterranean Sea and profile number four in the North Atlantic Ocean are seasonally dependent, i.e., there is a specific seasonal salinity profile for those areas represented by these profiles.

To find the appropriate salinity profile, first consult Figure 1 for the N. Atlantic Ocean and Mediterranean Sea, Figure 2 for the N. Pacific Ocean, or Figure 3 for the N. Indian Ocean. These figures contain the reference page numbers to consult for the detailed description of each broad ocean area (and season for the N. Atlantic Ocean). From the referenced page map determine the representative salinity profile number and select the appropriately labeled set (2) of magnetic cards from the salinity profile library.



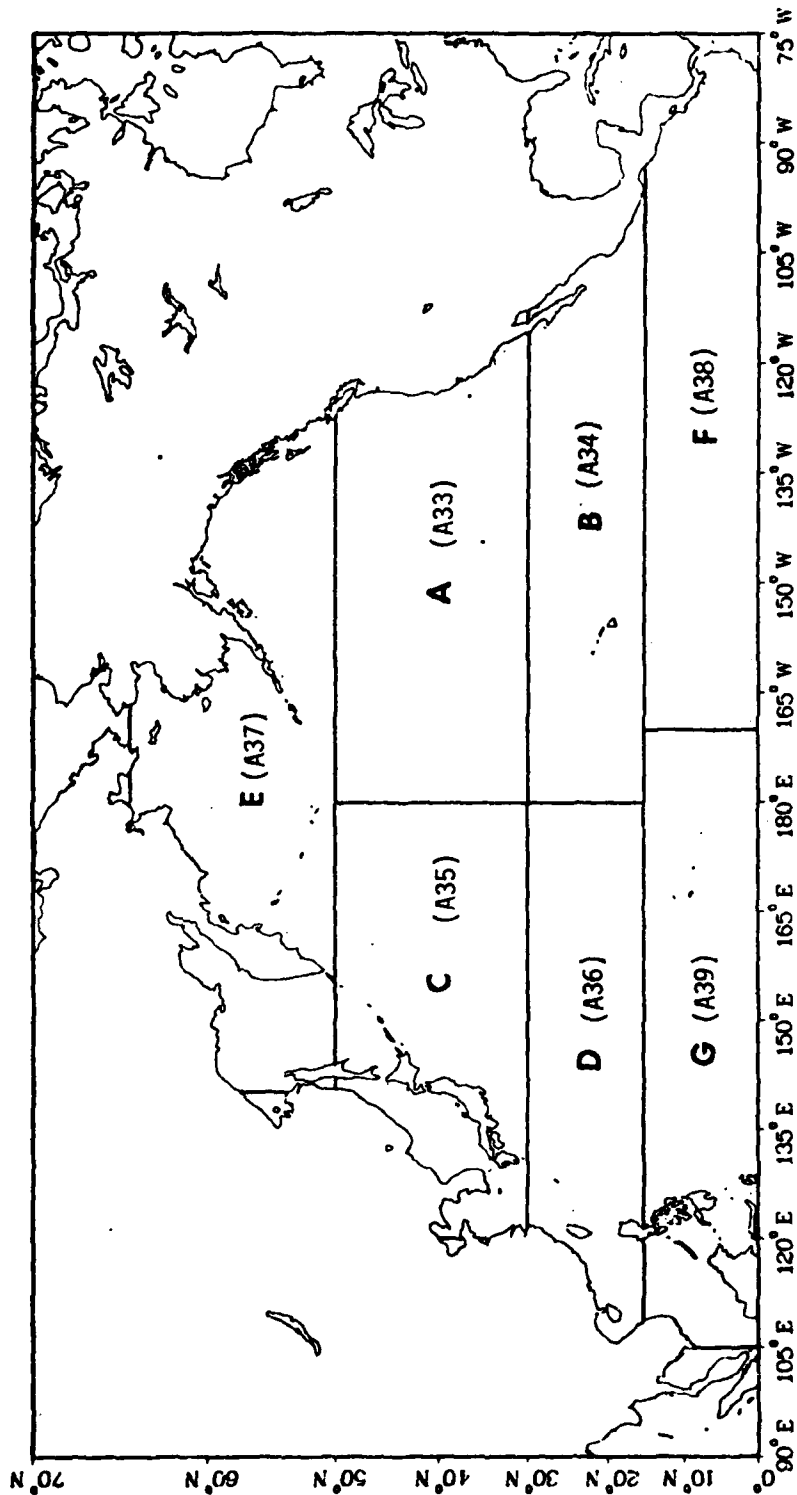


Figure 2. North Pacific Ocean Salinity Profile Area Location Chart. (Reference pages are given in parentheses).

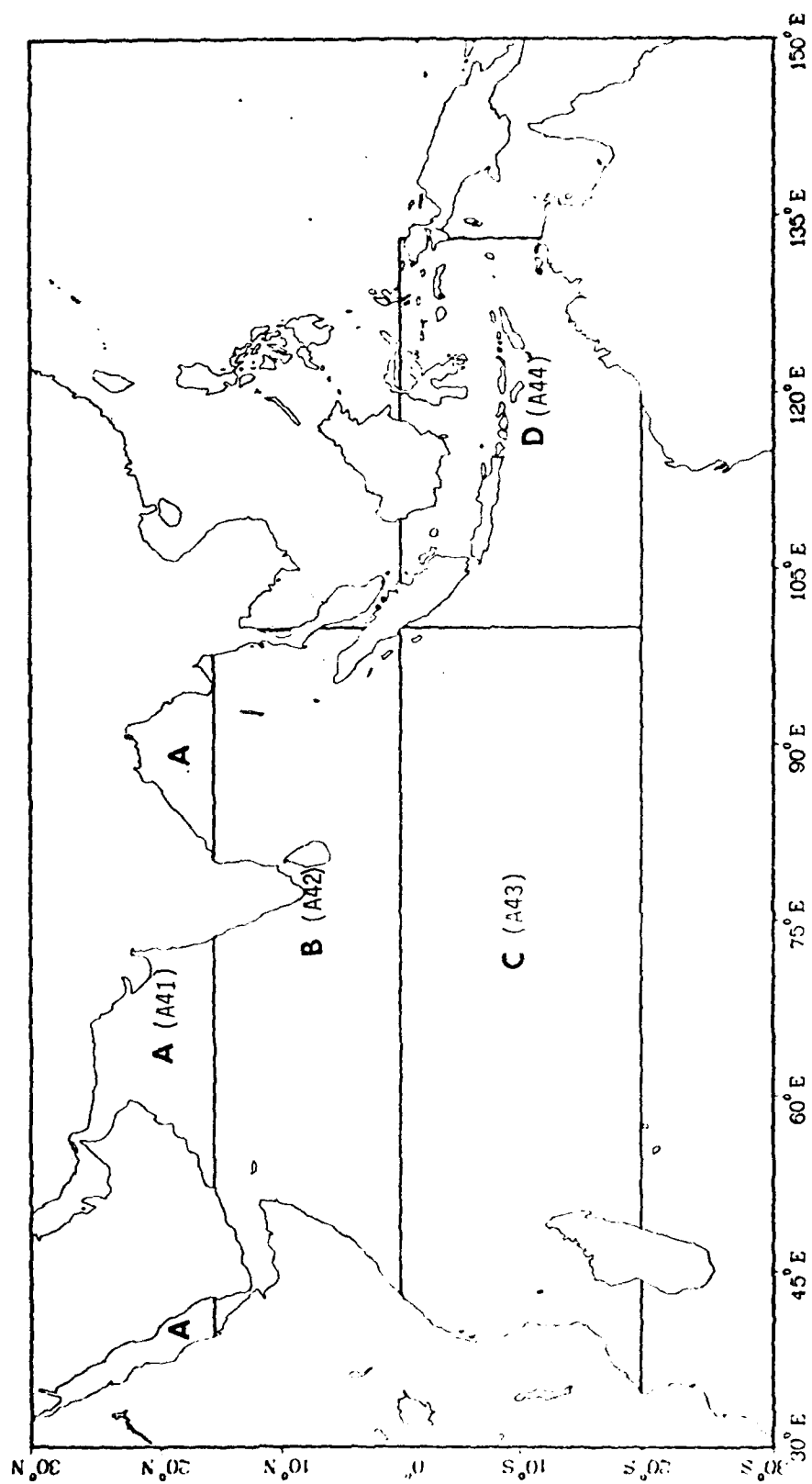
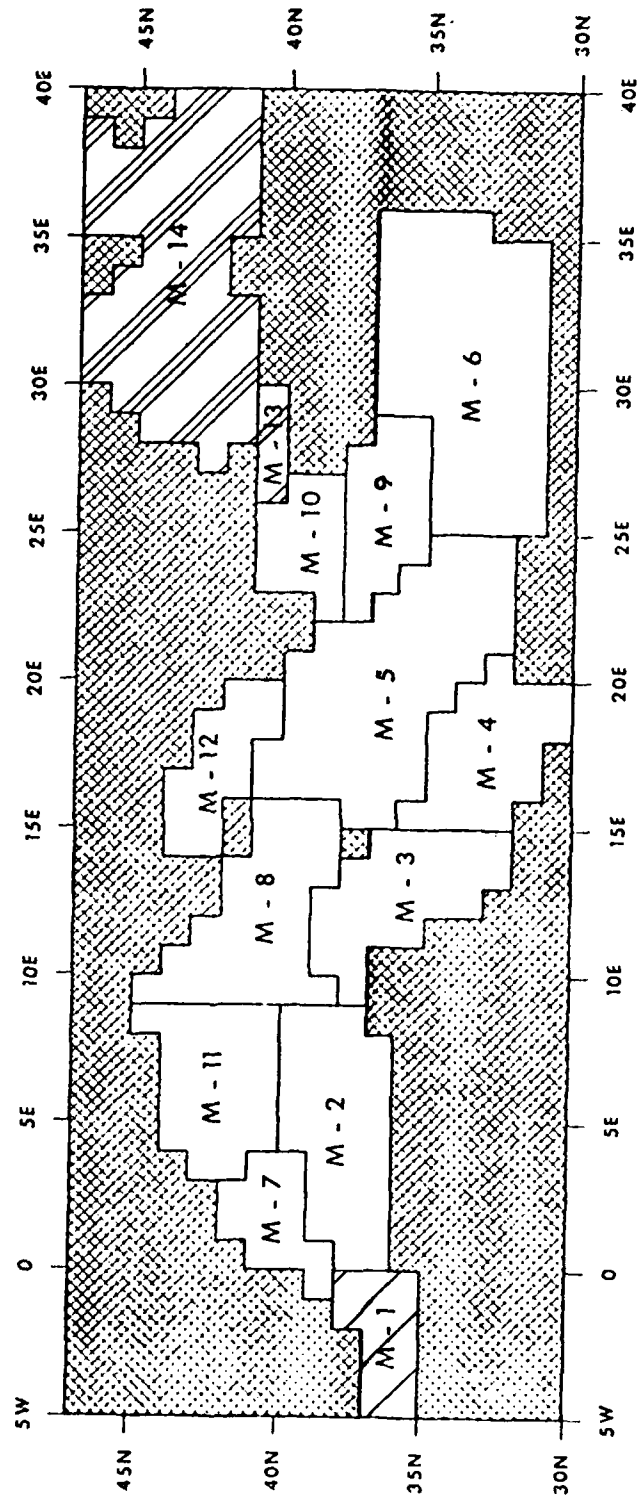


Figure 3. North Indian Ocean Salinity Profile Area Location Chart. (Reference pages are given in parentheses).

