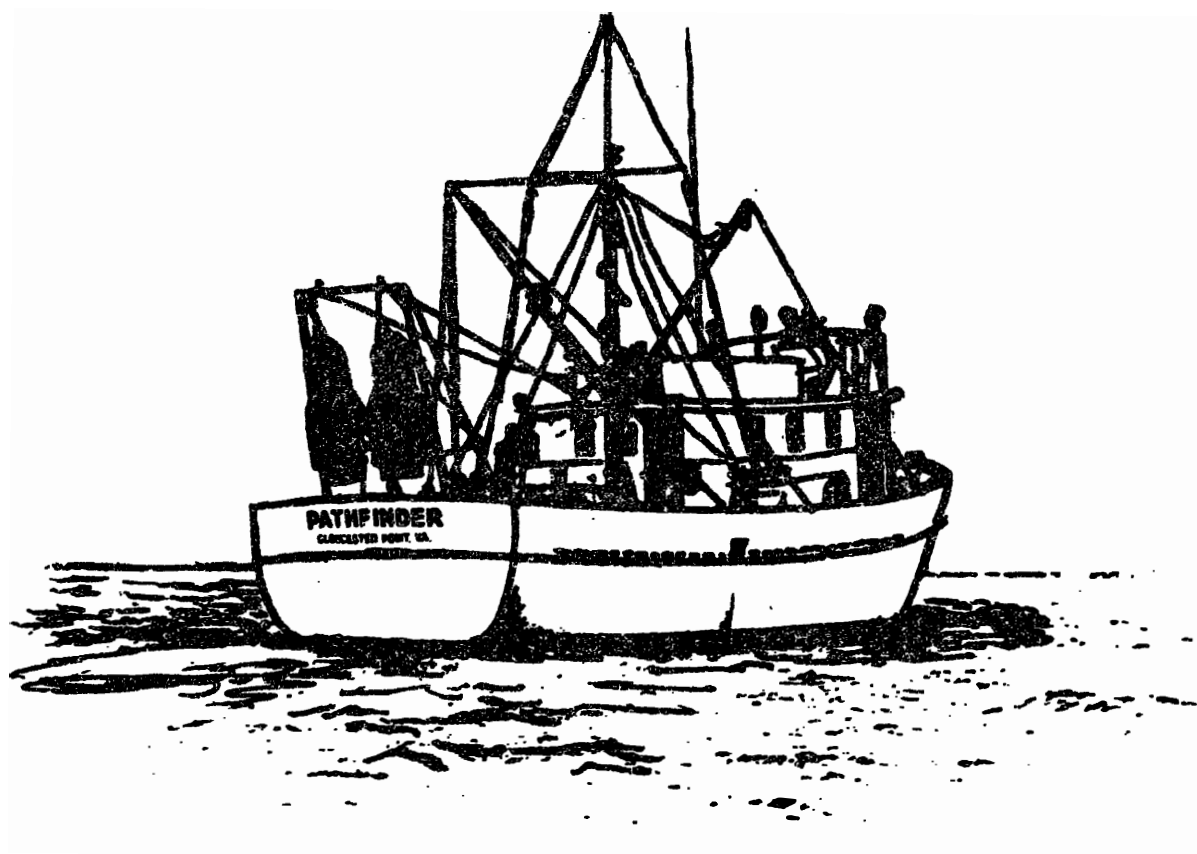


**DATA ON COASTAL CURRENTS  
OFF CHESAPEAKE BAY**



**Virginia Institute of Marine Science  
Special Scientific Report No. 31**

**1962**

DATA ON THE COASTAL CURRENTS OFF  
CHESAPEAKE BAY

This report summarizes all the information to date concerning the recovery of drift devices (surface and bottom drift bottles and plastic bottom drifters) released on Atlantic plankton cruises of the R/V Pathfinder. These data have originated from a series of cruises in lower Chesapeake Bay and adjacent waters of the Atlantic Ocean conducted by the Department of Ichthyology of the Virginia Institute of Marine Science. This Institute is grateful for the cooperation extended by Mr. Dean Bumpus, Oceanographer, Woods Hole Oceanographic Institution.

The survey program began in December 1959. Since that time monthly cruises have been made, except in October 1960 and January and February 1961 (for cruise dates see Table 1). Information is being sought on the distribution of pelagic fish eggs and larvae as well as on the nature of the coastal hydrography. It is hoped that in time we will be able to assess the role of coastal currents in the distribution of plankton. Joseph et al. (1960) have presented a description of the study area and a discussion of the coastal hydrography and (1961) have summarized hydrographic information obtained during the first year.

The station pattern (Fig. 1) for the period December 1959 - December 1960 consisted of 3 stations in lower Chesapeake Bay and 22 stations in the Atlantic. Station designations and locations are presented in Table 2.

With few exceptions, drift devices were released on each station on all cruises. The pattern of releases for the period December 1959 - December 1960 is given in Table 3; data on returns for the same period are presented in Table 4. A straight-line plot is indicated for each bottle under the heading "Recovery" and is given in miles and degrees bearing from release to point of stranding. This does not imply that any particular bottle traversed the trajectory indicated by the bearing.

The return rate of surface drift bottles by stations varied considerably (Table 5). In general, the return rate by station progressively decreased with increased distance from shore. A summary of the releases and returns by month is presented in Table 6. The predominant direction between release and return is given. The estimated minimum drift speed given in nautical miles per day for each month represents the highest ratio of miles traveled (straight-line plot) to days adrift for one or more bottles. The duration and areal extent of computed surface current velocities is not known. Although the percent return of bottom drift bottles is comparable to that of surface bottles, the great elapsed time between release and recovery of bottom drift bottles precludes any reasonable estimates of drift direction and speed. Seasonal differences in the rate of surface bottle returns are shown in Table 7.

A general pattern of surface circulation deduced from drift bottle recoveries for the first year of the survey is shown

in Fig. 1. A departure from this pattern was noted for July 1960 and the circulation for this month is shown in Fig. 2.

Beginning in March 1961, stations south of the 37°00' and north of the 37°20' N parallel were dropped from the ocean cruise pattern. The course then became rectangular with stations located 10 miles apart on parallels 37°00' and 37°20' N and extending to a distance of 60 miles offshore. Under favorable weather and sea conditions, alternate stations extended the distance to 80 miles. Two onshore stations, north of the Bay mouth (710 I and 710 II) were retained. The system of station designation, outlined by Joseph (op. cit.) was retained. Station designations and locations are given in Table 8 and in Fig. 3.

During the second year of the cruises the Woodhead Sea Bed Drifter was used. This device, designed to be transported by bottom currents, consists of a thin yellow, saucer-shaped, plastic disc. A red plastic stem trails from the center of the concave surface. Weight provided by a brass ferrule crimped near the distal end of the stem makes the specific gravity of the device slightly greater than sea water. Sea bed drifters are released in bundles of five held together by a salt ring. Added weight of the salt quickly carries the packet to the bottom where rapid dissolution of the ring releases the drifters.

The release pattern for the period March 1961 - January 1962 is given in Table 9, and data on the reported findings are given in Table 10. The release and return of drift bottles

Fig. 1. General pattern of surface circulation.

