SURFACE CURRENTS IN LAKE MICHIGAN

1954 and 1955

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SURFACE CURRENTS IN LAKE MICHIGAN, 1954 and 1955

by

James H. Johnson
Fishery Research Biologist
Bureau of Commercial Fisheries

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ABSTRACT

Surface currents were investigated in central and southern Lake Michigan in 1954, and in central and northern Lake Michigan in 1955. Drift bottles, drift envelopes, and plastic tubes were released in 1954, whereas drift bottles only were used in 1955.

Currents were highly variable in both years and in all areas of Lake Michigan. The general direction of drift was from west to east; currents were predominately north-bound along the eastern shore. No prevailing current was detected along the western shore.

SURFACE CURRENTS IN LAKE MICHIGAN, 1954 AND 1955

INTRODUCTION

Before 1954 the only publication describing the major surface-current circulation in Lake Michigan was by Harrington (1895). Subsequent investigations were either local or of limited scope (Crohurst and Veldee 1927; Deason 1932) or were discussions of Harrington's conclusions (Townsend 1916) and statements as to the inadvisability of studying the lake currents as a whole (Judson 1909). The recent analysis of synoptic surveys conducted in Lake Michigan in 1955 not only contributed to knowledge of the lake currents (Ayers et al. 1958) but also introduced oceanographic procedures and interpretations into the study of the circulation of the lake.

The present study of the circulation of Lake Michigan was part of the 1954-1955 fishery-limnological survey conducted by the M/V Cisco of the U. S. Bureau of Commercial Fisheries, Fish and Wildlife Service. The 1954 work was confined to the central and southern part of the lake and the 1955 survey was conducted in the central and northern area (fig. 1). Smith (1957) who commented briefly concerning the use of drift units and the determination of lake currents stated from preliminary analyses of the data that the major surface-current structure of Lake Michigan can change over a 3-week period. This report completes the analysis of returns of all drift units released in Lake Michigan in 1954 and 1955.

John Ayers of the Great Lakes Research Institute made suggestions in the preparation of the manuscript; Anthony Perlick and Robert Wetzel drafted the figures; and the U. S. Coast Guard made wind records available.

GENERAL FEATURES OF LAKE MICHIGAN

Lake Michigan, the third largest of the Great Lakes (22, 400 square miles) lies wholly within the United States. The maximum depth is 924 feet, the mean is 276 feet, and the channel depth of the Straits of Mackinac is about 100 feet (Emery 1951). The long axis of the lake, approximately 325 miles, lies in a north-northeast to south-southwest direction. Excluding bays and inlets, the maximum east-west width of 85 miles is about 43°00' north latitude approximately on a line from Grand Haven, Michigan, to Milwaukee, Wisconsin.

CURRENT-GENERATING AGENTS AND MODIFYING FACTORS

The circulation of Lake Michigan is an integration of the effects of generating agents (wind and density distribution) modified by morphology of the lake, the Coriolis force, and hydraulic currents.

Wind

The wind creates currents in two ways. First, the most direct and obvious effect is the formation of shallow wind drift; second, the transport of water by the wind stress alters the density distribution and, consequently, the currents. Movements of water in Lake Michigan in the Calumet district of Illinois and Indiana are considered to be wind drifts (Crohurst and Veldee 1927). Similarly, the prevailing westerly winds over Lake Michigan have been considered the cause of the general west-to-east drift of bottles across the lake (Harrington 1895; Deason 1932). For the particular years and area in which these investigators worked, it is possible that westerly winds did prevail. Recent evidence indicates, however, that in southern Lake Michigan from May through August winds tend to be variable and not from any one prevailing direction (Cooperman, et al. 1959).

Density

Ayers et al. (1956, 1958) have demonstrated that density currents are common in the Great Lakes. They have been careful to point out that extreme caution must be used in determining circulation from the distribution of density because of the ease with which the circulation can be changed by wind stress. At times it is impossible to tell whether the distribution of density causes the currents, or the currents cause the distribution of density (Sverdrup, Johnson, and Fleming 1942).

Morphology

A most important but little understood factor in the circulation of Lake Michigan is morphology. The Great Lakes' basins acquired their major topographic features in pre-Pleistocene time by subaerial erosion and stream development acting on a variety of bedrock formations (Hough 1953, 1958). The level of Lake Mich-

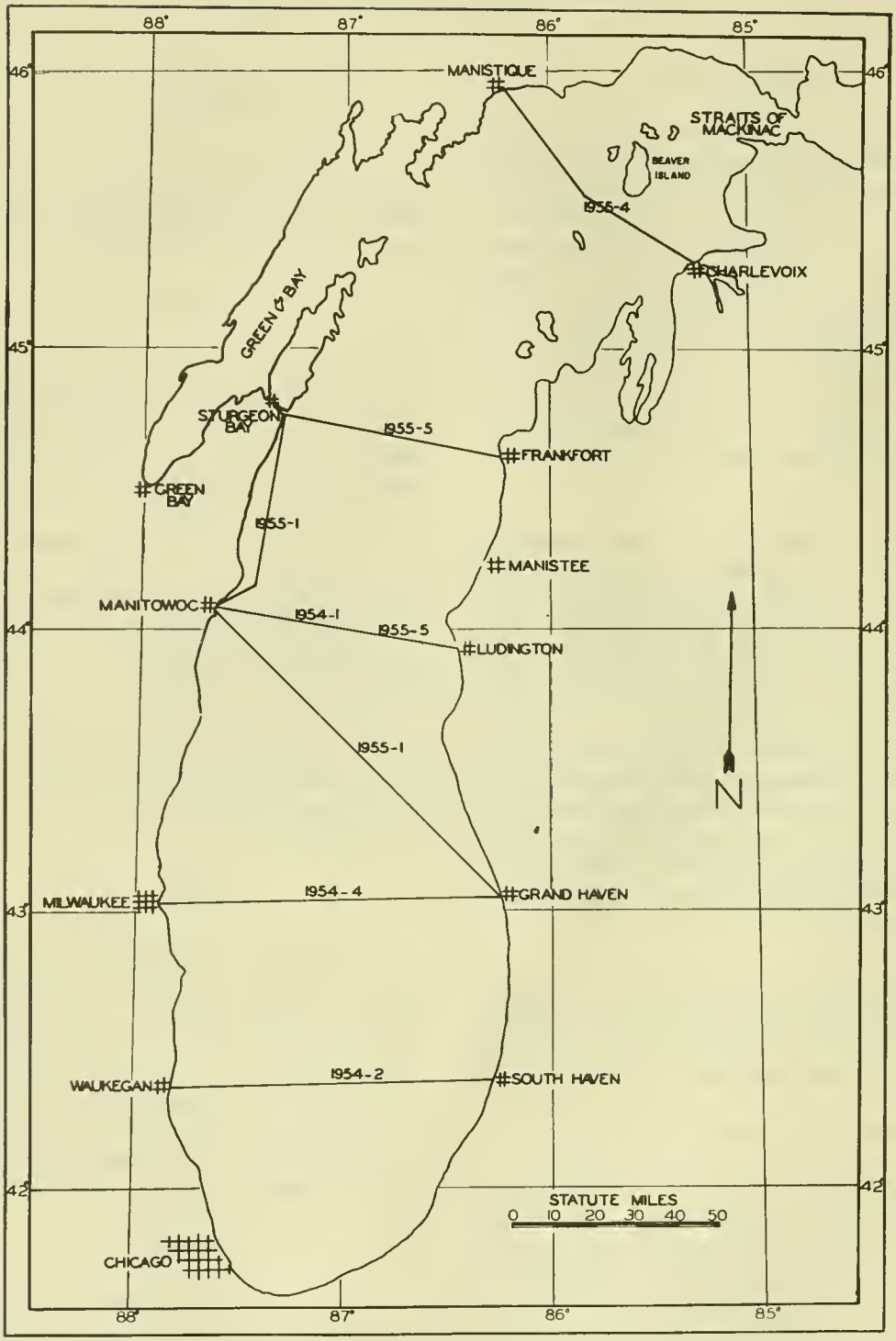

Figure 1. --Transects of the M/V Cisco of the U. S. Bureau of Commercial Fisheries, Fish and Wildlife Service, along which drift units were released. The year and number of times a transect was run are indicated on each transect.

igan has varied since the appearance of the first predecessor lake 24,000 years ago (Hough 1953, 1958) from 640 feet above sea level in the Glenwood stage 13,000 years ago to 230 feet above sea level in the Chippewa stage 5,000 years ago (Zumberge and Potz[g]er 1956). For the last 90 years the mean level has been 580.6 feet.

The bottom topography formed by these glacial events has been described in detail by Emery (1951). The lake can, in general, be divided into a southern basin of gentle bottom gradients and a northern basin with considerable fjord-like topography.

According to Sverdrup, Johnson, and Fleming (1942), Ekman has examined the influence of bottom topography on ocean currents. He concluded that in middle and high latitudes currents tend to follow bottom contours. He found also that a current is deflected cum sole when entering shallow water and contra solem when entering deeper water. If Lake Michigan behaves as an ocean, the bottom topography would effect major modification of the circulation, especially in view of the extremely irregular topography in the northern basin.

Near coast lines, secondary effects of the wind become important through alteration of density which in turn cause littoral currents (Sverdrup, Johnson, and Fleming 1942). In Lake Michigan where the ratio of length to width is approximately 5:1, the littoral currents become increasingly important in the general circulation of the lake.

Another effect of the confining nature of the coast line is the actual piling up of water in some areas and the removal of water in others when a strong wind blows for a prolonged period from one direction. Appreciable slopes of the water surface, which must be adjusted eventually, can be inferred in Lake Michigan from water-level records.

Coriolis Force

The effects of the Coriolis force upon currents were described in detail by Sverdrup, Johnson, and Fleming (1942). If the water surface is unlimited and the water is very deep in comparison with the depth of frictional resistance (i.e., the depth at which mixing due to wind is negligible) a deflection of 45° cum sole of the surface current from the generating wind direction is theoretically possible according to Ekman. Deflections of this magnitude were actually observed by Forch (1909), Gallé (1910), and others. Ekman proposed that in shallow water the deflection would be less, and it has been found so by Witting (1909) in depths of 9 to 65 meters and by Mandelbaum (1955) in less than 20 meters of water.

Studies of the Coriolis force in water movements of the Great Lakes are lacking. Because depths far greater than the depth of frictional resistance exist in Lake Michigan, and because of the relatively large surface area, it is suspected that Coriolis deflection exists as has been empirically demonstrated by Ayers et al. (1958).

Hydraulic Currents

Hydraulic currents are caused by the inflow and outflow of water from a basin. Maximum inflow into Lake Michigan from rivers and streams occurs generally in the spring and is minimum in the fall. Outflow is limited to the Straits of Mackinac (55,000 cfs. -- Powers and Ayers 1/) and the Chicago drainage system (approximately 3,000 cfs. --U. S. Corps of Engineers 1957). It appears in general that effects of the hydraulic currents in Lake Michigan are mostly local, occurring at the mouths of rivers and in the vicinity of the outlets.

TYPES OF DRIFT UNITS

Three types of units were used in 1954: drift bottles with metal drags (fig. 2A); plastic tubes with metal drags (fig. 2B); drift envelopes similar to those described by Olson (1951) (fig. 2C). Two types were released in 1955--drift bottles with metal drags or with sand ballast (fig. 2D).

Drift Bottles

The bottles were 4-ounce, Boston-round (4 1/2 inches long, 1 9/10-inch diameter) stoppered with corks, sealed with beeswax, and capped. Metal drags caused the bottles to sink until only about 1/2 inch was exposed. These bottles and drags were similar to those used in Lake Huron and Saginaw Bay (Johnson 1958).

1/ Powers, C.F., and J.C. Ayers. Water transport in the Straits of Mackinac region of Lake Huron. Limnol. and Oceanogr. Accepted for publication in 1960.

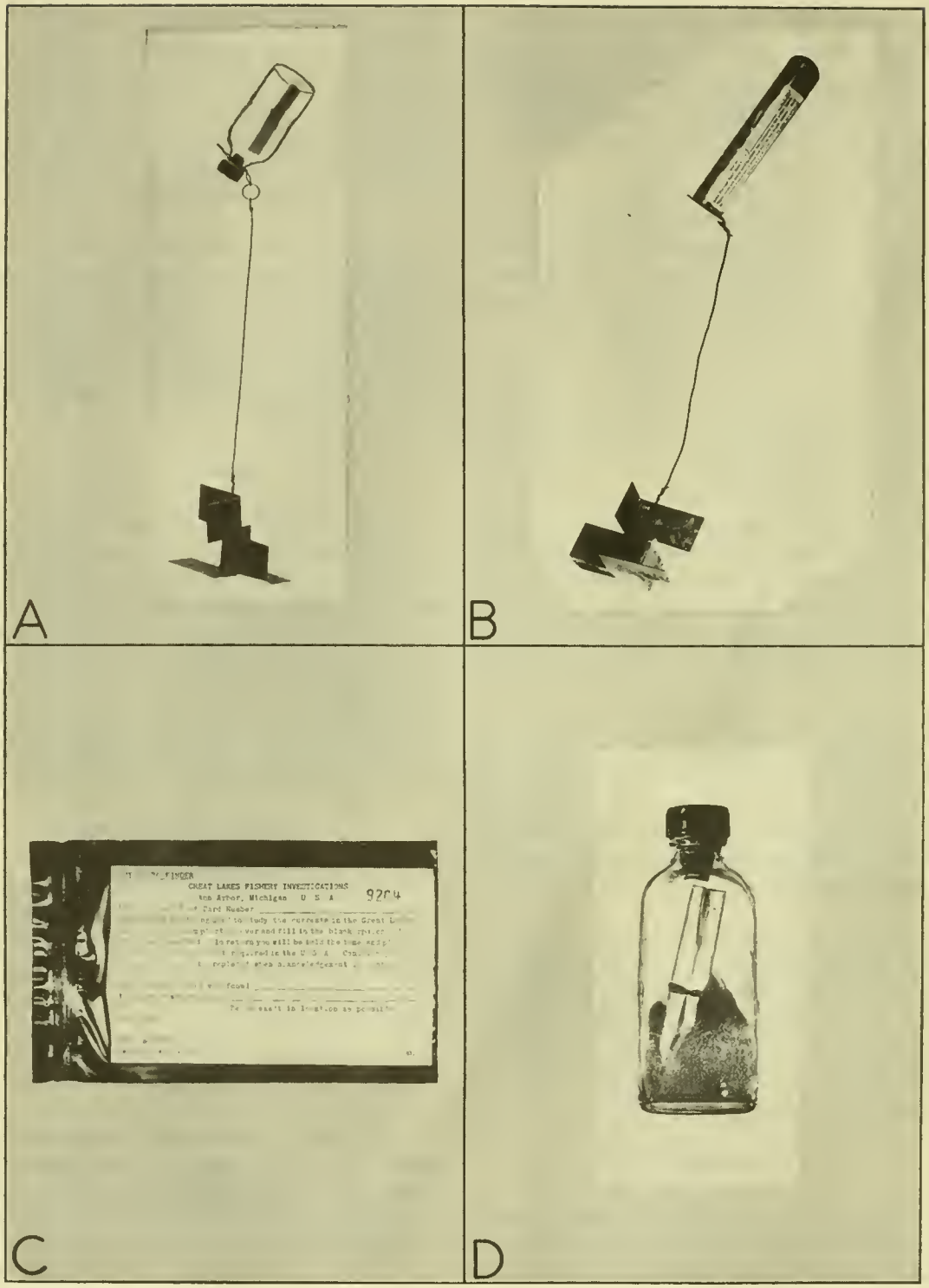

Figure 2. --Types of drift units used in the 1954 and 1955 surface-current studies of Lake Michigan. A. Drift bottle with metal drag. B. Plastic tube with metal drag. C. Drift envelope. D. Drift bottle with sand ballast.

During 1954 and until August 19 in 1955 the drag was suspended 3 feet below the bottles by a soft iron wire. Thereafter, the drag was suspended 1 foot below the bottles to lessen resistance to washing ashore. Observations of dye patches revealed that the movement of the bottles was not changed by the shortening of the drag (Smith 1956). Many of the bottles released prior to June 5, 1955, lost their drags. Apparently these losses were caused by repeated bending of the iron suspension wire to the point of breaking as the bottle was moved by waves. Introduction of a brass ring in the connection at the neck of the bottle greatly reduced but did not end the loss of drags (Smith 1956). Losses were reduced further, however, in Lake Superior and Lake Erie in 1958 by the insertion of a brass ring connecting the iron suspension wire to the drag.

Each ballasted bottle contained 40 grams of fine loose sand which caused the bottle to sink into the water so that only about 1/2 inch was exposed.

Plastic Tubes

The plastic-tube unit consisted of a cylindrical tube of cellulose acetate, 6 1/2 inches long and 1 1/4 inches in diameter, into which was inserted a reply card wound around a wooden block (fig. 2B). The unit was sealed with a square piece of cellulose acetate to which was attached a metal drag with a 3-foot suspension wire. The unit floated with approximately 2 inches of the tube above the surface.

Drift Envelopes

The drift-envelope unit consisted of a 3- by 5-inch reply card enclosed within a 3 3/4- by 6 1/4-inch polyethylene envelope of 0.002-inch thickness (fig. 2C). Water did not adhere to the plastic envelopes at first; most of the envelopes floated upon the surface film where they were under the direct propelling force of the wind. Some time after release the plastic envelopes no longer shed water and floated immediately under the surface film where they tumbled end for end in a rough sea.

RELEASES AND RECOVERIES

Central and Southern Lake Michigan, 1954

The U. S. Bureau of Commercial Fisheries M/V Cisco released 1,080 drift bottles with metal drags and 1,080 drift envelopes in central and southern Lake Michigan between July 9 and September 15, 1954 (table 1, fig. 1). In addition, 100 plastic tubes were released July 9 on the Grand Haven-Milwaukee transect; on this date, 6 each of the three types of units were released at all stations except the first out of Milwaukee at which 4 of each type were released. Subsequent to July 9, 10 drift bottles and 10 drift envelopes were released at each station. Units recovered after January 31, 1955, have not been included in the records of recovery or in analyses.

The 18 reply cards received from recovered plastic tubes were mostly from units released close to shore. This fact suggests that many of the plastic tubes released at stations distant from shore must have become waterlogged and sank.

Percentage recovery of drift envelopes was low (table 1). The normal seasonal decline in rate of recovery does not account for the precipitous decrease in reports of envelopes released after August 3. It is believed that the plastic envelopes containing the reply cards were improperly sealed and that many units became waterlogged and sank (Beeton, Johnson, and Smith 1959).

The percentage recovery of drift bottles ranged from 47.8 percent for the August 19 releases on the Grand Haven-Milwaukee transect to 62.9 percent for the releases on August 3 on the South Haven-Waukegan transect; for the combined releases the percentage recovery was 54.4 percent (table 1). The recovery rate was slightly higher for units released in July and early August than for those released in late August and September.

Central and Northern Lake Michigan, 1955

Between April 26 and November 8, 1955, 2,000 drift bottles with drags and 2,000 with sand ballast were released (table 2, fig. 1). Ten of each type were released at each station. Units recovered after January 31, 1956, have not been included in the tables and are not mentioned in the discussion.

The percentage recovery was slightly higher for bottles with drags (56.4 percent) than for sand-ballasted bottles (53.0 percent). The difference probably is not significant since more sand-ballasted bottles than bottles with drags were recovered from 6 of the 16 crossings (table 2).

Table 1. --Number of drift units released and recovered, percentage recovered, and average rates of drift for various transects of the M/V Cisco in central and southern Lake Michigan, 1954

Date	Transect	Number of units released		Number of units recovered		Percentage recovered		Average drift rate (miles per day)	
		Bottles	Envelopes	Bottles	Envelopes	Bottles	Envelopes	Bottles	Envelopes
July 9	Grand Haven, Mich. -Milwaukee, Wis...	100	100	59	19	59.0	19.0	1.6	3.1
July 29	Grand Haven, Mich. -Milwaukee, Wis...	170	170	97	22	57.1	12.9	2.0	5.7
August 3	South Haven, Mich. -Waukegan, Ill.....	170	170	107	27	62.9	15.9	1.0	2.7
August 19	Grand Haven, Mich. -Milwaukee, Wis...	180	180	86	5	47.8	2.8	2.1	1.3
August 23-25	Ludington, Mich. -Manitowoc, Wis.....	110	110	55	0	50.0	0.0	1.1	...
September 9-11	Grand Haven, Mich. -Milwaukee, Wis...	180	180	89	0	49.4	0.0	1.4	...
September 15	South Haven, Mich. -Waukegan, Ill....	170	170	94	4	55.3	2.4	1.9	2.9
Total or average		1,080	1,080	587	77	54.4	7.1	1.6	3.6

Table 2. --Number of drift bottles released and recovered, percentage recovered, and average rates of drift for various transects of the M/V Cisco in central and northern Lake Michigan, 1955

Date	Transect	Number of units released		Number of units recovered		Percentage recovered		Average drift rate (miles per day)	
		With drags	Sand ballasted	With drags	Sand ballasted	With drags	Sand ballasted	With drags	Sand ballasted
April 26	Grand Haven, Mich. -Manitowoc, Wis...	180	180	117	122	65.0	67.8	1.3	1.5
April 27	Manitowoc, Wis. -Sturgeon Bay, Wis.....	70	70	41	44	58.6	62.9	0.6	1.0
May 13	Ludington, Mich. -Manitowoc, Wis.....	120	120	73	80	60.8	66.7	1.5	1.2
May 16-17	Frankfort, Mich. -Sturgeon Bay, Wis.....	120	120	91	67	75.8	55.8	1.3	1.5
June 5	Charlevoix, Mich. -Manistique, Mich....	150	150	100	94	66.7	62.7	0.9	1.1
June 23	Frankfort, Mich. -Sturgeon Bay, Wis.....	120	120	79	66	65.8	55.0	1.7	2.2
June 26	Ludington, Mich. -Manitowoc, Wis.....	130	130	78	77	60.0	59.2	2.0	2.6
July 14	Charlevoix, Mich. -Manistique, Mich....	150	150	91	98	60.7	65.3	1.2	1.5
August 11	Ludington, Mich. -Manitowoc, Wis.....	130	130	93	80	71.5	61.5	1.7	1.4
August 19	Frankfort, Mich. -Sturgeon Bay, Wis.....	130	130	67	54	51.5	41.5	2.1	2.9
September 5	Charlevoix, Mich. -Manistique, Mich....	150	150	64	54	42.7	36.0	1.1	1.5
September 22	Frankfort, Mich. -Sturgeon Bay, Wis.....	130	130	76	63	58.5	48.5	1.7	2.5
September 26	Ludington, Mich. -Manitowoc, Wis.....	120	120	66	59	55.0	49.2	2.0	2.0
October 19	Charlevoix, Mich. -Manistique, Mich....	140	140	39	53	27.9	37.9	1.7	1.5
November 4	Frankfort, Mich. -Sturgeon Bay, Wis.....	80	80	21	24	26.3	30.0	2.6	2.8
November 8	Ludington, Mich. -Manitowoc, Wis.....	80	80	32	25	40.0	31.3	1.9	5.3
Total or average		2,000	2,000	1,128	1,060	56.4	53.0	1.5	1.8

Time and Localities of Recovery

In both 1954 and 1955 the recovery rate was slightly higher for units released in early summer than for those released in late summer and fall (tables 1 and 2). Recoveries were highest on weekends and holidays. A similar time distribution of recovery of drift bottles has been noted in Saginaw Bay and Lake Huron (Johnson 1958).

It is of course necessary that a unit reach shore if it is to be recovered. The actual efficiency of recovery of beached units is strongly influenced also by the conspicuousness of the unit once it has landed and the amount of shore traffic through the area. The latter factor, in turn, depends upon shore topography and the density of the human population. In southern Lake Michigan where the population is dense and sand beaches are extensive, most areas are covered equally well. Here the uneven distribution of shore traffic offers a scant source of bias. In northern Lake Michigan, on the contrary, the extensive areas of sparse population and the more rugged coast line contribute to lesser and unevenly distrib uted shore traffic. Records of recovery are correspondingly biased.

High visibility of units on shore is essential to efficient recovery and differences in conspicuousness probably inject a bias in comparison of percentage recoveries of different types of units. In early September 1954, causes of differential rates of recovery were studied by inspection of 5 miles of shore line in southern Lake Michigan. The following possibilities were revealed: plastic envelopes can be blown far back from the beach by strong winds and can be covered by blown sand much more easily than tubes and bottles; the color of the cards in plastic envelopes blends well with the flotsam in windrows along the beach; on open sand the glass bottle with drag is much more conspicuous than the tube or envelope because both the bottle and the drag attract attention; and glass bottles appear to be sought for rifle practice as was evidenced by the great number of broken bottles along the beach and the everpresent empty cartridge cases.

SURFACE CURRENTS IN LAKE MICHIGAN, 1954 and 1955

The understanding of discussions in the following sections should be made easier by a brief preliminary explanation of the methods of graphical representation of the data (figs. 3-18). The figures on wind direction (figs. 3 and 8) were designed in the same way for each month in each year and the plan of presenting records of recoveries (figs. 4-7; 9-18) is the same for each transect, regardless of type of drift unit.

The information on wind within a month is given in terms of lines that show the percentage of the total time the wind blew toward each of 8 sectors. The individual lines bisect the sectors 000°-045°, 045°-090°, ···; 315°-360°. The percentage of time is indicated by the length of line; the radii of the concentric circles are in multiples of 10 percent.

The graphs on recoveries give direction and number. The sectors are the same as described for the data on wind. The lengths of the radiating lines indicate numbers recovered in each direction from each station in accordance with the scale at the bottom. Care should be taken not to interpret these lines as showing actual locality of recovery. A line leading from an inshore station directly onto the shore (on occasion passing beyond it) does not indicate that the recoveries were made from the immediately adjacent beach. Many could have been, and indeed were, recovered in remote sections of the lake not shown on the strip map, but which would have been traversed by an extension of the line. To reach these points the units had to drift around intervening headlands or islands. Release stations on some of the transects do not lie in a straight line. This irregularity was because of problems in navigation in crossing the lake.

Tables 7-22 in the appendix give the location of release and recovery of drift units, number of days adrift, miles traveled, and average drift rate in miles per day. A bottle recovered on the day it was released was considered to have been adrift 1/2 day. If it was recovered the day after release, the drift period was one day. Stations numbered in the tables are located in figures 4-7 and 9-18 by counting from right to left (east to west) with the exception of the Manitowoc-Sturgeon Bay transect (figs. 9, 10); on this transect stations are located by counting from south to north.

Central and Southern Lake Michigan, 1954

South Haven-Waukegan transect. --The recoveries from releases along this transect illustrate the

considerable difference in recoveries of identical drift units released on different days and bring out also the dissimilarities of returns from different kinds of units released on the same date. As will be seen later, generally similar variability characterized all transects.

The most obvious difference in the directions of recovery of bottles released on August 3 and September 15 is from the four westernmost stations (fig. 4). Recoveries from the August 3 releases at these stations with the exception of 1 bottle, were from the Illinois (west) shores, whereas all recoveries from the September releases were from the Michigan (east) shores. Although the wind was decidedly variable in August (fig. 3, table 3), for 5 days following the August 3 releases the Chicago Weather Bureau reported prevailing east and northeast winds. Westerly winds prevailed during September and October (fig. 3). The recovery of most bottles released at the remaining stations from the Michigan shores indicates a general west-to-east drift in which the northerly movements predominated slightly above those toward the south. Time-areal distribution of recoveries from this transect suggested no gyral motion of surface water in southern Lake Michigan during the time the units were adrift.