MEDITERRANEAN SEA

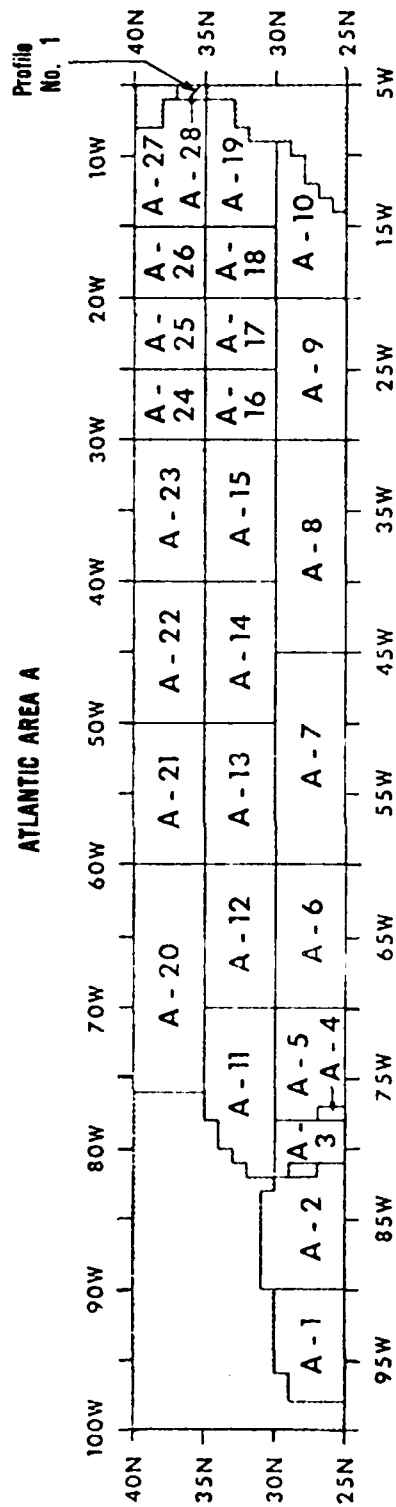
ALL SEASONS
MEDITERRANEAN



NORTH ATLANTIC WINTER

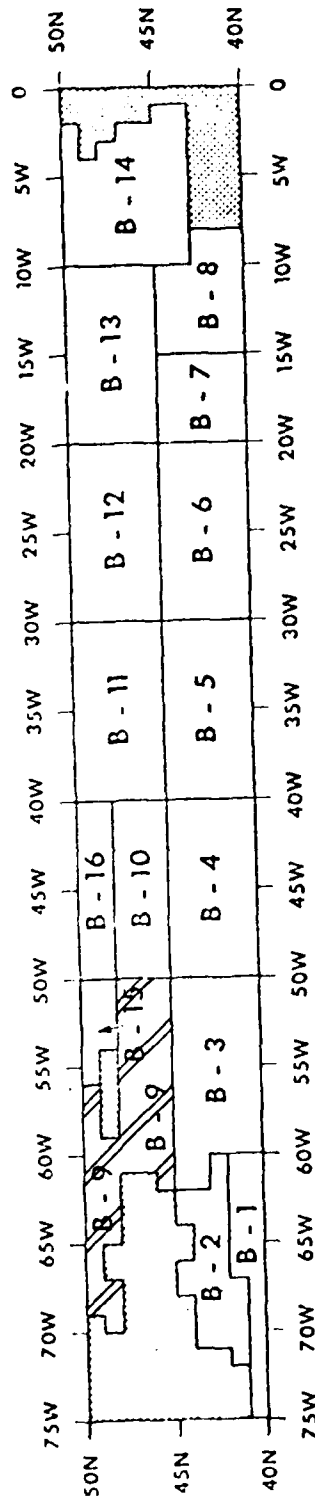
WINTER

ATLANTIC AREA A



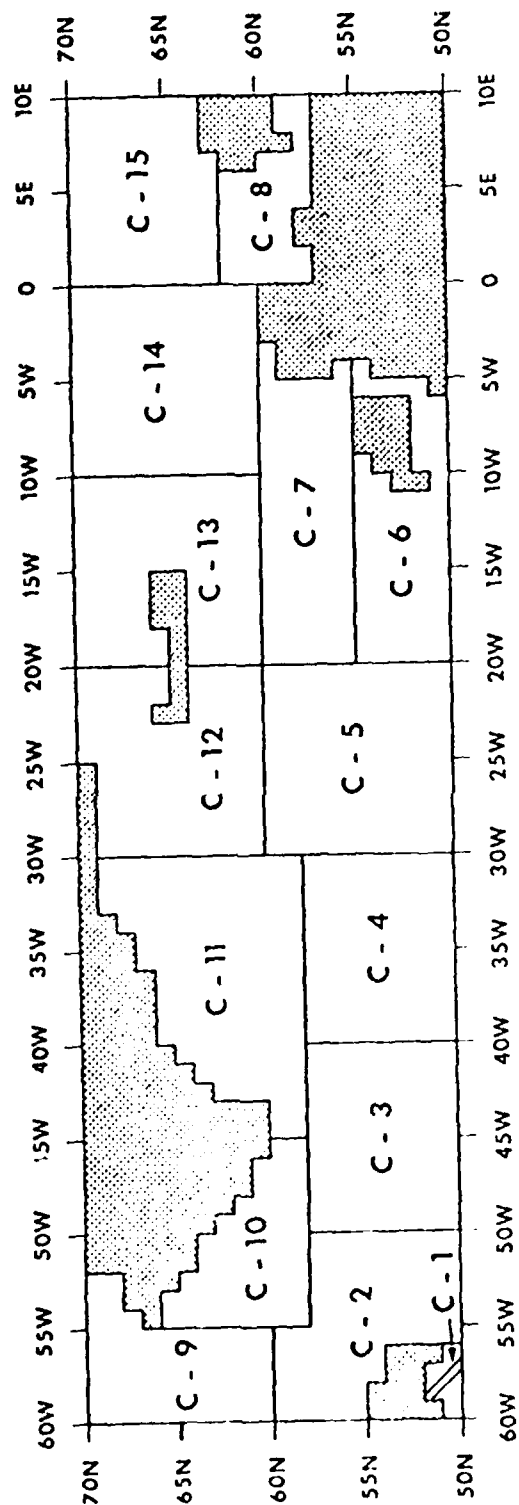
WINTER

ATLANTIC AREA B



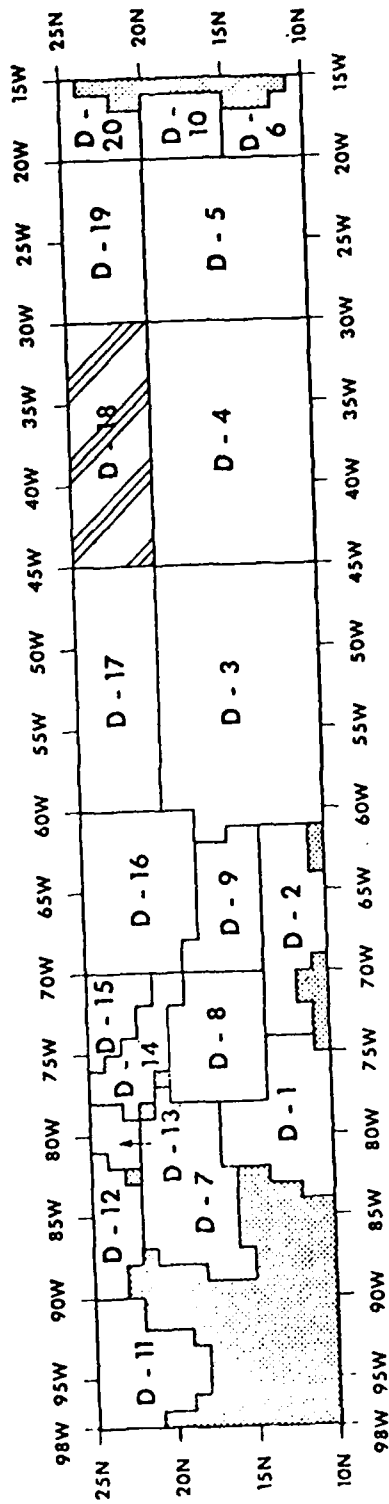
WINTER

ATLANTIC AREA C



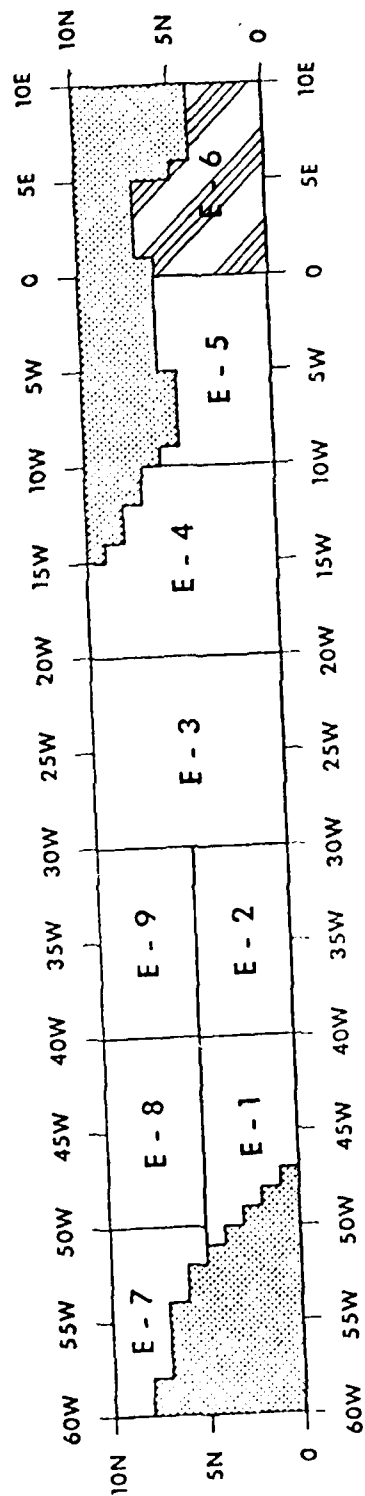
WINTER

ATLANTIC AREA D



WINTER

ATLANTIC AREA E



NORTH ATLANTIC SPRING

A14

I

I

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I

I

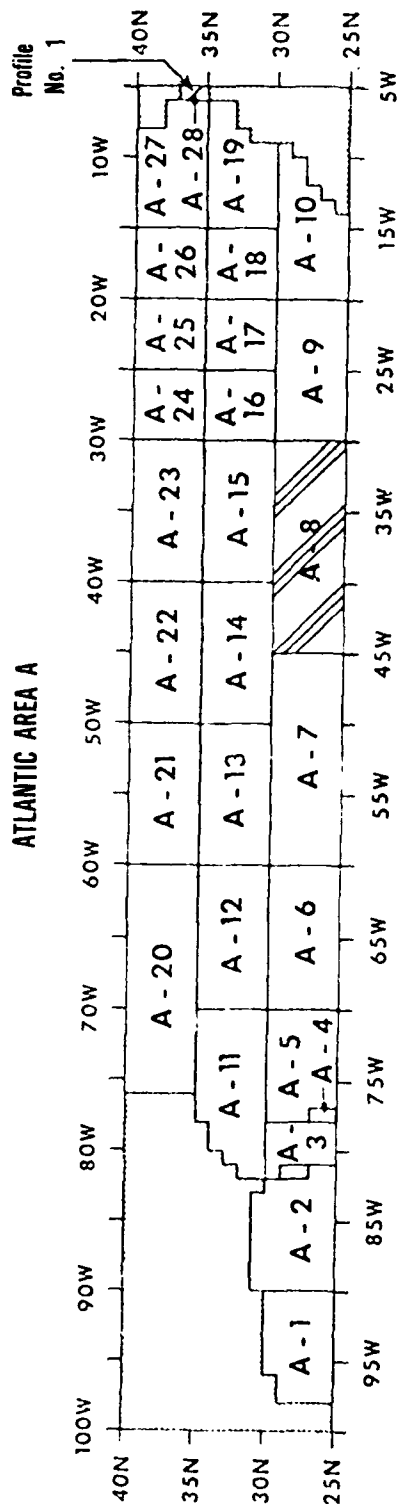
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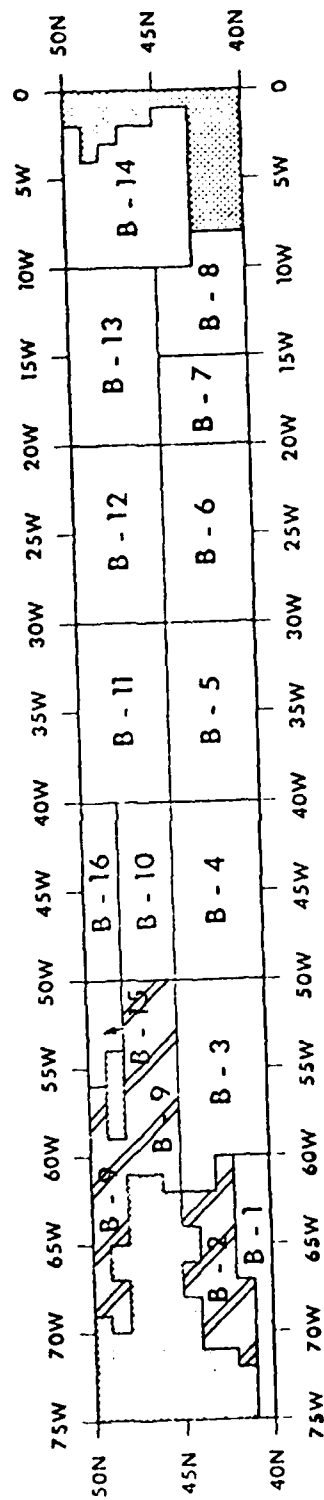
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SPRING