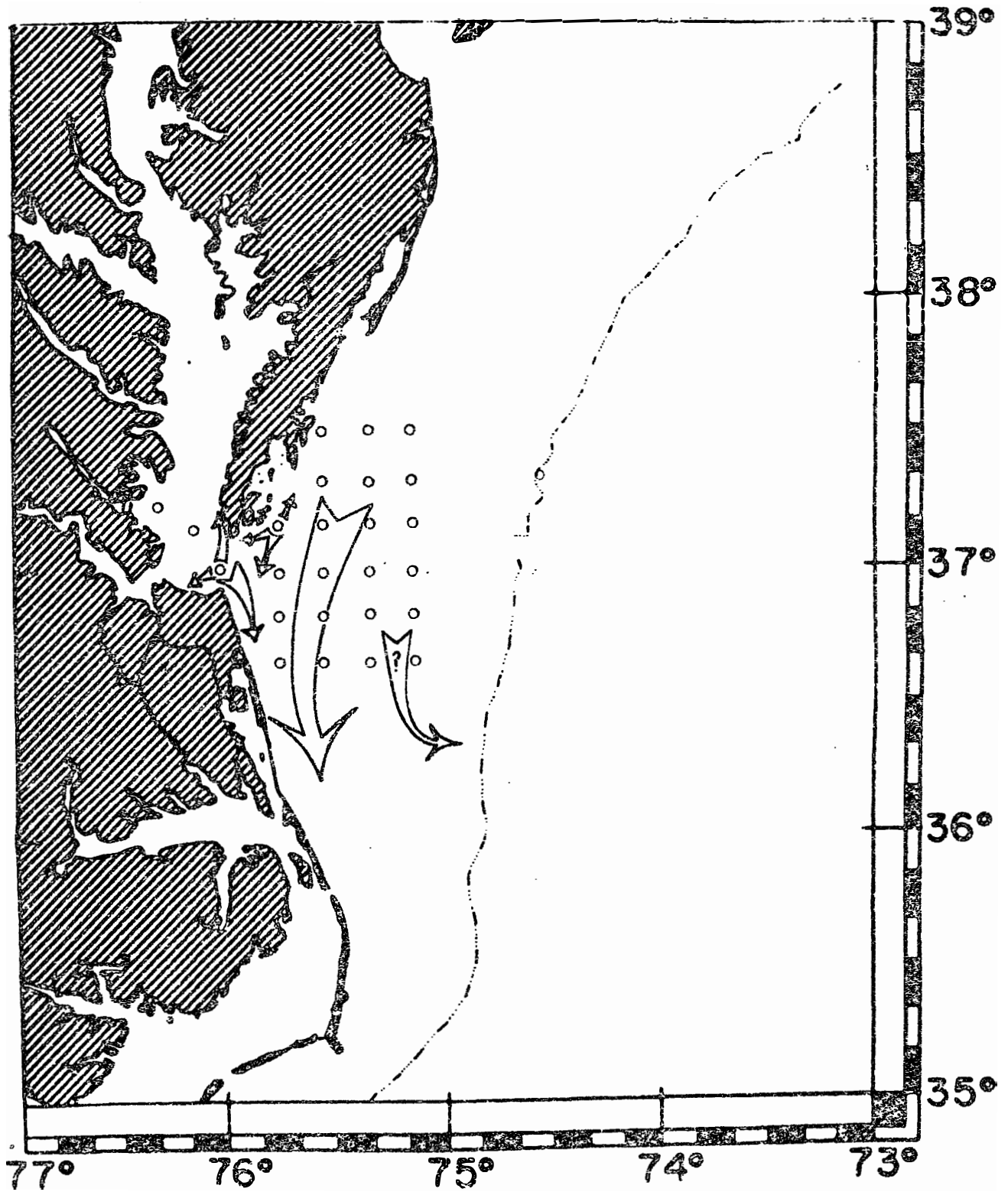
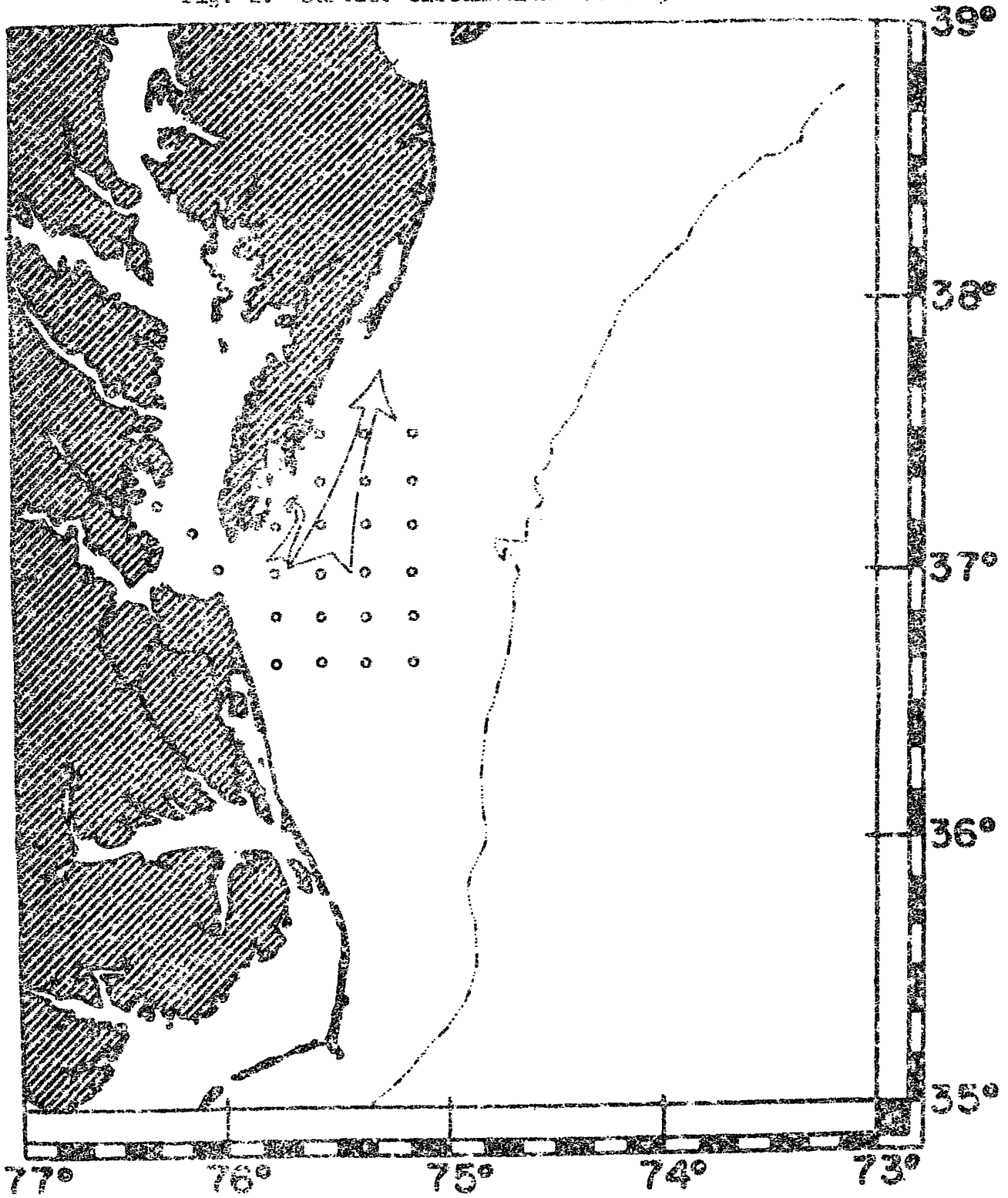


Fig. 2. Surface circulation for July 1966.



and sea bed drifters by station is presented in Table 11. It is noteworthy that no returns resulted from releases of surface drift bottles or sea bed drifters made beyond the IV line. A summary of releases and recoveries for the period is given in Table 12.