Recoveries of drift envelopes from releases along the South Haven-Waukegan transect were low (fig. 4). The location of recovery points of bottles and envelopes released at the 4 westernmost stations were significantly different; the envelopes exhibited a much greater tendency to drift to the south than did the bottles.

Grand Haven-Milwaukee transect. --Returns from drift units released along the Grand Haven-Milwaukee transect July 9 and July 29 had many similarities (figs. 5 and 6). Recoveries from the August 19 and September 9-11 (strong winds prevented completion of the transect on September 9) transects resembled each other, but differences between these two pairs of observations were substantial. Discrepancies between results from bottles and envelopes were less pronounced than those of the South Haven-Waukegan transect.

Recoveries from the releases made on July 9 suggest that a littoral current was flowing inshore to the north off Grand Haven, whereas surface-current movements were toward the south farther offshore (fig. 5). Recoveries from releases along the western half of the transect were obtained from several directions but those from the 2 most westerly stations indicate a northward drift similar to that on the east shore. The more definitely eastward drift between midlake and the 2 most westerly stations constituted a small difference between the July 9 and July 29 transects. The littoral current to the north appeared again inshore off Grand Haven following the July 29 releases, and flow was to the south from the next 6 stations. The recoveries from the releases along the western half of the transect were widely scattered, and the northbound current was still present near the west shore. Winds in July and August had slightly greater components from the north than from any other direction although variability was high in August (fig. 3). It is apparent from the recoveries of the July 9 and July 29 releases that no clearly defined counterclockwise whirl as postulated by Harrington (1895) had developed in the southern portion of the lake. Rather, surface water movements tended to be clockwise as described by Ayers et al. (1958).

At the time the bottles of the August 19 and September 9-11 releases were adrift the littoral current flowing to the north off Grand Haven had broadened to include the eastern 10 miles of the lake (August releases) and later the eastern half (September transect). Recoveries from the midlake area between inshore stations were made mostly from Michigan. The north-bound current that existed along the Wisconsin shore had disappeared; recoveries from the 2 inshore stations were scattered.

The few drift envelopes recovered from releases on the same dates at inshore stations on this transect had followed courses generally similar to those followed by bottles (fig. 6).

Ludington-Manitowoc transect. --Recoveries from bottles liberated on the Ludington-Manitowoc transect on August 23-25 indicate movement of surface water both to the north and south off Ludington (fig. 7). A similar condition existed off Manitowoc where there was evidence of a north-bound current inshore and a south-bound one farther offshore. Direction of recovery from the remaining stations was extremely variable.

Time distribution of recovery at the first station off Ludington suggests the possibility that all bottles at first were carried to the north of the release station where four landed; subsequently, a change of the current from north to south would account for the recovery of bottles to the south of the

Table 3. --Percentage time winds blew toward each of 8 sectors in southern Lake Michigan and mean velocity, July-October 1954

[Based on daily records from the U. S. Weather Bureau Stations at Milwaukee, Wisconsin, Chicago, Illinois, and South Bend, Indiana. When the wind direction for a day fell exactly along the line dividing sectors, the time was divided equally between the two]

Month and item	Sector							
	000°-045°	045°-090°	090°-135°	135°-180°	180°-225°	225°-270°	270°-315°	315°-360°
July								
Percentage time in sector	19.3	4.8	4.8	13.4	20.4	13.4	9.7	13.4
Mean velocity (mph)	8.1	8.0	6.6	8.6	8.7	7.1	7.4	8.5
August								
Percentage time in sector	12.4	11.8	12.9	14.5	14.5	12.4	10.7	10.7
Mean velocity (mph)	8.3	8.1	8.2	8.6	8.7	8.2	7.9	7.1
September								
Percentage time in sector	24.4	11.7	17.8	12.8	3.3	8.9	10.0	11.1
Mean velocity (mph)	9.8	10.8	12.0	10.5	9.6	9.2	10.1	9.5
October								
Percentage time in sector	27.4	15.1	12.9	15.1	7.5	6.5	4.3	11.3
Mean velocity (mph)	9.8	10.4	11.2	9.6	8.9	10.2	9.0	8.7

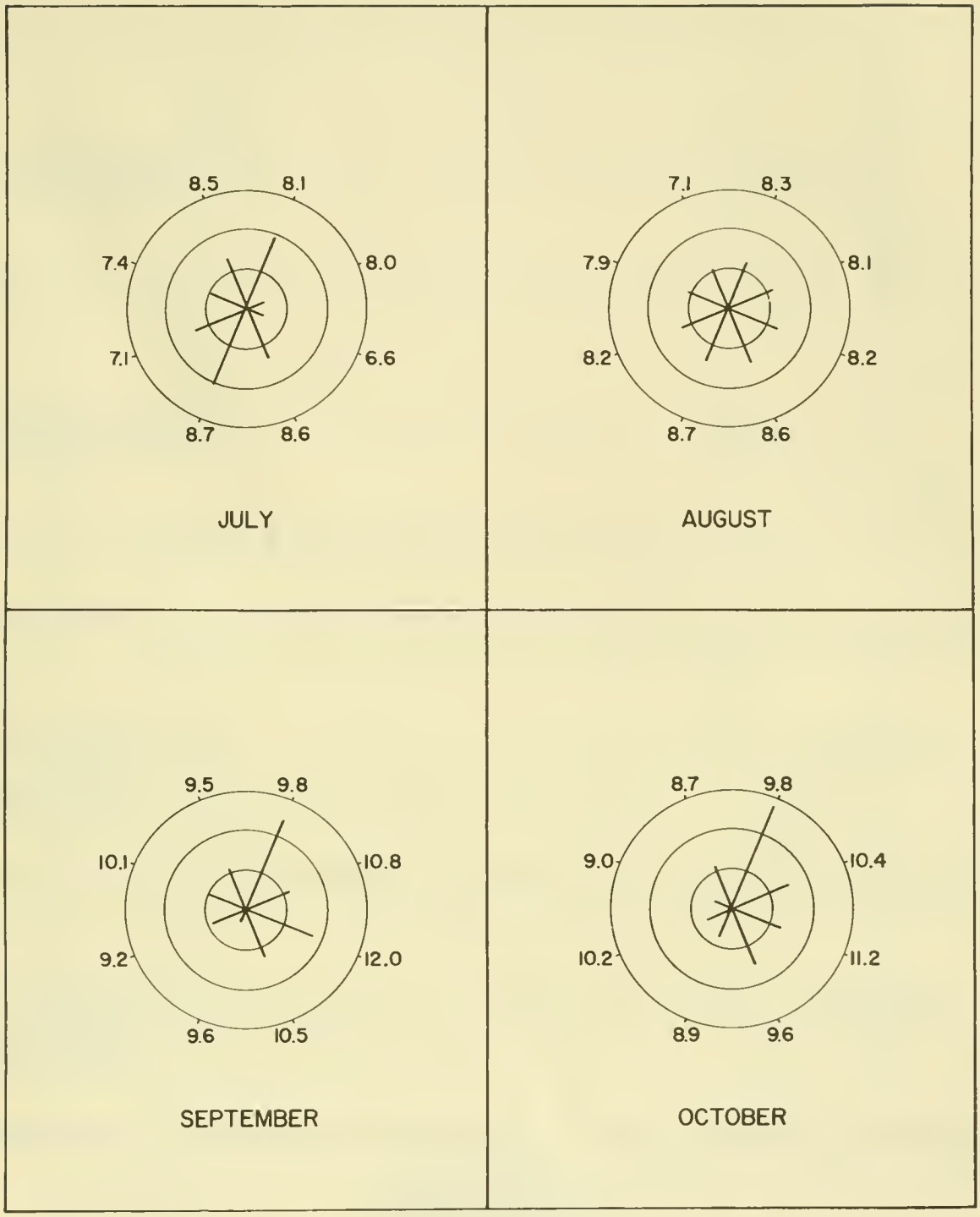

Figure 3. --Wind diagrams based on observations from the Milwaukee, Wisconsin, Chicago, Illinois, and South Bend, Indiana, U. S. Weather Bureau Stations, 1954. Lines radiating from the center are directions toward which the wind was blowing. Percentage of time is indicated by the length of the line; the radii of the concentric circles are in multiples of 10 percent. Numbers are average velocities in miles per hour.

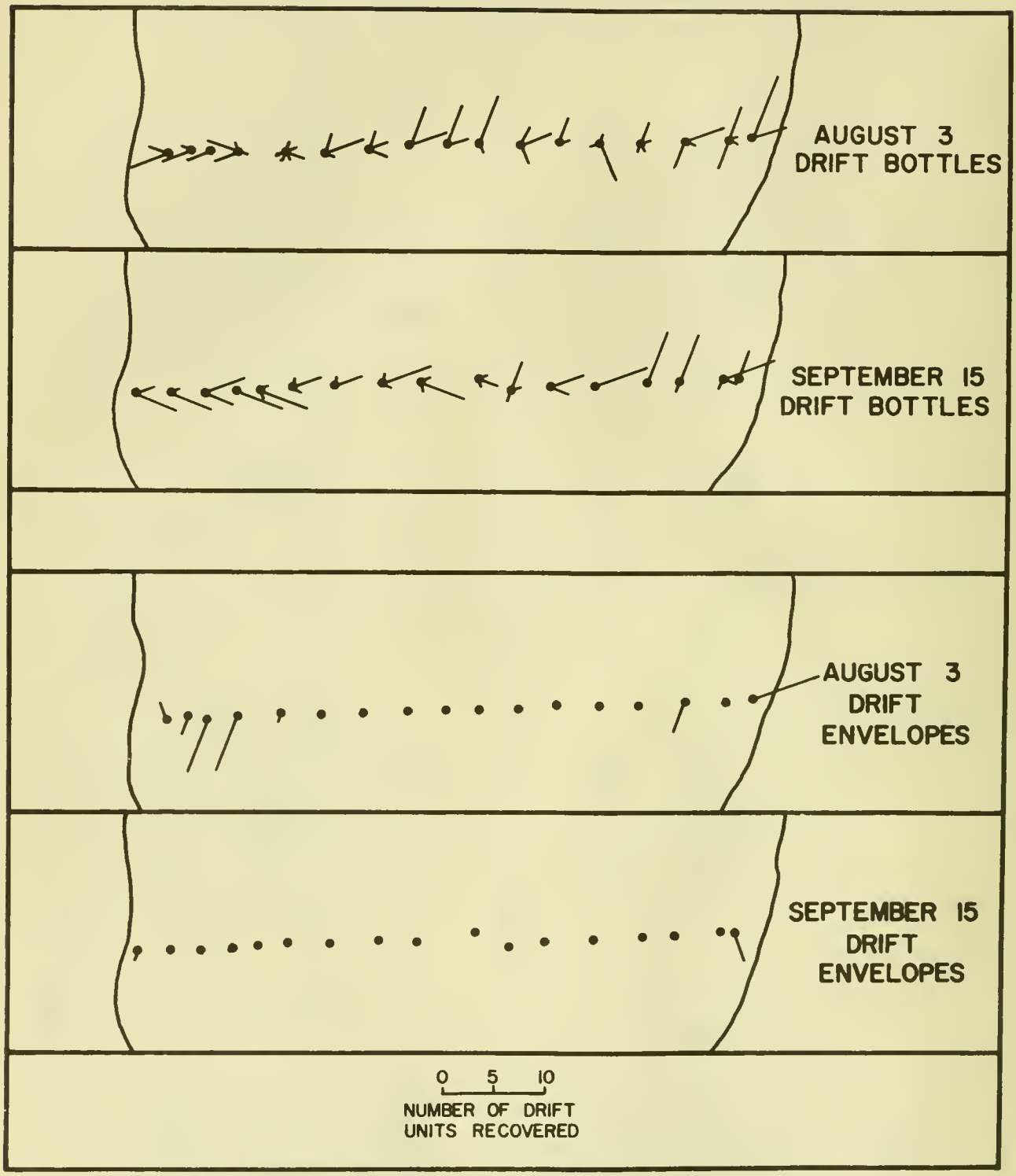

Figure 4. --Release stations, numbers recovered, and directions of recovery points of drift units that were released in 1954 on the South Haven-Waukegan transect.

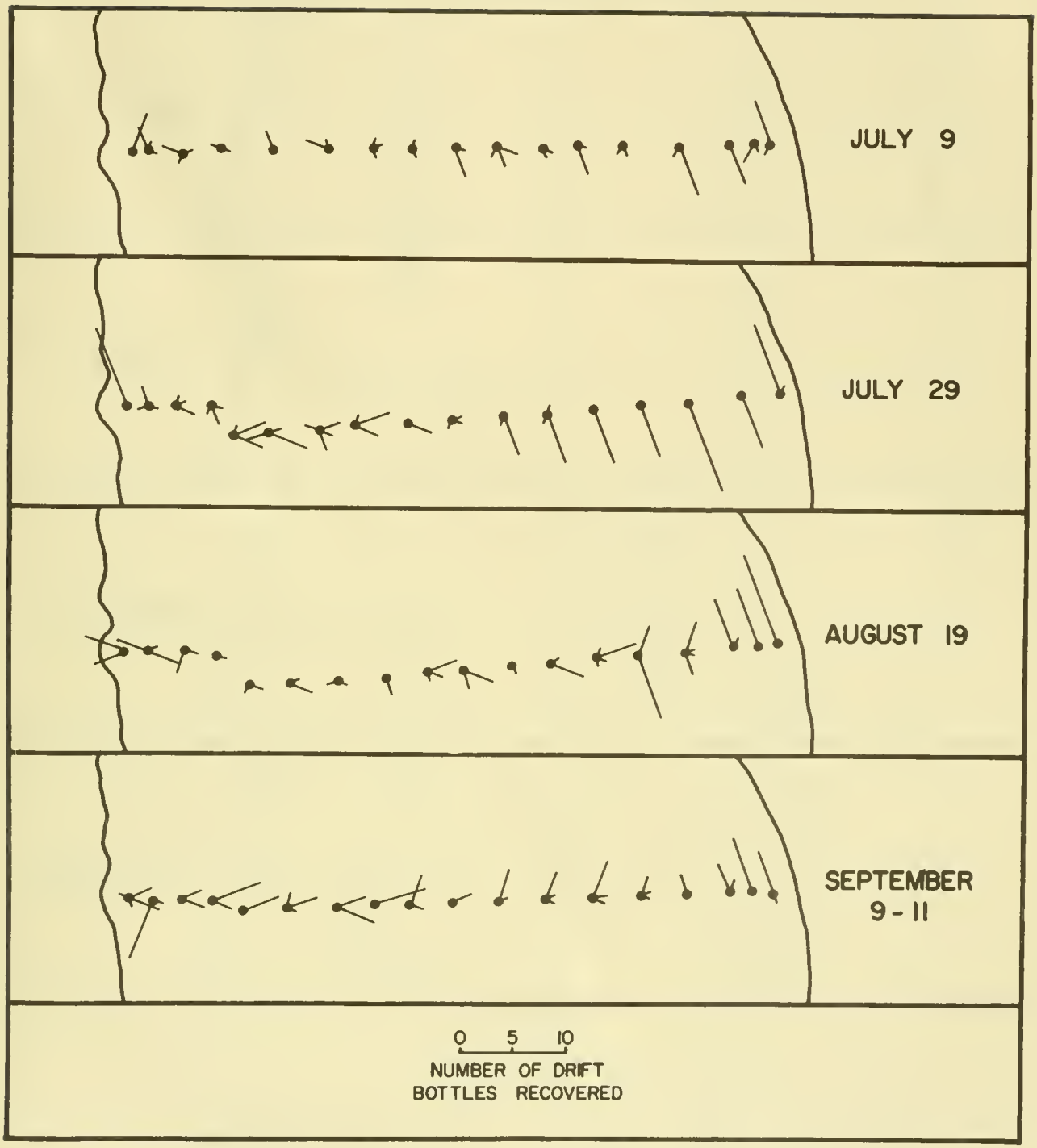

Figure 5. --Release stations, numbers recovered, and directions of recovery points of drift bottles that were released in 1954 on the Grand Haven-Milwaukee transect. For the transect in September bottles were released at the two easternmost stations on September 9 and the remaining stations on September 11.

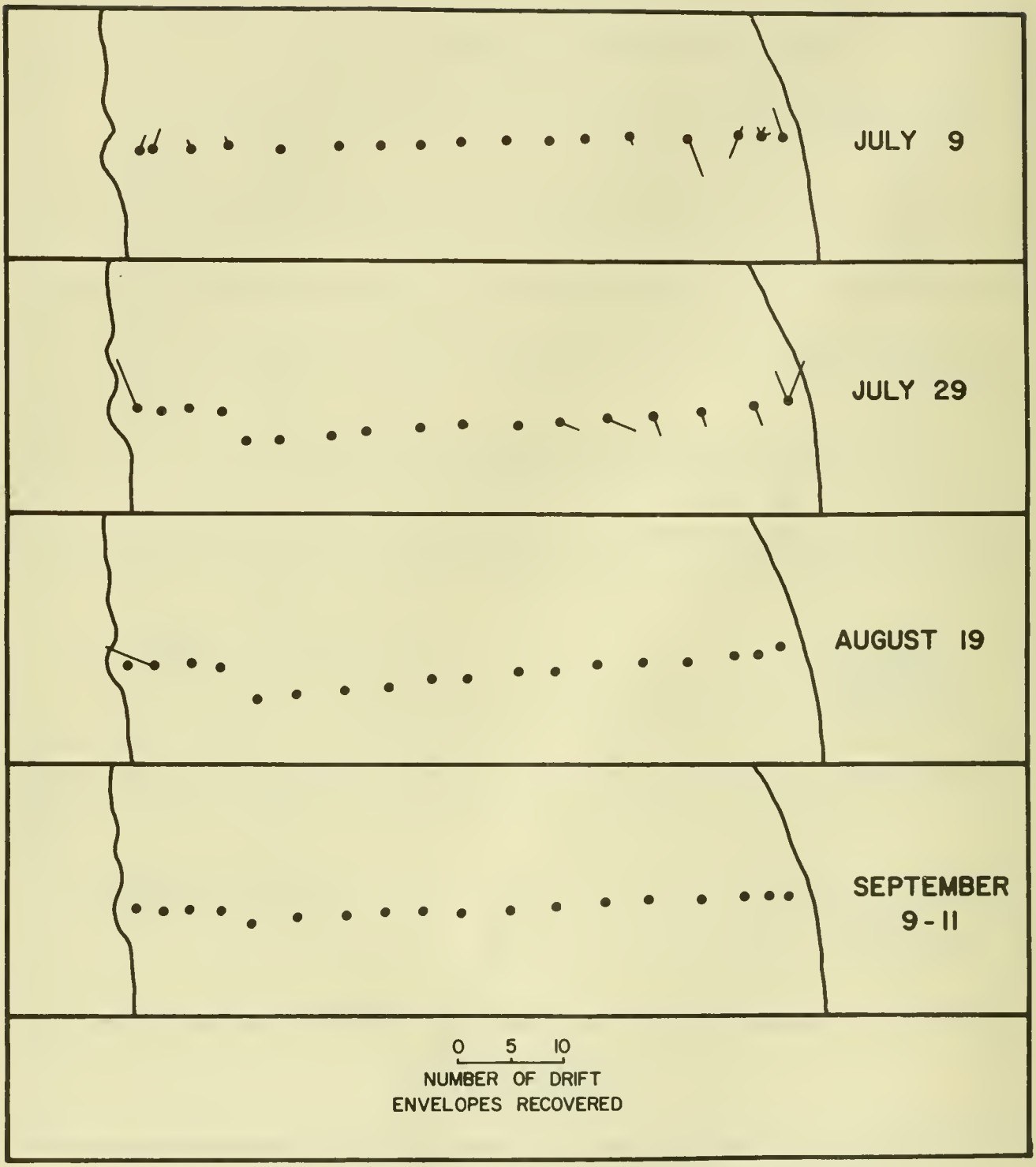

Figure 6.--Release stations, numbers recovered, and directions of recovery points of drift envelopes that were released in 1954 on the Grand Haven-Milwaukee transect. For the transect in September envelopes were released at the two eastern-most stations on September 9 and the remaining stations on September 11.

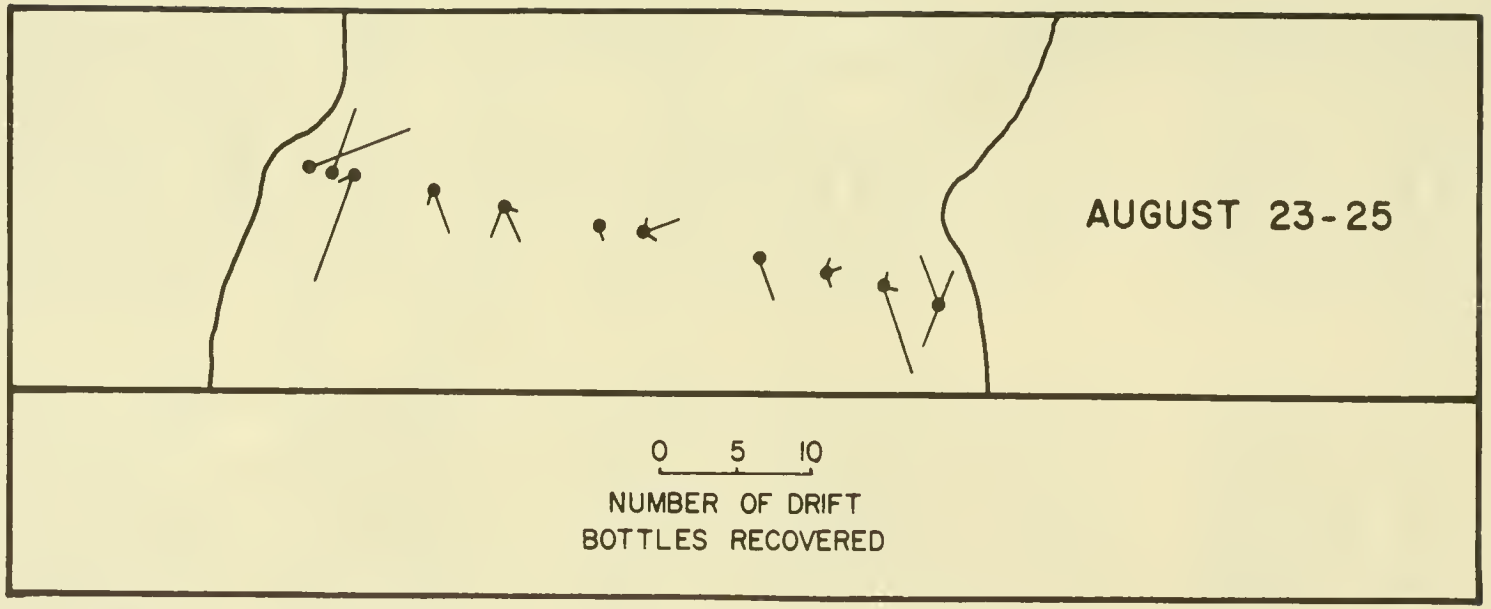

Figure 7. --Release stations, numbers recovered, and directions of recovery points of drift bottles that were released in 1954 on the Ludington-Manitowoc transect. Bottles were released at the westernmost station on August 23 and the remaining stations on August 25.

release station. The possibility exists also that the bottles at this station were released in an area of mixing between north- and south-bound currents.

None of the 110 drift cards released on the Ludington-Manitowoc transect were recovered.

I have talked to commercial fishermen from Ludington who speak freely of currents "in and out." They report that frequently currents flow in completely opposite directions along a north-south line a short distance offshore, and report also an inconstancy of these currents, which often change from one day to the next.

Rate of drift. --The average rate of drift for all bottles released on the 7 crossings ranged from 1.0 to 2.1 miles per day compared to 1.3 to 5.7 miles per day for drift envelopes (table 4). The difference in mean rate of drift between envelopes and bottles is not as great as appears from these averages. Recoveries of drift envelopes were nearly all from releases at inshore stations whereas drift bottles were recovered from all stations. In general, rates of drift for bottles released at inshore stations were higher than the rates for bottles released offshore. Bias because of difference in recovery pattern can be eliminated partially by comparing rates only for recovery of units from stations where both envelopes and bottles were recovered. From 26 of such stations, 20 indicated faster drift rates for envelopes than for bottles (table 4); thus a real difference exists between the two units.

The slow drift of bottles released at offshore stations (table 4) suggests the possibility of gyral movement of surface water. Calculated drift rates of bottles moving in curved paths to landing points would be lower than actual rates of movement since a straight line was used from release to recovery point in determining distance traveled.

Rates for some individual bottles were very much higher than the average, especially for those released in the littoral zone. Three bottles released at the station nearest Grand Haven on August 19 traveled slightly more than 100 miles to the north at a rate of approximately 10 miles per day (table 9). A similar rapid drift to the north had occurred 3 weeks previously when 3 bottles traveled 16 miles to the north in 2 days (table 9).

General characteristics of surface-water movements. --The surface-current pattern in southern Lake Michigan in 1954 was not stable. Over any one transect the current had changed from one release date to the next. The littoral current to the north off Grand Haven appears to have been the most stable; it was apparent from recoveries made from releases at four different times. A similar north-bound littoral current off South Haven followed both the August 3 and September 15 releases (fig. 4). From the remaining areas drift was mainly from west to east except that recoveries from the southwestern quarter of the lake were made in equal numbers along the east and west shores.

Central and Northern Lake Michigan, 1955

Grand Haven-Manitowoc-Sturgeon Bay transects. --The Grand Haven-Manitowoc section was traveled on April 26 and the Manitowoc-Sturgeon Bay leg on April 27. The recoveries from drift bottles released on the two days were mostly from Michigan shores (282 of 325 units). Most bottles were recovered north of their release station (figs. 9-10). Movements of bottles with drags and sand-ballasted bottles released on April 26 were similar whereas the drift of the two types of bottles differed significantly on the Manitowoc-Sturgeon Bay leg (figs. 9-10). Most of the sand-ballasted bottles were recovered from the eastern shores of the lake (34 of 44 bottles recovered), whereas well over half of the bottles with drags (29 of 41) were recovered from the northern and western shores.

The north-bound littoral current off Grand Haven, found consistently in the 1954 studies, was evident again as is shown by the recoveries from the liberations on April 26.

The prevailing winds for May, when most of the bottles released April 26-27 were adrift, were from the southwest and northwest (fig. 8, table 5).

Ludington-Manitowoc transect. --Movements of drift bottles with drags and sand-ballasted bottles released on the Ludington-Manitowoc transect were in good agreement. The first of the 5 transects was made on May 13 when 240 units were released. Bottles released on this date appeared in general to move in a counterclockwise pattern (figs. 11-12). Most of those from the 3 westernmost stations moved southward but, from these stations eastward the trend was increasing to the east and north.