ATLANTIC AREA A

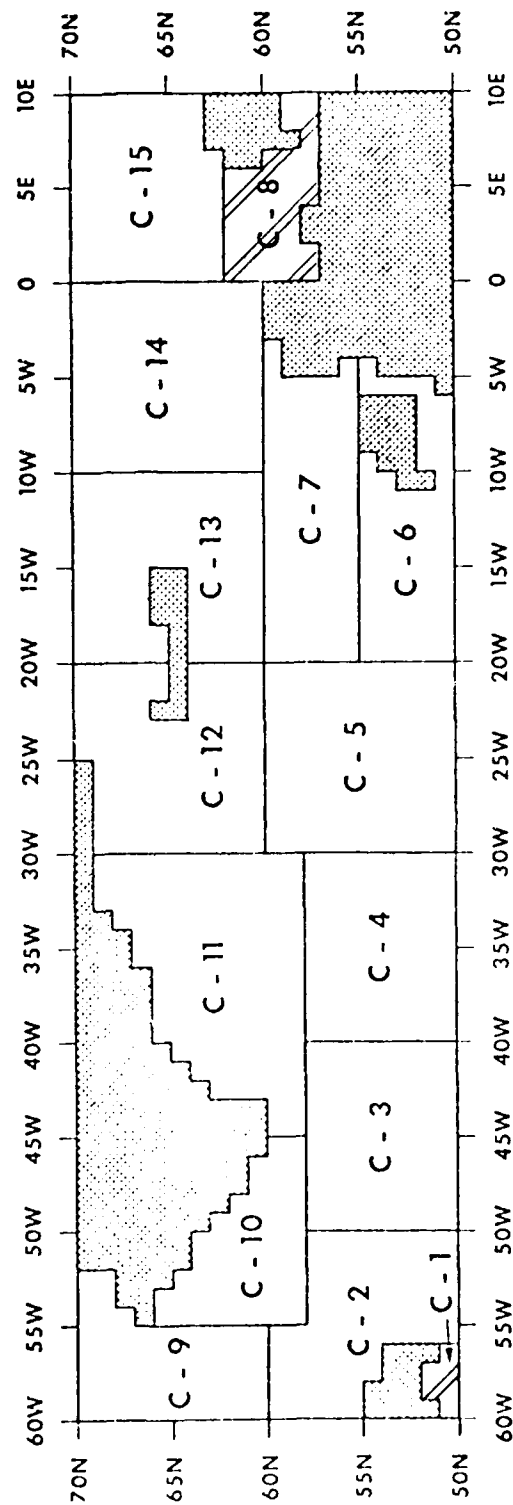


**SPRING
ATLANTIC AREA B**



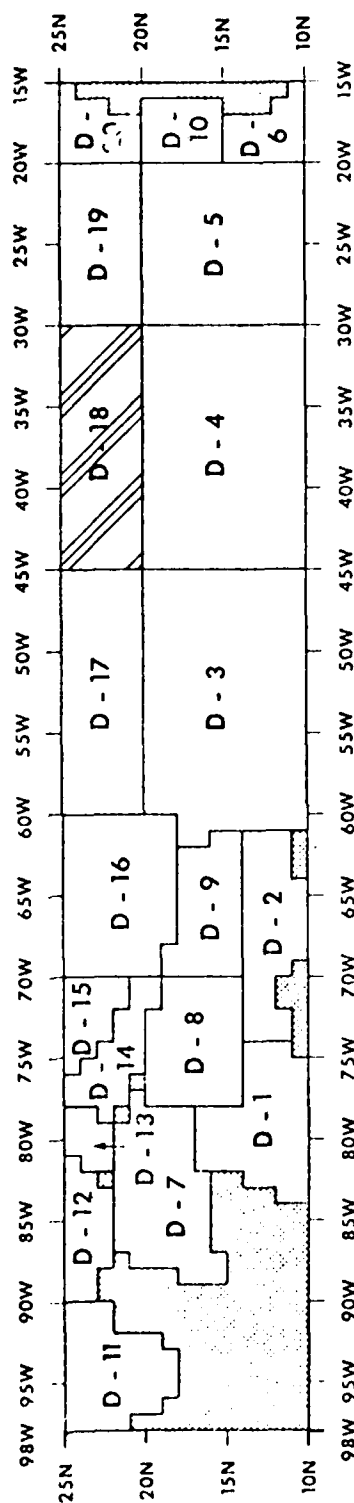
SPRING

ATLANTIC AREA C



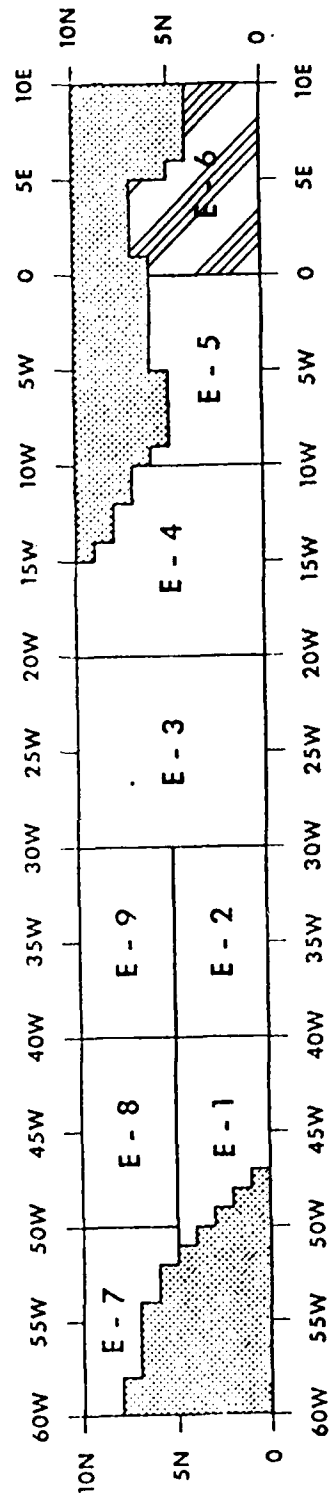
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ATLANTIC AREA D