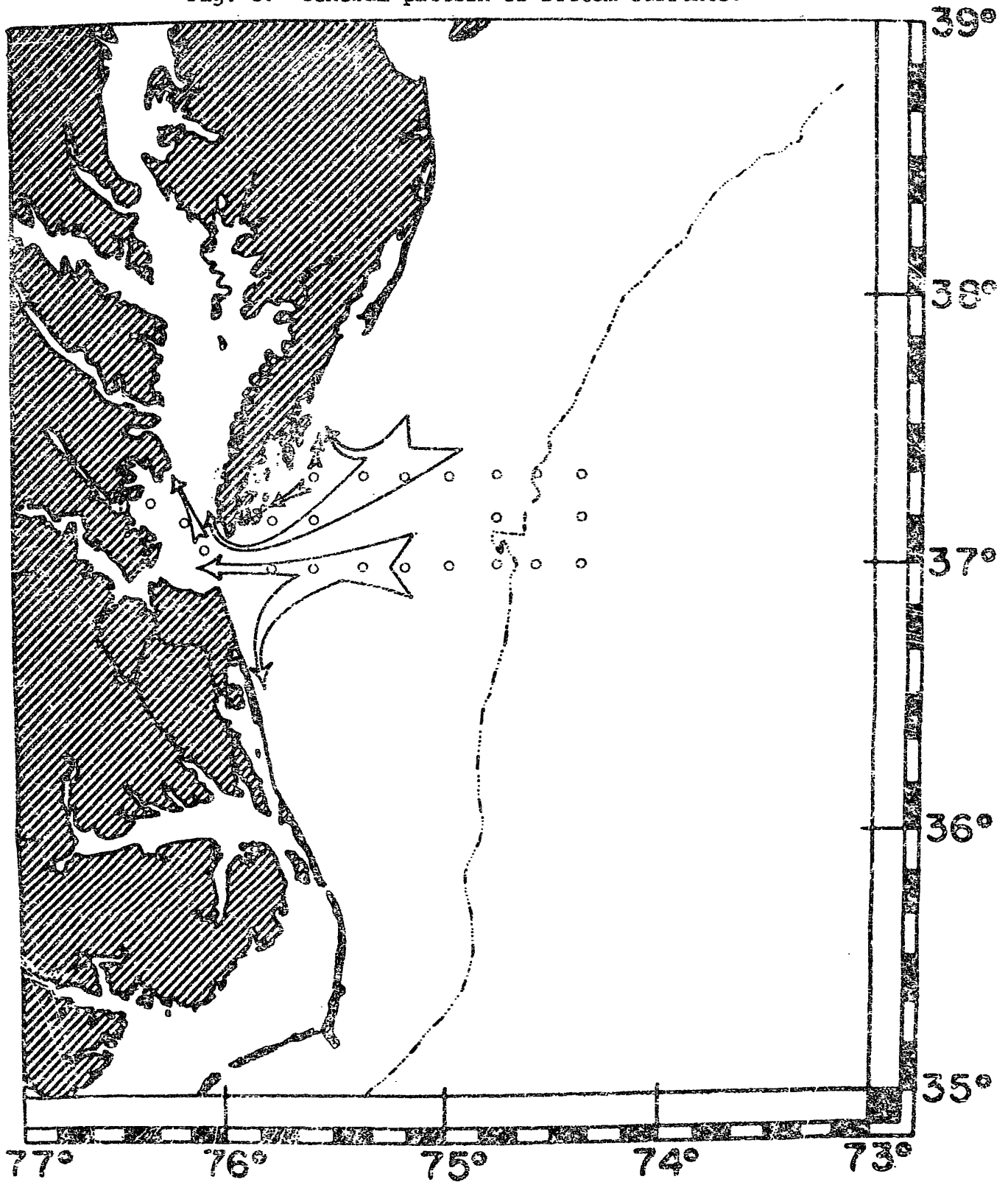
The surface circulation indicated by returns of releases from March 1961 - December 1961 was essentially the same as that prevailing for the preceding year. However, there was no evidence of a northerly drift for any one month, as was the case for July 1960. By eliminating bottle releases made beyond the IV line in the computation of return rates, a comparison of the return rates for the two periods may be made. Rates of return varied between months of different years and between months of the same year but there was no pronounced difference between rates of the two years.

The high return rate of the sea bed drifter permits a tentative evaluation of the bottom currents. The pattern of bottom circulation for the period July 1961 - December 1961 is presented in Fig. 3. Releases made at CB-0 demonstrated the salt wedge system. It is also apparent that the estuarine circulation of Chesapeake Bay influences to some degree the bottom circulation of adjacent ocean waters.

The sea bed drifter offers great promise as a tool for indirect measurement of bottom currents. As may be seen from Table 14 the return rate of the sea bed drifter is about 30 percent, exceeding the return of surface bottles threefold.

The study of ocean circulation in the area off

Fig. 3. General pattern of bottom currents.



Chesapeake Bay through use of drift devices has proved to be a short-term experiment. Data on elapsed time from release to stranding for the two years' study are presented in Table 15. It may be seen that approximately 90 percent of the surface bottle recoveries may be expected within 90 days.

The elapsed time between release and stranding for the sea bed drifters is slightly higher as might be expected. The distribution of bottom returns through time is shown in Table 16. The superiority of the Woodhead Sea Bed Drifter over the bottom drift bottle is clearly demonstrated.

#### LITERATURE CITED

- Joseph, E. B., W. H. Massmann and J. J. Norcross. 1960. Investigations of inner continental shelf waters off lower Chesapeake Bay. Part I - General introduction and hydrography. Ches. Sci. 1(3-4):155-63.
- Joseph, E. B., W. H. Massmann and J. J. Norcross. 1961. Hydrographic data from the Atlantic Cruises for the R/V Pathfinder, December 1959 - December 1960. Va. Fish. Lab. Spec. Sci. Rept. No. 18.

Distribution of this report does not constitute formal publication. The data are subject to revision and interpretation.

J. J. Norcross  
W. H. Massmann  
E. B. Joseph

Table 1. Dates of Atlantic plankton cruises.

Cruise designation	Inclusive dates
Pathfinder-1	December 7-10, 1959
Pathfinder-2	January 12-25, 1960
Pathfinder-3	February 15-17, 1960
Pathfinder-4	March 14-18, 1960
Pathfinder-5	April 11-13, 1960
Pathfinder-6	May 16-18, 1960
Pathfinder-7	June 20-23, 1960
Pathfinder-8	July 19-22, 1960
Pathfinder-9	August 15-19, 29-30, 1960
Pathfinder-10	September 19-24, 1960
Irma Virginia	November 16-18, 1960
Pathfinder-11	December 14-19, 1960
Pathfinder-12	March 13-18, 1961
Pathfinder-13	April 11-17, 1961
Pathfinder-14	May 15-19, 1961
Pathfinder-15	June 12-13, 1961
Pathfinder-16	July 11-13, 1961
Pathfinder-17	August 14-19, 1961
Pathfinder-18	September 11-13, 1961
Pathfinder-19	October 16-17, 24-25, 1961
Pathfinder-20	November 13-14, 1961
Pathfinder-21	December 11-12, 1961
Pathfinder-22	January 22-25, 1962

Table 1 continued.