Table 4. --Number of drift units recovered from those released at each station in 1954 and the average drift rates from these stations to point of recovery

[Envelopes were released but none were recovered on the Ludington-Manitowoc transect August 23-25, and the Grand Haven-Milwaukee transect September 9-11]

Station	Grand Haven-Milwaukee July 9				Grand Haven-Milwaukee July 29				South Haven-Waukegan August 3				Grand Haven-Milwaukee August 19				Ludington-Manitowoc August 23-25		Grand Haven-Milwaukee September 9-11		South Haven-Waukegan September 15			
	Bottles		Envelopes		Bottles		Envelopes		Bottles		Envelopes		Bottles		Envelopes		Bottles		Bottles		Bottles		Envelopes	
	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day	Number	Miles per day
1	5	2.7	3	2.1	8	4.5	7	8.0	10	2.1	7	2.4	9	7.6	0	...	8	0.6	5	0.9	3	0.8	3	3.3
2	3	3.4	3	2.8	5	4.0	2	7.9	8	1.6	0	...	6	4.8	0	...	8	0.7	6	2.1	7	1.1	0	...
3	4	2.1	3	4.5	9	4.5	1	10.7	8	0.7	3	5.6	6	2.9	0	...	3	0.7	4	3.1	6	3.8	0	...
4	6	2.1	4	3.1	5	1.4	2	4.9	5	0.9	0	...	7	1.0	0	...	3	1.5	2	2.3	6	2.8	0	...
5	2	2.0	1	2.0	6	1.6	3	6.1	6	0.7	0	...	9	1.1	0	...	4	0.9	4	0.6	6	2.4	0	...
6	4	1.7	0	...	7	1.2	2	3.6	4	0.7	0	...	7	1.0	0	...	1	1.3	6	1.3	5	2.6	0	...
7	2	1.5	0	...	5	1.6	0	...	7	0.6	0	...	4	0.9	0	...	5	1.4	5	1.4	5	2.0	0	...
8	5	1.4	0	...	3	1.0	0	...	6	0.9	0	...	1	1.5	0	...	4	1.7	4	1.5	4	1.2	0	...
9	4	1.1	0	...	2	0.9	0	...	6	0.7	0	...	5	1.5	0	...	8	1.4	2	0.7	6	1.2	0	...
10	2	0.8	0	...	7	0.8	0	...	8	1.0	0	...	5	0.8	0	...	4	0.5	4	1.6	7	1.5	0	...
11	3	0.6	0	...	6	0.8	0	...	6	0.9	0	...	2	1.1	0	...	7	1.9	5	0.9	4	1.7	0	...
12	3	0.8	0	...	7	1.0	0	...	7	0.9	0	...	2	0.9	0	...	...	...	7	0.9	5	1.3	0	...
13	2	0.9	0	...	7	1.0	0	...	7	0.9	1	2.1	3	1.1	0	...	...	...	6	0.9	7	1.2	0	...
14	2	0.6	1	3.4	4	0.8	0	...	7	0.6	6	3.3	2	0.7	0	...	...	...	4	0.9	5	1.1	0	...
15	4	0.3	1	4.3	4	1.0	0	...	2	0.7	6	2.2	1	0.7	0	...	...	...	7	1.1	7	2.6	0	...
16	4	1.2	2	2.3	4	0.8	0	...	4	0.9	2	1.3	3	1.0	0	...	...	...	4	1.5	5	1.6	0	...
17	4	3.0	1	3.4	8	2.9	5	1.8	6	0.6	2	1.8	7	1.3	5	1.3	...	...	7	1.9	6	1.9	1	1.7
18	.	...	.	...	.	...	.	...	.	...	.	...	7	0.6	0	...	...	...	7	1.5	.	...	.	...
Total or average	59	1.6	19	3.1	97	2.0	22	5.7	107	1.0	27	2.7	86	2.1	5	1.3	55	1.1	89	1.4	94	1.9	4	2.9

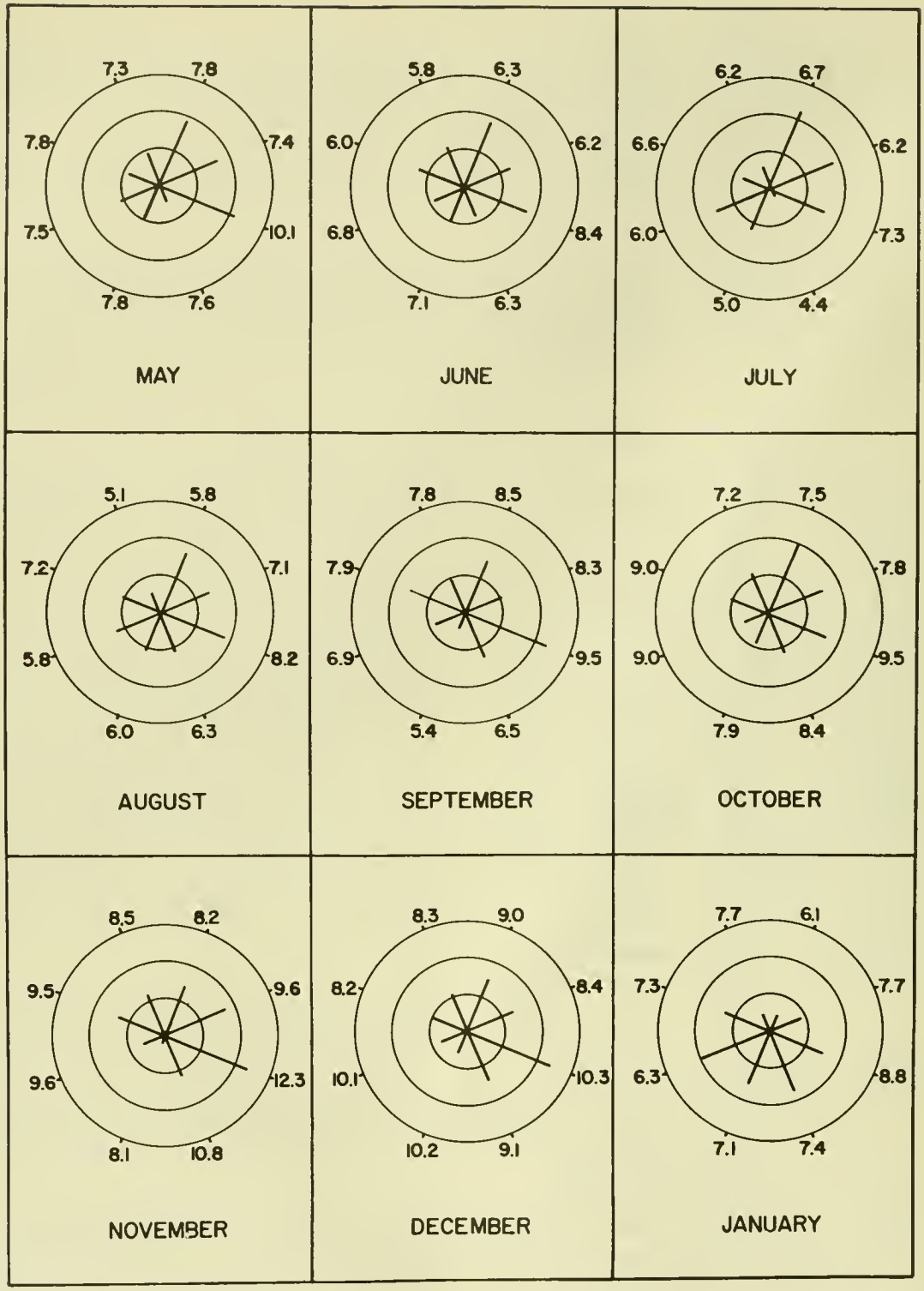

Figure 8. --Wind diagrams based on observations from the Green Bay, Wisconsin, Sault Ste. Marie, Michigan, and East Lansing, Michigan, U. S. Weather Bureau Stations May 1955-January 1956. Lines radiating from the center are directions toward which the wind was blowing. Percentage of time is indicated by the length of the line; the radii of the concentric circles are in multiples of 10 percent. Numbers are average velocities in miles per hour.

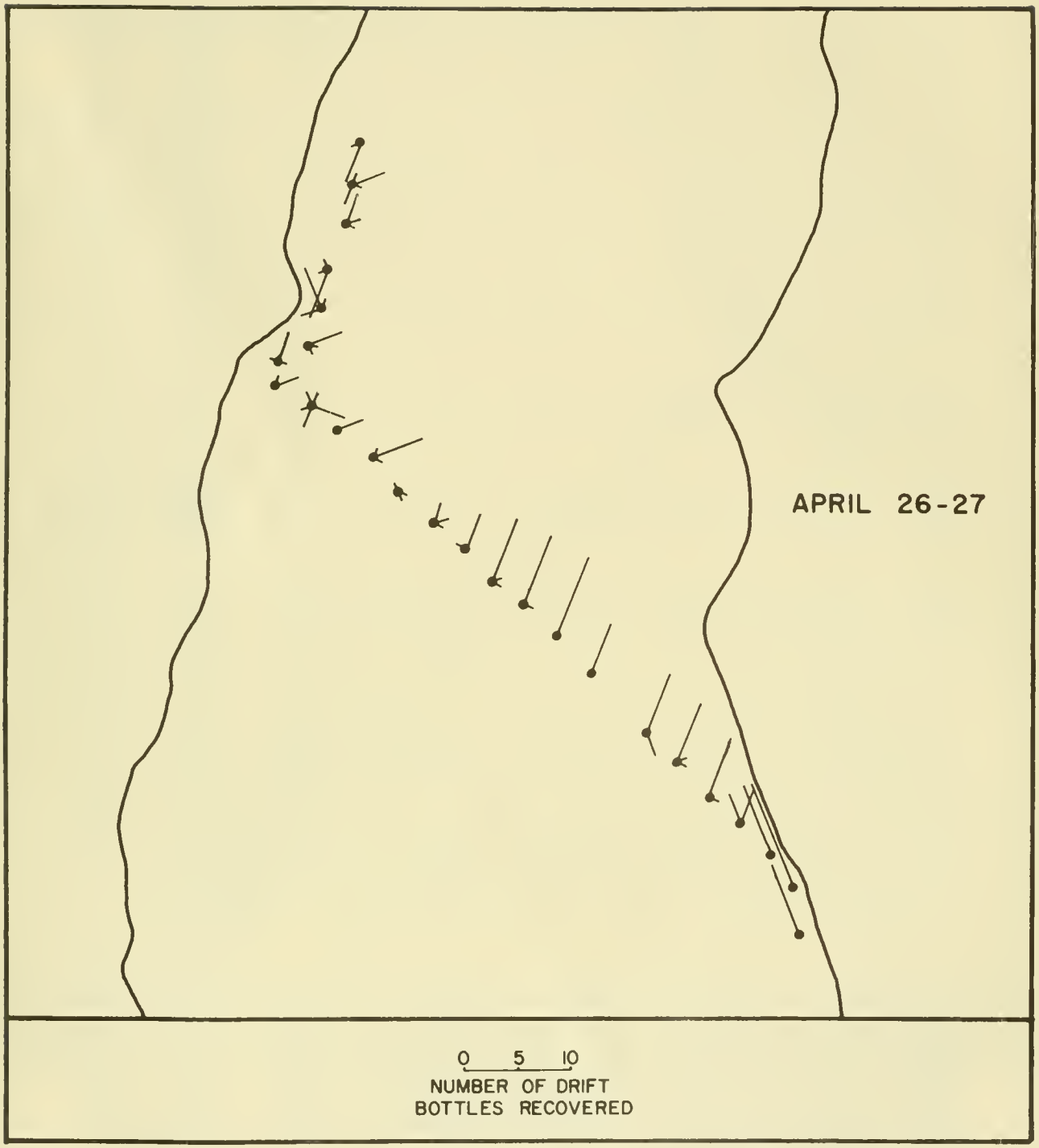

Figure 9.--Release stations, numbers recovered, and directions of recovery points of drift bottles with drags released in 1955 on the Grand Haven-Manitowoc-Sturgeon Bay transects.

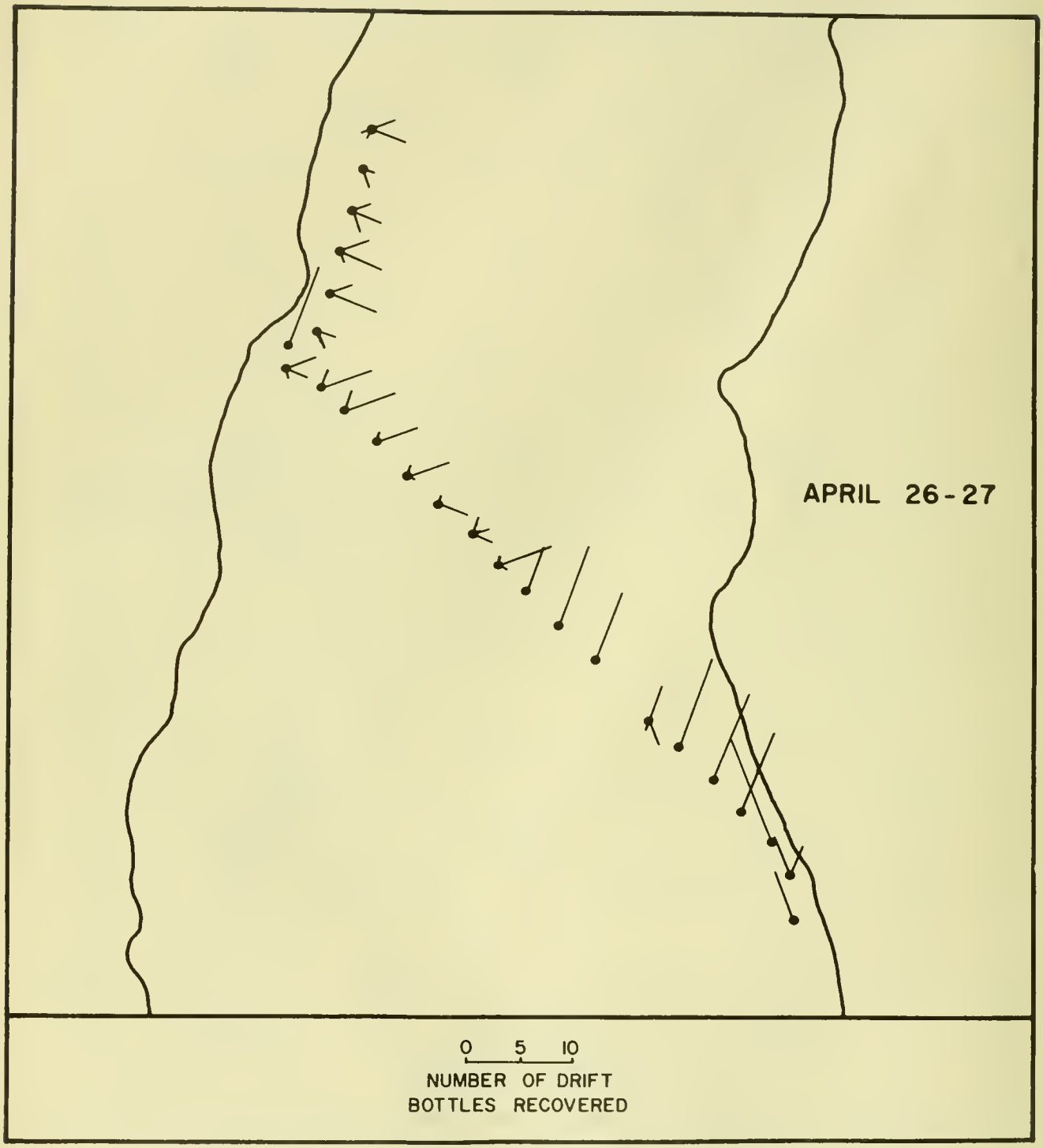

Figure 10.--Release stations, numbers recovered, and directions of recovery points of sand-ballasted bottles released in 1955 on the Grand Haven-Manitowoc-Sturgeon Bay transects.

Table 5. --Percentage time winds blew toward each of 8 sectors in northern Lake Michigan and mean velocity, May 1955-January 1956

[Based on daily records from the U. S. Weather Bureau Stations at Green Bay, Wisconsin, Sault Ste. Marie, Michigan, and East Lansing Michigan. When the wind direction for a day fell exactly along the line dividing sectors, the time was divided equally between the two]

Month and item	Sector							
	000°-045°	045°-090°	090°-135°	135°-180°	180°-225°	225°-270°	270°-315°	315°-360°
May								
Percentage time in sector	18.8	16.7	21.5	4.8	9.7	10.8	8.6	9.1
Mean velocity (mph)	7.8	7.4	10.1	7.6	7.8	7.5	7.8	7.3
June								
Percentage time in sector	18.3	12.8	17.8	8.3	10.0	8.9	12.8	11.1
Mean velocity (mph)	6.3	6.2	8.4	6.3	7.1	6.8	6.0	5.8
July								
Percentage time in sector	22.6	18.3	16.1	2.7	11.8	15.1	7.5	5.9
Mean velocity (mph)	6.7	6.2	7.3	4.4	5.0	6.0	6.6	6.2
August								
Percentage time in sector	17.2	14.0	18.3	11.3	10.8	12.4	10.2	5.9
Mean velocity (mph)	5.8	7.1	8.2	6.3	6.0	5.8	7.2	5.1
September								
Percentage time in sector	15.0	10.6	23.3	13.3	4.4	8.3	15.6	9.4
Mean velocity (mph)	8.5	8.3	9.5	6.5	5.4	6.9	7.9	7.8
October								
Percentage time in sector	19.4	15.1	16.7	11.8	9.1	6.5	10.2	11.3
Mean velocity (mph)	7.5	7.8	9.5	8.4	7.9	9.0	9.0	7.2
November								
Percentage time in sector	14.4	17.2	23.3	11.7	2.2	6.1	13.3	11.7
Mean velocity (mph)	8.2	9.6	12.3	10.8	8.1	9.6	9.5	8.5
December								
Percentage time in sector	15.1	13.4	23.7	14.5	6.5	7.0	9.7	10.2
Mean velocity (mph)	9.0	8.4	10.3	9.1	10.2	10.1	8.2	8.3
January								
Percentage time in sector	5.4	8.6	15.1	17.7	15.6	19.9	12.9	4.8
Mean velocity (mph)	6.1	7.7	8.8	7.4	7.1	6.3	7.3	7.7

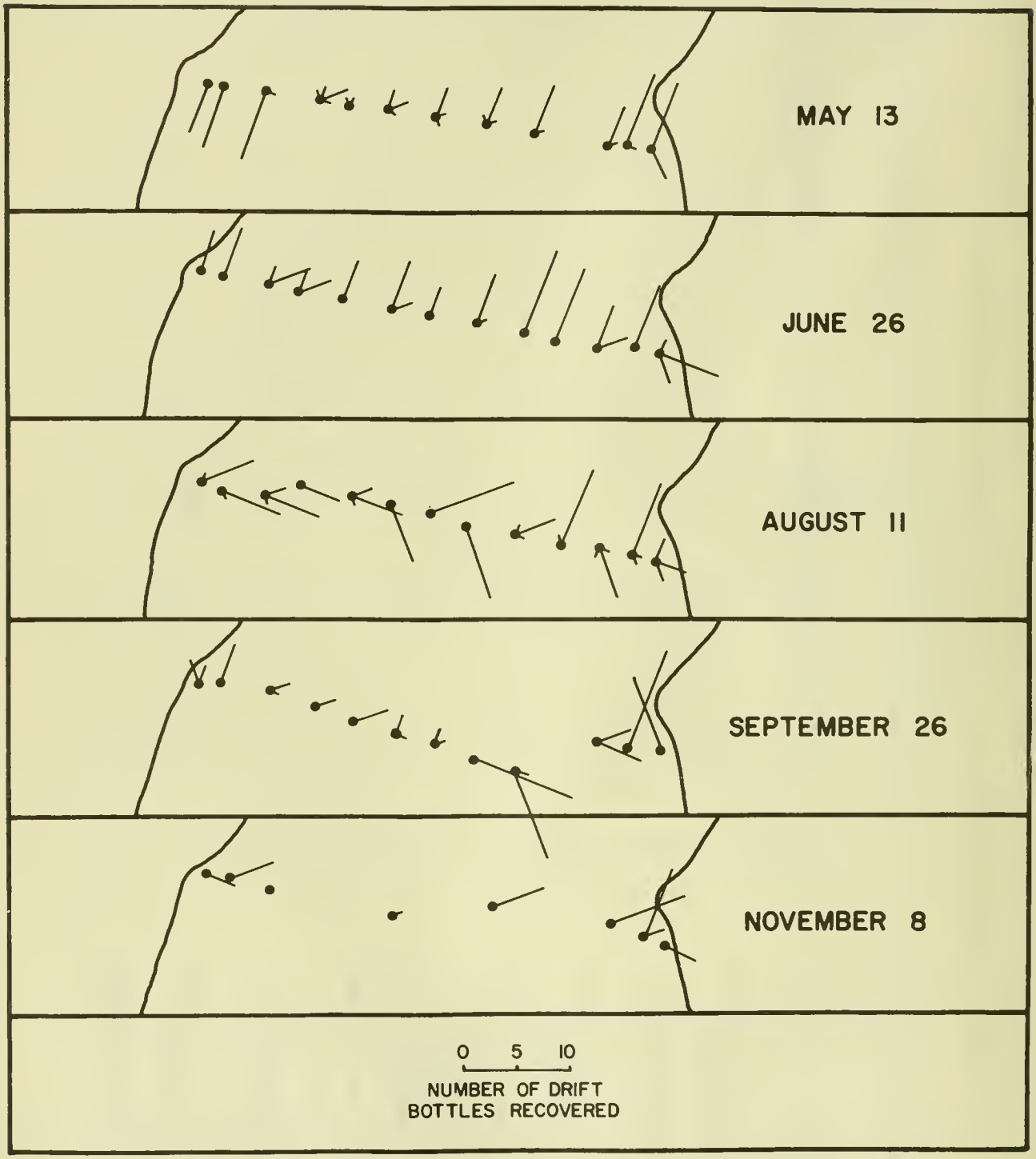

Figure 11. --Release stations, numbers recovered, and directions of recovery points of drift bottles with drags released in 1955 on the Ludington-Manitowoc transect.

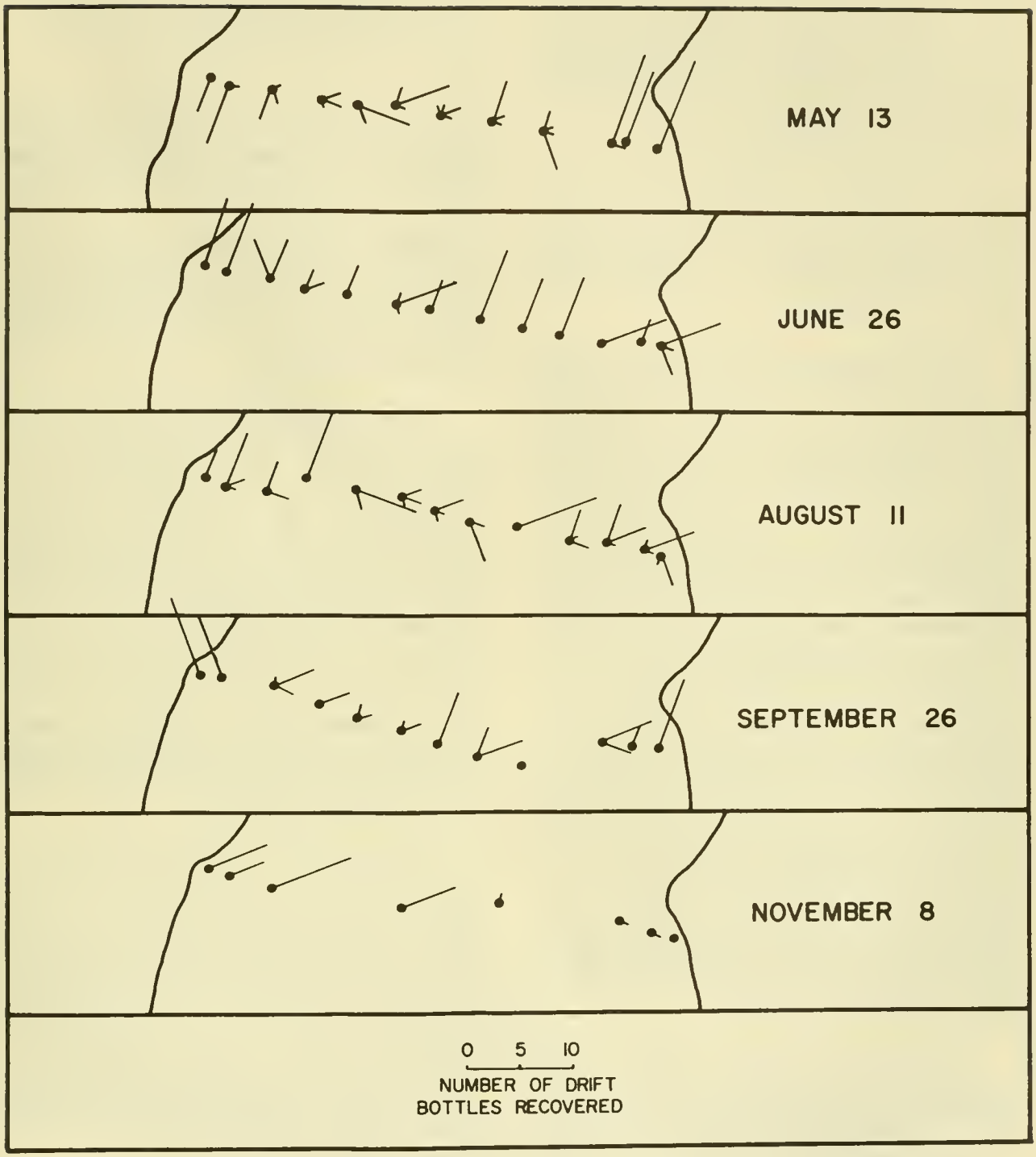

Figure 12. --Release stations, numbers recovered, and directions of recovery points of sand-ballasted bottles released in 1955 on the Ludington-Manitowoc transect.

The most prominent feature in the recoveries of the units liberated on June 26 was the movement almost exclusively to the north and east of release stations. Ayers et al. (1958) noted a similar movement of drift bottles released June 28 and 29, 1955, in this area. Only near the Michigan shore did any substantial numbers drift to the south. In July, when the major number of these bottles were adrift, the percentage of southwest winds was high (fig. 8).

A major change in circulation from that shown by the recoveries from the May 13 releases had occurred in the western area of the lake by June 26 or shortly thereafter. After May 13 the drift was to the south whereas subsequent to the June 26 releases the drift was to the north (figs. 11-12).

The drift of units released on August 11 was particularly complicated (figs. 11-12). The movement in general was from west to east, apparently under the influence of the prevailing westerly winds of August and September (fig. 8), but recoveries from releases at adjacent stations frequently were many miles apart on the east shores. An unusual combination of wind stress and density distribution probably caused the widespread recovery. Evidence of exceptional conditions comes from the major fluctuations in water temperatures first detected by the M/V Cisco off Ludington on August 9, 2 days before the drift bottles were released. Sharp decreases in the water temperature of the upper layers continued until the surface-water temperature had dropped to 4.8°C. on August 14, 2 miles offshore north of Ludington. The "normal" surface-water temperature in the area at this time of year is near 20.0° C. Ayers et al. (1958) also found the cold water along the east shore as well as a major north-south current in the area on synoptic surveys of August 9 and 10. They attributed this condition to the following situation: "When effective wind stress in the Straits is from directions too far north or east of normal, wind-driven surface water transport (current) is directed back into Lake Michigan where it induces modification of the normal current pattern."

The pronounced south-bound east-shore current described by Ayers is not substantiated by returns of drift bottles with drags released August 11 at the second and fourth stations west of Ludington (fig. 11). Bottles released at these stations were recovered mainly to the northeast and had traveled at relatively rapid rates. Ayers et al. (1958) believed, however, that shortly after August 10 (the date of his last synoptic survey) the north-bound current was soon re-established. This belief, if true, could account for the recovery locations of bottles released at stations 2 and 4, but would not, however, account for recovery to the south of bottles released at station 3.

The recoveries from the bottles released in September 26 and November 8 exhibited a general west-to-east drift caused presumably by the westerly winds that predominated in October and November (fig. 8).

Frankfort-Sturgeon Bay transect. --The transects from Frankfort to Sturgeon Bay offer still another example of the considerable variability of surface currents and also give another example of the similarity of results from releases of bottles with drags and bottles ballasted with sand.