SPRING

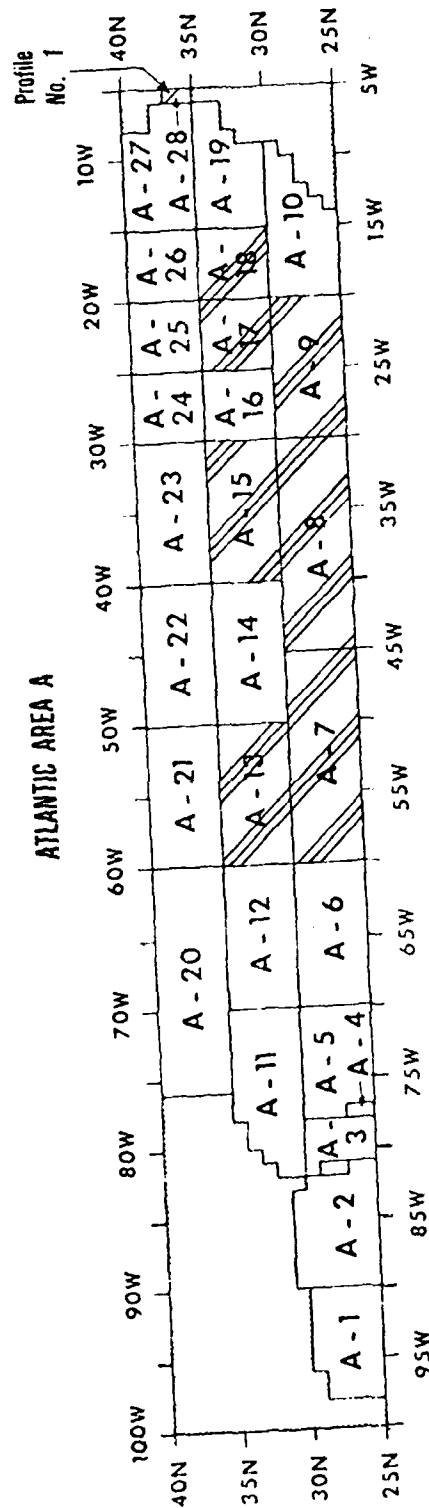
ATLANTIC AREA E



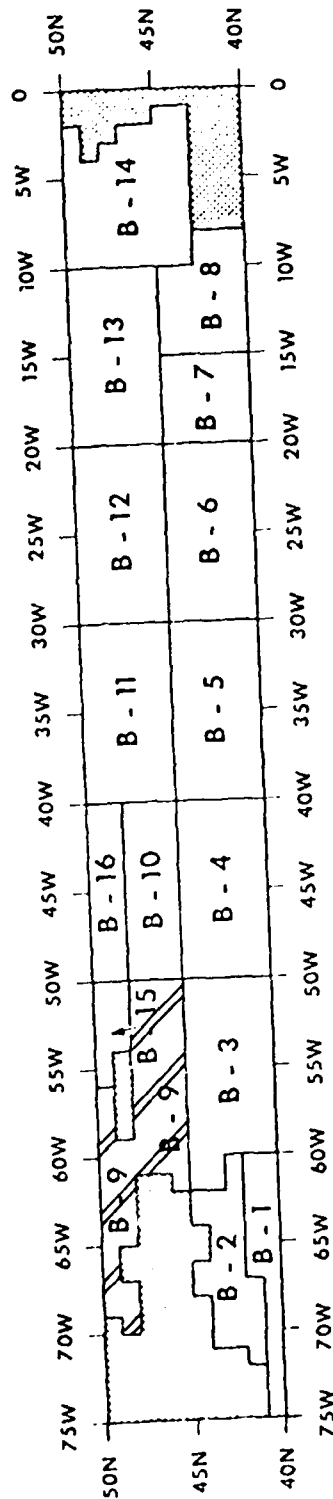
NORTH ATLANTIC SUMMER

SUMMER

ATLANTIC AREA A

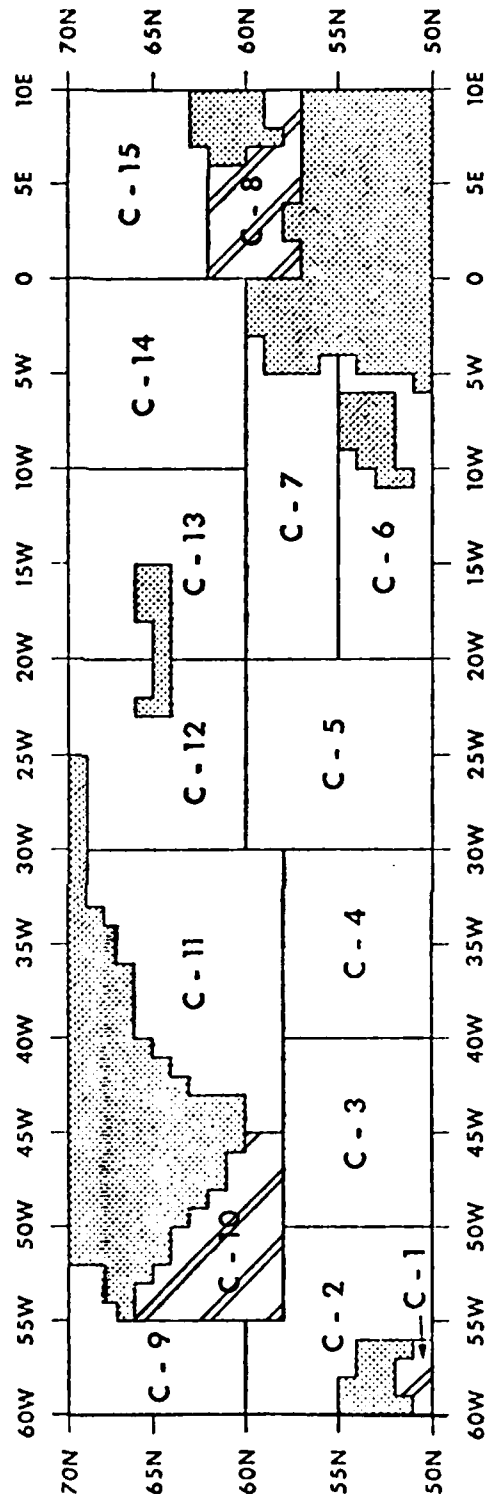


SUMMER
ATLANTIC AREA B



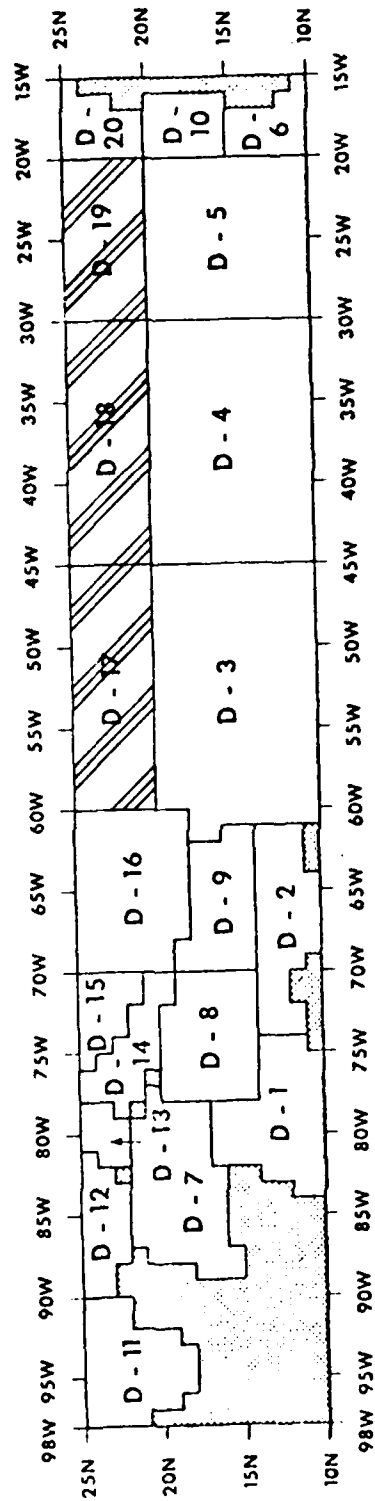
SUMMER

ATLANTIC AREA C



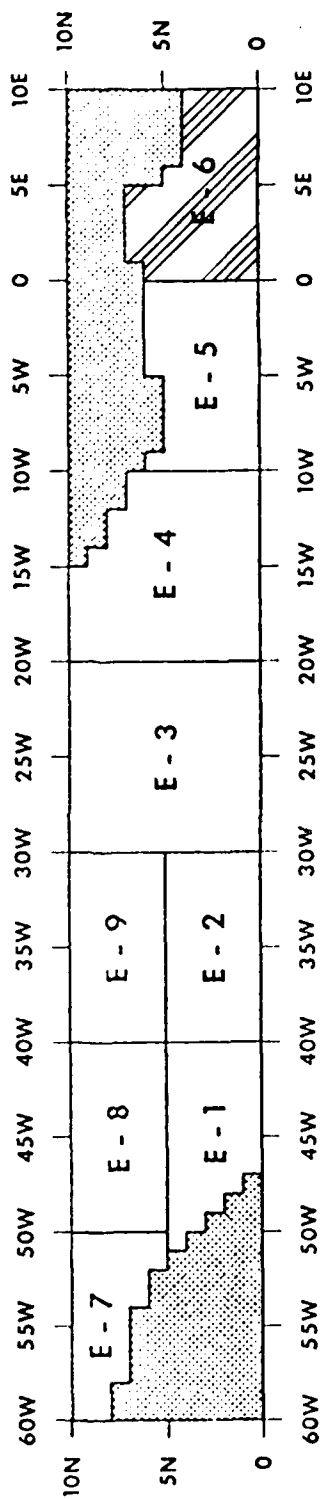
SUMMER

ATLANTIC AREA D



SUMMER

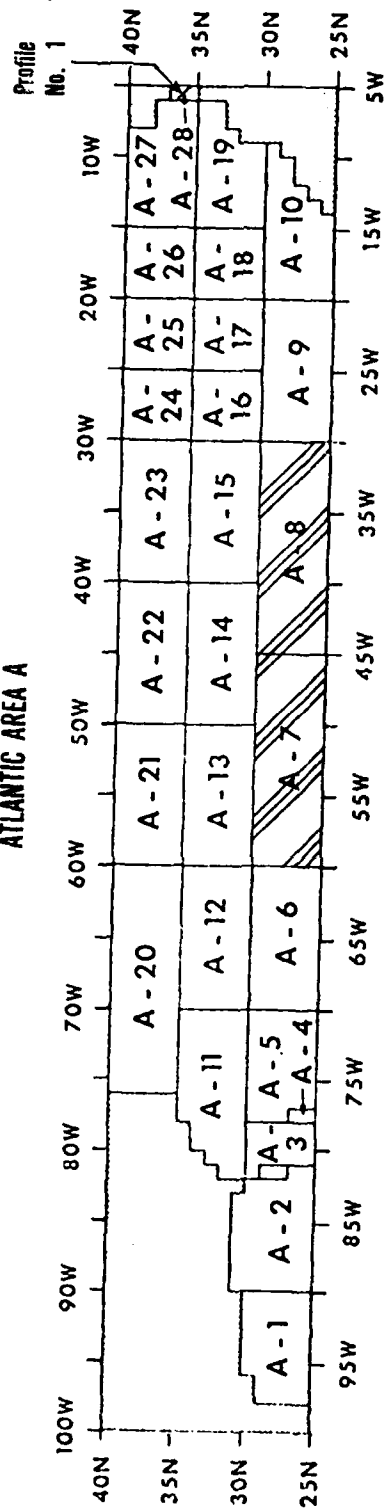
ATLANTIC AREA E



NORTH ATLANTIC FALL

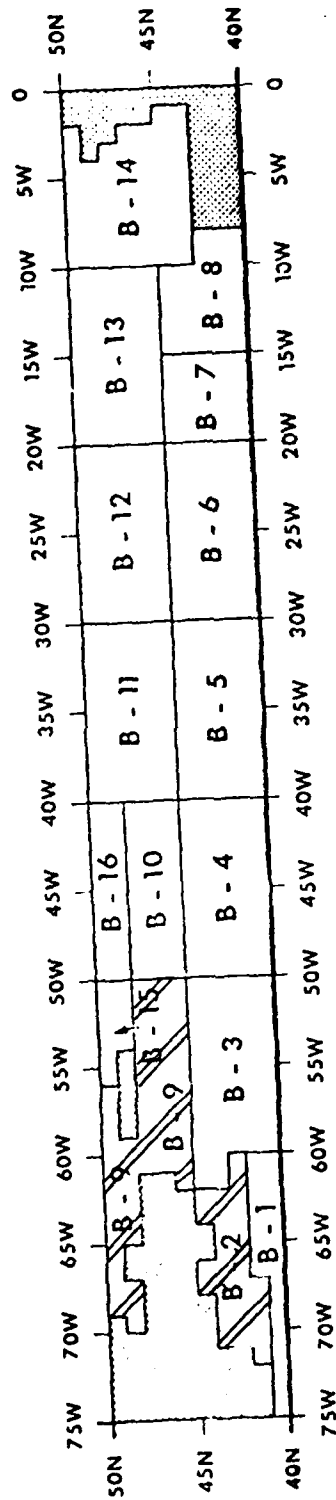
FALL

ATLANTIC AREA A

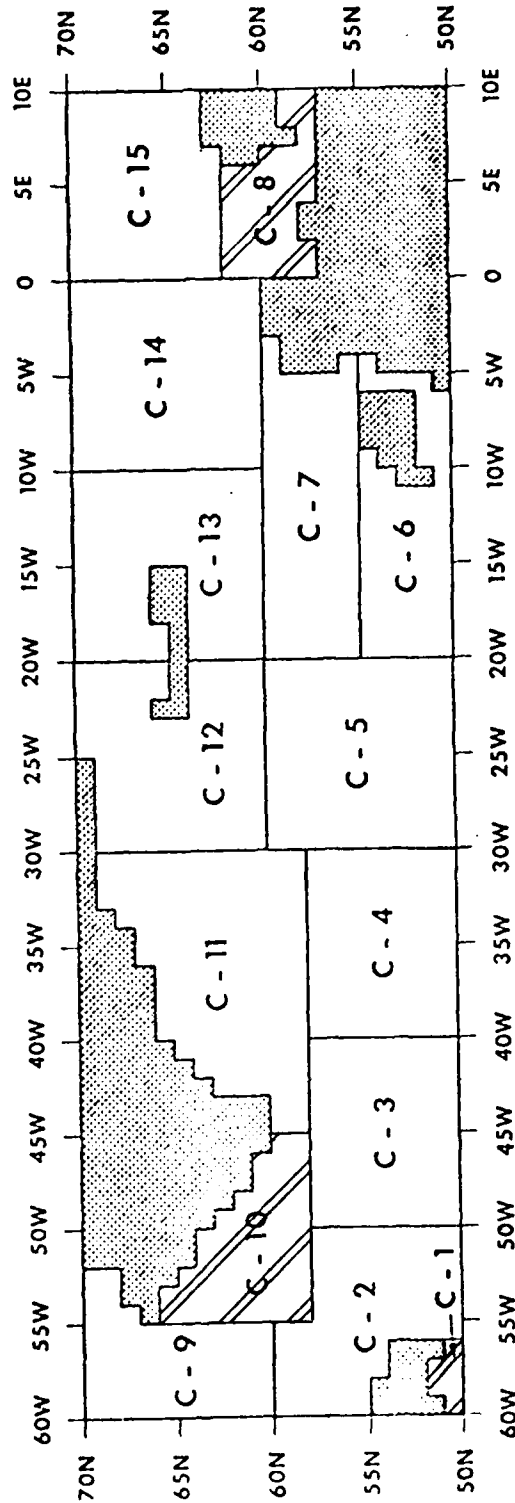


FALL

ATLANTIC AREA B

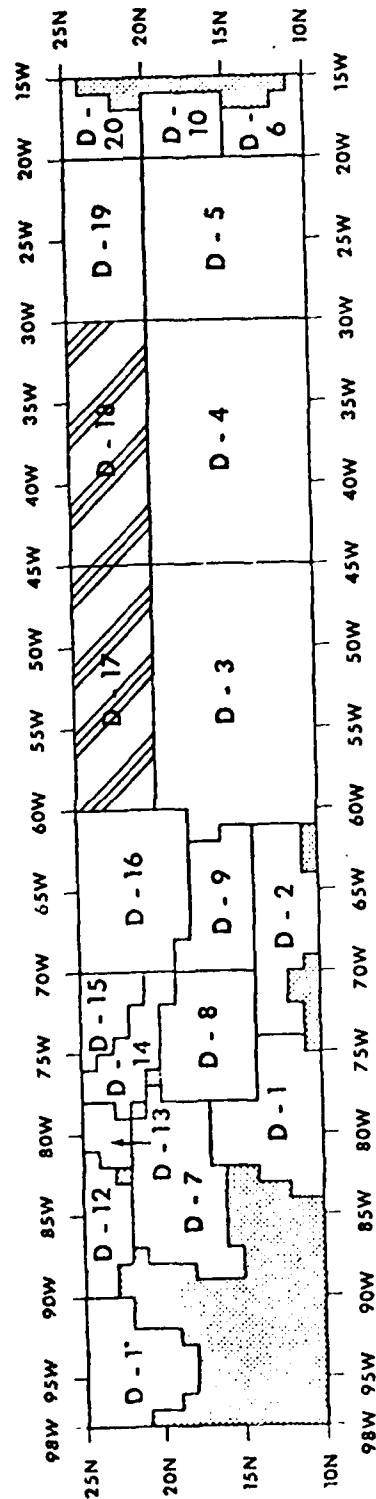


FALL
ATLANTIC AREA C

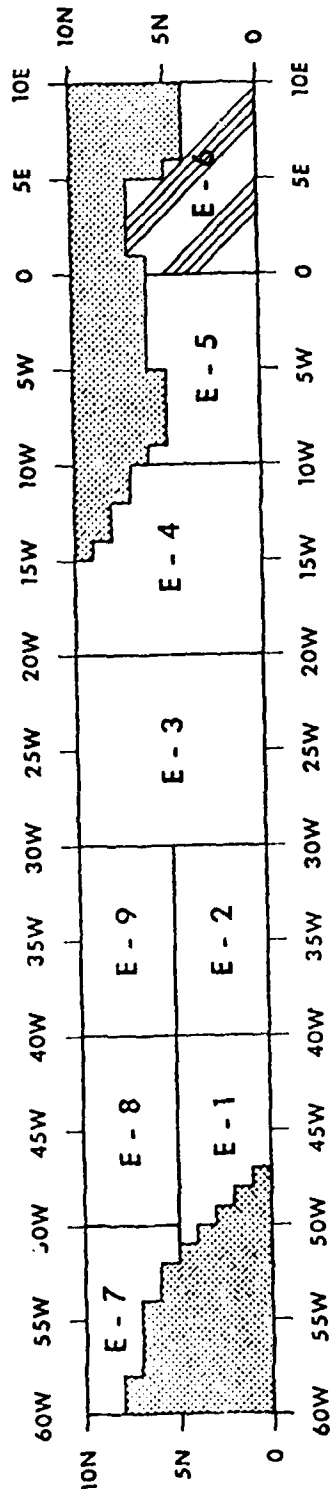


FALL

ATLANTIC AREA D



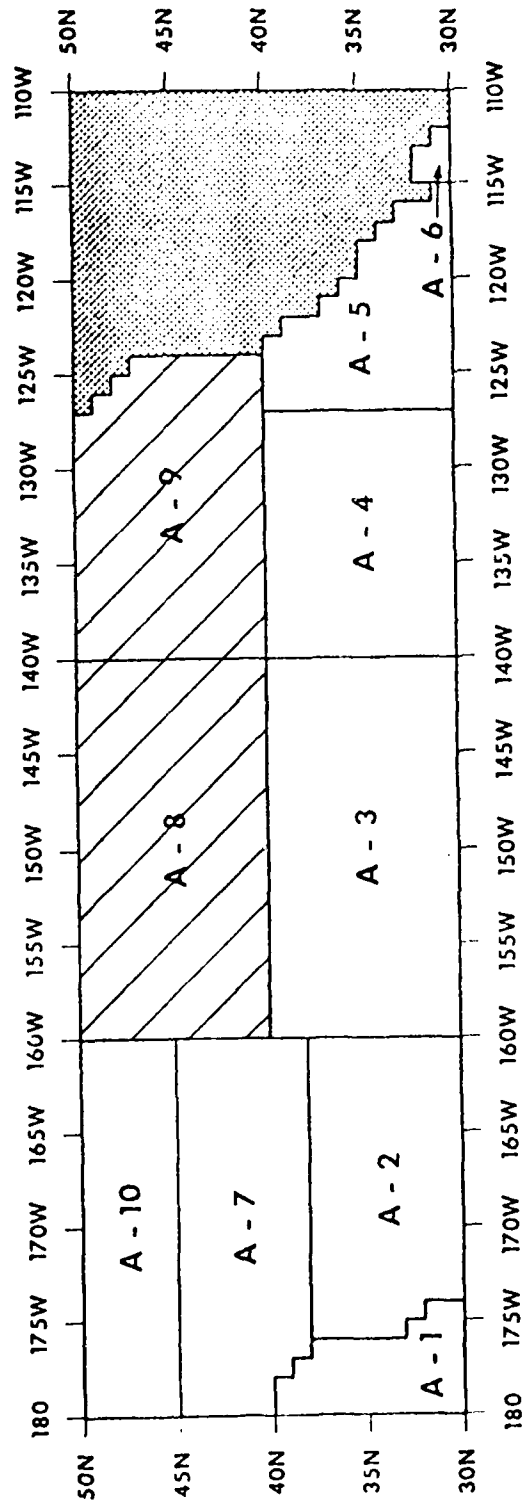
FALL ATLANTIC AREA E



NORTH PACIFIC OCEAN

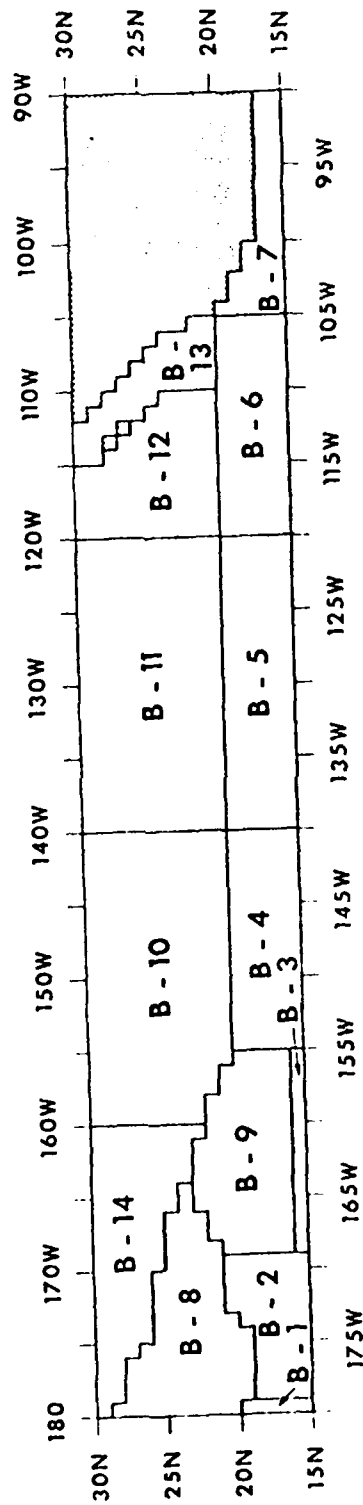
ALL SEASONS

PACIFIC AREA A



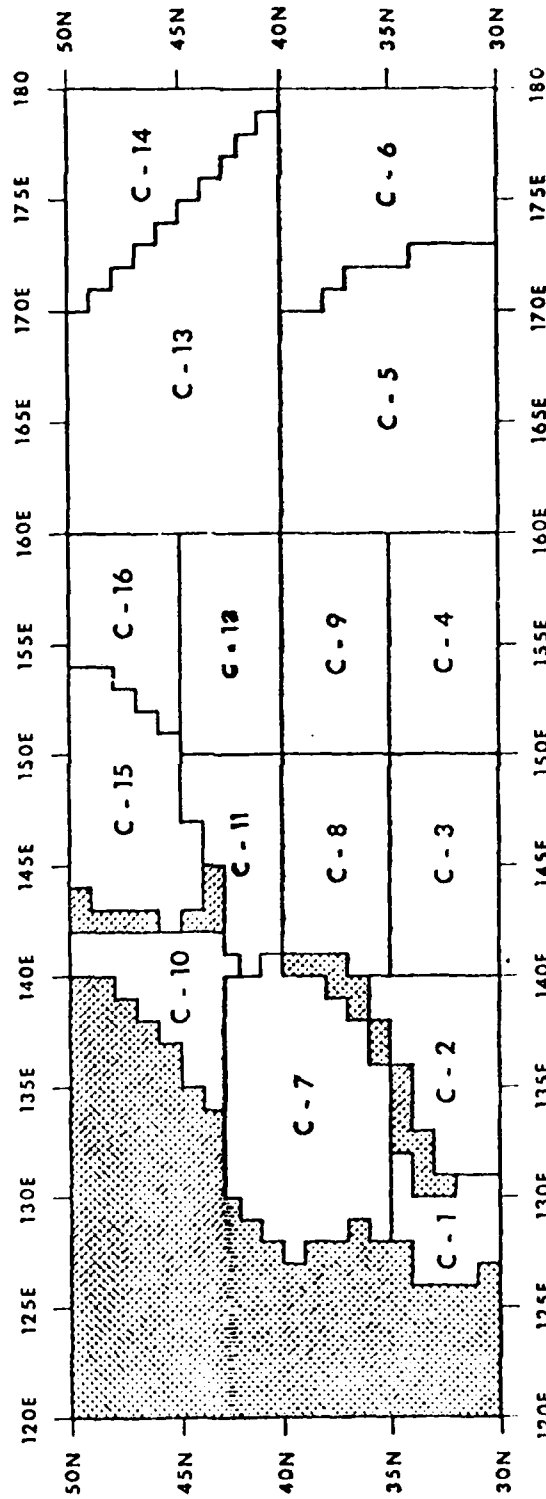
ALL SEASONS

PACIFIC AREA B



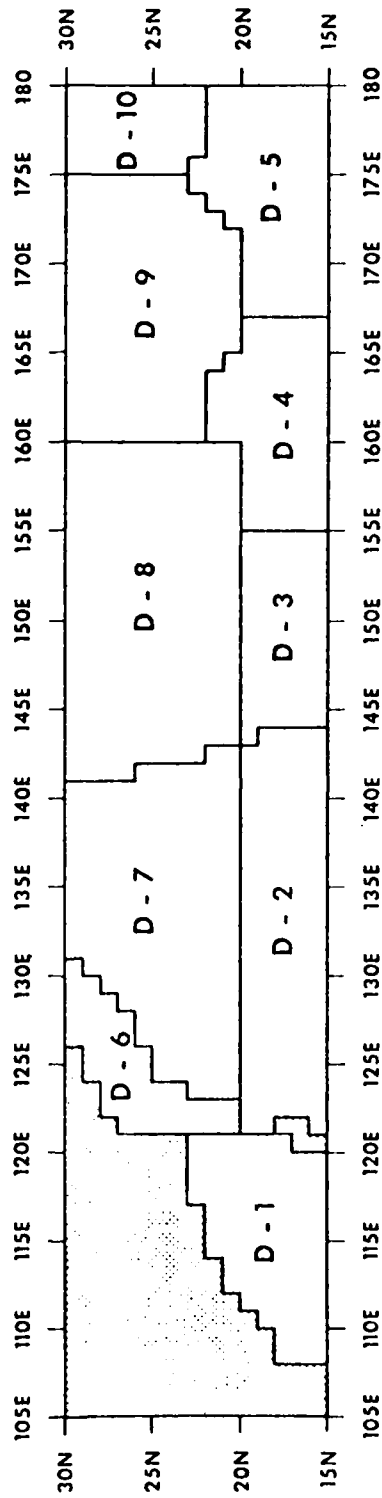
ALL SEALS

PACIFIC AREA C



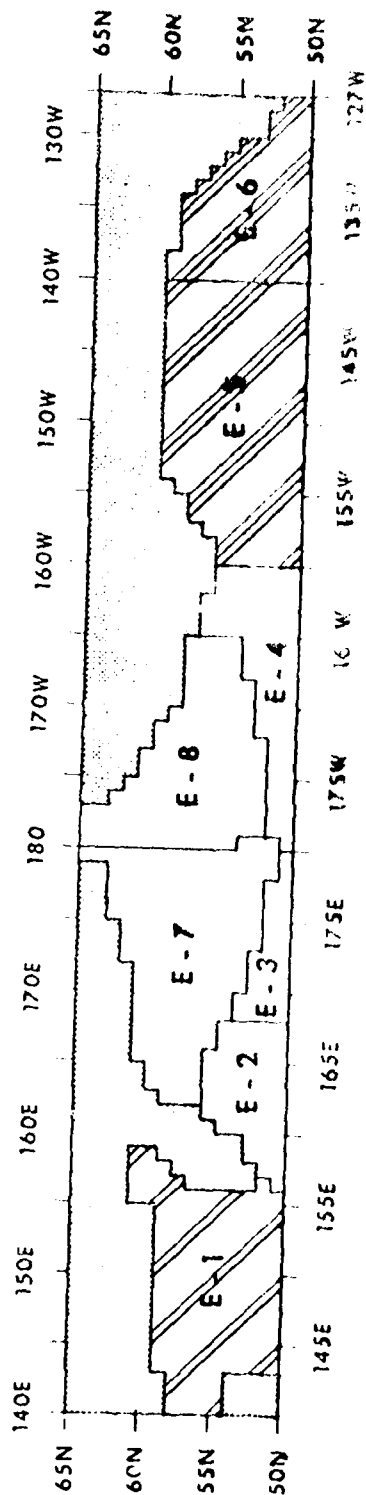
ALL SEASONS

PACIFIC AREA D



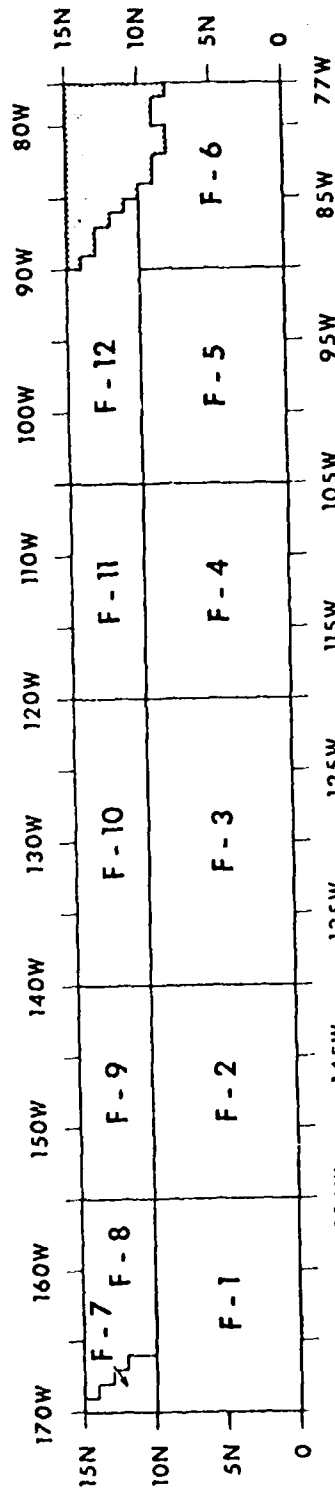
ALL SEASONS

PACIFIC AREA E

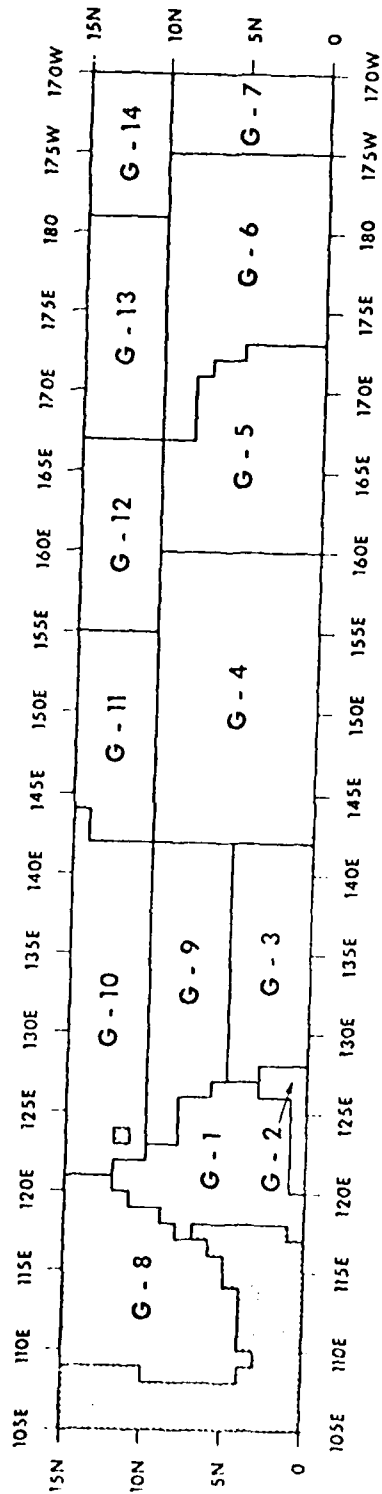


ALL SEASONS

PACIFIC AREA F



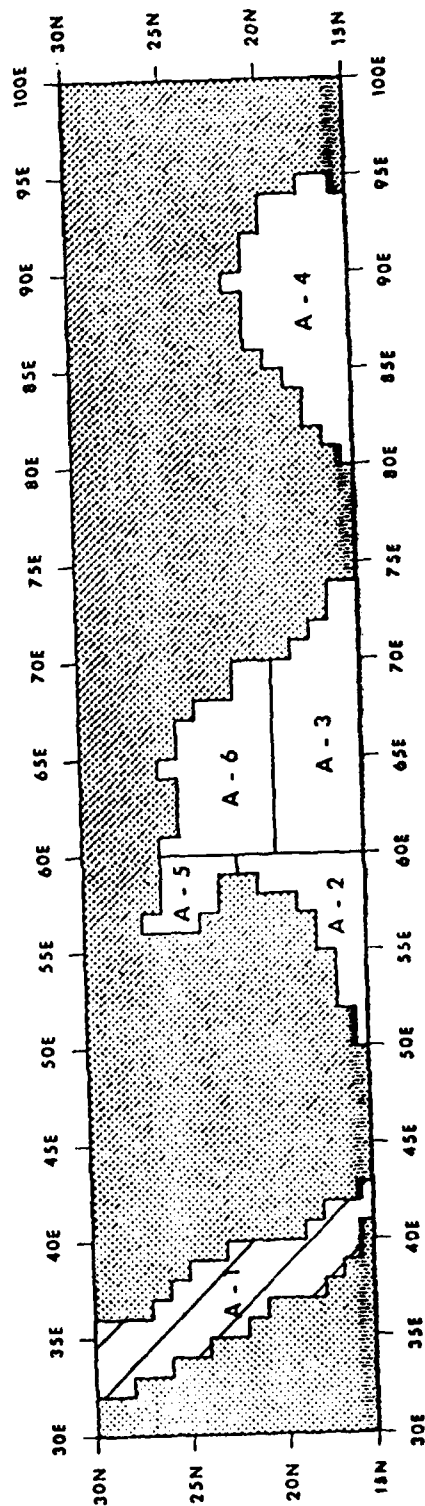
ALL SEASONS
PACIFIC AREA G



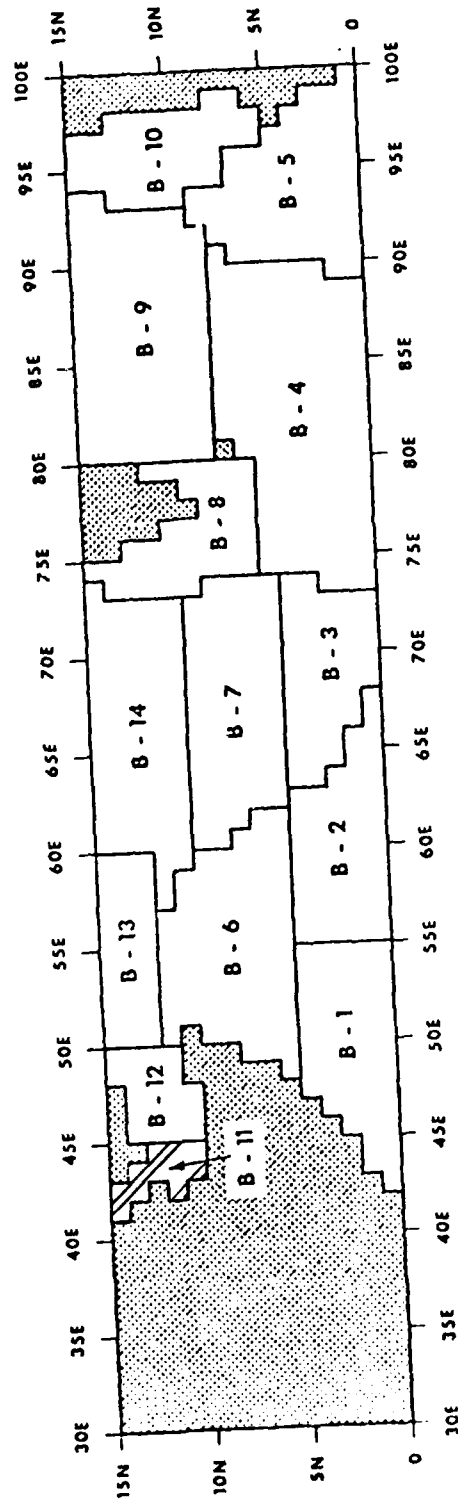
NORTH INDIAN OCEAN

ALL SEASONS

INDIAN AREA A

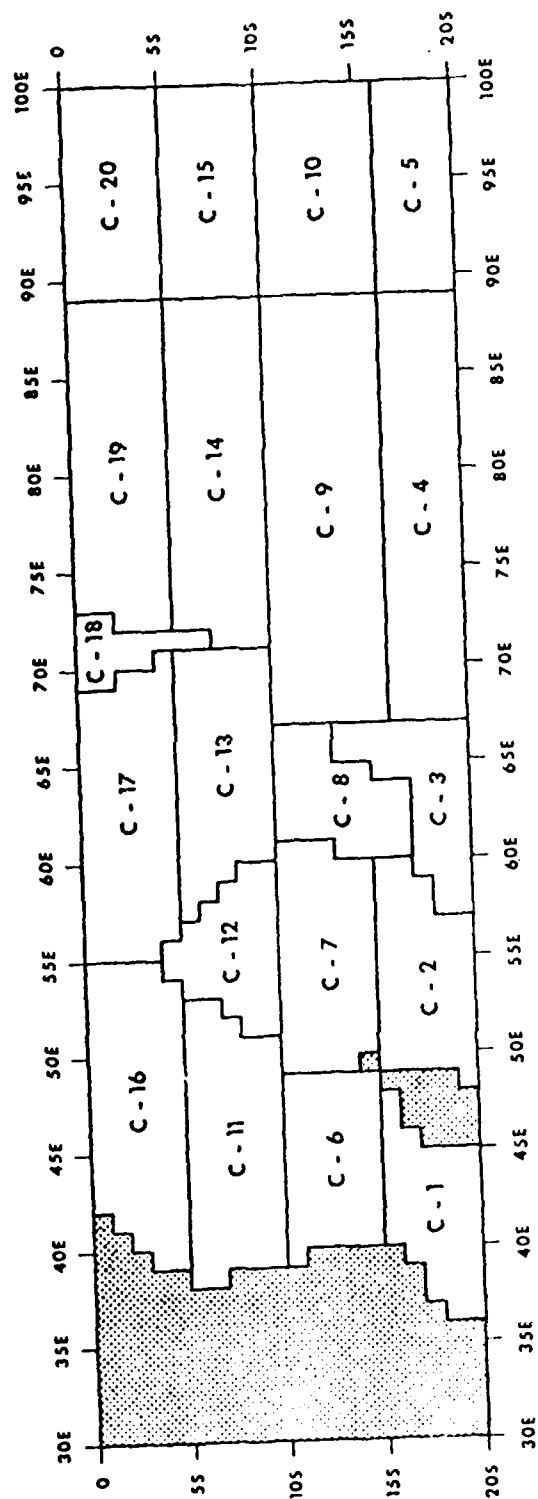


ALL SEASONS
INDIAN AREA B



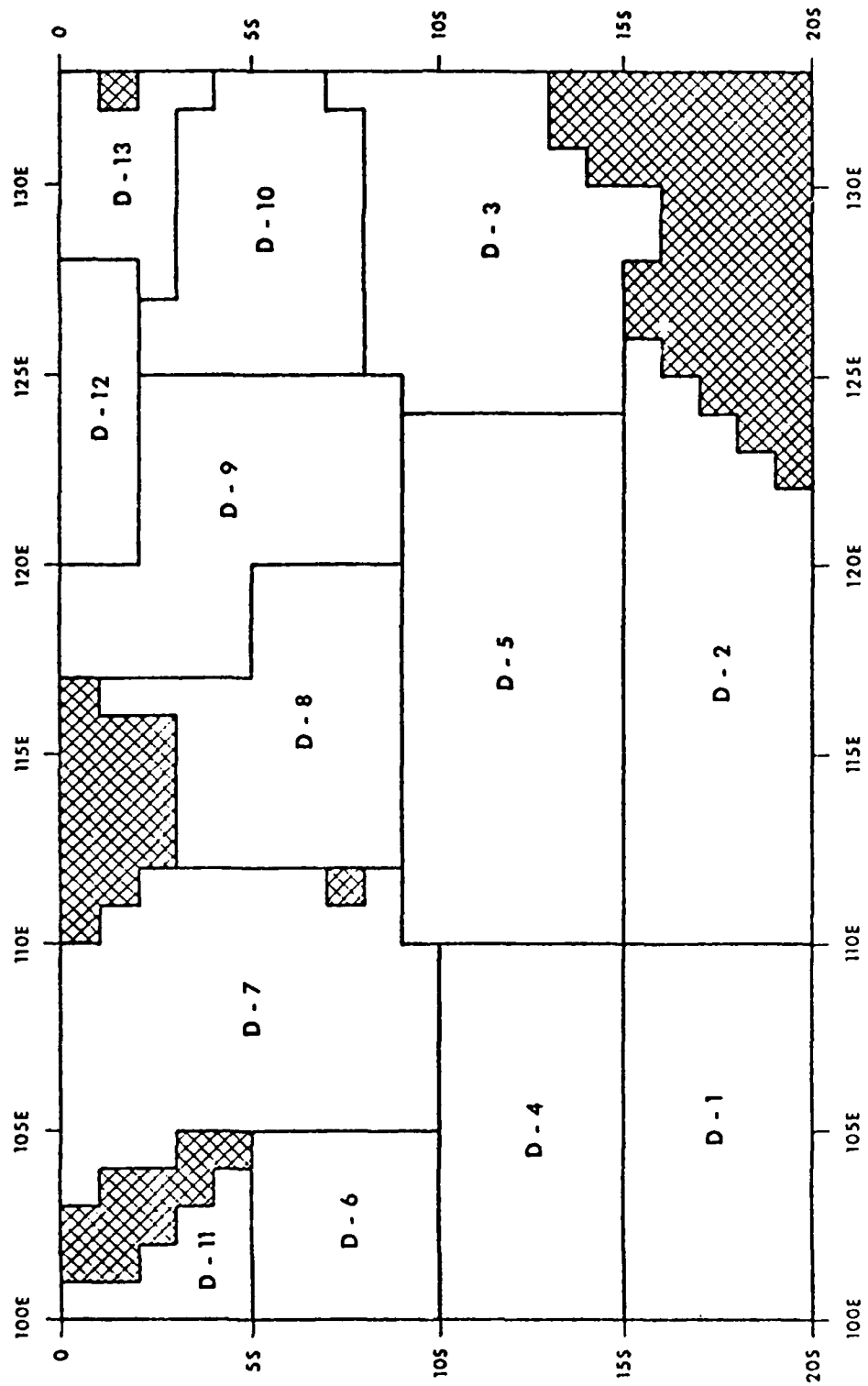
ALL SEASONS

INDIAN AREA C



ALL SEASONS

INDIAN AREA D



Appendix B. Creation of the HP41CV BT to Sound
Velocity Program Salinity Profile Data Base

I. Introduction

In order to insure a reasonable sound speed determination from only in-situ temperature versus depth (BT) information, salinity profiles representative of variable oceans had to be determined. Because of funding and time constraints, it was decided to employ the ICAPS water mass data base, which contains representative seasonal salinity profiles for the major oceans of the Northern Hemisphere.

II. Methods

For each season the ICAPS data base contained 401 salinity profiles; 160 in the Atlantic Ocean, 16 in the Mediterranean Sea, 152 in the Pacific Ocean, and 73 in the Indian Ocean. The raw data were received from NAVOCEANO on magnetic tape compatible with the NORDA Cyber computer.