Cruise designation

Inclusive dates

Pathfinder-23

February 20-22, 1962

Pathfinder-24

March 19-20, 1962

Table 2. Locations of stations occupied

December 1959 - December 1960.

Station Designation	N.	Location		Depth in feet
		Lat.	W. Long.	
CB-0	37	01	76 03	50
CB-10	37	08	76 11	40
CB-20	37	15	76 22	60
640 I	36	40	75 47	66
640 II	36	40	75 35	60
640 III	36	40	75 22	66
640 IV	36	40	75 10	120
650 I	36	50	75 47	56
650 II	36	50	75 35	48
650 III	36	50	75 22	72
650 IV	36	50	75 10	72
700 I	37	00	75 47	48
700 II	37	00	75 35	64
700 III	37	00	75 22	96
700 IV	37	00	75 10	114
710 I	37	10	75 47	20
710 II	37	10	75 35	54
710 III	37	10	75 22	84
710 IV	37	10	75 10	102
720 II	37	20	75 35	42
720 III	37	20	75 22	82
720 IV	37	20	75 10	82
730 II	37	30	75 35	36
730 III	37	30	75 22	82
730 IV	37	30	75 10	96

Table 3. Drift bottle releases for first year of Atlantic plankton cruises.

Station	1959 Dec. S-B	1960 Jan. S-B	1960 Feb. S-B	1960 March S- B	1960 April S- B	1960 May S-B	1960 June S- B	1960 July S- B	1960 Aug. S-B	1960 Sept. S-B	1960 Nov. S-B	1960 Dec. S-B
CB-0	6-0	6-0	6-0	6- 6	6- 0	6-0	6- 6	6- 6	6-0	6-0	6-0	6-0
CB-10	0-0	0-0	0-0	0- 6	0- 0	0-0	0- 6	6- 6	0-0	0-0	0-0	0-0
CB-20	0-0	0-0	0-0	0- 6	0- 0	0-0	0- 6	0- 0	0-0	0-0	0-0	0-0
640 I	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
640 II	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
640 III	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
640 IV	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
650 I	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
650 II	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
650 III	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
650 IV	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
700 I	6-0	6-0	6-0	6- 6	6- 6	6-0	6- 6	6- 6	6-0	6-0	6-0	6-0
700 II	6-0	6-0	6-0	6- 6	6- 6	6-0	6- 6	6- 6	6-0	6-0	6-0	6-0
700 III	6-0	6-0	6-0	6- 6	6- 6	6-0	6- 6	6- 6	6-0	6-0	6-0	6-0
700 IV	6-0	6-0	6-0	6- 6	6- 0	6-0	6- 6	6- 6	6-0	6-0	6-0	6-0
710 I	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
710 II	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	0-0
710 III	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
710 IV	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
720 II	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
720 III	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
720 IV	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	12-0	6-0	6-0	6-0
730 II	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
730 III	6-0	6-0	6-0	6- 0	6- 0	6-0	6- 0	6- 0	6-0	6-0	6-0	6-0
730 IV	<u>6-0</u>	<u>6-0</u>	<u>6-0</u>	<u>6- 0</u>	<u>6- 0</u>	<u>6-0</u>	<u>6- 0</u>	<u>6- 0</u>	<u>6-0</u>	<u>6-0</u>	<u>6-0</u>	<u>6-0</u>
Total	138-0	138-0	138-0	138-42	138-18	138-0	138-42	138-36	144-0	138-0	138-0	132-0

Table 4. Drift bottle returns for releases made  
December 1959 - December 1960.

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
December 1959					
730 II	35 20	75 30	131	184°	17
700 I	37 22.5	75 45	22.5	009°	8
January 1960					
700 III	36 36	75 53	34.5	202°	224
700 III	36 36	75 53	34.5	202°	224
700 III	36 01	75 39.6	62.0	193°	27
700 III	36 08	75 43.6	55.5	198°	7
700 IV	36 20.6	75 48.9	51.0	210°	63
710 I	36 36	75 53	35.0	187°	13
710 I	36 43.5	75 56	28.5	195°	139
710 I	36 50.5	75 58	22.25	204°	7
710 I	36 37	75 53	34.00	188°	62
710 II	36 10.5	75 45	61.00	188°	17
710 II	36 00	75 38.7	70.00	182°	11
720 II	36 06	75 42.7	77.50	190°	11
720 II	36 04	75 41.4	77.00	183°	13
720 II	36 10.5	75 45	70.5	187°	19
720 II	36 04	75 41.4	77.0	183°	13
730 II	36 13.4	75 46	78.0	180°	14
730 II	36 14.5	75 46.5	78.0	180°	14
730 II	36 13.4	75 46	78.0	180°	14
February 1960					
CB-0	37 09	75 58.5	9.0	024°	21
CB-0	37 25	75 59	25.0	010°	90
CB-0	37 21	76 00	20.5	022°	12
CB-0	37 21	76 00	20.5	022°	5
CB-0	37 20	76 00.8	19.25	022°	7
March 1960					
CB-0	36 51.2	75 58.5	10.5	South <sup>2</sup>	6
CB-0	36 53	75 59	8.25	South	3
CB-0	36 52	75 58.8	9.5	South	2
CB-0	36 55.5	76 00	6.25	South	3
CB-0 <sup>1</sup>	37 15	76 08	14.5	346°	336
CB-0 <sup>1</sup>	37 15	76 08	14.3	344°	336
CB-10 <sup>1</sup>	37 09	76 12	.5	270°	0
CB-10 <sup>1</sup>	36 44	75 56	27.25	South Capes	556
CB-10 <sup>1</sup>	37 09	76 12	.5	270°	0
CB-10 <sup>1</sup>	37 12	76 14	6.0	338°	3
CB-10 <sup>1</sup>	37 11.6	76 16.3	5.5	309°	11

<sup>1</sup> Bottom drift bottles.

<sup>2</sup> Nominal bearings are indicated where straight-line plots pass over land.

Table 4. continued.

- 2 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
March 1960 (continued)					
640 I	36 16.6	75 52.5	23.5	180°	132
640 I	36 10.6	75 44.8	29.5	178°	19
640 I	36 28.5	75 51	12.0	196°	89
640 I	36 15	75 46.8	25.0	182°	111
650 I	36 42	75 55.5	10.5	220°	1
650 I	36 42.5	75 55.6	10.5	222°	?
650 I	36 41.7	75 55.3	10.75	219°	8
650 I	36 42.5	75 55.7	11.00	227°	1
650 I	36 42	75 56	10.25	222°	18
710 I	37 08	75 58.3	10.5	C. B.	2
710 I	37 08	75 58.3	10.5	C. B.	2
April 1960					
CB-0	37 10	75 59	10	020°	4
CB-0	36 13.4	75 46	50	South	23
CB-0	37 13.4	75 59.7	50	South	11
700 I*	37 13	76 06	18	C. B.	305
May 1960					
640 I	36 04	75 41.3	36.5	172°	3
640 I	36 05	75 42	34.5	176°	3
650 I	36 27	75 50.5	23.5	187°	3
650 I	36 26.5	75 50.4	24.5	188°	?
650 II	35 57	75 37	54.5	182°	4
710 I	37 10.6	75 49.5	3.0	280°	11
710 II	36 42	75 55.5	33.3	214°	15
720 II	37 10	75 59	33.75	C. B.	26
720 II	37 09.5	75 52	14.50	265°	32
720 III	37 10.6	75 49.5	23.5	247°	11
720 III	37 09	75 51.5	26.0	245°	12
720 IV	36 50.6	75 58.4	49.25	233°	26
720 IV	36 30	75 51	60.00	213°	85
720 IV	36 51	75 58.5	48.75	233°	25
730 II	37 06	75 59.5	31.00	217°	21
730 III	37 09	75 51.5	31.00	230°	12
730 III	37 10.6	75 49.5	29.25	229°	11
730 III	37 10.6	75 49.5	29.25	229°	11

\* Bottom drift bottles.