The recoveries of the releases made on the transect on May 16 and 17 (strong winds prevented completion of the transect on May 16) disclose a pattern remarkably similar to the recoveries from the Ludington-Manitowoc releases 3 days earlier. The littoral current on the east shore was north-bound and that on the west shore was south-bound. Recoveries from the intermediate stations were made mostly to the east and north, particularly for stations to the east of the middle of the lake (figs. 13-14). Recoveries from the releases of June 23 disclose that the surface drift had shifted from south to north in the western area of the lake. The distribution of recoveries for this transect was similar to that of the recoveries from the Ludington-Manitowoc transect 3 days later in that the drift was almost entirely northward.

The bottles released on August 19 moved in a more consistent pattern than did those of the releases 8 days earlier on the Ludington-Manitowoc transect (figs. 13-14). Thermograph records from the M/V Cisco on August 15 off Ludington show an increase of surface-water temperatures over those during the major upwelling a week earlier. By August 19 surface temperatures off Frankfort (19° to 24° C.) were again near normal for mid-August and drift-bottle movement to the north from releases near shore off Frankfort suggest that the "normal" north-bound current had become re-established along the east shore.

The drift from the September 22 and November 4 liberations was generally from west to east except in

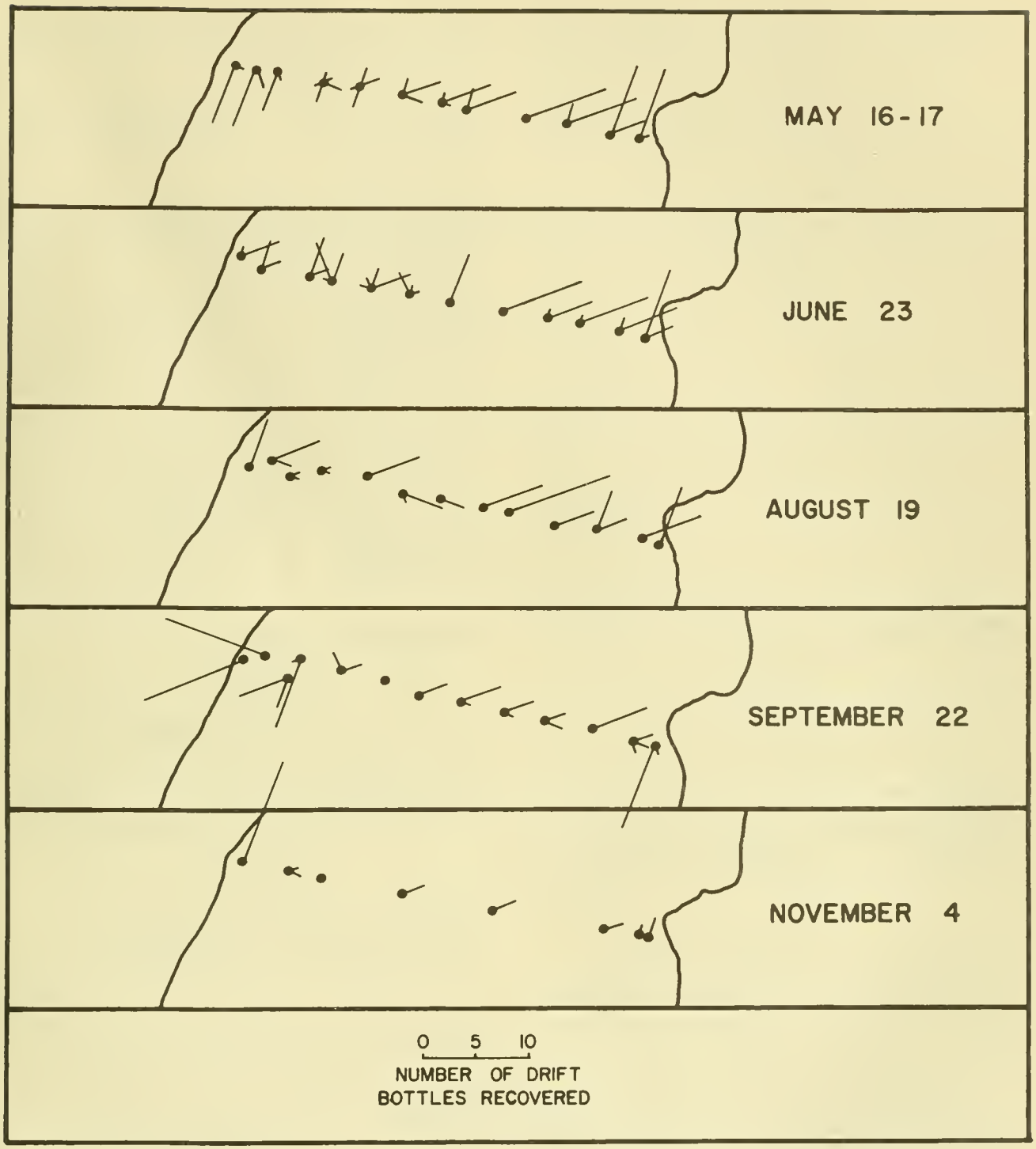

Figure 13. --Release stations, numbers recovered, and directions of recovery points of drift bottles with drags released in 1955 on the Frankfort-Sturgeon Bay transect. For the transect in May, bottles were released on the two westernmost stations on May 16 and at the remaining stations on May 17.

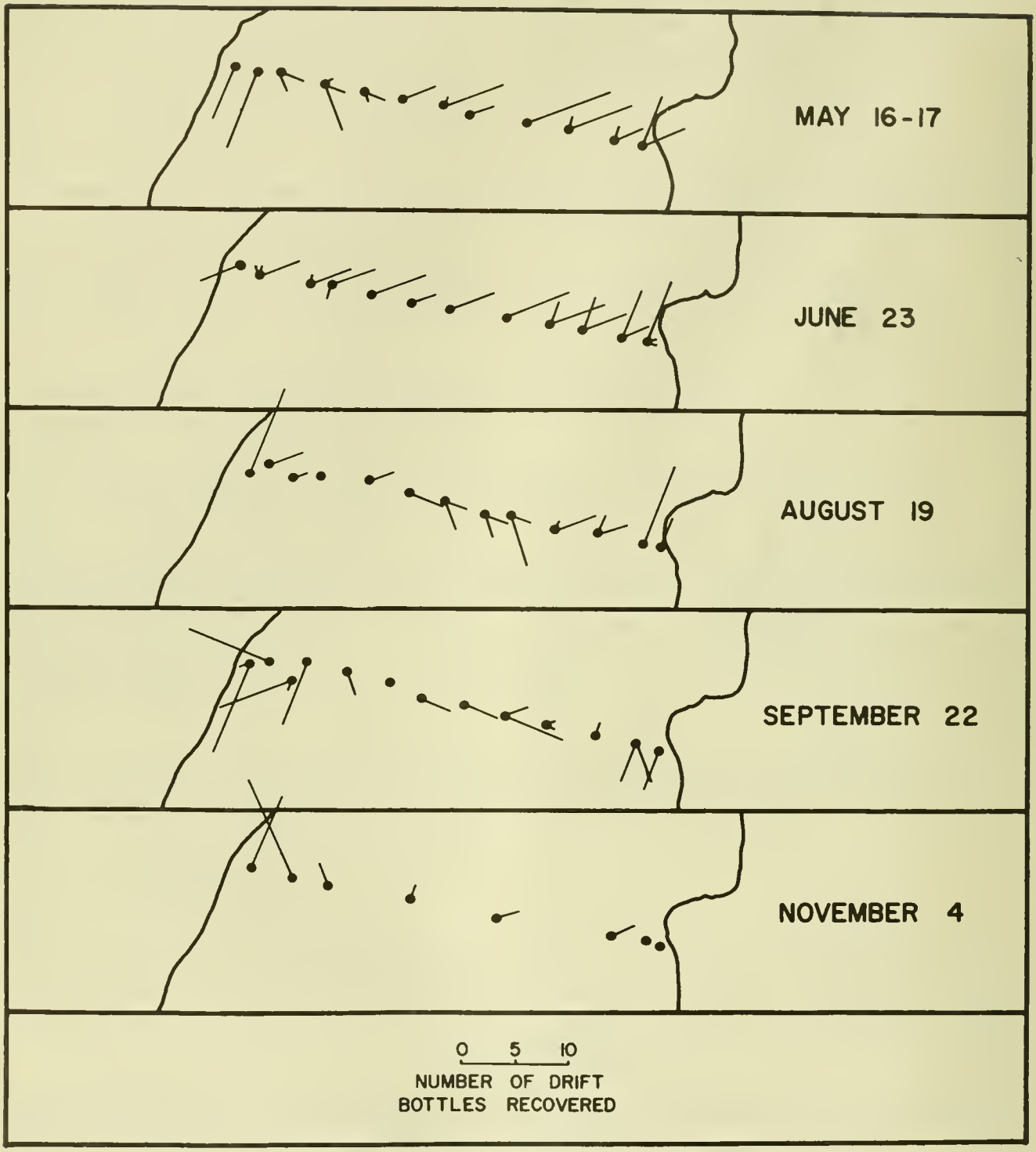

Figure 14. --Release stations, numbers recovered, and directions of recovery points of sand-ballasted bottles released in 1955 on the Frankfort-Sturgeon Bay transect. For the transect in May, bottles were released at the two westernmost stations on May 16 and at the remaining stations on May 17.

the western part of the lake (figs. 13-14). The mass landing on the Wisconsin shore from the 2 westernmost stations from the September 22 releases may have been caused by east winds. The U. S. Coast Guard station at Sturgeon Bay reported east winds from 2 days before until 1 day after release.

If Ayers et al. (1958) were correct in their conclusion that winds too far north or east of normal in the Straits of Mackinac cause modification of the normal flow (normal being north-bound off the east shore), north or east winds must have been strong on or about September 22 to cause the prominent southward flow off Frankfort (figs. 13-14). Wind observations at U.S. Coast Guard stations on Beaver Island and at Manistee, Michigan (table 6), support their conclusion.

Charlevoix-Manistique transect. --The returns from releases of bottles along this, the most northerly of transects, exhibited many similarities to those from releases at corresponding dates along more southerly transects. The data for bottles with drags and for sand-ballasted bottles agreed well again except for inshore stations off Charlevoix.

The recoveries of bottles released on June 5 resembled those from the first Ludington-Manitowoc and Frankfort-Sturgeon Bay releases in that the drift was essentially counterclockwise (figs. 15-16). The direction of drift of sand-ballasted bottles and bottles with drags differed at the first two stations off Charlevoix on June 5 (figs. 15-16). The bottles with drags drifted to the northeast whereas the sand-ballasted bottles were recovered mostly from the southwest.

On July 14, nearly 6 weeks after the first releases on this transect, the littoral current on the west shore was to the northeast instead of southwest. The returns from the remaining stations were similar to those of the June 5 transect (figs. 15-16).

The recoveries from releases made on the September 5 transect exhibit few clear trends (figs. 17-18). No strong littoral currents were evident, and many bottles released in the center of the lake traveled to the west shore and north to the islands.

West-to-east drift had reappeared by late October and November, as evidenced by recoveries of the October 19 releases (figs. 17-18).

Rate of drift. --The average drift rate of the bottles with drags was 1.5 miles per day as compared to 1.8 miles per day for the sand-ballasted bottles (table 2). On 3 of 16 transects, however, the drift rate of the bottles with drags was higher than that of the sand-ballasted bottles. A very high rate of drift for a bottle with drag was for one that traveled 64 miles across the lake from west to east in 10 days, a drift rate of 6.4 miles per day (table 17). A sand-ballasted bottle released at an adjacent station made a 65-mile crossing in 9 days, a drift rate of 7.2 miles per day (table 18). These bottles were released on November 8 at stations 7 and 8 respectively on the Ludington-Manitowoc transect. The Sturgeon Bay Coast Guard station reported prevailing westerly winds for the 10 days following release of these bottles on November 8, and southwest winds of Beaufort 10 (55 to 63 miles per hour) on November 16. The maximum drift rate for sand-ballasted bottles (11.0 miles per day) occurred for 2 bottles released on November 4, approximately 15 miles east of Sturgeon Bay, Wisconsin (table 20). Both types of units released at station 4 (approximately 15 miles west of Ludington, Michigan) on June 26 traveled to the north at high rates of drift; a sand-ballasted bottle traveled 115 miles in 14 days (8.2 miles per day, table 18) and a bottle with drag 87 miles in 14 days (6.2 miles per day, table 17). During these 14 days the Manistee Coast Guard station reported 57 observations of winds with a southerly component (wind from the south), 11 northerly, 26 westerly, and 16 easterly; the south winds were slightly stronger than those from any other direction. The overwhelmingly predominance of south winds over north winds and the relatively greater number of west winds over east winds doubtless account for this rapid drift rate to the northeast.

General characteristics. --The north-bound littoral current found off Grand Haven in 1954 was evident in 1955 as is shown by the recoveries from bottles released April 26 (figs. 9-10).

In central areas of the lake, drift was generally west to east and south to north. Greatest deviation from this pattern followed the release of bottles August 11 on the Ludington-Manitowoc crossing (figs. 11-12) when drift to the south was equally as prominent as drift to the north.

In the northern areas of the lake, drift was mainly west to east.

Table 6. --Wind data from Coast Guard stations in northern Lake Michigan
[Numbers following directions are velocities in miles per hour converted from Beaufort scale readings]

Hour of observation	September 21		September 22		September 23	
	Beaver Island	Manistee	Beaver Island	Manistee	Beaver Island	Manistee
0400	NE 16	E 5	E 35	W 5	E 28	N 10
0800	E 28	E 5	E 35	E 2	E 16	E 16
1200	E 28	E 16	E 21	SE 5	E 16	E 10
1600	E 28	E 16	NE 28	ESE 5	NE 16	W 5
2000	E 28	E 10	E 28	ESE 2	NE 10	E 2
2400	E 35	N 16	E 21	E 5	N 10	S 10

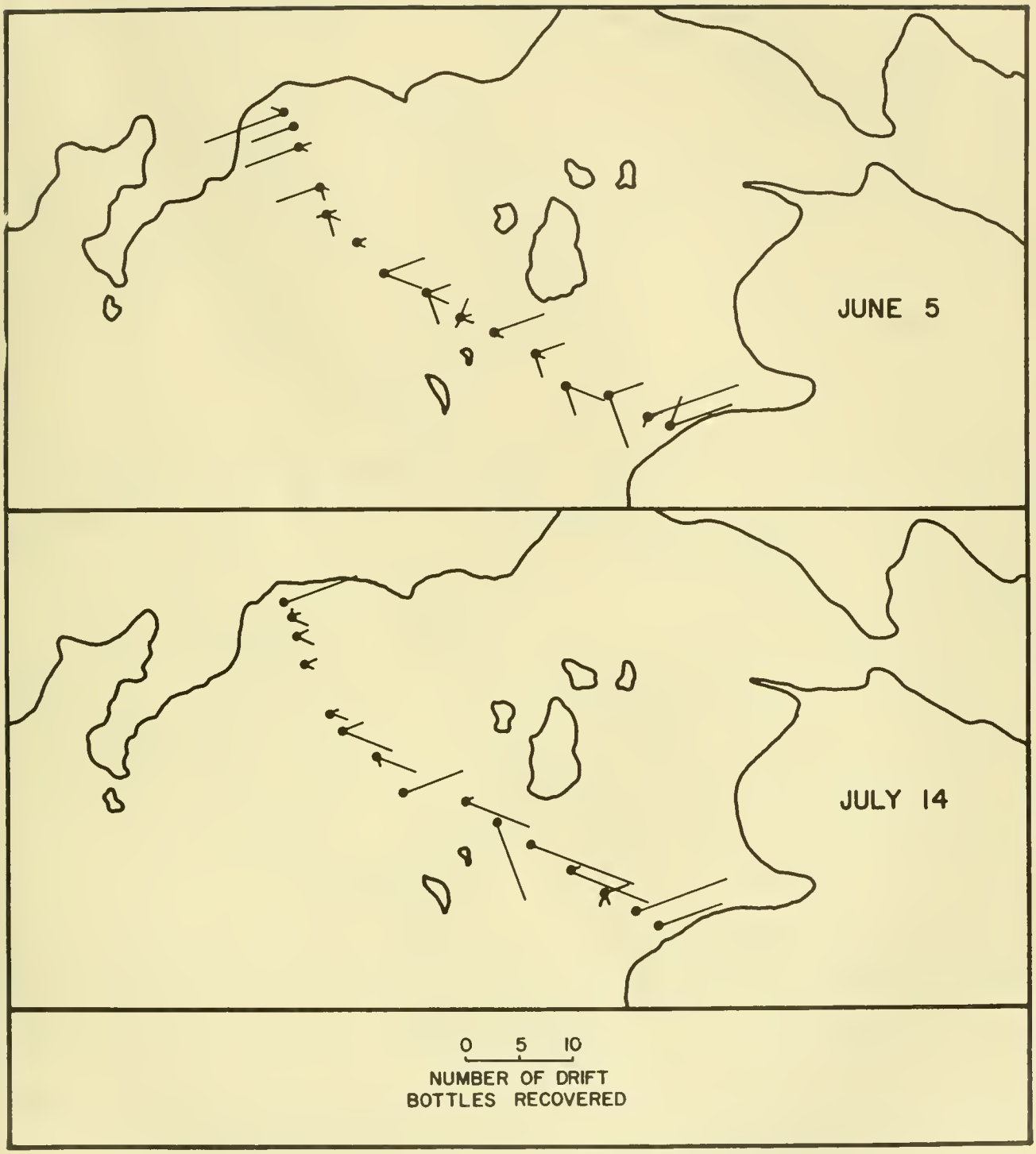

Figure 15. --Release stations, numbers recovered, and directions of recovery points of drift bottles with drags released June 5 and July 14, 1955, on the Charlevoix-Manistique transect.

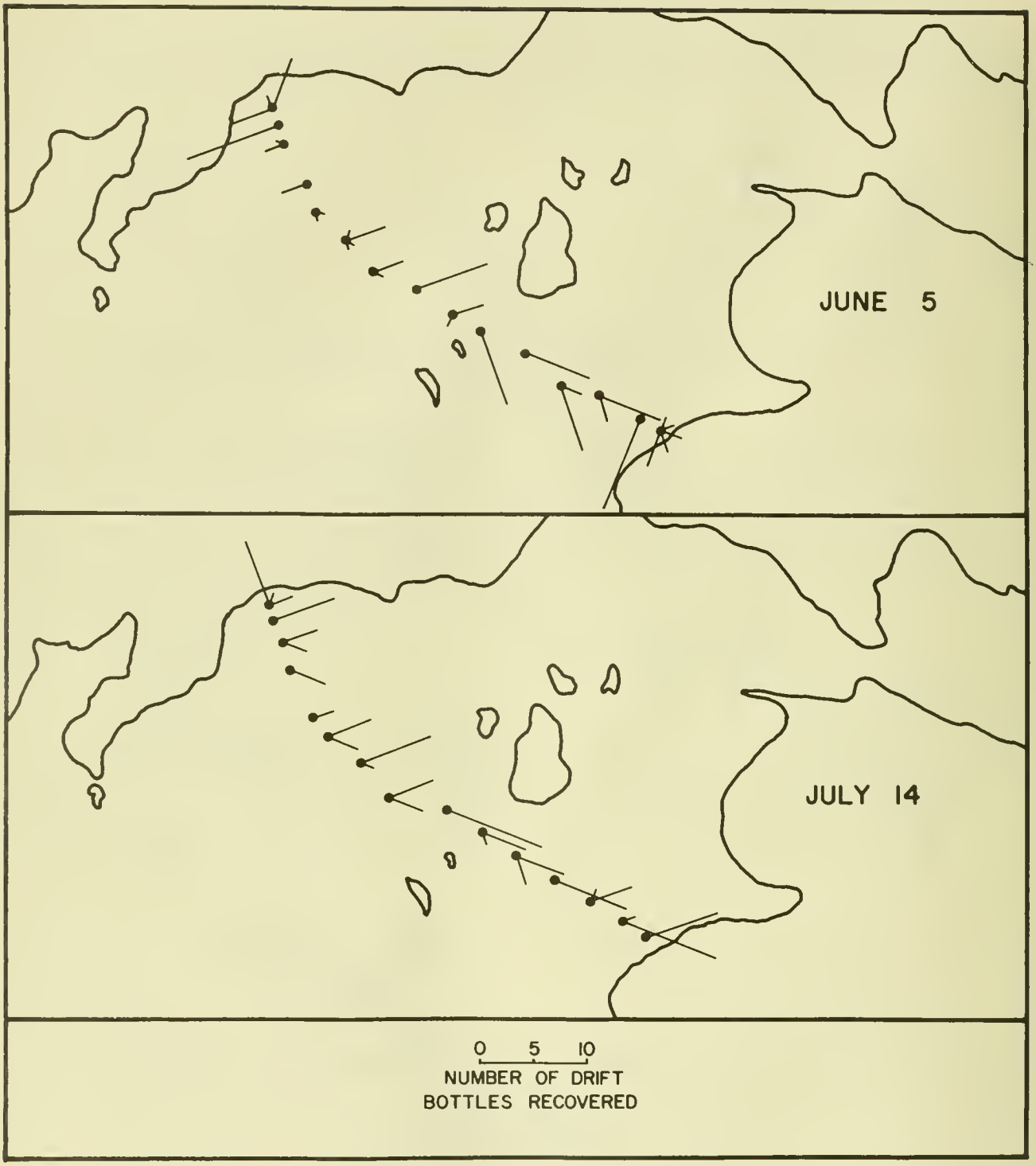

Figure 16. --Release stations, numbers recovered, and directions of recovery points of sand-ballasted bottles released June 5 and July 14, 1955, on the Charlevoix-Manistique transect.

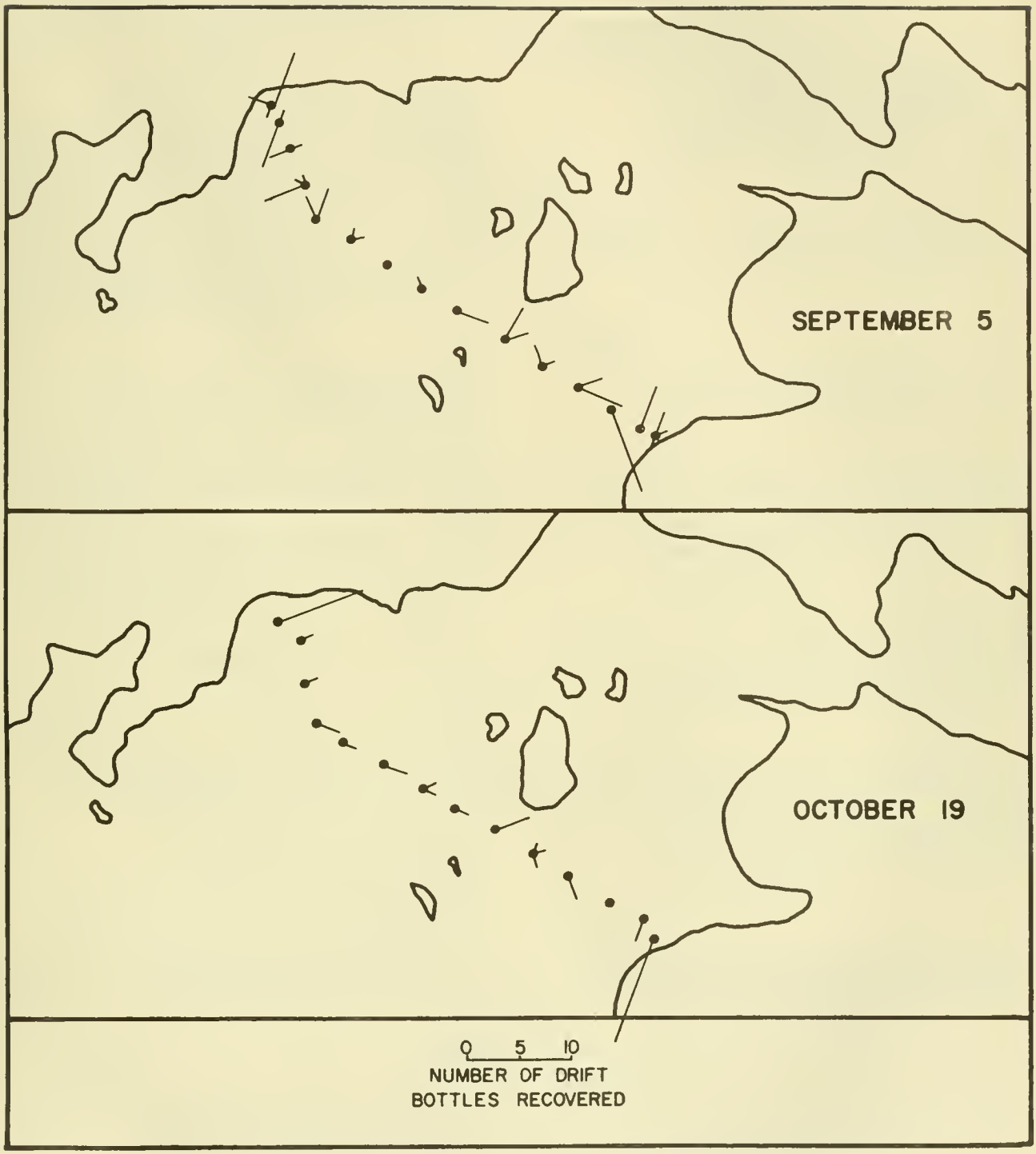

Figure 17. --Release stations, numbers recovered, and directions of recovery points of drift bottles with drags released September 5 and October 19, 1955, on the Charlevoix-Manistique transect.

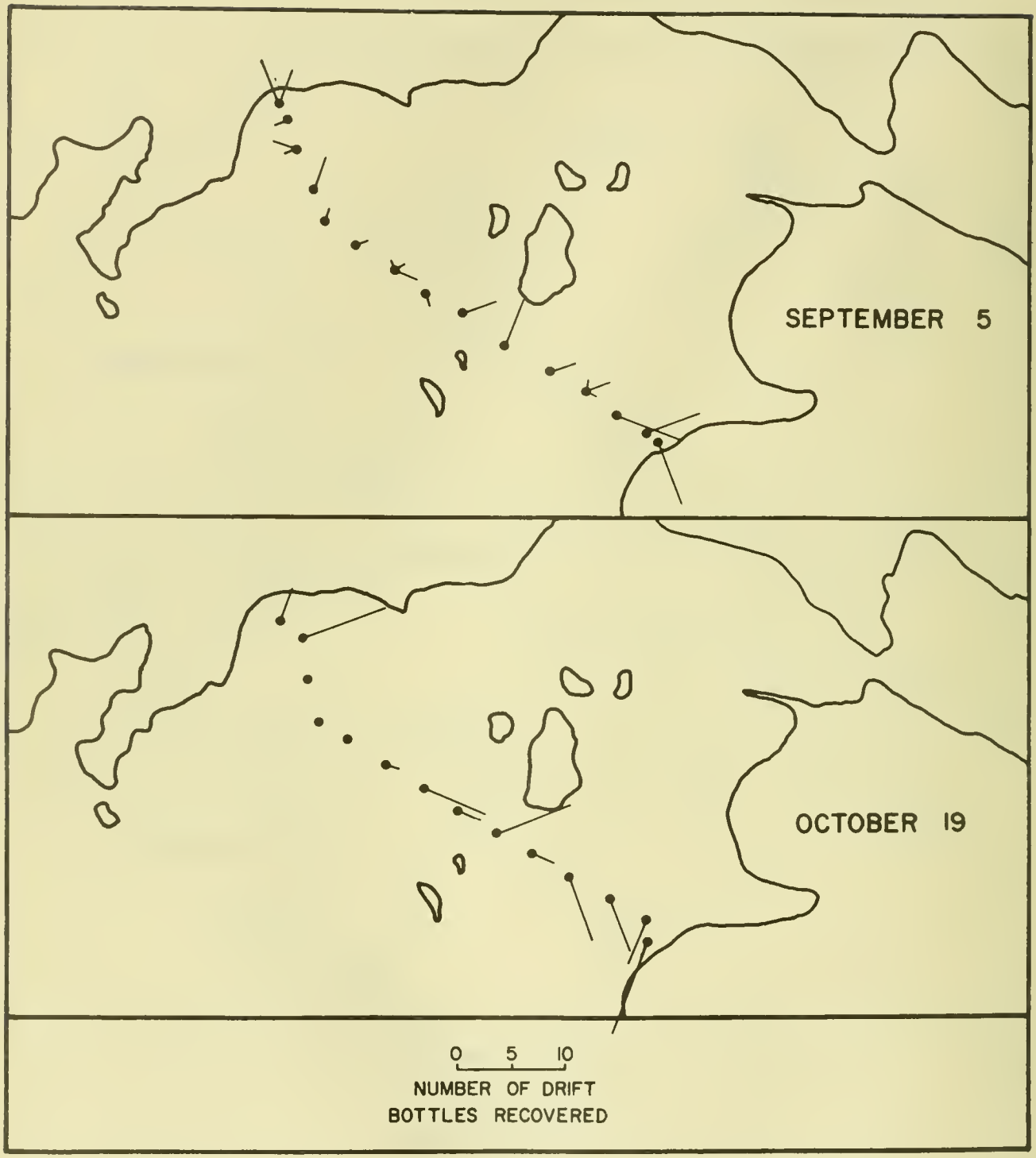

Figure 18. --Release stations, numbers recovered, and directions of recovery points of sand-ballasted bottles released September 5 and October 19, 1955, on the Charlevoix-Manistique transect.