It was decided to compare the salinity value at each standard depth with the corresponding salinity in every profile for each season within each ocean. A maximum allowable salinity difference was selected on the basis of the resulting sound speed difference. If the absolute difference between salinity values exceeded the maximum allowable, a counter was incremented. The analysis results consisted of an NxN symmetric matrix containing the counts of the number of times each salinity profile differed significantly from every other salinity profile for each season and ocean at each standard depth. The total number of standard depth differences detected for each profile was also calculated to aid in interpretation.

If the maximum allowable salinity difference was made too large than all profiles would appear similar. If the maximum allowable salinity difference was made too small then interpretation of the results become difficult. For the final analysis a maximum salinity difference of 2.25 ppt was used in all oceans. This difference resulted in an approximate sound speed difference of 3 m/sec under a constant temperature condition.

From the analysis outlined above, a "best" salinity profile was selected as being that profile which had the lowest difference count of all profiles. All salinity profiles differing from the "best" were examined against each other to determine if any of these could be considered similar. Finally, the frequency of occurrence of the selected ICAPS water masses (more than one water mass usually occupied an ICAPS area) were examined to insure that the salinity profiles selected to represent small areas were representative most of the time.

III. Results

A "best" salinity profile was selected in all oceans. For the North Atlantic Ocean, there were four salinity regimes which could not be described by the "best" profile; in the Mediterranean Sea and North Pacific Ocean there were three additional regimes; and in the North Indian Ocean there were two.

Because the differences in salinity at standard depths were small (0.7 ppt) across the seasons, and because of the desire to keep the size of the salinity library as small as possible, in a majority of instances a single salinity profile was chosen to represent the salinity field for all seasons. The annual salinity profile was the seasonal profile which best approximated (smallest absolute total difference at standard depth) the mean across season profile.