Table 4. continued.

- 3 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
May 1960 (continued)					
730 III	36 03	75 41	90.00	190°	129
June 1960					
CB-0	37 21	75 59.8	21	000°	24
CB-0	37 05	75 58	5.5	047°	38
CB-0	37 17	76 02	16.25	006°	4
CB-0	37 05	75 58	5.5	047°	134
CB-0*	37 07.3	76 09	8.25	324°	207
CB-0*	37 07	75 54	9.25	052°	316
CB-0*	37 02	76 09	5.00	275°	170
CB-0*	37 01	76 14	8.75	270°	168
640 I	36 18.5	75 48.2	21.25	184°	16
640 I	36 23	76 49.4	17.50	188°	5
640 I	36 24.5	75 49.7	15.50	188°	37
640 I	36 25	75 50	15.50	188°	5
640 II	39 24	74 22.3	170.00	019°	91
640 III	35 51	75 34	50.50	191°	457
640 IV	39 12	74 39.5	152.00	007°	157
650 I	36 36.8	75 53	14.75	199°	19
650 I	36 36	75 52.8	14.25	199°	1
650 I	36 37.3	75 53.2	13.50	201°	1
650 II	38 58	74 50	132.5	015°	294
730 II	36 01	75 39	90.0	182°	106
730 IV	36 01	75 39.3	93.5	195°	95
July 1960					
CB-0	37 51.7	75 21.4	61	North	12
CB-0*	37 09	76 40	35.5	Up James	176
650 II	37 05.7	75 58.8	24.75	307°	29
700 I	37 07	75 58.2	11.50	308°	16
700 II	37 51.7	75 21.4	53.0	011°	17
700 II	37 51	75 28	51.5	006°	97
700 II	37 55	75 22.5	56.0	010°	11
700 II	38 19	75 05.7	82.25	016°	11
710 I	37 18.1	75 46.3	8.00	005°	23
710 I	36 54.4	76 05.5	22.50	228°	28
710 I	37 07	75 56	8.00	244°	17

\* Bottom drift bottles.

Table 4. continued

- 4 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
July 1960 (continued)					
710 II	36 51.5	75 58.6	27.00	225°	15
710 III	35 44.5	75 30	87.00	184°	66
720 II	38 16.5	75 05	61.00	021°	37
720 III	35 44.5	75 30	97.00	184°	67
730 II	37 41	75 35	11.00	355°	128
730 II	37 55	75 24	27.00	018°	14
730 III	38 13	75 08.5	45.00	014°	70
730 III	38 20	75 05	52.75	015°	26
730 III	37 51	75 28	21.50	347°	63
730 IV	38 03	75 13.5	33.50	355°	65
August 1960					
CB-0	36 01	75 39	64.00	South	3
CB-0	35 55	75 35	71.25	South	4
CB-0	35 53	75 35	73.00	South	3
640 I	36 06	75 42.5	34.25	175°	1
640 I	36 13	75 46	27.25	179°	2
640 I	35 53	75 35	49.00	169°	2
640 II	35 41	75 29	58.50	178°	103
640 II	35 12	75 44.7	102.5	185°	4
650 I	35 56.9	75 37	55.0	172°	2
650 I	35 55	75 36	57.0	172°	2
650 I	35 53	75 35	59.0	172°	2
650 I	35 55	75 36	57.0	172°	2
700 I	36 01	75 39.3	59.5	175°	27
700 I	36 04	75 41.4	57.0	176°	26
700 I	36 00	75 38	61.0	174°	27
700 I	35 49	75 32.5	72.75	172°	26
700 II	35 48	75 35.8	72.5	181°	31
700 II	36 06	75 42.5	54.75	187°	26
700 II	35 54	75 35	66.00	180°	25
710 I	37 54	75 20	48.75	027°	45
710 I	37 34	75 33	25.50	019°	45
710 II	35 46	75 31	34.75	178°	79
710 II	36 13.5	75 46	58.00	189°	26
710 II	35 25	75 29	103.50	178°	29
720 II	36 02	75 40	78.50	183°	25
720 II	36 55.5	76 00	32.00	219°	70
720 II	35 48	75 32	92.50	179°	28
720 II	36 00	75 38.7	81.25	182°	28
720 III	35 15.7	75 31	126.00	183°	35
720 IV	35 37.5	75 27.2	105.50	188°	73
720 IV	36 46.7	75 31.6	48.0	204°	25

Table 4. continued.

- 5 -

Point of Release	Recovery Location				Recovery		Days Adrift
	N. Lat.		W. Long.		Miles	Bearing	
August 1960 (continued)							
720 IV	35	55	75	35.5	88.5	194°	24
730 II	36	02	25	40	89.0	183°	40
730 III	37	45	75	32.5	17.25	332°	37
730 IV	36	45	75	10	54.25	180°	32
730 IV	35	23.3	75	29.3	128.75	187°	39
September 1960							
CB-0	36	45	75	56.5	16.75	South	6
CB-0	36	55.8	76	10.6	9.00	225°	14
CB-0	34	54.5	76	05.4	152.50	South	6
CB-0	36	50	75	58.2	10.50	South	9
640 I	35	47	75	02.5	55.00	168°	5
640 I	35	49	75	33	53.25	168°	6
640 I	35	03	76	02	121.5	188°	25
640 I	35	53	75	35	48.5	169°	2
640 I	35	49	75	35	52.5	169°	4
640 III	35	23	75	29.4	78.0	135°	8
650 I	36	04	75	41.4	47.5	176°	5
650 I	36	01	75	39.3	50.5	174°	10
650 I	36	02	75	40	49.75	174°	7
650 I	36	04	75	41.5	47.50	175°	5
650 I	35	52	75	34	60.00	171°	12
650 I	35	42	75	29	71.00	169°	11
650 II	35	42	75	29	69.75	177°	11
700 I	36	30	75	51.5	30.00	138°	4
700 I	36	22.5	75	49.4	38.00	183°	4
700 I	36	26.5	75	50.3	33.75	185°	4
700 I	36	27	75	50.5	33.25	186°	4
700 I	36	28	75	50.8	32.5	186°	4
700 II	36	01.5	75	39.5	59.0	184°	5
700 II	36	02	75	40	58.0	185°	4
700 II	36	05	75	42	55.5	187°	6
700 II	35	48	75	32.5	72.0	179°	27
700 II	35	55	75	36	65.0	182°	8
700 III	35	57	75	37	65.0	190°	5
700 III	35	56.7	75	36.8	71.0	189°	4
700 III	35	16	75	31	105	183°	16
710 I	36	42	75	55	30	194	29
710 III	35	49	75	33	83	187°	5
710 III	35	55	75	36	77	187°	5
710 III	35	56.2	75	36.7	76	188°	5
710 IV	35	23	75	29.4	120	187°	7
710 IV	35	34	75	27.7	98.5	188°	10