SUMMARY

1. The U. S. Bureau of Commercial Fisheries conducted surface-current studies with drift bottles, drift envelopes, and cylindrical plastic tubes as part of fishery and limnological investigations of Lake Michigan in 1954 and 1955.

2. Releases in central and southern Lake Michigan in 1954 were: 1,080 drift bottles, 1,080 drift envelopes, and 100 plastic tubes. Dates of release were between July 9 and September 15. Returns were received of 587 reply cards from drift bottles, 77 from drift envelopes, and 18 from plastic tubes. The distribution of these returns indicated that no stable pattern of surface currents existed in the summer of 1954. In general, the drift was west to east; movements to the north or south were about equal.

3. Releases in 1955 in central and northern Lake Michigan between April 26 and November 8 totaled 2,000 sand-ballasted drift bottles and 2,000 drift bottles with drags. Returns were received of 1,060 reply cards from sand-ballasted bottles and 1,128 from bottles with drags. In 1955 as in 1954 surface currents in Lake Michigan exhibited no stable pattern. Drift in general was west to east; drift in the eastern areas was mainly to the north but that in the western area showed no prevailing pattern.

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APPENDIX

Tables 7-22 in the appendix contain release and recovery points of drift units, dates of release and recovery, number of days units were adrift, miles covered, and average drift rates in miles per day. Stations are located on figures 4-7; 9-18 by counting from right to left (east to west, with the exception of the Manitowoc-Sturgeon Bay transect (figs. 9-10); on this transect stations are located by counting from south to north.

For units released in 1954, recoveries are listed up to January 31, 1955; for those released in 1955, recoveries are listed up to January 31, 1956.

Ten bottles and 10 envelopes were released in 1954 at each station (tables 7-12) with the exception of the releases July 9 on the Grand Haven-Milwaukee transect; on this date 6 each of the 3 types of units were released at all stations except the first out of Milwaukee at which 4 of each type were released. Data on the plastic tubes have not been included in the tables.

Ten bottles with drags and 10 sand-ballasted bottles were released in 1955 at each station (tables 13-22).

Table 7. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect

[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 3								
1	42°25'	86°20'	8/6	42°25'	86°17'	3	3	1.0
			8/7	42°25'	86°17'	4	3	0.8
			9/4	42°25'	86°17'	32	3	0.1
			8/7	42°28'	86°16'	4	5	1.3
			8/6	42°29'	86°16'	3	7	2.3
			8/9	42°29'	86°16'	6	7	1.2
			8/5	42°32'	86°15'	2	10	5.0
			8/5	42°32'	86°15'	2	10	5.0
			8/6	42°32'	86°15'	3	10	3.3
			8/12	42°32'	86°15'	9	10	1.1
2	42°25'	86°24'	8/18	42°27'	86°18'	15	6	0.4
			8/5	42°28'	86°16'	2	8	4.0
			9/24	42°13'	86°24'	52	13	0.3
			8/12	42°11'	86°25'	9	15	1.7
			8/12	42°11'	86°25'	9	15	1.7
			8/19	42°44'	86°13'	16	25	1.6
			8/16	42°45'	86°13'	13	26	2.0
			8/27	42°48'	86°13'	24	29	1.2
3	42°25'	86°30'	9/28	42°16'	86°21'	56	12	0.2
			9/4	42°27'	86°16'	32	12	0.4
			9/5	42°30'	86°15'	33	14	0.4
			9/4	42°33'	86°15'	32	16	0.5
			9/5	42°35'	86°14'	33	19	0.6
			9/3	42°06'	86°30'	31	21	0.7
			8/19	42°04'	86°31'	16	23	1.4
			9/12	41°52'	86°40'	40	38	1.0
4	42°24'	86°36'	9/10	42°32'	86°15'	38	21	0.6
			9/4	42°05'	86°30'	32	22	0.7
			9/18	42°55'	86°14'	46	41	0.9
			10/3	42°55'	86°14'	61	41	0.7
			9/11	41°41'	87°01'	39	54	1.4
5	42°24'	86°41'	11/6	42°11'	86°25'	95	20	0.2
			9/4	42°04'	86°31'	32	25	0.8
			9/4	42°04'	86°31'	32	25	0.8
			11/4	42°01'	86°33'	93	27	0.3
			9/17	41°51'	87°36'	45	61	1.4
			10/28	43°26'	86°27'	86	73	0.8
6	42°24'	86°48'	11/15	42°42'	86°13'	104	37	0.4
			10/13	43°04'	86°15'	71	54	0.8

Table 7.--Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 3								
6	42°24'	86°48'	10/21	43°04'	86°15'	79	55	0.8
			10/15	43°08'	86°17'	73	57	0.9
7	42°24'	86°54'	10/18	42°24'	86°17'	76	32	0.4
			9/22	41°51'	86°40'	50	39	0.8
			9/26	41°49'	86°44'	54	41	0.8
			11/6	42°46'	86°14'	95	43	0.5
			10/28	42°53'	86°14'	86	49	0.6
			11/2	42°55'	86°14'	91	50	0.5
			11/5	43°25'	86°27'	94	74	0.8
8	42°24'	86°59'	9/27	41°48'	86°46'	55	43	0.8
			10/15	43°07'	86°16'	73	62	0.8
			10/13	43°08'	86°17'	71	63	0.9
			10/15	43°10'	86°18'	73	64	0.9
			10/13	43°14'	86°21'	71	67	0.9
			10/23	43°26'	86°27'	81	77	1.0
9	42°24'	87°04'	10/27	42°28'	86°16'	85	42	0.5
			10/29	42°28'	86°16'	87	42	0.5
			10/30	43°07'	86°17'	88	65	0.7
			10/15	43°13'	86°20'	73	68	0.9
			11/25	43°13'	86°20'	114	68	0.6
			10/18	43°34'	86°31'	76	86	1.1
10	42°23'	87°10'	10/20	42°29'	86°16'	78	47	0.6
			10/24	42°30'	86°15'	82	47	0.6
			10/4	42°40'	86°14'	62	52	0.8
			10/9	42°40'	86°14'	67	52	0.8
			11/15	43°13'	86°20'	104	71	0.7
			10/24	43°24'	86°26'	82	79	1.0
			10/15	44°17'	86°19'	73	139	1.9
			11/26	44°17'	86°19'	115	139	1.2
11	42°23'	87°16'	10/17	42°14'	86°23'	75	47	0.6
			10/23	42°14'	86°23'	81	47	0.6
			11/6	42°45'	86°13'	95	59	0.6
			10/3	42°47'	86°13'	61	60	1.0
			10/15	43°10'	86°19'	73	73	1.0
			10/2	43°28'	86°28'	60	85	1.4
12	42°23'	87°22'	10/18	42°09'	86°27'	76	49	0.6
			10/7	42°26'	86°17'	65	55	0.8

Table 7.--Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 3								
12	42°23'	87°22'	11/2	42°34'	86°15'	91	58	0.6
			10/24	42°54'	86°14'	82	69	0.8
			10/13	43°02'	86°15'	71	72	1.0
			10/17	43°20'	86°25'	75	81	1.1
			10/14	43°23'	86°26'	72	83	1.2
13	42°23'	87°28'	9/15	42°16'	87°50'	43	20	0.5
			9/21	42°07'	87°44'	49	23	0.5
			9/25	41°43'	86°57'	53	52	1.0
			9/25	41°57'	86°35'	53	54	1.0
			9/22	41°55'	86°36'	50	54	1.1
			9/26	42°37'	86°14'	54	65	1.2
			11/5	43°25'	86°27'	94	88	0.9
14	42°23'	87°35'	8/22	42°25'	87°49'	19	12	0.6
			8/21	42°26'	87°49'	18	13	0.7
			8/21	42°26'	87°49'	18	13	0.7
			9/28	42°21'	87°50'	56	13	0.2
			8/19	42°15'	87°50'	16	15	0.9
			*1/16	42°47'	87°46'	166	31	0.2
			10/31	41°51'	86°41'	89	58	0.7
15	42°22'	87°38'	9/13	42°21'	87°50'	41	10	0.2
			8/14	42°15'	87°50'	11	13	1.2
16	42°22'	87°42'	8/11	42°24'	87°49'	8	6	0.8
			8/17	42°20'	87°50'	14	7	0.5
			8/28	42°20'	87°50'	25	7	0.3
			8/7	42°19'	87°50'	4	8	2.0
17	42°22'	87°45'	8/21	42°23'	87°49'	18	3	0.2
			8/22	42°23'	87°49'	19	3	0.2
			8/7	42°21'	87°50'	4	4	1.0
			8/7	42°21'	87°50'	4	4	1.0
			8/8	42°21'	87°50'	5	4	0.8
			8/19	42°21'	87°50'	16	4	0.3
September 15								
1	42°24'	86°21'	9/20	42°28'	86°16'	5	6	1.2
			9/25	42°28'	86°16'	10	6	0.6
			9/27	42°29'	86°15'	12	8	0.7

Table 7. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 15								
2	42°24'	86°23'	9/25	42°23'	86°18'	10	5	0.5
			9/20	42°25'	86°17'	5	5	1.0
			9/20	42°25'	86°17'	5	5	1.0
			9/20	42°25'	86°17'	5	5	1.0
			9/21	42°25'	86°17'	6	5	0.8
			9/20	42°26'	86°16'	5	6	1.2
			9/24	42°06'	86°30'	9	22	2.4
3	42°24'	86°29'	9/20	42°37'	86°14'	5	21	4.2
			9/20	42°37'	86°14'	5	21	4.2
			10/1	42°05'	86°30'	16	22	1.4
			9/20	42°39'	86°14'	5	22	4.4
			9/20	42°39'	86°14'	5	22	4.4
			9/20	42°39'	86°14'	5	22	4.4
4	42°23'	86°34'	10/2	43°28'	86°27'	17	75	4.4
			11/13	43°43'	86°29'	59	93	1.6
			10/21	43°47'	86°26'	36	98	2.7
			10/23	43°57'	86°28'	38	108	2.8
			11/26	44°36'	86°14'	72	155	2.2
			11/23	45°05'	85°42'	69	202	2.9
5	42°23'	86°42'	9/22	42°26'	86°16'	7	22	3.1
			9/24	42°26'	86°16'	9	22	2.4
			9/25	42°26'	86°16'	10	22	2.2
			10/24	42°26'	86°16'	39	22	0.6
			9/27	42°26'	86°16'	12	22	1.8
			9/22	42°35'	86°14'	7	28	4.0
6	42°22'	86°47'	9/26	42°22'	86°18'	11	25	2.3
			9/26	42°22'	86°18'	11	25	2.3
			9/25	42°25'	86°17'	10	26	2.6
			9/25	42°30'	86°15'	10	29	2.9
			9/26	42°36'	86°14'	11	33	3.0
7	42°22'	86°53'	10/17	42°38'	86°14'	32	38	1.2
			12/15	41°43'	86°55'	91	44	0.5
			10/14	43°14'	86°20'	29	65	2.2
			10/24	43°25'	86°26'	39	75	1.9
			10/15	44°14'	86°21'	30	133	4.4
8	42°24'	87°00'	10/23	42°15'	86°22'	38	34	0.9
			11/4	42°15'	86°22'	50	34	0.7
			10/21	42°32'	86°15'	36	39	1.1
			10/6	41°48'	86°45'	21	43	2.0

Table 7. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 15								
9	42°24'	87°06'	10/23	42°13'	86°24'	38	38	1.0
			10/23	42°19'	86°19'	38	40	1.1
			10/11	42°20'	86°19'	26	40	1.5
			10/24	42°21'	86°18'	39	41	1.1
			10/17	41°54'	86°37'	32	43	1.3
			10/27	42°39'	86°13'	42	47	1.1
10	42°24'	87°11'	10/24	42°24'	86°18'	39	46	1.2
			10/24	42°41'	86°13'	39	54	1.4
			11/12	42°52'	86°13'	58	59	1.0
			11/12	42°52'	86°13'	58	59	1.0
			10/16	43°00'	86°14'	31	64	2.1
			10/17	43°00'	86°14'	32	64	2.0
			10/28	43°18'	86°23'	43	74	1.7
11	42°24'	87°18'	10/15	43°03'	86°15'	30	70	2.3
			11/3	43°18'	86°23'	49	77	1.6
12	42°24'	87°24'	11/23	42°18'	86°20'	69	55	0.8
			11/14	42°37'	86°14'	60	62	1.0
			11/14	42°41'	86°13'	60	64	1.1
			10/27	42°43'	86°13'	42	65	1.5
			10/23	43°21'	86°25'	38	82	2.2
13	42°24'	87°30'	10/27	42°08'	86°28'	42	55	1.3
			10/30	41°54'	86°37'	45	57	1.3
			11/11	41°50'	86°42'	57	57	1.0
			11/7	42°19'	86°19'	53	61	1.2
			11/7	42°22'	86°18'	53	61	1.2
			11/7	42°24'	86°18'	53	62	1.2
			11/2	42°44'	86°13'	48	69	1.4
14	42°24'	87°33'	11/10	42°05'	86°31'	56	58	1.0
			12/23	42°05'	86°31'	99	58	0.6
			10/27	42°09'	86°28'	42	58	1.4
			11/10	41°52'	86°40'	56	59	1.1
			10/30	42°12'	86°25'	45	60	1.3
15	42°23'	87°37'	9/22	41°52'	86°40'	7	61	8.7
			10/24	42°20'	86°19'	39	67	1.7
			11/16	42°23'	86°18'	62	68	1.1
			11/21	42°33'	86°15'	67	71	1.1
			12/5	42°44'	86°13'	81	75	0.9

Table 7. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 15								
15	42°23'	87°37'	11/7	43°02'	86°15'	53	83	1.6
			10/15	43°04'	86°16'	30	84	2.8
			10/24	42°58'	86°13'	39	67	1.7
			11/7	43°04'	86°15'	53	71	1.3
16	42°23'	87°42'	11/2	41°48'	86°46'	48	63	1.3
			11/11	42°05'	86°31'	57	64	1.1
			11/21	42°21'	86°19'	67	71	1.1
			10/17	42°23'	86°17'	32	72	2.3
			10/16	42°29'	86°15'	31	74	2.4
17	42°22'	87°47'	10/6	41°45'	86°51'	21	63	3.0
			11/7	41°56'	86°35'	53	67	1.3
			11/3	42°08'	86°29'	49	68	1.4
			10/31	42°09'	86°27'	46	69	1.5
			11/28	43°13'	86°20'	74	94	1.3
			10/17	43°15'	86°20'	32	94	2.9

Table 8. --Release and recovery points of drift envelopes that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 3								
1	42°25'	86°20'	8/5	42°26'	86°16'	2	4	2.0
			8/5	42°26'	86°16'	2	4	2.0
			8/5	42°26'	86°16'	2	4	2.0
			8/5	42°27'	86°16'	2	5	2.5
			8/5	42°27'	86°16'	2	5	2.5
			8/5	42°27'	86°16'	2	5	2.5
			8/5	42°28'	86°16'	2	6	3.0
2	42°25'	86°24'	...	...	...	...	...	...
3	42°25'	86°30'	8/10	41°52'	86°40'	7	38	5.4
			8/10	41°51'	86°41'	7	40	5.7
			8/11	41°47'	86°48'	8	46	5.8
4	42°24'	86°36'	...	...	...	...	...	...
5	42°24'	86°41'	...	...	...	...	...	...
6	42°24'	86°48'	...	...	...	...	...	...
7	42°24'	86°54'	...	...	...	...	...	...
8	42°24'	86°59'	...	...	...	...	...	...
9	42°24'	87°04'	...	...	...	...	...	...
10	42°23'	87°10'	...	...	...	...	...	...
11	42°23'	87°16'	...	...	...	...	...	...
12	42°23'	87°22'	...	...	...	...	...	...
13	42°23'	87°28'	8/17	41°58'	87°38'	14	30	2.1
14	42°23'	87°35'	8/7	42°13'	87°47'	4	16	4.0
			8/7	42°13'	87°47'	4	16	4.0
			8/8	42°13'	87°47'	5	16	3.2
			8/8	42°13'	87°47'	5	16	3.2
			8/8	42°11'	87°46'	5	17	3.4
			8/12	42°11'	87°46'	9	17	1.9
15	42°22'	87°38'	8/7	42°15'	87°49'	4	13	3.3
			8/7	42°15'	87°49'	4	13	3.3
			8/8	42°15'	87°49'	5	13	2.6
			8/15	42°13'	87°49'	12	14	1.2
			8/22	42°11'	87°48'	19	15	0.8
			8/14	42°06'	87°44'	11	19	1.7
16	42°22'	87°42'	8/22	42°15'	87°49'	19	10	0.5
			8/12	42°06'	87°43'	9	18	2.0
17	42°22'	87°45'	8/6	42°27'	87°49'	3	6	2.0
			8/8	42°29'	87°49'	5	8	1.6

Table 8. --Release and recovery points of drift envelopes that were released in 1954 on the South Haven, Michigan-Waukegan, Illinois transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 15								
1	42°24'	86°21'	9/16	42°21'	86°18'	1	4	4.0
			9/16	42°21'	86°18'	1	4	4.0
			9/17	42°21'	86°18'	2	4	2.0
2	42°24'	86°23'	...	...	...	...	...	...
3	42°24'	86°29'	...	...	...	...	...	...
4	42°23'	86°34'	...	...	...	...	...	...
5	42°23'	86°42'	...	...	...	...	...	...
6	42°22'	86°47'	...	...	...	...	...	...
7	42°22'	86°53'	...	...	...	...	...	...
8	42°24'	87°00'	...	...	...	...	...	...
9	42°24'	87°06'	...	...	...	...	...	...
10	42°24'	87°11'	...	...	...	...	...	...
11	42°24'	87°18'	...	...	...	...	...	...
12	42°24'	87°24'	...	...	...	...	...	...
13	42°24'	87°30'	...	...	...	...	...	...
14	42°24'	87°33'	...	...	...	...	...	...
15	42°23'	87°37'	...	...	...	...	...	...
16	42°23'	87°42'	...	...	...	...	...	...
17	42°22'	87°47'	9/18	42°18'	87°50'	3	5	1.7

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 9								
1	43°03'	86°18'	7/12	43°11'	86°18'	3	8	2.7
			7/12	43°14'	86°20'	3	12	4.0
			7/13	43°14'	86°20'	4	12	3.0
			7/29	43°18'	86°24'	20	18	0.9
			8/18	41°48'	87°34'	40	108	2.7
2	43°03'	86°22'	7/21	42°28'	86°16'	12	41	3.4
			8/11	41°40'	87°04'	33	103	3.1
			8/7	41°50'	87°36'	29	106	3.7
3	43°03'	86°25'	8/4	42°35'	86°14'	26	34	1.3
			7/22	42°25'	86°17'	13	44	3.4
			8/1	42°25'	86°17'	23	44	1.9
			8/2	42°25'	86°17'	24	44	1.8
4	43°03'	86°32'	7/20	42°45'	86°13'	11	26	2.4
			7/20	42°40'	86°13'	11	31	2.8
			9/3	42°38'	86°14'	56	33	0.6
			8/3	42°22'	86°18'	25	49	2.0
			8/12	42°11'	86°25'	34	59	1.7
			8/7	41°58'	87°38'	29	94	3.2
5	43°03'	86°39'	9/8	42°25'	86°16'	61	47	0.8
			8/8	41°52'	87°36'	30	95	3.2
6	43°03'	86°45'	8/16	42°52'	86°13'	38	29	0.8
			8/16	42°22'	86°18'	38	52	1.4
			8/11	42°02'	86°33'	33	72	2.2
			8/12	41°52'	86°40'	34	83	2.4
7	43°03'	86°50'	8/6	42°51'	86°13'	28	34	1.2
			8/14	42°10'	86°26'	36	64	1.8
8	43°03'	86°56'	8/22	42°55'	86°13'	44	38	0.9
			8/6	42°52'	86°13'	28	39	1.4
			9/12	42°22'	86°18'	65	57	0.9
			8/9	42°19'	86°19'	31	59	1.9
			9/1	41°38'	87°11'	54	99	1.8
9	43°03'	87°03'	9/28	42°54'	86°13'	81	43	0.5
			9/3	41°52'	86°39'	56	83	1.5
			9/23	41°51'	86°41'	76	84	1.1
			9/23	41°45'	86°51'	76	90	1.2

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 9								
10	43°02'	87°10'	11/16	43°39'	86°33'	130	52	0.4
			9/10	42°16'	86°21'	63	68	1.1
11	43°02'	87°15'	10/27	43°12'	86°19'	110	48	0.4
			10/21	42°45'	86°13'	104	57	0.5
			11/10	44°15'	86°21'	124	96	0.8
12	43°02'	87°22'	8/21	43°04'	87°52'	43	26	0.6
			8/22	43°11'	87°54'	44	29	0.7
			8/27	43°47'	87°43'	49	55	1.1
13	43°02'	87°28'	8/19	43°32'	87°48'	41	38	0.9
			8/21	43°32'	87°48'	43	38	0.9
14	43°02'	87°37'	8/22	43°03'	87°52'	44	13	0.3
			10/3	43°00'	86°14'	86	71	0.8
15	43°02'	87°42'	9/17	43°03'	87°53'	70	9	0.1
			9/17	43°02'	87°54'	70	10	0.1
			9/17	42°48'	87°47'	70	16	0.2
			11/9	43°10'	86°18'	123	71	0.6
16	43°01'	87°47'	7/27	43°10'	87°53'	18	11	0.6
			7/30	43°29'	87°48'	21	32	1.5
			8/1	43°41'	87°42'	23	45	2.0
			11/7	42°28'	86°15'	121	87	0.7
17	43°01'	87°50'	7/24	43°32'	87°48'	15	34	2.3
			7/21	43°38'	87°44'	12	43	3.6
			7/21	43°38'	87°44'	12	43	3.6
			7/31	43°47'	87°43'	22	53	2.4
July 29								
1	43°03'	86°18'	8/4	43°05'	86°16'	6	3	0.5
			8/1	43°09'	86°18'	3	7	2.3
			8/2	43°12'	86°20'	4	11	2.8
			8/2	43°13'	86°20'	4	12	3.0
			8/2	43°14'	86°21'	4	14	3.5
			7/31	43°16'	86°23'	2	16	8.0
			7/31	43°16'	86°23'	2	16	8.0
			7/31	43°16'	86°23'	2	16	8.0

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 29								
2	43°03'	86°24'	8/6	42°43'	86°13'	8	24	3.0
			8/6	42°43'	86°13'	8	24	3.0
			8/4	42°39'	86°14'	6	28	4.7
			8/4	42°39'	86°14'	6	28	4.7
			8/4	42°39'	86°14'	6	28	4.7
3	43°03'	86°30'	8/5	42°38'	86°14'	7	32	4.6
			8/4	42°37'	86°14'	6	33	5.5
			8/4	42°37'	86°14'	6	33	5.5
			8/5	42°37'	86°14'	7	33	4.7
			8/5	42°37'	86°14'	7	33	4.7
			8/5	42°35'	86°14'	7	34	4.9
			8/5	42°35'	86°14'	7	34	4.9
			8/8	42°35'	86°14'	10	34	3.4
			8/14	42°35'	86°14'	16	34	2.1
4	43°02'	86°37'	9/7	42°34'	86°14'	40	37	0.9
			9/8	42°33'	86°15'	41	39	1.0
			9/4	42°05'	86°30'	37	66	1.8
			9/4	42°01'	86°33'	37	70	1.9
			9/24	41°56'	86°35'	57	76	1.3
5	43°02'	86°44'	9/6	42°11'	86°25'	39	60	1.5
			9/8	42°11'	86°25'	41	60	1.5
			9/4	42°07'	86°29'	37	64	1.7
			9/4	42°07'	86°29'	37	64	1.7
			9/4	42°07'	86°29'	37	64	1.7
			9/25	41°55'	86°36'	58	76	1.3
6	43°02'	86°50'	10/24	43°31'	86°29'	87	38	0.4
			10/2	42°35'	86°14'	65	43	0.7
			10/16	42°25'	86°17'	79	51	0.6
			9/21	41°50'	86°42'	54	82	1.5
			9/22	41°49'	86°44'	55	83	1.5
			9/22	41°47'	86°46'	55	85	1.5
			9/17	41°46'	87°33'	50	93	1.9
7	43°01'	86°56'	9/28	42°19'	86°19'	61	57	0.9
			9/5	42°09'	86°27'	38	64	1.7
			9/8	42°09'	86°27'	41	64	1.6
			9/22	41°45'	86°52'	55	87	1.6
			9/11	41°37'	87°19'	44	98	2.2

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 29								
8	43°01'	87°03'	10/24	43°24'	86°26'	87	41	0.5
			10/2	42°48'	86°13'	65	45	0.7
			9/22	41°37'	87°19'	55	97	1.8
9	43°00'	87°09'	9/26	42°41'	86°13'	59	53	0.9
			10/3	42°29'	86°15'	66	59	0.9
10	43°00'	87°17'	10/13	43°20'	86°24'	76	50	0.7
			10/15	43°10'	86°18'	78	51	0.7
			10/7	43°04'	86°15'	70	52	0.7
			10/15	43°05'	86°16'	78	52	0.7
			9/26	42°51'	86°13'	59	55	0.9
			9/25	42°34'	86°15'	58	61	1.1
			10/19	43°58'	86°28'	82	78	1.0
11	43°00'	87°24'	9/17	43°06'	87°53'	50	26	0.5
			10/17	43°28'	86°28'	80	57	0.7
			11/6	43°08'	86°17'	100	57	0.6
			11/14	42°32'	86°15'	108	66	0.6
			10/30	41°56'	86°35'	93	84	0.9
			9/22	41°55'	86°36'	55	85	1.5
12	42°59'	87°30'	8/20	42°58'	87°51'	22	18	0.8
			8/21	42°45'	87°47'	23	21	0.9
			9/29	43°03'	86°15'	62	63	1.0
			9/23	42°50'	86°13'	56	65	1.2
			10/2	42°45'	86°13'	65	67	1.0
			9/22	42°34'	86°15'	55	71	1.3
			10/23	42°31'	86°15'	86	72	0.8
13	42°59'	87°35'	9/29	43°13'	86°20'	62	65	1.0
			10/3	43°34'	86°31'	66	68	1.0
			11/29	43°06'	86°16'	123	68	0.6
			9/25	42°50'	86°13'	58	70	1.2
			11/7	42°50'	86°13'	101	70	0.7
			9/26	42°39'	86°14'	59	73	1.2
			10/15	44°17'	86°19'	78	110	1.4
14	43°02'	87°37'	9/18	42°48'	87°46'	51	18	0.4
			10/17	42°43'	86°13'	80	75	0.9
			10/28	42°11'	86°25'	91	85	0.9
			11/11	42°09'	86°28'	105	85	0.8