Table 1 lists the salinity values by season for the "best" representative profile for the North Atlantic Ocean. Table 2 through Table 5 lists the salinity values for those profiles differing significantly from the best. Table 6 lists the "best" salinity profile for the Mediterranean Sea; Tables 7 through 9 present the profiles which differed from the "best." Table 10 gives the salinity values for the "best" North Pacific Ocean profiles; Tables 11 through 13 give the salinity profiles which were unlike the "best." Table 14 lists the "best"

salinity profile for the North Indian Ocean; Table 15 and 16 present those which were different. In the tables, an asterisk is used to identify the seasonal profile which was chosen to represent all seasons.

In several instances, the ICAPS salinity profiles selected did not extend to 2000 meters. In these cases, the salinity values at those depths for which information was not available were estimated from neighboring ICAPS areas.

Suggestions for further improvement

The selection of representative salinity profiles was based on a rather large salinity (sound speed) difference of 2.25 ppt (≈ 3 m/sec). Reducing the allowable salinity difference would increase the size of the profile library to perhaps unmanageable proportions depending on the user's environment. The complete seasonal ICAPS salinity field library would require 3208 magnetic cards. This number could be halved if the standard depths at which salinity values are given were provided in the calculator program and not by the data card.

A better alternative to a complete magnetic card library would be to provide the user with a computer listing of the ICAPS salinity data base from which the user could select profiles in their area of interest. These profiles could then be transferred to a magnetic card, using a creation program, for utilization with the sound speed calculation program.

TABLE 1. NORTH ATLANTIC OCEAN

Library Profile Q, ICAPS Profile No. 108, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	34.86	34.68	34.39	34.71
10	34.85	34.68	34.46	34.71
20	34.86	34.72	34.57	34.72
30	34.86	34.76	34.67	34.73
50	34.86	34.82	34.83	34.76
75	34.86	34.86	34.90	34.81
100	34.85	34.88	34.92	34.84
125	34.84	34.88	34.92	34.87
150	34.84	34.88	34.92	34.89
175	34.84	34.88	34.89	34.88
200	34.85	34.89	34.89	34.86
250	34.86	34.89	34.88	34.86
300	34.88	34.90	34.89	34.88
350	34.88	34.90	34.90	34.90
400	34.88	34.91	34.91	34.90
450	34.89	34.91	34.92	34.90
500	34.91	34.91	34.91	34.91
550	34.91	34.91	34.91	34.91
600	34.91	34.91	34.91	34.91
650	34.90	34.90	34.91	34.90

TABLE 2. NORTH ATLANTIC OCEAN
Library Profile 1, ICAPS Profile No. 47, Seasonal Salinities

Depth (m)	Winter	Spring	Summer	Fall*
0	36.53	36.31	36.40	36.40
10	36.52	36.32	36.38	36.39
20	36.51	36.33	36.35	36.39