Table 4. continued

- 6 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long	Miles	Bearing	
September 1960 (continued)					
710 IV	35 42.3	75 32	90.0	191°	5
720 IV	35 12.5	75 41.5	142.0	191°	26
730 IV	35 58	75 37.5	96.5	194°	27
November 1960					
CB-0	37 07	75 58	7.5	034°	397
December 1960					
CB-0	37 06	75 58.8	6.0	041°	9

Table 5. Release and return of surface drift bottles by stations,  
December 1959 - December 1960

Station	Number Released	Number Returns	Percent Returns
CB-0	72	26	36.1
640 I	72	18	25.0
640 II	72	3	4.2
640 III	72	2	2.8
640 IV	72	1	1.4
650 I	72	20	27.8
650 II	72	4	5.5
650 III	72	0	0.0
650 IV	72	0	0.0
700 I	72	11	15.3
700 II	72	12	16.7
700 III	72	7	9.7
700 IV	72	1	1.4
710 I	72	13	18.0
710 II	66	7	10.6
710 III	72	4	2.27
710 IV	72	3	4.2
720 II	72	11	15.3
720 III	72	4	5.5
720 IV	78	7	9.0
730 II	72	9	12.5
730 III	72	8	11.1
730 IV	<u>72</u>	<u>5</u>	<u>6.9</u>
Total	1656	176	10.6

Table 6. Summary of release and return of drift bottles during first year of Pathfinder Atlantic plankton cruises.

Month	<u>Surface Bottles</u>				<u>Bottom Bottles</u>			
	Number Released	Number Returned	Percent Returned	Drift	Est./1 Min. drift speed	Number Released	Number Returned	Percent Returned
Dec. 1959	138	2	1.4	South	7.7	0	-	-
Jan. 1960	138	18	13.0	South	7.9	0	-	-
Feb. 1960	138	5	3.6	North/2	4.1	0	-	-
Mar. 1960	138	15	10.9	Southwest	10.5	42	7	16.7
April 1960	138	3	2.2	South	4.5	18	1	5.5
May 1960	138	19	13.8	South	13.6	0	0	-
June 1960	138	17	12.3	South	14.25	42	4	9.5
July 1960	138	20	14.5	North/3	7.5	36	4	11.1
Aug. 1960	144	36	25.0	South	29.5	0	-	-
Sept. 1960	138	39	28.3	South	25.0	0	-	-
Nov. 1960	138	1	0.7	North/2	0.7	0	-	-
Dec. 1960	<u>132</u>	<u>1</u>	<u>0.7</u>	North/2	-	<u>0</u>	<u>-</u>	<u>-</u>
Total	1656	176	10.6			Total 138	16	11.6

/1 Nautical miles per day

/2 Tidal drift from station CB-0

/3 See Fig. 2

Table 7. Seasonal returns on surface drift bottles released during the period December 1959-December 1960.

Season	Month	Number Released	Number Returned	Percent Returns
Winter	Dec.	270	3	
	Jan.	138	18	
	Feb.	<u>138</u>	<u>5</u>	
	Total	546	26	4.76
Spring	March	138	15	
	April	138	3	
	May	<u>138</u>	<u>19</u>	
	Total	414	37	8.94
Summer	June	138	17	
	July	138	20	
	August	<u>144</u>	<u>36</u>	
	Total	420	73	17.38
Fall	Sept.	138	39	
	Oct.	-	-	
	Nov.	<u>144</u>	<u>40</u>	
	Total	282	40	14.18

Table 8. Locations of stations occupied.

March 1961 - March 1962

Station Designation	Location				Depth in feet
	N. °	Lat. ‡	W. °	Long. ‡	
CB-0/1	37	04	76	05	44
CB-10	37	08	76	11	40
CB-20	37	15	76	22	60
700-I	37	00	75	47	48
700-II	37	00	75	35	64
700-III	37	00	75	22	96
700-IV	37	00	75	10	114
700-V	37	00	74	58	138
700-VI	37	00	74	45	258
700-VII/2	37	00	74	34	3600
700-VIII/2	37	00	74	22	5380
710-I	37	10	75	47	20
710-II	37	10	75	35	54
710-VI	37	10	74	45	240
710-VIII/2	37	10	74	22	5600
720-II	37	20	75	35	42
720-III	37	20	75	22	82
720-IV	37	20	75	10	82
720-V	37	20	74	58	116
720-VI	37	20	74	45	340
720-VII/2	37	20	74	34	343
720-VIII/2	37	20	74	21	3000

/1 Location change of Station CB-0 necessitated by construction of Chesapeake Bay Bridge - Tunnel.

/2 Alternate stations.

Table 9. Surface bottle and sea bed drifter releases for second year of Pathfinder Atlantic plankton cruises.

Station	1961	1961	1961	1961	1961	1961	1961	1961	1961	1961	1962
	Mar. S-B	Apr. S-B	May S-B	June S-B	July S- B	Aug. S- B	Sept. S- B	Oct. S- B	Nov. S- B	Dec. S- B	Jan. S- B
CB-0	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
700 I	6-0	6-0	6-0	6-0	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5
700 II	6-0	6-0	6-0	6-0	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5
700 III	6-0	6-0	6-0	6-0	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5	6- 5
700 IV	6-0	6-0	6-0	6-0	6- 5	6- 0	6- 5	6- 5	6- 5	6- 5	6- 5
700 V	6-0	6-0	6-0	6-0	6- 5	6- 0	6- 5	6- 5	6- 5	6- 5	6- 5
700 VI	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
700 VII	- -	- -	6-0	6-0	- -	- -	6- 5	6- 5	- -	6- 5	6- 5
700 VIII	- -	- -	6-0	6-0	- -	- -	6- 5	6- 5	- -	- -	- -
710 I	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
710 II	6-0	6-0	6-0	6-0	6- 5	- -	6- 0	6- 5	6- 5	6- 5	6- 5
710 VI	6-0	6-0	- -	- -	6- 5	- -	- -	- -	6- 5	6- 5	6- 5
710 VIII	- -	- -	6-0	6-0	- -	- -	6- 0	6- 5	- -	- -	- -
720 II	6-0	6-0	6-0	- -	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
720 III	6-0	6-0	6-0	- -	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
720 IV	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
720 V	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
720 VI	6-0	6-0	6-0	6-0	6- 5	- -	6- 5	6- 5	6- 5	6- 5	6- 5
720 VII	- -	- -	- -	6-0	- -	- -	6- 0	6- 5	- -	- -	- -
720 VIII	- -	- -	- -	6-0	- -	- -	6- 0	6- 5	- -	- -	- -
Total	90-0	90-0	90-0	102-0	90-75	30-15	114-75	114-95	90 75	90-75	90-75

Table 10. Surface drift bottle and sea bed drifter returns  
March 1961 - January 1962

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
March 1961					
CB-0	35 46.7	75 31.9	78.5	South	39
CB-0	36 19	75 48.4	42.0	South	11
CB-0	35 16	75 31	46.0	South	?
CB-0	35 50	75 33	74.5	South	27
CB-0	35 55	75 47	69.5	South	10
700 I	35 26.5	75 28.5	96.5	170°	19
700 I	35 30	75 28.5	91.5	170°	22
700 I	35 32	75 28	89.0	170°	117
710 II	36 55.5	76 00	26.0	237°	5
710 II	36 55.5	76 00	26.0	237°	5
April 1961					
CB-0	35 47	75 32	92	South	4
CB-0	35 44	75 29.7	81	South	9
700 I	35 30	75 28.5	92	171°	22
May 1961					
CB-0	36 45	75 56	15.5	South	5
CB-0	36 45	75 56.5	15.5	South	5
700 I	36 04	75 41.4	56.0	177°	5
700 I	35 47	75 33	73.5	172°	5
700 I	36 13	75 46	47.5	175°	44
700 I	36 13	75 46	47.5	175°	8
700 I	36 32	75 52	28.0	188°	27
710 I	37 06	75 59	11.0	245°	52
710 I	37 20	75 44	10.25	007°	30
710 I	37 12	75 48	3.5	330°	31
June 1961					
No Recoveries					
July 1961					
CB-0	37 06	75 58.7	5.25	060°	2
CB-0*	37 23	76 14.7	21.5	337°	124

\* Sea bed drifter

Table 10. continued.