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 29								
15	43°02'	87°43'	10/3	43°34'	86°31'	66	71	1.1
			*1/16	42°41'	86°12'	171	80	0.5
			11/8	42°36'	86°14'	102	81	0.8
			10/29	44°35'	86°14'	92	131	1.4
16	43°02'	87°46'	11/20	43°00'	87°53'	114	5	1/0.0
			8/7	43°10'	87°53'	9	11	1.2
			8/7	43°10'	87°53'	9	11	1.2
			11/2	42°47'	86°13'	96	82	0.9
17	43°02'	87°50'	7/31	43°10'	87°53'	2	10	5.0
			7/31	43°10'	87°53'	2	10	5.0
			7/31	43°10'	87°53'	2	10	5.0
			8/3	43°10'	87°53'	5	10	2.0
			8/4	43°10'	87°53'	6	10	1.7
			8/4	43°10'	87°53'	6	10	1.7
			8/5	43°10'	87°53'	7	10	1.4
			8/6	43°10'	87°53'	8	10	1.3
August 19								
1	43°03'	86°18'	9/29	43°59'	86°28'	41	67	1.6
			9/4	44°14'	86°21'	16	87	5.4
			9/12	44°14'	86°21'	24	87	3.6
			8/30	44°22'	86°16'	11	97	8.8
			8/29	44°26'	86°15'	10	101	10.1
			8/29	44°26'	86°15'	10	101	10.1
			8/29	44°29'	86°15'	10	104	10.4
			8/30	44°30'	86°15'	11	105	9.5
			8/31	44°30'	86°15'	12	105	8.8
2	43°03'	86°21'	9/4	44°44'	86°10'	16	124	7.8
			9/4	44°44'	86°10'	16	124	7.8
			12/26	44°44'	86°10'	129	124	1.0
			9/6	44°44'	86°06'	18	128	7.1
			9/30	44°44'	86°06'	42	128	3.0
			10/24	44°44'	86°06'	66	128	1.9
3	43°03'	86°24'	10/24	43°10'	86°18'	66	9	0.1
			9/5	43°59'	86°28'	17	66	3.9
			9/8	44°15'	86°20'	20	88	4.4
			9/8	44°17'	86°19'	20	91	4.6
			9/22	44°23'	86°15'	34	98	2.9
			11/6	44°42'	86°13'	79	118	1.5

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect(cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
4	43°03'	86°31'	9/7	43°04'	86°15'	19	14	0.7
			9/23	43°01'	86°14'	35	15	0.4
			9/26	43°13'	86°20'	38	15	0.4
			9/6	43°14'	86°20'	18	16	0.9
			9/3	42°47'	86°13'	15	24	1.6
			9/3	42°39'	86°14'	15	32	2.1
			9/29	43°32'	86°29'	41	33	0.8
5	43°02'	86°37'	10/11	43°22'	86°25'	53	25	0.5
			10/3	42°31'	86°15'	45	41	0.9
			11/9	42°28'	86°15'	82	44	0.5
			9/28	42°24'	86°17'	40	48	1.2
			10/23	42°10'	86°26'	65	61	0.9
			9/26	42°09'	86°27'	38	62	1.6
			10/25	43°58'	86°27'	67	65	1.0
			9/25	41°57'	86°35'	37	75	2.0
			10/26	44°31'	86°14'	68	106	1.6
6	43°02'	86°44'	9/7	43°10'	86°18'	19	23	1.2
			9/11	43°10'	86°18'	23	23	1.0
			9/25	43°07'	86°16'	37	24	0.6
			9/26	43°04'	86°15'	38	24	0.6
			9/14	42°51'	86°12'	26	29	1.1
			9/25	43°39'	86°33'	37	44	1.2
			9/26	42°24'	86°17'	38	49	1.3
7	43°02'	86°50'	9/26	43°16'	86°22'	38	29	0.8
			9/26	42°58'	86°14'	38	31	0.8
			9/25	42°52'	86°13'	37	33	0.9
			9/26	42°41'	86°13'	38	39	1.0
8	43°01'	86°56'	9/25	42°23'	86°17'	37	54	1.5
9	43°01'	87°01'	10/3	42°31'	86°15'	45	53	1.2
			9/25	42°30'	86°15'	37	53	1.4
			9/25	42°26'	86°16'	37	56	1.5
			9/22	42°23'	86°18'	34	58	1.7
			9/26	42°22'	86°19'	38	59	1.6
10	43°01'	87°07'	9/28	43°11'	86°19'	40	43	1.1
			10/21	43°23'	86°26'	63	43	0.7
			11/4	43°03'	86°15'	77	44	0.6
			11/12	42°52'	86°12'	85	47	0.6
			11/5	42°01'	86°33'	78	75	1.0

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
11	43°00'	87°14'	10/23	42°11'	86°25'	65	70	1.1
			10/30	41°55'	86°36'	72	82	1.1
12	43°00'	87°19'	9/15	42°47'	87°45'	27	26	1.0
			11/7	42°34'	86°15'	80	63	0.8
13	43°00'	87°26'	10/7	43°05'	86°15'	49	60	1.2
			10/24	42°42'	86°13'	66	65	1.0
			10/29	42°25'	86°17'	71	71	1.0
14	43°00'	87°32'	10/8	42°40'	87°48'	50	27	0.5
			11/7	42°54'	86°14'	80	67	0.8
15	43°02'	87°37'	11/26	42°46'	86°13'	99	74	0.7
16	43°02'	87°41'	11/7	42°29'	87°48'	80	38	0.5
			9/15	42°27'	87°48'	27	41	1.5
			11/8	42°29'	86°15'	81	82	1.0
17	43°02'	87°46'	8/21	43°03'	87°53'	2	6	3.0
			8/23	43°03'	87°53'	4	6	1.5
			8/26	43°03'	87°53'	7	6	0.9
			11/8	43°22'	86°25'	81	72	0.9
			11/6	42°54'	86°13'	79	79	1.0
			12/11	42°41'	86°13'	114	82	0.7
			11/2	42°33'	86°15'	75	84	1.1
18	43°02'	87°50'	8/22	43°01'	87°54'	3	3	1.0
			8/23	43°01'	87°54'	4	3	0.8
			8/23	43°02'	87°54'	4	3	0.8
			8/23	43°02'	87°54'	4	3	0.8
			8/26	43°01'	87°54'	7	3	0.4
			8/26	43°02'	87°54'	7	3	0.4
			8/28	43°02'	87°54'	9	3	0.3
September 9								
1	43°03'	86°18'	10/3	43°10'	86°18'	24	8	0.3
			9/21	43°11'	86°19'	12	9	0.8
			9/21	43°11'	86°19'	12	9	0.8
			9/25	43°18'	86°24'	16	18	1.1
			9/22	42°48'	86°13'	13	18	1.4

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 9								
2	43°03'	86°21'	10/10	43°26'	86°27'	31	27	0.9
			10/5	43°28'	86°28'	26	29	1.1
			9/20	43°33'	86°31'	11	36	3.3
			9/23	43°33'	86°31'	14	36	2.6
			9/25	43°38'	86°33'	16	41	2.6
			10/1	43°39'	86°33'	22	42	1.9
September 11								
3	43°03'	86°25'	9/22	43°13'	86°20'	11	12	1.1
			10/1	44°03'	86°31'	20	70	3.5
			10/19	45°00'	85°47'	38	152	4.0
			10/24	45°05'	85°41'	43	158	3.7
4	43°03'	86°31'	10/1	44°03'	86°31'	20	70	3.5
			12/26	44°33'	86°14'	106	108	1.0
5	43°03'	86°37'	11/7	43°12'	86°20'	57	19	0.3
			11/12	42°55'	86°13'	62	23	0.4
			11/7	43°25'	86°27'	57	27	0.5
			11/7	44°02'	86°31'	57	68	1.2
6	43°02'	86°44'	10/29	43°03'	86°15'	48	24	0.5
			10/2	43°19'	86°23'	21	25	1.2
			11/5	42°59'	86°13'	55	26	0.5
			10/7	43°38'	86°32'	26	42	1.6
			12/24	44°03'	86°31'	104	70	0.7
			10/17	44°43'	86°07'	36	127	3.5
7	43°02'	86°51'	11/5	43°12'	86°19'	55	29	0.5
			10/22	43°01'	86°15'	41	31	0.8
			11/7	43°26'	86°27'	57	34	0.6
			10/1	43°39'	86°33'	20	45	2.3
			10/23	44°35'	86°15'	42	112	2.7
8	43°02'	86°58'	9/28	43°04'	86°15'	17	36	2.1
			11/21	44°08'	86°25'	71	81	1.1
			11/26	44°36'	86°14'	76	114	1.5
			12/26	45°03'	86°08'	106	143	1.4
9	43°02'	87°03'	11/20	43°18'	86°23'	70	38	0.5
			10/29	43°09'	86°17'	48	39	0.8

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 11								
10	43°02'	87°09'	*1/10	42°45'	86°12'	121	52	0.4
			10/24	43°46'	86°27'	43	61	1.4
			10/24	43°48'	86°26'	43	64	1.5
			10/25	44°41'	86°16'	44	123	2.8
11	43°01'	87°15'	10/23	43°11'	86°18'	42	49	1.2
			10/30	43°03'	86°14'	49	50	1.0
			10/31	43°07'	86°16'	50	50	1.0
			11/8	43°04'	86°15'	58	50	0.9
			12/26	43°07'	86°16'	106	50	0.5
12	43°01'	87°20'	11/8	43°14'	86°21'	58	53	0.9
			11/8	43°14'	86°21'	58	53	0.9
			11/23	43°10'	86°17'	73	54	0.7
			11/7	42°59'	86°13'	57	57	1.0
			12/6	42°52'	86°14'	86	58	0.7
			12/6	42°52'	86°14'	86	58	0.7
			11/2	42°49'	86°13'	52	59	1.1
13	43°01'	87°27'	11/14	43°22'	86°25'	64	57	0.9
			11/14	43°15'	86°21'	64	58	0.9
			12/4	43°34'	86°31'	84	61	0.7
			11/21	42°54'	86°14'	71	62	0.9
			12/15	43°51'	86°26'	95	77	0.8
			11/28	43°54'	86°25'	78	80	1.0
14	43°01'	87°33'	11/8	43°13'	86°20'	58	63	1.1
			11/12	43°11'	86°18'	62	64	1.0
			12/27	43°28'	86°27'	107	64	0.6
			11/25	43°35'	86°31'	75	65	0.9
15	43°01'	87°38'	10/28	43°15'	86°21'	47	66	1.4
			11/9	43°15'	86°21'	59	66	1.1
			12/5	43°15'	86°21'	85	66	0.8
			11/12	43°33'	86°30'	62	67	1.1
			12/5	43°06'	86°15'	85	70	0.8
			11/6	42°49'	86°13'	56	74	1.3
			11/7	42°49'	86°13'	57	74	1.3
16	43°01'	87°42'	11/7	43°14'	86°20'	57	71	1.2
			11/7	43°10'	86°17'	57	72	1.3
			11/2	42°25'	86°16'	52	84	1.6
			10/31	42°25'	86°16'	50	84	1.7

Table 9. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1955]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 11								
17	43°01'	87°46'	9/18	42°49'	87°49'	7	15	2.1
			9/19	42°49'	87°49'	8	15	1.9
			9/19	42°49'	87°49'	8	15	1.9
			9/19	42°48'	87°47'	8	15	1.9
			9/26	42°47'	87°46'	15	16	1.1
			9/18	42°47'	87°46'	7	16	2.3
			10/28	42°13'	86°23'	47	90	1.9
18	43°01'	87°51'	9/13	43°03'	87°53'	2	3	1.5
			10/16	42°40'	87°49'	35	26	0.7
			10/27	43°03'	86°14'	46	82	1.8
			11/11	43°03'	86°14'	61	82	1.3
			11/13	42°27'	86°16'	63	89	1.4
			10/27	42°11'	86°25'	46	93	2.0
			10/31	42°10'	86°26'	50	93	1.9

1/ Less than 0.05

Table 10. --Release and recovery points of drift envelopes that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 9								
1	43°03'	86°18'	7/25	43°15'	86°18'	16	14	0.9
			7/27	43°17'	86°23'	18	17	0.9
			7/13	43°18'	86°23'	4	18	4.5
2	43°03'	86°22'	7/27	43°04'	86°15'	18	5	0.3
			7/25	43°15'	86°18'	16	14	0.9
			7/12	43°22'	86°25'	3	22	7.3
3	43°03'	86°25'	7/18	43°21'	86°24'	9	20	2.2
			7/26	41°38'	87°09'	17	104	6.1
			7/29	41°47'	87°35'	20	105	5.3
4	43°03'	86°32'	7/20	42°45'	86°13'	11	26	2.4
			7/19	42°44'	86°13'	10	28	2.8
			7/19	42°37'	86°14'	10	33	3.3
			7/19	42°33'	86°14'	10	37	3.7
5	43°03'	86°39'	8/7	42°14'	86°22'	29	58	2.0
6	43°03'	86°45'	...	...	...	...	...	...
7	43°03'	86°50'	...	...	...	...	...	...
8	43°03'	86°56'	...	...	...	...	...	...
9	43°03'	87°03'	...	...	...	...	...	...
10	43°02'	87°10'	...	...	...	...	...	...
11	43°02'	87°15'	...	...	...	...	...	...
12	43°02'	87°22'	...	...	...	...	...	...
13	43°02'	87°28'	...	...	...	...	...	...
14	43°02'	87°37'	7/24	43°46'	87°42'	15	51	3.4
15	43°02'	87°42'	7/21	43°46'	87°42'	12	51	4.3
16	43°01'	87°47'	7/21	43°32'	87°47'	12	34	2.8
			7/31	43°37'	87°45'	22	40	1.8
17	43°01'	87°50'	7/25	43°48'	87°43'	16	55	3.4
July 29								
1	43°03'	86°18'	7/29	43°10'	86°18'	1/2	8	16.0
			7/30	43°10'	86°18'	1	8	8.0
			7/30	43°10'	86°18'	1	8	8.0
			7/30	43°10'	86°18'	1	8	8.0
			7/31	43°14'	86°21'	2	12	6.0
			7/31	43°14'	86°21'	2	12	6.0
			8/1	43°14'	86°21'	3	12	4.0

Table 10.--Release and recovery points of drift envelopes that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 29								
2	43°03'	86°24'	8/1	42°45'	86°13'	3	23	7.7
			8/1	42°44'	86°13'	3	24	8.0
3	43°03'	86°30'	8/1	42°38'	86°14'	3	32	10.7
4	43°02'	86°37'	8/3	42°38'	86°14'	5	35	7.0
			8/11	42°37'	86°14'	13	36	2.8
5	43°02'	86°44'	8/4	42°43'	86°12'	6	34	5.7
			8/4	42°43'	86°12'	6	34	5.7
			8/3	42°43'	86°12'	5	34	6.8
6	43°02'	86°50'	8/6	42°54'	86°13'	8	32	4.0
			8/10	42°44'	86°12'	12	37	3.1
7	43°01'	86°56'	...	...	...	...	...	...
8	43°01'	87°03'	...	...	...	...	...	...
9	43°00'	87°09'	...	...	...	...	...	...
10	43°00'	87°17'	...	...	...	...	...	...
11	43°00'	87°24'	...	...	...	...	...	...
12	42°59'	87°30'	...	...	...	...	...	...
13	42°59'	87°35'	...	...	...	...	...	...
14	43°02'	87°37'	...	...	...	...	...	...
15	43°02'	87°43'	...	...	...	...	...	...
16	43°02'	87°46'	...	...	...	...	...	...
17	43°02'	87°50'	8/3	43°10'	87°53'	5	10	2.0
			8/3	43°10'	87°53'	5	10	2.0
			8/3	43°10'	87°53'	5	10	2.0
			8/5	43°10'	87°53'	7	10	1.4
			8/5	43°10'	87°53'	7	10	1.4
August 19								
1	43°03'	86°18'	...	...	...	...	...	...
2	43°03'	86°21'	...	...	...	...	...	...
3	43°03'	86°24'	...	...	...	...	...	...
4	43°03'	86°31'	...	...	...	...	...	...
5	43°02'	86°37'	...	...	...	...	...	...
6	43°02'	86°44'	...	...	...	...	...	...
7	43°02'	86°50'	...	...	...	...	...	...
8	43°01'	86°56'	...	...	...	...	...	...
9	43°01'	87°01'	...	...	...	...	...	...
10	43°01'	87°07'	...	...	...	...	...	...
11	43°00'	87°14'	...	...	...	...	...	...

Table 10. --Release and recovery points of drift envelopes that were released in 1954 on the Grand Haven, Michigan-Milwaukee, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrlft	Miles covered	Miles per day
August 19								
12	43°00'	87°19'	...	...	...	...	...	...
13	43°00'	87°26'	...	...	...	...	...	...
14	43°00'	87°32'	...	...	...	...	...	...
15	43°02'	87°37'	...	...	...	...	...	...
16	43°02'	87°41'	...	...	...	...	...	...
17	43°02'	87°46'	8/21	43°03'	87°54'	2	6	3.0
			8/23	43°03'	87°54'	4	6	1.5
			8/26	43°03'	87°54'	7	6	0.9
			8/27	43°03'	87°54'	8	6	0.8
			9/2	43°03'	87°54'	14	6	0.4
18	43°02'	87°50'	...	...	...	...	...	...
September 9								
1	43°03'	86°18'	...	...	...	...	...	...
2	43°03'	86°21'	...	...	...	...	...	...
September 11								
3	43°03'	86°25'	...	...	...	...	...	...
4	43°03'	86°31'	...	...	...	...	...	...
5	43°03'	86°37'	...	...	...	...	...	...
6	43°02'	86°44'	...	...	...	...	...	...
7	43°02'	86°51'	...	...	...	...	...	...
8	43°02'	86°58'	...	...	...	...	...	...
9	43°02'	87°03'	...	...	...	...	...	...
10	43°02'	87°09'	...	...	...	...	...	...
11	43°01'	87°15'	...	...	...	...	...	...
12	43°01'	87°20'	...	...	...	...	...	...
13	43°01'	87°27'	...	...	...	...	...	...
14	43°01'	87°33'	...	...	...	...	...	...
15	43°01'	87°38'	...	...	...	...	...	...
16	43°01'	87°42'	...	...	...	...	...	...
17	43°01'	87°46'	...	...	...	...	...	...
18	43°01'	87°51'	...	...	...	...	...	...

Table 11.--Release and recovery points of drift bottles with metal drags that were released in 1954 on the Ludington, Michigan-Manitowoc, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 25								
1	43°57'	86°31'	9/5	43°59'	86°28'	11	3	0.3
			9/25	44°00'	86°29'	31	4	0.1
			9/16	44°06'	86°26'	22	14	0.6
			11/5	44°06'	86°26'	72	14	0.2
			10/3	44°11'	86°24'	39	19	0.5
			11/7	43°26'	86°27'	74	38	0.5
			10/29	42°55'	86°14'	65	75	1.2
			11/7	42°49'	86°14'	74	82	1.1
2	44°00'	86°37'	10/18	43°59'	86°28'	54	7	0.1
			9/26	43°50'	86°26'	32	14	0.4
			11/6	43°47'	86°26'	73	17	0.2
			11/7	43°47'	86°26'	74	17	0.2
			10/9	43°21'	86°25'	45	48	1.1
			10/14	43°17'	86°22'	50	53	1.1
			10/3	43°14'	86°20'	39	57	1.5
			10/24	44°43'	86°11'	60	57	1.0
3	44°00'	86°43'	10/22	44°14'	86°21'	58	24	0.4
			9/26	43°35'	86°32'	32	31	1.0
			11/25	44°44'	86°10'	92	59	0.6
4	44°01'	86°50'	10/7	43°39'	86°33'	43	29	0.7
			9/26	43°08'	86°17'	32	67	2.1
			10/17	42°53'	86°13'	53	84	1.6
5	44°02'	87°00'	10/1	44°03'	86°31'	37	25	0.7
			11/7	44°04'	86°31'	74	25	0.3
			9/26	43°40'	86°32'	32	34	1.1
			10/24	44°54'	86°05'	60	76	1.3
6	44°02'	87°06'	11/6	42°47'	86°13'	73	98	1.3
7	44°03'	87°15'	9/15	43°39'	87°43'	21	37	1.8
			11/7	43°38'	86°33'	74	46	0.6
			11/7	43°26'	86°27'	74	59	0.8
			12/26	42°22'	86°18'	123	128	1.0
			10/17	41°51'	87°37'	53	153	2.9
8	44°04'	87°22'	12/5	42°44'	86°13'	102	109	1.1
			12/6	42°39'	86°18'	103	112	1.1
			11/21	42°31'	86°15'	88	121	1.4
			10/7	42°15'	87°49'	43	127	3.0

Table 11. --Release and recovery points of drift bottles with metal drags that were released in 1954 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 25								
9	44°05'	87°30'	10/12	43°59'	87°42'	48	12	0.3
			9/15	43°45'	87°42'	21	25	1.2
			9/15	43°45'	87°40'	21	25	1.2
			9/24	43°32'	87°47'	30	40	1.3
			9/29	43°32'	87°47'	35	40	1.1
			11/12	43°24'	87°51'	79	51	0.6
			9/16	43°16'	87°55'	22	59	2.7
			9/18	43°03'	87°54'	24	74	3.1
August 23								
10	44°05'	87°34'	9/23	44°10'	87°32'	31	6	0.2
			9/26	44°21'	87°32'	34	19	0.6
			10/30	44°25'	87°31'	68	23	0.3
			9/25	44°34'	87°27'	33	33	1.0
11	44°05'	87°36'	10/3	44°20'	87°33'	41	18	0.4
			8/29	44°23'	87°31'	6	21	3.5
			9/5	44°23'	87°31'	13	21	1.6
			8/29	44°25'	87°31'	6	23	3.8
			10/2	44°26'	87°30'	40	25	0.6
			12/7	44°30'	87°29'	106	30	0.3
			9/8	44°42'	87°21'	16	45	2.8

Table 12. --Release points of drift envelopes in 1954 on the Ludington, Michigan-Manitowoc, Wisconsin transect

Station	Date	Latitude (North)	Longitude (West)
1	8/25	43°57'	86°31'
2	8/25	44°00'	86°37'
3	8/25	44°00'	86°43'
4	8/25	44°01'	86°50'
5	8/25	44°02'	87°00'
6	8/25	44°02'	87°06'
7	8/25	44°03'	87°15'
8	8/25	44°04'	87°22'
9	8/25	44°05'	87°30'
10	8/23	44°05'	87°34'
11	8/23	44°05'	87°36'

Table 13. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
1	43°06'	86°20'	5/11	43°24'	86°26'	15	22	1.5
			5/21	43°24'	86°26'	25	22	0.9
			5/8	43°26'	86°27'	12	24	2.0
			5/8	43°32'	86°30'	12	31	2.6
			5/10	43°32'	86°30'	14	31	2.2
			6/14	43°32'	86°30'	49	31	0.6
			5/21	43°33'	86°30'	25	32	1.3
2	43°11'	86°21'	5/7	43°21'	86°25'	11	13	1.2
			5/10	43°28'	86°27'	14	21	1.5
			5/7	43°30'	86°27'	11	23	2.1
			5/10	43°32'	86°29'	14	26	1.9
			5/19	43°35'	86°31'	23	30	1.3
			5/12	43°37'	86°32'	16	32	2.0
			5/7	43°38'	86°32'	11	34	3.1
			5/8	44°04'	86°31'	12	63	5.3
			5/11	44°04'	86°31'	15	63	4.2
			6/12	44°08'	86°25'	47	71	1.5
3	43°14'	86°23'	5/7	43°29'	86°28'	11	18	1.6
			5/7	43°29'	86°28'	11	18	1.6
			8/15	43°31'	86°28'	111	20	0.2
			5/12	43°41'	86°32'	16	31	1.9
			5/12	43°48'	86°25'	16	43	2.7
			5/8	44°00'	86°30'	12	56	4.7
			5/7	44°01'	86°30'	11	57	5.2
4	43°18'	86°28'	5/12	43°42'	86°31'	16	28	1.8
			5/15	43°53'	86°26'	19	42	2.2
			6/13	43°53'	86°26'	48	42	0.9
			5/11	44°03'	86°31'	15	53	3.5
			5/14	44°03'	86°31'	18	53	2.9
			6/22	44°34'	86°13'	57	92	1.6
			6/24	44°47'	86°04'	59	110	1.9
5	43°20'	86°32'	7/2	43°16'	86°22'	67	10	0.1
			5/12	43°40'	86°32'	16	22	1.4
			6/12	43°55'	86°27'	47	41	0.9
			6/19	43°55'	86°27'	54	41	0.8
			5/14	44°11'	86°24'	18	61	3.4
			6/23	44°18'	86°18'	58	70	1.2
			7/21	44°44'	86°06'	86	105	1.2

Table 13. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
6	43°24'	86°36'	6/25	43°26'	86°26'	60	8	0.1
			6/25	43°36'	86°32'	60	14	0.2
			6/23	43°16'	86°21'	58	16	0.3
			6/22	43°40'	86°33'	57	18	0.3
			7/5	43°57'	86°27'	70	40	0.6
			6/12	44°09'	86°25'	47	55	1.2
			6/10	44°13'	86°21'	45	60	1.3
			7/23	44°35'	86°13'	88	85	1.0
7	43°27'	86°41'	7/17	43°37'	86°33'	82	14	0.2
			6/25	43°06'	86°16'	60	31	0.5
			6/23	43°05'	86°15'	58	34	0.6
			7/5	43°57'	86°28'	70	36	0.5
			7/5	44°01'	86°30'	70	40	0.6
			7/5	44°01'	86°30'	70	40	0.6
			7/15	44°01'	86°30'	80	40	0.5
			6/25	44°05'	86°30'	60	44	0.7
8	43°33'	86°49'	5/21	43°50'	86°27'	25	29	1.2
			7/15	44°36'	86°14'	80	78	1.0
			7/9	44°52'	86°05'	74	98	1.3
			6/14	44°56'	85°57'	49	110	2.2
			6/5	44°56'	85°57'	40	110	2.8
9	43°37'	86°55'	6/3	44°08'	86°25'	38	42	1.1
			5/30	44°34'	86°13'	34	74	2.2
			7/22	44°43'	86°11'	87	84	1.0
			7/22	44°43'	86°11'	87	84	1.0
			7/22	44°43'	86°11'	87	84	1.0
			6/1	44°44'	86°09'	36	86	2.4
			6/12	44°57'	85°52'	47	110	2.3
			6/25	44°57'	85°48'	60	113	1.9
10	43°41'	86°58'	6/23	43°22'	86°25'	58	35	0.6
			6/5	44°05'	86°30'	40	37	0.9
			5/14	44°06'	86°28'	18	39	2.2
			5/31	44°06'	86°28'	35	39	1.1
			5/31	44°06'	86°28'	35	39	1.1
			6/22	44°21'	86°16'	57	58	1.0
			6/23	44°23'	86°15'	58	61	1.1
			7/30	44°48'	86°04'	95	93	1.0
11	43°43'	87°04'	7/5	43°56'	86°28'	70	34	0.5
			7/15	43°26'	86°27'	80	38	0.5
			7/6	44°16'	86°19'	71	53	0.7