30	36.52	36.35	36.34	36.39
50	36.58	36.40	36.39	36.41
75	36.66	36.46	36.47	36.44
100	36.82	36.58	36.61	36.55
125	37.04	36.73	36.83	37.00
150	37.26	36.88	37.09	37.30
200	38.00	37.62	37.71	37.66
250	38.30	38.10	38.08	37.98
300	38.39	38.23	38.24	38.22
400	38.45	38.34	38.35	38.37
500	38.46	38.35	38.38	38.39
600	38.48	38.40	38.40	38.40
800	38.46	38.40	38.39	38.40
1000	38.37	38.40	38.39	38.39
1200	38.39	38.41	38.38	38.39
1500	38.39	38.41	38.39	38.40
2000	38.40	38.42	38.40	38.40

TABLE 3. NORTH ATLANTIC OCEAN

Library Profile 2, ICAPS Profile No. 67, Seasonal Salinities

Depth (m)	Winter	Spring	Summer*	Fall
0	32.03	32.33	31.75	32.00
10	32.07	32.39	31.91	32.04
20	32.13	32.46	32.20	32.10
30	32.20	32.55	32.41	32.18
50	32.35	32.81	32.73	32.41
75	32.64	33.27	32.94	32.77
100	33.00	33.61	33.26	33.27
125	33.50	33.94	33.56	33.76
150	33.88	34.23	33.89	34.15
200	34.55	34.75	34.56	34.54
250	34.63	34.78	34.67	34.61
300	34.71	34.80	34.70	34.68
400	34.80	34.85	34.75	34.78
500	34.83	34.86	34.80	34.83
600	34.85	34.81	34.85	34.85
800	34.87	34.81	34.87	34.87
1000	34.87	34.81	34.87	34.87
1200	34.88	34.82	34.88	34.88
1500	34.90	34.84	34.90	34.90
2000	34.93	34.87	34.93	34.93

TABLE 4. NORTH ATLANTIC OCEAN

Library Profile 3, ICAPS Profile No. 147, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	37.09	37.04	37.29	37.29
10	37.09	37.14	37.29	37.28
20	37.09	37.14	37.29	37.28
30	37.09	37.13	37.28	37.27
50	37.09	37.11	37.21	37.26
75	37.09	37.08	37.03	37.07
100	37.05	37.03	36.95	36.93
125	36.93	36.91	37.84	36.81
150	36.83	36.79	36.73	36.70
200	36.63	36.54	36.51	36.52
250	36.42	36.40	36.37	36.38
300	36.25	36.22	36.25	36.25
400	35.95	35.94	36.01	36.00
500	35.72	35.80	35.79	35.77
600	35.52	35.60	35.63	35.59
800	35.21	35.32	35.36	35.30
1000	35.09	35.15	35.22	35.17
1200	35.11	35.11	35.20	35.16
1500	35.10	35.12	35.15	35.13
2000	35.01	35.04	35.02	35.04

TABLE 5. NORTH ATLANTIC OCEAN

Library Profile 4, ICAPS Profile No. 156, Seasonal Salinities

Depth (m)	Winter	Spring	Summer	Fall
0	33.09	32.17	34.00	32.24
10	33.45	32.58	34.11	33.07
20	34.14	33.79	34.37	34.02
30	35.05	35.32	34.97	34.71
50	35.72	35.83	35.70	35.44
75	35.74	35.79	35.72	35.62
100	35.67	35.68	35.63	35.57
125	35.60	35.60	35.56	35.54
150	35.53	35.53	35.50	35.51
200	35.36	35.40	35.36	35.41
250	35.17	35.20	35.16	35.23
300	34.99	35.00	34.99	35.06
400	34.79	34.79	34.80	34.83
500	34.64	34.65	34.68	34.66
600	34.57	34.58	34.62	34.60
800	34.55	34.53	34.55	34.56
1000	34.65	34.64	34.60	34.65
1200	34.80	34.80	34.75	34.79
1500	34.93	34.92	34.92	34.92
2000	34.95	34.95	34.95	34.95