- 2 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long	Miles	Bearing	
July 1961 (continued)					
CB-0*	37 23.5	76 14.7	22.25	338°	197
700 I*	37 05	75 58.5	8.5	309°	10
700 I*	37 20	76 00.8	23.75	C. B.	46
700 IV*	36 02	75 40	63.5	203°	152
710 I*	37 10	75 50	2.0	270°	25
710 I*	37 14.5	75 48	4.5	350°	49
710 II*	37 17	76 01.5	32.0	C. B.	169
720 IV*	36 51	75 58.5	49.5	234°	138
720 IV*	36 55	76 00	47.5	239°	193
August 1961					
700 I	36 55	75 59.6	11.5	251°	5
700 I	37 08	75 58	13.0	310°	8
700 I	36 45	75 56.3	16.5	209°	6
700 I	36 51	75 58.5	13.5	228°	5
700 II	36 23.5	75 49	39.0	198°	38
700 IV	35 57	75 37	66.75	200°	38
September 1961					
CB-0	37 08	75 58	6.5	045°	2
CB-0	37 0.55	75 59	4.8	066°	4
CB-0	36 57	76 15	10.0	234°	9
CB-0*	37 21	76 16.4	20.5	332°	48
CB-0*	37 24	76 14	23.25	338°	40
CB-0*	37 22.5	76 14.9	20.8	336°	30
CB-0*	35 20	75 30	90.5	164°	22
700 I	36 30	75 51.5	30.5	187°	10
700 I	36 47	75 57	15.25	213°	17
700* II	36 37	75 53	28.0	215°	119
700* II	35 55	75 36	65.0	181°	118
710 I	36 54.4	76 05.5	22.75	222°	10
710 II*	36 33	75 52	40.0	200°	72
720 II	33 54	78 22	287.5	180°	54
720 II	35 35.7	75 27.6	94.5	177°	19
720 II*	36 55.5	76 00	31.50	221°	38
720 II*	36 51	75 58	35	212°	38
720 III*	36 51	75 58	41.5	225°	72
720 III*	36 51	75 58	41.5	225°	72

\* Sea bed drifter.

Table 10. continued

- 3 -

Point of Release	Recovery Location		Recovery		Days Adrift
	N. Lat.	W. Long.	Miles	Bearing	
September 1961 (continued)					
720 III*	36 51	75 58	41.5	225°	72
720 IV*	36 55.5	76 00	47.5	239°	106
720 IV*	37 15	76 24	65.5	C. B.	128
September 1961					
CB-0	37 08	75 58	6.5	045°	2
CB-0	37 0.55	75 59	4.8	066°	4
CB-0	36 57	76 15	10.0	234°	9
CB-0*	37 21	76 16.4	20.5	332°	48
CB-0*	37 24	76 14	23.25	338°	40
CB-0*	37 22.5	76 14.9	20.8	336°	30
CB-0*	35 20	75 30	90.5	164°	22
700 I	36 30	75 51.5	30.5	187°	10
700 I	36 47	75 57	15.25	213°	17
700 II*	36 37	75 53	28.0	215°	119
700 II*	35 55	75 36	65.0	181°	118
710 I	36 54.5	76 05.5	22.75	222°	10
710 II*	36 33	75 52	40.0	200°	72
720 II	33 54	78 22	287.5	180°	54
720 II	35 35.7	75 27.6	94.5	177°	19
720 II*	36 55.5	76 00	31.50	221°	38
720 II*	36 51	75 58	35	212°	38
720 III*	36 51	75 58	41.5	225°	72
720 III*	36 51	75 58	41.5	225°	72
720 III*	36 51	75 58	41.5	225°	72
720 IV*	36 55.5	76 00	47.5	239°	106
720 IV*	37 15	76 24	65.5	C. B.	128
October 1961					
CB-0	36 57	76 15	10.5	234°	6
CB-0	36 57	76 15	10.5	234°	6
CB-0	35 56	75 36	68.0	South	8
CB-0	36 56	76 12	9.75	224°	7
CB-0	36 56	76 12	9.75	224°	7
CB-0*	37 22	76 15	20.75	334°	20
CB-0*	37 23	76 14.7	21.00	335°	27
CB-0*	37 22.5	76 14.8	21.00	336°	31
CB-0*	37 23.5	76 14.5	21.8	337°	17
700 I*	36 55.6	76 00.4	11.5	247°	7
700 I*	36 55.5	76 00	11.5	247°	11

\* Sea bed drifter.

Table 10. continued.

- 4 -

Point of Release	Recovery Location				Recovery		Days Adrift
	N. °	Lat. '	W. °	Long '	Miles	Bearing	
October 1961 (continued)							
700 I*	36	55.9	75	59	12.00	250°	12
700 I*	36	55	76	01	11.5	250°	11
700 I*	36	55	76	02	13.5	250°	12
700 II*	36	34	75	52	29.5	208°	71
700 II*	36	51	75	58.5	20.4	243°	42
700 II*	36	51	75	58	20.5	243°	38
700 III*	36	36	75	52	34.5	227°	68
700 III*	36	34	75	52	35.5	223°	58
700 III*	36	32	75	52	37.0	221°	47
700 IV*	36	17	75	31	46.5	204°	46
700 IV*	36	23.8	75	49.4	49.0	222°	91
710 I*	37	12	75	48	3.0	302°	36
710 II*	37	00.5	76	18	38.0	C. B.	97
710 II*	37	02	76	17	40.0	C. B.	68
720 II*	37	25	75	41	7.5	318°	34
720 IV*	37	47.1	75	31.3	31.5	327°	55
720 IV*	37	33	75	36	25	304°	64
720 IV*	37	33	75	36	25	304°	63
November 1961							
CB-0*	36	56	76	12.5	9.75	224°	68
CB-0*	37	02.5	76	17.3	11.0	268°	30
700 I*	36	55	76	00	11.5	246°	9
700 I*	36	55	76	00	11.5	246°	11
700 I*	36	55	76	00	11.5	246°	9
700 I	36	45	75	56.5	17.0	207°	7
700 II*	36	55	76	00	20.0	258°	21
700 II*	36	51	75	48	14.5	231°	31
700 III*	36	51	75	58.5	30.5	251°	39
700 III*	37	02.5	76	17.5	45.0	273°	81
700 III*	36	55	76	00	32.0	262°	72
710 I*	37	00.5	76	18	30.0	C. B.	23
710 I*	36	55	76	00	17.0	217°	14
710 I*	36	57	76	15	25.0	C. B.	72
710 I*	36	56	76	12.5	24.25	C. B.	54
710 II*	37	00	76	18	38.25	C. B.	54
720 II*	37	00	76	21	39.5	C. B.	43
720 II*	36	57.5	76	15	36.75	C. B.	57
720 IV*	37	00.5	76	18	52.5	C. B.	90

\* Sea bed drifter.