Table 13. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
11	43°43'	87°04'	7/5	44°26'	86°15'	70	63	0.9
			7/6	44°30'	86°15'	71	67	0.9
			6/22	44°35'	86°14'	57	72	1.3
			6/25	44°40'	86°16'	60	76	1.3
			7/27	44°40'	86°16'	92	76	0.8
12	43°46'	87°07'	6/13	43°48'	87°43'	48	30	0.6
			8/5	44°32'	86°14'	101	68	0.7
			7/5	44°34'	86°14'	70	69	1.0
			8/4	44°54'	86°01'	100	96	1.0
			9/1	45°52'	86°20'	128	148	1.2
13	43°48'	87°12'	8/14	44°04'	86°30'	110	39	0.4
			9/10	43°21'	86°25'	137	50	0.4
			9/4	44°15'	86°21'	131	51	0.4
			9/27	44°52'	87°13'	154	72	0.5
			9/3	44°48'	86°05'	130	88	0.7
14	43°52'	87°17'	8/8	44°12'	87°30'	104	25	0.2
			6/23	43°48'	86°26'	58	42	0.7
			7/1	43°13'	86°20'	66	65	1.0
15	43°56'	87°21'	6/23	44°03'	86°31'	58	42	0.7
			6/23	43°57'	86°28'	58	44	0.8
			7/17	43°54'	86°27'	82	45	0.5
			6/25	44°11'	86°23'	60	51	0.9
			6/28	44°29'	86°14'	63	67	1.1
			6/24	44°45'	86°05'	59	86	1.5
			8/8	45°10'	85°36'	104	124	1.2
16	43°59'	87°25'	7/9	44°12'	86°22'	74	55	0.7
			7/16	44°20'	86°16'	81	62	0.8
			9/2	44°36'	86°13'	129	73	0.6
17	44°02'	87°29'	5/30	44°11'	87°31'	34	11	0.3
			5/27	43°57'	87°42'	31	12	0.4
			5/26	43°46'	87°42'	30	22	0.7
			5/29	43°38'	87°44'	33	30	0.9
			8/11	43°56'	86°27'	107	52	0.5
			8/14	43°55'	86°27'	110	52	0.5
			9/5	43°46'	86°26'	132	55	0.4
			7/3	45°00'	86°07'	68	94	1.4
18	44°04'	87°34'	6/22	44°13'	87°31'	57	11	0.2
			9/5	44°11'	86°23'	132	59	0.4
			11/5	45°12'	85°23'	193	135	0.7

Table 14. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
1	43°06'	86°20'	5/6	43°15'	86°21'	10	11	1.1
			5/6	43°15'	86°21'	10	11	1.1
			5/8	43°15'	86°21'	12	11	0.9
			5/9	43°15'	86°21'	13	11	0.8
			5/7	43°35'	86°32'	11	35	3.2
2	43°11'	86°21'	4/29	43°13'	86°20'	3	3	1.0
			5/26	43°13'	86°20'	30	3	0.1
			7/31	43°13'	86°20'	96	3	1/0.0
			5/7	43°20'	86°25'	11	12	1.1
			6/11	43°45'	86°26'	46	45	1.0
			5/11	43°50'	86°25'	15	50	3.3
			5/7	44°00'	86°29'	11	59	5.4
3	43°14'	86°23'	5/6	43°47'	86°26'	10	41	4.1
			5/6	43°47'	86°26'	10	41	4.1
			5/12	43°47'	86°26'	16	41	2.6
			5/12	43°47'	86°26'	16	41	2.6
			5/12	43°47'	86°26'	16	41	2.6
			5/12	43°47'	86°26'	16	41	2.6
			5/12	43°47'	86°26'	16	41	2.6
			5/8	43°52'	86°26'	12	47	3.9
			6/4	43°52'	86°26'	39	47	1.2
			5/9	43°56'	86°27'	13	51	3.9
4	43°18'	86°28'	5/9	43°50'	86°25'	13	40	3.1
			7/8	44°05'	86°27'	73	59	0.8
			7/18	44°06'	86°25'	83	60	0.7
			5/9	44°09'	86°25'	13	62	4.8
			5/14	44°13'	86°21'	18	68	3.8
			6/22	44°14'	86°20'	57	69	1.2
			6/25	44°21'	86°15'	60	78	1.3
			6/22	44°57'	85°56'	57	124	2.2
5	43°20'	86°32'	5/6	43°57'	86°27'	10	42	4.2
			5/17	44°05'	86°30'	21	52	2.5
			6/23	44°19'	86°19'	58	70	1.2
			6/22	44°25'	86°15'	57	78	1.4
			7/9	44°25'	86°15'	74	78	1.1
			6/22	44°35'	86°14'	57	89	1.6
			6/22	44°35'	86°14'	57	89	1.6
			7/21	44°44'	86°06'	86	105	1.2
			6/24	44°46'	86°05'	59	106	1.8

Table 14. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
6	43°24'	86°36'	6/9	43°41'	86°32'	44	20	0.5
			6/9	43°57'	86°28'	44	40	0.9
			5/17	44°05'	86°30'	21	47	2.2
			6/8	44°07'	86°27'	43	54	1.3
			6/12	44°07'	86°27'	47	54	1.1
			6/24	44°26'	86°15'	59	77	1.3
			7/21	44°44'	86°05'	86	100	1.2
			6/24	44°48'	86°04'	59	106	1.8
			6/25	44°50'	86°04'	60	108	1.8
7	43°27'	86°41'	6/30	43°09'	86°18'	65	28	0.4
			7/5	43°51'	86°26'	70	31	0.4
			7/3	42°56'	86°13'	68	42	0.6
			6/23	44°04'	86°31'	58	43	0.7
			7/3	42°54'	86°13'	68	44	0.6
			7/10	44°53'	86°01'	75	107	1.4
			7/20	41°38'	87°19'	85	130	1.5
8	43°33'	86°49'	6/27	44°38'	86°15'	62	80	1.3
			6/24	44°45'	86°05'	59	95	1.6
			6/13	44°58'	85°46'	48	119	2.5
			6/13	44°58'	85°46'	48	119	2.5
			6/27	45°04'	85°42'	62	125	2.0
			7/9	45°27'	85°03'	74	165	2.2
			7/11	45°45'	84°48'	76	194	2.6
9	43°37'	86°55'	5/27	44°03'	86°31'	31	37	1.2
			6/27	44°48'	86°05'	62	93	1.5
			6/26	44°56'	85°58'	61	103	1.7
			6/29	44°56'	85°58'	64	103	1.6
			6/13	44°58'	85°47'	48	117	2.4
			9/5	45°09'	85°39'	132	126	1.0
			7/12	45°27'	85°04'	77	162	2.1
			7/10	45°43'	84°57'	75	176	2.3
10	43°41'	86°58'	6/3	44°09'	86°25'	38	42	1.1
			6/24	44°46'	86°05'	59	91	1.5
			6/25	44°48'	86°05'	60	94	1.6
			6/25	45°08'	85°40'	60	126	2.1
11	43°43'	87°04'	6/29	43°33'	86°30'	64	30	0.5
			6/23	44°00'	86°29'	58	32	0.6
			6/24	43°48'	86°27'	59	32	0.5

Table 14. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
11	43°43'	87°04'	6/26	43°55'	86°28'	61	33	0.5
			7/23	43°52'	86°27'	88	33	0.4
			6/28	44°01'	86°30'	63	35	0.6
			8/11	44°42'	86°13'	107	81	0.8
12	43°46'	87°07'	7/10	43°48'	86°26'	75	34	).5
			6/30	43°33'	86°30'	65	35	0.5
			7/24	44°12'	86°23'	89	46	0.5
			7/1	43°15'	86°22'	66	51	0.8
			7/10	44°54'	86°02'	75	101	1.3
			9/25	45°35'	85°36'	152	146	1.0
13	43°48'	87°12'	7/4	43°47'	86°27'	69	38	0.6
			7/6	43°47'	86°27'	71	38	0.5
			6/30	43°21'	86°26'	65	51	0.8
			8/8	45°08'	85°39'	104	121	1.2
14	43°52'	87°17'	6/28	43°47'	86°27'	63	42	0.7
			6/26	44°20'	86°17'	61	59	1.0
			6/26	44°35'	86°13'	61	72	1.2
			7/22	44°43'	86°11'	87	83	1.0
			6/24	44°46'	86°05'	59	87	1.5
			7/3	45°22'	85°09'	68	152	2.2
15	43°56'	87°21'	6/30	43°57'	86°28'	65	44	0.7
			7/3	43°55'	86°27'	68	45	0.7
			6/25	44°33'	86°14'	60	70	1.2
			7/20	45°18'	85°16'	85	142	1.7
			7/10	45°23'	84°55'	75	159	2.1
16	43°59'	87°25'	6/22	44°33'	86°14'	57	71	1.2
			7/16	45°03'	85°58'	81	103	1.3
			7/9	44°57'	85°54'	74	104	1.4
			9/20	45°08'	86°03'	147	104	0.7
			7/24	45°12'	85°23'	89	134	1.5
			9/17	45°16'	85°23'	144	134	0.9
			7/10	45°23'	84°55'	75	161	2.1
17	44°02'	87°29'	7/2	44°04'	86°31'	67	48	0.7
			6/22	44°34'	86°14'	57	73	1.3
			6/22	44°34'	86°14'	57	73	1.3
			7/17	45°03'	85°59'	82	104	1.3
			7/12	45°08'	85°36'	77	138	1.8

Table 14. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Grand Haven, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 26								
17	44°02'	87°29'	9/23	45°45'	85°31'	150	156	1.0
			7/12	45°22'	84°59'	77	158	2.1
18	44°04'	87°34'	8/23	44°18'	86°19'	119	55	0.5
			9/5	44°08'	86°25'	132	57	0.4
			7/23	43°38'	86°33'	88	60	0.7
			8/4	43°38'	86°33'	100	60	0.6
			7/24	44°54'	86°01'	89	99	1.1
			10/10	42°27'	86°16'	167	130	0.8

1/ Less than 0.05

Table 15. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Manitowoc, Wisconsin-Sturgeon Bay, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 27								
1	44°06'	87°34'	5/30	44°07'	87°37'	33	3	0.1
			5/30	44°09'	87°33'	33	3	0.1
			5/1	44°14'	87°31'	4	9	2.3
			6/12	44°15'	87°31'	46	10	0.2
			8/21	44°00'	86°29'	116	54	0.5
2	44°07'	87°30'	9/1	43°46'	86°28'	127	57	0.4
			8/5	44°30'	86°15'	100	67	0.7
			9/18	45°00'	86°08'	144	90	0.6
			10/9	43°05'	86°15'	165	94	0.6
			7/14	44°59'	85°36'	78	144	1.8
3	44°12'	87°28'	5/30	44°12'	87°31'	33	3	0.1
			5/29	44°16'	87°32'	32	6	0.2
			5/26	44°16'	87°32'	29	6	0.2
			6/18	44°16'	87°32'	52	6	0.1
			6/12	44°23'	87°31'	46	12	0.3
			6/10	44°06'	87°40'	44	13	0.3
			5/3	44°35'	87°24'	6	26	4.3
4	44°16'	87°27'	6/12	44°15'	87°31'	46	4	0.1
			5/29	44°12'	87°30'	32	6	0.2
			10/8	44°10'	87°32'	164	9	0.1
			5/29	44°08'	87°34'	32	11	0.3
			5/28	44°28'	87°30'	31	14	0.5
			5/29	44°08'	87°36'	32	14	0.4
			7/10	44°08'	87°36'	74	14	0.2
5	44°21'	87°25'	8/18	44°49'	87°18'	113	33	0.3
			8/25	44°56'	87°10'	120	42	0.4
			8/9	43°44'	86°28'	104	64	0.6
			9/3	45°51'	86°20'	129	115	0.9
			10/30	45°35'	85°06'	186	141	0.8
6	44°26'	87°23'	6/12	44°16'	87°31'	46	13	0.3
			6/12	44°11'	87°31'	46	18	0.4
			9/4	44°12'	86°22'	130	53	0.4
			8/5	45°06'	85°41'	100	97	1.0
			7/10	45°11'	85°38'	74	101	1.4
			8/13	45°12'	85°31'	108	110	1.0
			10/9	45°51'	86°20'	165	111	0.7
7	44°30'	87°22'	8/1	44°27'	87°30'	96	7	0.1
			9/18	44°18'	87°32'	144	16	0.1
			6/12	44°13'	87°30'	46	20	0.4
			6/20	44°10'	87°31'	54	23	0.4
			6/5	44°06'	87°39'	39	31	0.8

Table 16. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Manitowoc, Wisconsin-Sturgeon Bay, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 27								
1	44°06'	87°34'	4/29	44°09'	87°32'	2	5	2.5
			4/29	44°09'	87°32'	2	5	2.5
			4/29	44°09'	87°32'	2	6	3.0
			4/29	44°10'	87°32'	2	6	3.0
			4/29	44°10'	87°32'	2	6	3.0
			4/29	44°10'	87°32'	2	6	3.0
			4/29	44°10'	87°32'	2	6	3.0
			4/29	44°11'	87°31'	2	8	4.0
2	44°07'	87°30'	8/1	43°42'	86°31'	96	57	0.6
			7/27	43°22'	86°26'	91	74	0.8
			6/28	43°11'	86°19'	62	78	1.3
			10/15	42°44'	86°13'	171	117	0.7
3	44°12'	87°28'	9/8	44°07'	86°26'	134	51	0.4
			8/7	44°07'	86°26'	102	51	0.5
			8/31	43°50'	86°27'	126	56	0.4
			7/31	43°47'	86°27'	95	58	0.6
			8/4	43°33'	86°30'	99	66	0.7
			8/30	44°40'	86°15'	125	68	0.5
			9/3	45°09'	85°39'	129	112	0.9
4	44°16'	87°27'	10/1	44°05'	86°30'	157	48	0.3
			7/31	44°01'	86°30'	95	50	0.5
			8/22	44°18'	86°17'	117	56	0.5
			8/6	43°46'	86°27'	101	60	0.6
			10/2	43°39'	86°32'	158	61	0.4
			7/31	44°37'	86°15'	95	64	0.7
			9/3	43°31'	86°29'	129	69	0.5
			9/6	44°52'	86°04'	132	81	0.6
5	44°21'	87°25'	8/15	44°08'	86°25'	110	52	0.5
			7/26	44°15'	86°20'	90	54	0.6
			9/2	44°22'	86°16'	128	58	0.5
			8/5	44°38'	86°15'	100	61	0.6
			8/24	44°41'	86°16'	119	62	0.5
			8/20	43°08'	86°18'	115	99	0.9
			9/4	42°46'	86°13'	130	124	1.0
6	44°26'	87°23'	8/31	44°17'	86°18'	126	53	0.4
			8/5	43°44'	86°28'	100	65	0.7
			8/30	43°13'	86°20'	125	97	0.8

Table 16. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Manitowoc, Wisconsin-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
April 27								
7	44°30'	87°22'	10/30	44°25'	87°30'	186	10	0.1
			6/13	44°16'	87°31'	47	18	0.4
			9/5	44°05'	86°30'	131	52	0.4
			9/4	44°22'	86°15'	130	55	0.4
			8/9	44°36'	86°14'	104	56	0.5
			9/23	43°48'	86°27'	149	65	0.4
			11/18	45°12'	85°32'	205	103	0.5

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 13								
1	43°57'	86°30'	5/30	44°00'	86°29'	17	3	0.2
			5/29	43°55'	86°27'	16	4	0.3
			6/5	44°04'	86°30'	23	8	0.3
			5/30	43°48'	86°26'	17	11	0.6
			5/30	43°47'	86°27'	17	12	0.7
			6/7	44°08'	86°25'	25	14	0.6
			6/10	44°09'	86°25'	28	16	0.6
			7/5	44°41'	86°16'	53	53	1.0
			7/21	44°43'	86°09'	69	61	0.9
			7/15	44°46'	86°05'	63	66	1.0
2	43°58'	86°34'	6/16	43°57'	86°28'	34	5	0.1
			6/12	44°07'	86°26'	30	14	0.5
			6/22	44°40'	86°16'	40	50	1.3
			6/28	44°44'	86°06'	46	62	1.3
			6/25	44°48'	86°04'	43	65	1.5
			7/3	44°51'	86°04'	51	68	1.3
			6/23	44°55'	85°58'	41	75	1.8
			6/24	45°08'	85°40'	42	97	2.3
3	43°58'	86°37'	6/1	44°02'	86°30'	19	7	0.4
			6/1	44°07'	86°26'	19	14	0.7
			6/24	44°41'	86°16'	42	53	1.3
			7/17	45°08'	85°40'	65	97	1.5
			7/4	45°24'	84°54'	52	140	2.7
4	44°00'	86°47'	6/17	44°04'	86°30'	35	15	0.4
			7/27	44°41'	86°15'	75	55	0.7
			6/24	44°44'	86°10'	42	60	1.4
			6/22	44°50'	86°04'	40	68	1.7
			6/26	44°53'	86°04'	44	71	1.6
			7/4	45°24'	84°54'	52	141	2.7
5	44°00'	86°55'	7/4	44°15'	86°20'	52	34	0.7
			8/20	44°36'	87°26'	99	49	0.5
			7/10	44°41'	86°16'	58	57	1.0
			8/25	44°55'	85°58'	104	82	0.8
			7/26	45°03'	85°45'	74	96	1.3
			10/30	45°43'	86°34'	170	118	0.7
6	44°01'	87°02'	7/1	43°26'	86°27'	49	49	1.0
			6/5	44°36'	86°14'	23	57	2.5
			7/11	44°53'	86°01'	59	82	1.4

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases				Recoveries				
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 13								
6	44°01'	87°02'	7/9	44°56'	85°58'	57	84	1.5
			7/23	44°56'	85°50'	71	96	1.4
7	44°02'	87°08'	7/2	44°01'	86°30'	50	32	0.6
			9/5	44°15'	86°21'	115	42	0.4
			7/23	44°22'	86°16'	71	49	0.7
			9/20	45°07'	86°04'	130	92	0.7
			8/29	45°47'	86°25'	108	126	1.2
8	44°03'	87°13'	8/13	44°24'	87°31'	92	28	0.3
			10/28	45°45'	86°30'	168	122	0.7
9	44°03'	87°19'	9/5	44°07'	86°27'	115	44	0.4
			9/5	44°07'	86°27'	115	44	0.4
			7/24	43°42'	86°30'	72	47	0.7
			8/14	44°44'	87°20'	93	48	0.5
			8/13	44°35'	86°14'	92	66	0.7
			9/7	45°41'	84°58'	117	160	1.4
10	44°04'	87°26'	5/28	43°37'	87°45'	15	35	2.3
			6/12	43°28'	87°49'	30	45	1.5
			5/30	43°26'	87°50'	17	48	2.8
			5/28	43°26'	87°50'	15	48	3.2
			5/28	43°23'	87°53'	15	52	3.5
			8/30	43°39'	86°32'	109	53	0.5
			6/26	43°14'	87°55'	44	62	1.4
			8/12	43°04'	87°53'	91	72	0.8
11	44°05'	87°32'	5/25	43°10'	87°54'	12	65	5.4
			5/27	43°10'	87°54'	14	65	4.6
			5/30	43°10'	87°54'	17	65	3.8
			6/4	43°10'	87°54'	22	65	3.0
			5/27	43°06'	87°54'	14	70	5.0
			6/12	42°54'	87°51'	30	82	2.7
12	44°05'	87°34'	5/21	43°43'	87°43'	8	26	3.3
			5/25	43°43'	87°43'	12	26	2.2
			7/27	43°35'	86°32'	75	63	0.8
			5/30	43°11'	87°54'	17	64	3.8
			5/29	43°07'	87°54'	16	68	4.3
			7/31	43°05'	87°53'	79	71	0.9

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 26								
1	43°57'	86°30'	7/2	43°57'	86°28'	6	2	0.3
			6/29	43°56'	86°27'	3	4	1.3
			7/1	43°56'	86°27'	5	4	0.8
			7/1	43°56'	86°27'	5	4	0.8
			7/1	43°56'	86°27'	5	4	0.8
			7/3	43°56'	86°27'	7	4	0.6
			7/2	43°52'	86°26'	6	7	1.2
			7/3	43°52'	86°26'	7	7	1.0
			7/10	43°50'	86°26'	14	10	0.7
			7/5	44°14'	86°20'	9	21	2.3
2	43°58'	86°33'	7/21	44°51'	86°04'	25	67	2.7
			7/26	45°03'	85°45'	30	89	3.0
			8/16	45°12'	85°32'	51	106	2.1
			7/17	45°09'	85°34'	21	112	5.3
			7/24	45°22'	85°07'	28	129	4.6
			7/23	45°26'	84°56'	27	136	5.0
3	43°58'	86°39'	7/2	44°01'	86°30'	6	8	1.3
			7/3	44°03'	86°31'	7	9	1.3
			7/8	43°59'	86°28'	12	9	0.8
			7/9	44°05'	86°30'	13	11	0.8
			9/18	45°00'	86°09'	84	76	0.9
			7/19	44°56'	85°50'	23	86	3.7
			7/19	44°56'	85°50'	23	86	3.7
4	43°59'	86°45'	7/16	45°00'	86°08'	20	77	3.9
			9/18	45°00'	86°08'	84	77	0.9
			7/10	44°56'	85°50'	14	87	6.2
			9/25	44°56'	85°50'	91	87	1.0
			8/21	45°16'	85°21'	56	117	2.1
			9/11	45°21'	85°11'	77	126	1.6
			9/4	45°23'	84°57'	70	138	2.0
5	43°59'	86°50'	7/16	44°56'	85°49'	20	88	4.4
			9/25	45°07'	86°03'	91	88	1.0
			9/25	45°07'	86°03'	91	88	1.0
			9/25	45°07'	86°03'	91	88	1.0
			7/28	45°00'	85°46'	32	91	2.8
			8/28	45°04'	85°42'	63	96	1.5
			8/28	45°07'	85°36'	63	120	1.9
			7/30	45°08'	85°23'	34	120	3.5

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 26								
6	44°00'	86°57'	9/1	44°25'	86°15'	67	45	0.7
			7/11	44°56'	85°50'	15	93	6.2
			7/11	44°56'	85°50'	15	93	6.2
			7/15	44°56'	85°50'	19	93	4.9
			7/24	44°56'	85°50'	28	93	3.3
			8/20	44°56'	85°50'	55	93	1.7
7	44°01'	87°04'	7/28	44°54'	86°04'	32	78	2.4
			8/22	45°03'	86°07'	57	85	1.5
			9/11	45°18'	85°20'	77	124	1.6
8	44°01'	87°08'	9/4	44°24'	86°15'	70	50	0.7
			8/7	44°26'	86°15'	42	51	1.2
			9/29	45°01'	87°08'	95	68	0.7
			9/1	44°44'	86°09'	67	69	1.0
			7/27	44°54'	85°59'	31	87	2.8
			8/24	45°01'	85°46'	59	98	1.7
			9/23	45°08'	85°39'	89	106	1.2
9	44°03'	87°16'	7/19	44°43'	86°10'	23	71	3.1
			8/6	44°54'	86°02'	41	88	2.1
			7/29	44°55'	85°58'	33	91	2.8
			8/31	44°58'	85°55'	66	92	1.4
10	44°03'	87°22'	7/31	44°46'	86°04'	35	81	2.3
			9/23	45°00'	86°09'	89	89	1.0
			9/25	45°08'	86°03'	91	98	1.1
			9/5	45°08'	85°40'	71	112	1.6
			9/6	45°17'	85°21'	72	132	1.8
11	44°04'	87°26'	9/11	44°55'	87°10'	77	60	0.8
			10/22	45°01'	87°08'	118	66	0.6
			8/25	44°38'	86°15'	60	71	1.2
			9/4	44°43'	86°06'	70	81	1.2
			9/18	44°43'	86°06'	84	81	1.0
			9/10	44°54'	86°01'	76	93	1.2
12	44°05'	87°33'	7/31	44°38'	87°24'	35	39	1.1
			8/21	44°42'	87°21'	56	44	0.8
			7/29	44°51'	87°14'	33	55	1.7
			8/23	45°04'	87°05'	58	71	1.2
			8/17	45°05'	87°05'	52	73	1.4

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 26								
13	44°06'	87°36'	8/19	44°37'	87°25'	54	38	0.7
			8/21	44°53'	87°13'	56	59	1.1
			9/12	45°45'	86°31'	78	127	1.6
			9/1	45°55'	86°17'	67	141	2.1
August 11								
1	43°57'	86°30'	8/18	43°57'	86°27'	7	3	0.4
			8/18	43°56'	86°27'	7	3	0.4
			8/19	43°56'	86°27'	8	3	0.4
			8/18	43°51'	86°25'	7	7	1.0
			8/19	43°51'	86°25'	8	7	0.9
			8/20	44°08'	86°25'	9	15	1.7
			8/20	44°08'	86°25'	9	15	1.7
			10/8	41°56'	86°35'	58	140	2.4
2	43°58'	86°33'	8/18	43°58'	86°27'	7	4	0.6
			8/18	43°51'	86°25'	7	9	1.3
			8/20	44°09'	86°23'	9	17	1.9
			8/20	44°09'	86°23'	9	17	1.9
			8/20	44°09'	86°23'	9	17	1.9
			8/20	44°09'	86°23'	9	17	1.9
			8/20	44°09'	86°23'	9	17	1.9
			9/18	44°36'	86°13'	38	47	1.2
			8/31	44°51'	86°04'	20	68	3.4
3	43°58'	86°38'	9/1	43°50'	86°26'	21	14	0.7
			8/31	43°48'	86°26'	20	15	0.8
			8/31	43°48'	86°26'	20	15	0.8
			8/31	43°41'	86°32'	20	21	1.1
			9/24	43°11'	86°19'	44	57	1.3
			10/11	43°04'	86°15'	61	67	1.1
			10/2	42°22'	87°49'	52	126	2.4
4	44°00'	86°43'	9/4	44°26'	86°15'	24	39	1.6
			9/1	44°36'	86°13'	21	49	2.3
			9/8	44°36'	86°13'	28	49	1.8
			8/22	44°39'	86°15'	11	52	4.7
			9/9	44°41'	86°15'	29	53	1.8
			11/3	44°36'	87°26'	84	55	0.7
			8/31	44°55'	85°58'	20	79	4.0
			9/2	44°55'	85°58'	22	79	3.6
			9/3	45°04'	85°42'	23	94	4.1