TABLE 6. MEDITERRANEAN SEA

Library Profile 0, ICAPS Profile No. 11, Seasonal Salinities

Depth (m)	Winter	Spring	Summer*	Fall
0	38.94	38.97	39.05	39.12
10	38.94	38.97	39.05	39.11
20	38.94	38.98	39.04	39.13
30	38.94	38.98	39.00	39.10
50	38.94	38.98	38.97	39.01
75	38.96	38.99	38.97	38.95
100	38.96	39.00	38.98	38.98
125	38.96	38.99	38.98	38.99
150	38.96	38.99	38.98	38.99
200	38.96	38.98	38.97	38.98
250	38.95	38.96	38.96	38.96
300	38.94	38.93	38.94	38.94
400	38.90	38.90	38.90	38.89
500	38.86	38.86	38.86	38.86
600	38.83	38.83	38.83	38.83
800	38.80	38.80	38.80	38.80
1000	38.79	38.78	38.79	38.81
1200	38.81	38.79	38.77	38.81
1500	38.81	38.78	38.72	38.82
2000	38.81	38.74	38.70	38.81

TABLE 7. MEDITERRANEAN SEA

Library Profile 1, ICAPS Profile No. 2, Seasonal Salinities

Depth (m)	Winter	Spring	Summer*	Fall
0	36.53	36.31	36.40	36.40
10	36.52	36.32	36.38	36.39
20	36.51	36.33	36.35	36.39
30	36.52	36.35	36.34	36.39
50	36.58	36.40	36.39	36.41
75	36.66	36.46	36.47	36.44
100	36.82	36.58	36.61	36.55
125	37.04	36.73	36.83	37.00
150	37.26	36.88	37.09	37.30
200	38.00	37.62	37.71	37.66
250	38.30	38.10	38.08	37.98
300	38.39	38.23	38.24	38.22
400	38.45	38.34	38.35	38.37
500	38.46	38.35	38.38	38.39
600	38.48	38.40	38.40	38.40
800	38.46	38.40	38.39	38.40
1000	38.37	38.40	38.39	38.39
1200	38.39	38.41	38.38	38.39
1500	38.39	38.41	38.39	38.40
2000	38.40	38.42	38.40	38.40

TABLE 8. MEDITERRANEAN SEA

Library Profile 2, ICAPS Profile No. 15, Seasonal Salinities

Depth (m)	Winter	Spring	Summer	Fall
0	22.00	23.00	21.26	26.16
10	26.00	27.00	22.14	26.44
20	30.00	31.00	28.63	30.94
30	34.00	35.00	37.24	35.82
50	38.40	38.45	38.45	38.53
75	38.55	38.50	38.54	38.56
100	38.55	38.55	38.55	38.57
125	38.55	38.55	38.55	38.57
150	38.54	38.54	38.55	38.57
200	38.54	38.53	38.54	38.56
250	38.53	38.52	38.53	38.54
300	38.53	38.52	38.52	38.54
400	38.52	38.52	38.52	38.53
500	38.52	38.52	38.52	38.53
600	38.52	38.52	38.51	38.52
800	38.51	38.52	38.53	38.53
1000	38.50	38.51	38.51	38.51
1200	38.49	38.49	38.49	38.50
1500	38.48	38.48	38.48	38.48
2000	38.45	38.45	38.45	38.45

TABLE 9. MEDITERRANEAN SEA

Library Profile 3, ICAPS Profile No. 16, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	18.26	17.97	17.87	17.95
10	18.30	18.08	18.00	18.08
20	18.32	18.19	18.13	18.13
30	18.39	18.27	18.23	18.21
50	18.66	18.49	18.46	18.53
75	19.30	19.13	19.28	19.37
100	19.98	19.80	20.02	20.09
125	20.44	20.35	20.57	20.58
150	20.78	20.71	20.93	20.89
200	21.24	21.21	21.34	21.28
250	21.47	21.47	21.56	21.48
300	21.63	21.65	21.71	21.61
400	21.85	21.86	21.90	21.83
500	21.96	22.00	22.03	21.98
600	21.85	22.07	22.13	21.95
800	21.98	22.20	22.23	22.08
1000	22.23	22.30	22.26	22.12
1200	22.23	22.36	22.30	22.13
1500	22.36	22.35	22.31	22.30
2000	22.33	22.34	22.34	22.34

TABLE 10. NORTH PACIFIC OCEAN

Library Profile 0, ICAPS Profile No. 68, Seasonal Salinities

Depth (m)	Winter*	Spring	Summer	Fall
0	34.23	33.97	33.83	34.03
10	34.10	33.97	33.96	34.01
20	34.10	33.98	34.03	34.00
30	34.10	33.99	34.09	34.03
50	34.11	34.01	34.20	34.11
75	34.12	34.06	34.23	34.15
100	34.12	34.08	34.22	34.21
125	34.12	34.08	34.17	34.16
150	34.12	34.07	34.13	34.13
200	34.07	34.05	34.06	34.08
250	34.04	34.04	34.04	34.04
300	34.04	34.04	34.03	34.01
400	34.03	34.05	34.04	34.00
500	34.04	34.07	34.05	34.00
600	34.05	34.06	34.09	34.05
800	34.07	34.04	34.10	34.10
1000	34.09	34.04	34.10	34.10
1200	34.10	34.05	34.10	34.10
1500	34.09	34.06	34.09	34.08
2000	34.08	34.08	34.08	34.08

TABLE 11. NORTH PACIFIC OCEAN

Library Profile 1, ICAPS Profile No. 14, Seasonal Salinities

Depth (m)	Winter	Spring	Summer	Fall*
0	32.48	32.24	32.14	32.36
10	32.49	32.28	32.20	32.36
20	32.51	32.41	32.39	32.39
30	32.53	32.49	32.52	32.44
50	32.58	32.59	32.68	32.65
75	32.82	32.82	32.86	32.94
100	33.21	33.19	33.12	33.23
125	33.52	33.50	33.41	33.48
150	33.72	33.71	33.64	33.68
200	33.89	33.89	33.87	33.88
250	33.94	33.94	33.93	33.93
300	33.97	33.97	33.96	33.96
400	34.03	34.03	34.03	34.02
500	34.10	34.11	34.10	34.09
600	34.18	34.18	34.18	34.17
800	34.30	34.31	34.30	34.30
1000	34.39	34.40	34.39	34.39
1200	34.45	34.45	34.45	34.45
1500	34.52	34.52	34.51	34.52
2000	34.59	34.59	34.59	34.59

TABLE 12. NORTH PACIFIC OCEAN

Library Profile 2, ICAPS Profile No. 99, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	33.06	32.78	32.50	32.33
10	33.04	32.79	32.55	32.33
20	33.05	32.84	32.68	32.37
30	33.07	32.89	32.79	32.58
50	33.10	32.98	32.92	32.84
75	33.14	33.04	33.02	32.99
100	33.17	33.13	33.10	33.08
125	33.25	33.22	33.19	33.19
150		33.29	33.26	33.26
200	33.50	33.38	33.35	33.35
250	33.60	33.45	33.41	33.40
300	33.65	33.51	33.47	33.46
400	33.66	33.63	33.59	33.59
500	33.70	33.75	33.74	33.71
600	33.85	33.90	33.94	33.89
800	34.15	34.14	34.21	34.14
1000	34.30	34.32	34.35	34.32
1200	34.42	34.44	34.43	34.44
1500	34.50	34.50		
2000		34.54		

TABLE 13. NORTH PACIFIC OCEAN

Library Profile 3, ICAPS Profile No. 104, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	32.18	32.00	31.96	31.88
10	32.19	32.04	32.01	31.92
20	32.22	32.11	32.12	31.99
30	32.25	32.18	32.24	32.08
50	32.33	32.31	32.45	32.32
75	32.50	32.51	32.66	32.62
100	32.82	32.81	32.90	32.93
125	33.16	33.13	33.22	33.23
150	33.39	33.37	33.49	33.46
200	33.63	33.62	33.74	33.69
250	33.74	33.73	33.82	33.79
300	33.81	33.81	33.88	33.84
400	33.97	33.96	33.98	33.95
500	34.07	34.06	34.07	34.05
600	34.16	34.16	34.14	34.14
800	34.28	34.29	34.27	34.28
1000	34.36	34.37	34.34	34.37
1200	34.43	34.43	34.40	34.44
1500	34.51	34.51	34.50	34.52
2000	34.59	34.58	34.58	34.57

TABLE 14. NORTH INDIAN OCEAN

Library Profile 0, ICAPS Profile No. 13, Seasonal Salinities

Depth (m)	Winter	Spring	Summer*	Fall
0	34.41	34.43	34.43	34.41
10	34.40	34.43	34.43	34.40
20	34.48	34.43	34.43	34.48
30	34.63	34.46	34.46	34.63
50	34.82	34.65	34.65	34.82
75	35.10	34.91	34.91	35.10
100	35.12	35.09	35.09	35.12
125	35.04	35.14	35.14	35.04
150	35.01	35.13	35.13	35.01
200	35.03	35.07	35.07	35.03
250	35.08	35.06	35.06	35.08
300	35.08	35.05	35.05	35.08
400	35.06	35.03	35.03	35.06
500	35.05	35.02	35.02	35.05
600	35.03	35.01	35.01	35.03
800	34.99	34.98	34.98	34.99
1000	34.94	34.93	34.93	34.94
1200	34.90	34.89	34.89	34.90
1500	34.85	34.84	34.84	34.85
2000	34.78	34.77	34.77	34.78

TABLE 15. NORTH INDIAN OCEAN

Library Profile 1, ICAPS Profile No. 1, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	39.02	38.76	38.76	39.02
10	39.01	38.76	38.76	39.01
20	39.02	38.83	38.83	39.02
30	39.08	38.89	38.89	39.08
50	39.21	39.01	39.01	39.21
75	39.54	39.48	39.48	39.54
100	39.98	40.03	40.03	39.98
125	40.22	40.29	40.29	40.22
150	40.35	40.42	40.42	40.35
200	40.45	40.50	40.50	40.45
250	40.49	40.54	40.54	40.49
300	40.51	40.57	40.57	40.51
400	40.54	40.58	40.58	40.54
500	40.56	40.61	40.61	40.56
600	40.56	40.61	40.61	40.56
800	40.57	40.63	40.63	40.57
1000	40.58	40.65	40.65	40.58
1200	40.60	40.63	40.63	40.60
1500	40.60	40.65	40.65	40.60
2000	40.70	40.66	40.66	40.70

TABLE 16. NORTH INDIAN OCEAN

Library Profile 2, ICAPS Profile No. 23, Seasonal Salinities

Depth (m)	Winter	Spring*	Summer	Fall
0	36.25	36.51	36.51	36.25
10	36.22	36.46	36.46	36.22
20	36.20	36.32	36.32	36.20
30	36.22	36.24	36.24	36.22
50	36.18	36.06	36.06	36.18
75	36.10	35.97	35.97	36.10
100	35.80	35.91	35.91	35.80
125	35.75	35.90	35.90	35.75
150	35.70	35.89	35.89	35.70
200	35.67	35.87	35.87	35.67
250	35.80	36.19	36.19	35.80
300	36.05	36.54	36.54	36.05
400	36.35	37.07	37.07	36.35
500	36.61	37.12	37.12	36.61
600	36.93	37.18	37.18	36.93
800	37.22	37.25	37.25	37.22
1000	37.35	37.45	37.45	37.35
1200	37.34	37.51	37.51	37.34
1500	37.30	37.50	37.50	37.30
2000		37.25		

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This technical note documents a program written specifically for the HP-41CV calculator to convert a bathythermograph profile to a sound speed profile. The format of the report follows the guidelines set forth by the Navy Tactical Support Activity, Fleet Mission Program Library. The program documented herein differs from existing calculator programs used for a similar purpose (Kerr, 1983) in that an archival salinity profile library is included with the program.		

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Magnetic card copies of the program and salinity profile library may be obtained from the Naval Oceanographic Office, Code 9200.

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