Table 10. continued

- 5 -

Point of Release	Recovery Location				Recovery		Days Adrift
	N. °	Lat. †	W. °	Long. †	Miles	Bearing	
December 1961 (Incomplete returns)							
CB-0*	37	28	75	57	25.0	010°	41
700 I*	36	55.5	76	00	11.5	247°	17
700 I*	36	55.5	76	00	11.5	247°	17
700 I*	36	55.5	76	00	11.5	247°	8
700 II*	36	59	76	23	39.0	C. B.	54
700 II*	37	02.5	76	17.5	34.0	C. B.	61
700 II*	36	55	76	00	22.0	257°	25
700 III*	36	36	75	52	34.5	226°	33
710 I*	37	23	76	14.8	34.25	C. B.	70
710 I*	37	05	75	58	10.0	239°	35
720 II*	37	05	75	58	20.5	257°	23
720 II*	37	05	75	58	20.5	257°	26
720 II*	37	19	76	01	42 +	C. B.	65
January 1962 (Incomplete returns)							
CB-0	37	08	75	58.5	6.75	047°	4
CB-0	37	05.5	75	58.5	5.25	060°	5
700 I*	36	51	75	58	14.5	230°	16
700 I*	36	51	75	58	13.0	227°	11
700 II*	36	51	75	58.5	21.0	245°	10
710 II*	36	55	76	00	25.5	234°	27

\* Sea bed drifter.

Table 11. Release and return of surface drift bottles and sea bed drifters by station, March 1961 - January 1962.

Station	Surface bottles			Sea bed drifters		
	Number Released	Number Recovered	Percent Recovery	Number Released	Number Returned	Percent Recovery
CB-0	60	20	33.3	30	13	43.3
700 I	66	16	24.2	35	15	42.8
700 II	66	1	1.5	35	11	31.4
700 III	66	0	0	35	7	20.0
700 IV	66	1	1.5	30	3	10.0
700 V	66	0	0	30	0	0
700 VI	60	0	0	30	0	0
700 VII	18	0	0	10	0	0
700 VIII	18	0	0	10	0	0
710 I	60	4	6.7	30	9	30.0
710 II	60	2	3.3	25	6	23.0
710 VI	42	0	0	20	0	0
710 VIII	18	0	0	5	0	0
720 II	54	2	3.7	30	8	26.7
720 III	54	0	0	30	3	10.0
720 IV	60	0	0	30	8	26.7
720 V	60	0	0	30	0	0
720 VI	60	0	0	30	0	0
720 VII	18	0	0	5	0	0
720 VIII	<u>18</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>
Total	990	46	4.6	485	83	17.1

Table 12. Summary of release and recovery of surface drift bottles and sea bed drifters on Atlantic plankton cruises, March 1961 - January 1962.

Month	<u>Surface drift bottles</u>					<u>Sea bed drifters</u>				
	Number Released	Number Returned	Percent Returned	Drift	Est. Min. speed	Number Released	Number Returned	Percent Returned	Drift	Est. Min. speed
March	90	10	11.1	South	7.0	0	-	-	-	-
April	90	3	3.3	South	23.0	0	-	-	-	-
May	90	10	11.1	South	14.7	0	-	-	-	-
June	102	0	-	-	-	0	-	-	-	-
July	90	1	1.1	NE/ <u>1</u>	-	75	10	13.3	SW	0.35
Aug.	30	6	20.0	SW	2.7	15	0	-	-	-
Sept.	114	8	7.0	South	5.0	75	14	18.7	SW	0.90
Oct.	114	5	4.4	/ <u>1</u>	-	95	24	25.3	SW	1.64
Nov.	90	1	1.1	South	2.4	75	18	24.0	SW	1.28
Dec./ <u>2</u>	90	0	-	-	-	75	13	17.3	WSW	1.44
Jan./ <u>2</u>	<u>90</u>	<u>2</u>	<u>2.2</u>	/ <u>1</u>	-	<u>75</u>	<u>4</u>	<u>5.3</u>	SW	2.10
Total	990	46	4.6			485	83	17.1		

/1 Tidal drift pattern within CB from Station CB-0.

/2 Incomplete returns.

Table 13. Comparison of surface bottle returns for Dec. 1959 -  
Dec. 1960 and March 1961 - Dec. 1961./1

Month	Number Released	Number Returned	Percent Returned	Month	Number Released	Number Returned	Percent Returned
Dec. 1959	138	2	1.4	-	-	-	-
Jan. 1960	138	18	13.0	-	-	-	-
Feb. 1960	138	5	3.6	-	-	-	-
March 1960	138	15	10.9	March 1961	60	10	16.7
April 1960	138	3	2.2	April 1961	60	3	5.0
May 1960	138	19	13.8	May 1961	60	10	16.7
June 1960	138	17	12.3	June 1961	48	0	0
July 1960	138	20	14.5	July 1961	60	1	1.7
Aug. 1960	144	36	25.0	Aug. 1961	24	6	25.0
Sept. 1960	138	39	28.3	Sept. 1961	60	8	13.3
Oct. 1960	0	-	-	Oct. 1961	60	5	8.3
Nov. 1960	138	1	0.7	Nov. 1961	60	1	1.7
Dec. 1960	<u>132</u>	<u>1</u>	<u>0.7</u>	Dec. 1961	<u>60</u>	<u>0</u>	<u>0</u>
Total	1656	176	10.6	Total	552	44	8.0

/1 Stations beyond IV line excluded.

Table 14. Returns of sea bed drifter released through Dec. 1961-  
excluding released made beyond IV line.

Month	Release	Return	Percent Returned
July	50	10	20.0
Aug.	15	0	-
Sept.	45	14	31.1
Oct.	50	24	48.0
Nov.	50	18	36.0
Dec.	<u>50</u>	<u>13</u>	<u>26.0</u>
Total	260	79	30.4

Table 15. Chronology of surface bottle returns.

	0-14	15-29	30-59	Days adrift		120-49	150-79	<179	Total
				60-89	90-119				
Returns 1959-60	90	43	12	12	7	4	2	5	175/ <u>1</u>
Percent	51.4	24.6	6.8	6.8	4.0	2.3	1.1	2.8	
Accum. %	51.4	76.0	82.8	89.6	93.6	95.9	97.0	-	
Returns 1961	27	7	8	0	1	0	0	0	43/ <u>1</u>
Percent	62.8	16.3	18.6	0	2.3				
Accum. %	62.8	79.1	97.7						
Returns combined 1959-61	117	50	20	12	8	4	2	5	218
Percent	53.7	22.9	9.2	5.5	3.7	1.8	0.90	2.3	
Accum. %	53.7	76.6	85.8	91.3	95.0	96.8	97.7	-	

/1 Exclusive of 1 undated bottle return.

Table 15. Chronology of bottom device returns.

	0-14	15-29	30-59	Days adrift		120-149	150-179	< 179	Total
				60-89	90-119				
Bottom drift bottle 1960	4	0	0	0	0	0	3	9	16
Percent	25.0	-	-	-	-	-	18.8	56.2	
Sea bed drifter 1961	11	12	27	16	6	3	3	1	79
Percent	13.9	15.2	34.2	20.2	7.6	3.8	3.8	1.3	
Accum. %	13.9	29.1	63.3	83.5	91.1	94.9	98.7	-	