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 11								
5	44°00'	86°50'	8/19	44°01'	86°30'	8	17	2.1
			10/15	43°56'	86°26'	65	20	0.3
			9/4	44°08'	86°24'	24	23	1.0
			9/1	44°11'	86°21'	21	27	1.3
			8/30	44°20'	86°16'	19	36	1.9
			8/30	44°39'	86°15'	19	53	2.8
6	44°01'	86°58'	10/15	43°38'	86°32'	65	33	0.5
			10/9	43°11'	86°19'	59	67	1.1
			9/17	43°03'	86°15'	37	76	2.1
			9/19	43°03'	86°15'	39	76	1.9
			10/20	42°55'	86°13'	70	85	1.2
			10/17	42°41'	86°13'	67	99	1.5
			10/8	42°21'	86°17'	58	119	2.1
7	44°02'	87°03'	9/4	44°15'	86°20'	24	38	1.6
			9/1	44°16'	86°19'	21	39	1.9
			8/31	44°16'	86°19'	20	39	2.0
			9/5	44°16'	86°19'	25	39	1.6
			8/30	44°19'	86°18'	19	42	2.2
			8/30	44°19'	86°18'	19	42	2.2
			8/31	44°19'	86°18'	20	42	2.1
			9/7	44°21'	86°16'	27	44	1.6
8	44°03'	87°09'	9/24	43°25'	86°26'	44	57	1.3
			10/13	43°16'	86°22'	63	67	1.1
			11/20	43°14'	86°20'	101	69	0.7
			10/9	42°50'	86°13'	59	96	1.6
			10/26	42°45'	86°13'	76	102	1.3
			10/17	42°08'	86°27'	67	138	2.1
9	44°04'	87°15'	9/9	44°06'	86°28'	29	38	1.3
			9/1	44°10'	86°24'	21	42	2.0
			9/2	43°45'	86°30'	22	42	1.9
			9/9	43°46'	86°26'	29	44	1.5
			9/10	43°46'	86°26'	30	44	1.5
			9/11	43°40'	86°32'	31	45	1.5
			9/6	43°36'	86°32'	26	48	1.8
			9/14	43°04'	86°15'	34	86	2.5
10	44°05'	87°21'	10/10	44°04'	86°31'	60	42	0.7
			9/8	43°43'	86°30'	28	50	1.8
			10/13	43°27'	86°27'	63	63	1.0
			10/2	43°25'	86°26'	52	66	1.3

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 11								
11	44°04'	87°27'	10/30	44°04'	86°31'	80	47	0.6
			9/5	43°49'	86°27'	25	53	2.1
			10/12	43°36'	86°32'	62	56	0.9
			10/9	43°36'	86°32'	59	56	0.9
			10/13	43°28'	86°27'	63	65	1.0
			10/28	42°24'	86°17'	78	129	1.7
			11/15	45°03'	85°21'	96	141	1.5
			10/26	45°38'	85°01'	76	162	2.1
12	44°05'	87°33'	9/10	43°40'	86°32'	30	58	1.9
			9/11	43°40'	86°32'	31	58	1.9
			10/10	43°49'	86°26'	60	59	1.0
			9/17	43°20'	86°24'	37	77	2.1
			9/10	43°15'	86°21'	30	83	2.8
			9/11	43°11'	86°19'	31	88	2.8
			9/11	43°05'	86°16'	31	95	3.1
13	44°06'	87°36'	9/28	44°36'	87°25'	48	38	0.8
			9/26	44°14'	86°21'	46	63	1.4
			9/3	44°16'	86°20'	23	64	2.8
			9/3	44°19'	86°17'	23	66	2.9
			9/6	44°20'	86°16'	26	68	2.6
			9/3	44°25'	86°15'	23	70	3.0
September 26								
1	43°57'	86°30'	10/2	44°03'	86°31'	6	6	1.0
			10/2	44°03'	86°31'	6	6	1.0
			10/2	44°03'	86°31'	6	6	1.0
			10/2	44°03'	86°31'	6	6	1.0
			10/2	44°03'	86°31'	6	6	1.0
			10/2	44°03'	86°31'	6	6	1.0
			10/14	44°03'	86°31'	18	6	0.3
2	43°58'	86°35'	10/2	44°05'	86°28'	6	11	1.8
			10/2	44°06'	86°27'	6	13	2.2
			10/2	44°06'	86°27'	6	13	2.2
			10/2	44°06'	86°27'	6	13	2.2
			10/3	44°08'	86°25'	7	15	2.1
			10/3	44°08'	86°25'	7	15	2.1
			10/3	44°08'	86°25'	7	15	2.1
			10/3	44°08'	86°25'	7	15	2.1
			10/4	44°08'	86°25'	8	15	1.9
			10/2	44°10'	86°24'	6	17	2.8

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 26								
3	43°59'	86°39'	10/8	44°01'	86°30'	12	8	0.7
			10/1	44°03'	86°31'	5	9	1.8
			10/15	43°56'	86°26'	19	10	0.5
			10/15	43°56'	86°26'	19	10	0.5
			11/6	43°55'	86°26'	41	11	0.3
			10/2	43°52'	86°25'	6	12	2.0
			10/4	44°06'	86°26'	8	14	1.8
4	43°55'	86°51'	10/12	43°48'	86°25'	16	23	1.4
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
			10/9	43°14'	86°20'	13	54	4.2
5	43°57'	86°57'	10/7	43°46'	86°26'	11	28	2.5
			10/7	43°46'	86°26'	11	28	2.5
			10/11	43°46'	86°26'	15	28	1.9
			10/8	43°44'	86°29'	12	28	2.3
			10/15	43°44'	86°29'	19	28	1.5
			10/16	43°44'	86°29'	20	28	1.4
			10/8	43°42'	86°30'	12	28	2.3
			10/8	43°42'	86°30'	12	28	2.3
			10/8	43°42'	86°30'	12	28	2.3
			10/8	43°42'	86°30'	12	28	2.3
6	43°58'	87°03'	11/2	44°15'	86°20'	37	40	1.1
			11/30	44°56'	85°50'	65	95	1.5
			11/24	45°41'	84°58'	59	157	2.7
7	44°00'	87°09'	10/28	43°52'	86°26'	32	36	1.1
			11/6	44°54'	86°04'	41	82	2.0
			11/26	45°18'	85°19'	61	130	2.1
8	44°00'	87°15'	11/12	44°20'	86°17'	47	53	1.1
			10/18	44°23'	86°15'	22	55	2.5
			10/15	44°39'	86°15'	19	66	3.5

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 26								
9	44°02'	87°20'	10/15	44°55'	86°03'	19	88	4.6
			10/23	44°55'	86°03'	27	88	3.3
10	44°04'	87°27'	11/5	44°06'	86°27'	40	49	1.2
			11/5	43°49'	86°25'	40	53	1.3
			11/18	44°35'	86°13'	53	70	1.3
11	44°05'	87°33'	9/29	44°09'	87°33'	3	5	1.7
			9/30	44°09'	87°33'	4	5	1.3
			9/30	44°09'	87°33'	4	5	1.3
			9/30	44°09'	87°33'	4	5	1.3
12	44°06'	87°36'	9/29	44°07'	87°37'	3	2	0.7
			10/2	44°07'	87°37'	6	2	0.3
			9/29	44°09'	87°35'	3	4	1.3
			9/29	44°09'	87°35'	3	4	1.3
November 8								
1	43°58'	86°30'	11/10	43°57'	86°28'	2	2	1.0
			11/25	43°57'	86°28'	17	2	0.1
			11/13	43°56'	86°28'	5	3	0.6
2	43°59'	86°33'	11/24	44°00'	86°29'	16	3	0.2
			11/24	44°00'	86°29'	16	3	0.2
			11/12	44°01'	86°30'	4	4	1.0
			11/12	44°01'	86°30'	4	4	1.0
			11/12	44°01'	86°30'	4	4	1.0
			11/12	44°01'	86°30'	4	4	1.0
			11/12	44°01'	86°30'	4	4	1.0
			11/12	44°01'	86°30'	4	4	1.0
			11/10	44°03'	86°31'	2	5	2.5
3	44°00'	86°37'	11/12	44°01'	86°30'	4	6	1.5
			11/12	44°01'	86°30'	4	6	1.5
			11/12	44°01'	86°30'	4	6	1.5
			11/12	44°01'	86°30'	4	6	1.5
			11/12	44°01'	86°30'	4	6	1.5
			11/12	44°02'	86°31'	4	6	1.5
			11/13	44°02'	86°31'	5	6	1.2
4	44°02'	86°55'	11/18	44°19'	86°19'	10	36	3.6
			11/18	44°19'	86°19'	10	36	3.6

Table 17. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
November 8								
4	44°02'	86°55'	11/18	44°19'	86°19'	10	36	3.6
			11/25	44°19'	86°19'	17	36	2.1
			11/20	44°25'	86°15'	12	42	3.5
5	44°01'	87°10'	11/26	44°13'	86°21'	18	42	2.3
6	44°04'	87°27'	...	...	...	...	...	...
7	44°05'	87°33'	11/24	44°15'	86°21'	16	62	3.9
			11/18	44°18'	86°19'	10	64	6.4
			11/28	44°21'	86°16'	20	66	3.3
			11/25	44°23'	86°16'	17	67	3.9
8	44°06'	87°35'	*1/1	43°41'	86°31'	54	60	1.1
			*1/1	43°48'	86°26'	54	61	1.1
			11/28	43°45'	86°28'	20	61	3.1

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 13								
1	43°57'	86°30'	6/9	44°05'	86°30'	27	10	0.4
			6/23	44°35'	86°14'	41	42	1.0
			6/22	44°40'	86°15'	40	52	1.3
			7/7	44°43'	86°09'	55	61	1.1
			7/18	44°43'	86°07'	66	62	0.9
			6/24	44°47'	86°05'	42	65	1.5
			6/24	44°54'	85°59'	42	78	1.9
			7/3	44°57'	85°49'	51	87	1.7
			7/7	45°23'	84°57'	55	138	2.5
2	43°58'	86°34'	6/24	44°21'	86°16'	42	31	0.7
			6/28	44°32'	86°14'	46	42	0.9
			6/28	44°44'	86°05'	46	62	1.3
			7/4	44°44'	86°05'	52	62	1.2
			7/25	44°47'	86°05'	73	64	0.9
			6/30	44°54'	85°59'	48	76	1.6
			7/10	44°54'	85°59'	58	76	1.3
3	43°58'	86°37'	6/16	43°54'	86°27'	34	9	0.3
			7/1	44°32'	86°15'	49	43	0.9
			6/30	44°42'	86°15'	48	53	1.1
			7/21	44°43'	86°08'	69	60	0.9
			7/21	44°43'	86°08'	69	60	0.9
			7/21	44°43'	86°08'	69	60	0.9
			7/7	44°46'	86°05'	55	66	1.2
			6/29	44°52'	86°05'	47	76	1.6
			6/26	44°54'	85°59'	44	77	1.8
			6/26	44°54'	85°59'	44	77	1.8
4	44°00'	86°47'	7/2	44°02'	86°30'	50	14	0.3
			7/4	43°51'	86°26'	52	19	0.4
			9/1	43°35'	86°32'	111	31	0.3
			7/1	43°33'	86°30'	49	33	0.7
			7/1	43°22'	86°26'	49	46	0.9
			7/10	42°56'	86°13'	58	72	1.2
			7/10	44°55'	85°58'	58	76	1.3
			9/18	45°15'	85°23'	128	117	0.9
5	44°00'	86°55'	6/24	43°51'	86°27'	42	26	0.6
			7/4	44°15'	86°21'	52	32	0.6
			7/7	44°44'	86°06'	55	67	1.2
			8/22	45°03'	86°07'	101	83	0.8
			7/17	45°03'	86°00'	65	85	1.3
			8/16	44°56'	85°52'	95	91	1.0

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 13								
6	44°01'	87°02'	9/4	43°54'	86°27'	114	30	0.3
			9/1	44°12'	86°22'	111	36	0.3
			10/1	44°24'	86°15'	141	46	0.3
			8/7	44°43'	86°10'	86	66	0.8
			9/25	45°03'	87°07'	135	71	0.5
7	44°02'	87°08'	8/21	43°52'	86°27'	100	36	0.4
			7/27	44°10'	86°24'	75	38	0.5
			7/23	44°18'	86°18'	71	45	0.6
			8/5	44°27'	86°15'	84	53	0.6
			9/4	44°27'	86°15'	114	53	0.5
			8/31	44°31'	86°14'	110	56	0.5
			7/24	44°42'	86°16'	72	63	0.9
			7/27	44°54'	86°02'	75	89	1.2
8	44°03'	87°13'	8/5	43°54'	86°27'	84	40	0.5
			7/24	43°45'	86°28'	72	43	0.6
			7/31	43°47'	86°27'	79	43	0.5
			7/24	43°42'	86°31'	72	43	0.6
			7/23	43°39'	86°33'	71	44	0.6
			7/27	43°20'	86°25'	75	64	0.9
			7/27	43°18'	86°24'	75	66	0.9
9	44°03'	87°19'	12/24	43°57'	86°28'	225	43	0.2
			8/30	43°34'	86°30'	109	54	0.5
			8/5	44°20'	86°17'	84	56	0.7
			9/8	45°13'	85°33'	118	119	1.0
			10/8	42°13'	86°23'	148	135	0.9
10	44°04'	87°26'	7/28	43°09'	87°53'	76	67	0.9
			8/12	43°04'	87°51'	91	72	0.8
			8/14	44°44'	86°05'	93	82	0.9
			10/11	43°11'	86°18'	151	84	0.6
			8/12	42°48'	87°48'	91	90	1.0
11	44°05'	87°32'	5/17	43°46'	87°42'	4	23	5.8
			5/17	43°46'	87°42'	4	23	5.8
			5/17	43°46'	87°42'	4	23	5.8
			5/17	43°46'	87°42'	4	23	5.8
			5/18	43°46'	87°42'	5	23	4.6
			5/18	43°46'	87°42'	5	23	4.6
			9/3	43°54'	86°27'	113	57	0.5
12	44°05'	87°34'	6/25	43°51'	87°44'	43	18	0.4
			6/14	43°49'	87°44'	32	19	0.6
			5/20	43°48'	87°44'	7	21	3.0

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 26								
1	43°57'	86°30'	6/28	43°58'	86°28'	2	2	1.0
			6/28	43°58'	86°28'	2	2	1.0
			6/28	43°58'	86°28'	2	2	1.0
			6/28	43°58'	86°28'	2	2	1.0
			6/28	43°58'	86°28'	2	2	1.0
			6/28	43°58'	86°28'	2	2	1.0
			7/3	43°56'	86°27'	7	3	0.4
			7/10	43°53'	86°26'	14	6	0.4
			7/10	43°53'	86°26'	14	6	0.4
			7/10	43°53'	86°26'	14	6	0.4
2	43°58'	86°33'	7/17	44°56'	85°50'	21	85	4.0
			7/24	45°22'	85°04'	28	116	4.1
3	43°58'	86°39'	6/29	44°01'	86°30'	3	8	2.7
			6/29	44°01'	86°30'	3	8	2.7
			6/29	44°01'	86°30'	3	8	2.7
			6/29	44°01'	86°30'	3	8	2.7
			6/29	43°59'	86°28'	3	8	2.7
			6/30	44°03'	86°31'	4	8	2.0
			7/2	44°01'	86°30'	6	8	1.3
4	43°59'	86°45'	7/17	45°03'	86°00'	21	82	3.9
			7/8	44°57'	85°48'	12	88	7.3
			7/10	45°09'	85°33'	14	115	8.2
			7/12	45°09'	85°33'	16	115	7.2
			7/12	45°09'	85°33'	16	115	7.2
			7/12	45°04'	85°34'	16	121	7.6
5	43°59'	86°50'	8/21	44°41'	86°16'	56	56	1.0
			7/12	45°00'	86°08'	16	80	5.0
			7/12	45°00'	86°08'	16	80	5.0
			8/8	45°12'	85°36'	43	104	2.4
			8/7	45°17'	85°22'	42	118	2.8
6	44°00'	86°57'	7/10	44°54'	86°02'	14	80	5.7
			7/10	44°54'	86°02'	14	80	5.7
			7/10	44°54'	86°02'	14	80	5.7
			7/10	44°54'	86°02'	14	80	5.7
			7/13	44°54'	86°02'	17	80	4.7
			7/25	45°01'	85°46'	29	94	3.2
			7/25	45°12'	85°32'	29	114	3.9
7	44°01'	87°04'	7/11	44°55'	85°58'	15	83	5.5
			9/5	45°16'	85°22'	71	124	1.7
			7/24	45°18'	85°20'	28	133	4.8

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 26								
8	44°01'	87°08'	8/17	44°21'	86°16'	52	49	0.9
			9/1	44°21'	86°16'	67	49	0.7
			9/5	44°24'	86°15'	71	51	0.7
			9/11	44°26'	86°15'	77	52	0.7
			9/1	44°42'	86°14'	67	65	1.0
			9/21	43°09'	86°17'	87	74	0.9
			8/18	45°11'	87°01'	53	81	1.5
			9/2	45°03'	85°45'	68	100	1.5
9	44°03'	87°16'	9/2	45°09'	85°40'	68	112	1.6
			8/30	45°46'	86°26'	65	128	2.0
			10/8	45°34'	85°33'	104	138	1.3
10	44°03'	87°22'	8/13	44°50'	87°17'	48	54	1.1
			9/3	44°56'	85°50'	69	103	1.5
			9/5	45°09'	85°39'	71	114	1.6
			10/8	45°35'	85°33'	104	138	1.3
11	44°04'	87°26'	8/11	44°28'	87°30'	46	28	0.6
			9/4	44°33'	87°28'	70	34	0.5
			11/3	44°33'	87°28'	130	34	0.3
			7/20	44°35'	87°27'	24	37	1.5
			7/23	44°38'	87°25'	27	40	1.5
			7/21	44°43'	87°20'	25	46	1.8
			7/25	44°48'	87°18'	29	52	1.8
			7/28	45°02'	87°08'	32	71	2.2
12	44°05'	87°33'	7/13	44°43'	87°20'	17	47	2.8
			7/14	44°50'	87°16'	18	55	3.1
			7/13	44°53'	87°13'	17	58	3.4
			7/18	44°57'	87°12'	22	64	2.9
			7/18	44°57'	87°12'	22	64	2.9
			7/19	44°57'	87°12'	23	64	2.8
			8/11	45°13'	87°00'	46	83	1.8
13	44°06'	87°36'	8/9	44°50'	87°16'	44	55	1.3
			7/14	44°53'	87°13'	18	59	3.3
			7/21	44°56'	87°10'	25	63	2.5
			7/31	45°04'	87°07'	35	74	2.1
			8/17	45°16'	86°57'	52	89	1.7
			8/18	45°25'	86°49'	53	100	1.9
			9/1	45°55'	86°18'	67	140	2.1

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 11								
1	43°57'	86°30'	8/21	43°47'	86°26'	10	13	1.3
			8/23	43°45'	86°27'	12	15	1.3
			8/24	43°44'	86°29'	13	16	1.2
			8/22	43°39'	86°32'	11	21	1.9
2	43°58'	86°33'	8/20	43°59'	86°28'	9	4	0.4
			8/20	43°59'	86°28'	9	4	0.4
			8/20	43°59'	86°28'	9	4	0.4
			8/20	43°59'	86°28'	9	4	0.4
			8/24	43°58'	86°28'	13	4	0.3
			8/21	43°57'	86°28'	10	5	0.5
			8/21	44°03'	86°31'	10	6	0.6
3	43°58'	86°38'	8/21	43°59'	86°29'	10	8	0.8
			8/21	43°59'	86°29'	10	8	0.8
			8/22	44°03'	86°31'	11	8	0.7
			8/26	43°59'	86°29'	15	8	0.5
			8/23	43°57'	86°27'	12	9	0.8
			8/27	44°12'	86°22'	16	21	1.3
			8/22	44°41'	86°15'	11	54	4.9
			8/29	44°41'	86°15'	18	54	3.0
			9/1	44°43'	86°10'	21	59	2.8
4	44°00'	86°43'	8/21	44°00'	86°29'	10	13	1.3
			8/21	43°56'	86°27'	10	14	1.4
			8/21	43°55'	86°27'	10	14	1.4
			8/30	44°37'	86°15'	19	51	2.7
			9/4	44°37'	86°15'	24	51	2.1
			8/30	44°43'	86°12'	19	57	3.0
5	44°00'	86°50'	8/21	44°02'	86°31'	10	17	1.7
			8/21	44°02'	86°31'	10	17	1.7
			8/21	44°02'	86°31'	10	17	1.7
			8/22	44°02'	86°31'	11	17	1.5
			8/24	44°04'	86°31'	13	17	1.3
			8/20	44°01'	86°30'	9	18	2.0
			8/21	44°00'	86°29'	10	18	1.8
			8/21	44°00'	86°29'	10	18	1.8
6	44°01'	86°58'	9/2	43°43'	86°30'	22	32	1.5
			9/1	43°39'	86°32'	21	33	1.6
			9/10	43°28'	86°27'	30	46	1.5
			9/10	43°16'	86°21'	30	61	2.0
			10/11	42°59'	86°13'	61	80	1.3

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 11								
7	44°02'	87°03'	9/3	43°46'	86°26'	23	35	1.5
			8/31	44°15'	86°20'	20	39	2.0
			9/4	44°18'	86°18'	24	41	1.7
			8/31	44°33'	86°14'	20	54	2.7
			9/15	43°13'	86°20'	35	67	1.9
8	44°03'	87°09'	8/31	44°05'	86°30'	20	23	1.2
			9/1	44°06'	86°27'	21	32	1.5
			8/31	43°57'	86°27'	20	35	1.8
			9/1	43°48'	86°26'	21	40	1.9
			10/11	43°10'	86°18'	61	75	1.2
9	44°04'	87°15'	10/16	43°58'	86°28'	66	39	0.6
			9/20	43°48'	86°26'	40	45	1.1
			9/20	43°43'	86°30'	40	45	1.1
			9/11	43°36'	86°32'	31	48	1.5
			9/10	43°33'	86°30'	30	52	1.7
			9/17	43°31'	86°29'	37	54	1.5
			9/14	43°28'	86°28'	34	57	1.7
			9/17	43°15'	86°21'	37	72	1.9
10	44°05'	87°21'	10/2	44°46'	87°19'	52	48	0.9
			9/23	44°51'	87°13'	43	53	1.2
			10/13	44°51'	87°13'	63	53	0.8
			10/5	44°58'	87°10'	55	62	1.1
			10/2	45°02'	87°07'	52	67	1.3
			10/29	45°05'	87°05'	79	71	0.9
			11/6	45°19'	86°56'	87	89	1.0
11	44°04'	87°27'	9/12	43°44'	86°28'	32	55	1.7
			9/29	44°58'	87°10'	49	64	1.3
			11/13	45°05'	87°05'	94	73	0.8
			10/11	43°16'	86°21'	61	79	1.3
			10/29	45°47'	85°30'	79	154	1.9
12	44°05'	87°33'	8/27	44°25'	87°18'	16	26	1.6
			9/4	44°47'	87°18'	24	37	1.5
			9/27	44°50'	87°15'	47	42	0.9
			10/25	43°59'	86°28'	75	54	0.7
			10/30	44°15'	86°20'	80	61	0.8
			9/23	45°00'	87°10'	43	65	1.5
			9/24	45°03'	87°07'	44	69	1.6
			11/16	45°11'	85°35'	97	125	1.3

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 11								
13	44°06'	87°36'	9/24	44°38'	87°23'	44	40	0.9
			9/24	44°48'	87°16'	44	54	1.2
			8/28	44°52'	87°13'	17	58	3.4
September 26								
1	43°57'	86°30'	10/14	44°06'	86°28'	18	12	0.7
			10/14	44°06'	86°28'	18	12	0.7
			10/14	44°06'	86°28'	18	12	0,7
			10/14	44°06'	86°28'	18	12	0.7
			10/14	44°06'	86°28'	18	12	0.7
			10/14	44°06'	86°28'	18	12	0.7
			10/14	44°06'	86°28'	18	12	0.7
2	43°58'	86°35'	10/28	44°04'	86°31'	32	7	0.2
			10/2	44°10'	86°25'	6	15	2.5
3	43°59'	86°39'	10/11	44°01'	86°30'	15	8	0.5
			10/11	44°01'	86°30'	15	8	0.5
			10/16	44°00'	86°29'	20	9	0.5
			10/1	44°03'	86°31'	5	9	1.8
			10/2	43°57'	86°28'	6	10	1.7
			10/9	43°57'	86°28'	13	10	0.8
			10/12	44°05'	86°30'	16	11	0.7
			11/6	43°55'	86°27'	41	11	0.3
4	43°55'	86°51'	...	...	...	...	...	...
5	43°57'	86°57'	10/11	44°01'	86°30'	15	23	1.5
			10/15	44°04'	86°31'	19	23	1.2
			10/9	44°00'	86°28'	13	24	1.8
			10/14	44°00'	86°28'	18	24	1.3
			10/20	44°36'	86°14'	24	58	2.4
			11/18	44°36'	86°14'	53	58	1.1
			10/15	44°37'	86°15'	19	59	3.1
6	43°58'	87°03'	10/7	44°55'	86°04'	11	81	7.4
			...	44°55'	86°04'	...	81	...
			11/13	44°57'	85°47'	48	97	2.0
			11/13	44°57'	85°47'	48	97	2.0
			10/16	45°00'	85°46'	20	98	4.9
7	44°00'	87°09'	11/11	44°05'	86°30'	46	33	0.7
			10/25	44°30'	86°15'	29	58	2.0
			10/14	44°42'	86°12'	18	69	3.8

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 26								
8	44°00'	87°15'	10/15	44°54'	86°05'	19	85	4.5
			11/12	44°58'	85°47'	47	101	2.1
9	44°02'	87°20'	11/17	44°50'	86°04'	52	83	1.6
			10/15	44°54'	86°04'	19	87	4.6
			10/16	44°54'	86°00'	20	91	4.6
10	44°04'	87°27'	11/12	43°44'	86°29'	47	53	1.1
			11/12	43°44'	86°29'	47	53	1.1
			10/14	44°48'	86°04'	18	85	4.7
			10/17	44°48'	86°04'	21	85	4.0
			10/22	44°48'	86°04'	26	85	3.3
			10/22	44°48'	86°04'	26	85	3.3
			10/29	45°48'	86°21'	33	131	4.0
11	44°05'	87°33'	10/28	44°08'	87°36'	32	4	0.1
			9/28	44°09'	87°34'	2	5	2.5
			9/28	44°09'	87°34'	2	5	2.5
			9/28	44°09'	87°34'	2	5	2.5
			9/28	44°09'	87°34'	2	5	2.5
			9/28	44°09'	87°34'	2	5	2.5
			9/28	44°09'	87°34'	2	5	2.5
12	44°06'	87°36'	9/27	44°07'	87°37'	1	2	2.0
			9/27	44°07'	87°37'	1	2	2.0
			9/27	44°07'	87°37'	1	2	2.0
			9/27	44°07'	87°37'	1	2	2.0
			9/27	44°07'	87°37'	1	2	2.0
			9/28	44°07'	87°37'	2	2	1.0
			9/30	44°07'	87°37'	4	2	0.5
			9/30	44°07'	87°37'	4	2	0.5
November 8								
1	43°58'	86°30'	...	...	...	...	...	...
2	43°59'	86°33'	11/15	43°56'	86°27'	7	5	0.7
3	44°00'	86°37'	11/24	44°00'	86°28'	16	7	0.4
4	44°02'	86°55'	11/18	44°54'	86°04'	10	73	7.3

Table 18. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Ludington, Michigan-Manitowoc, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
November 8								
5	44°01'	87°10'	11/18	44°36'	86°14'	10	61	6.1
			11/18	44°36'	86°14'	10	61	6.1
			11/18	44°36'	86°14'	10	61	6.1
			11/18	44°36'	86°14'	10	61	6.1
			11/21	44°36'	86°14'	13	61	4.7
6	44°04'	87°27'	11/24	44°15'	86°21'	16	57	3.6
			11/24	44°15'	86°21'	16	57	3.6
			11/18	44°16'	86°20'	10	58	5.8
			11/18	44°16'	86°20'	10	58	5.8
			11/18	44°18'	86°19'	10	60	6.0
			11/18	44°18'	86°19'	10	60	6.0
			11/18	44°18'	86°19'	10	60	6.0
			11/18	44°18'	86°19'	10	60	6.0
7	44°05'	87°33'	11/20	44°26'	86°15'	12	68	5.7
			11/24	44°26'	86°15'	16	68	4.3
			11/25	44°22'	86°16'	17	66	3.9
8	44°06'	87°35'	11/17	44°17'	86°19'	9	65	7.2
			11/18	44°17'	86°19'	10	65	6.5
			11/18	44°17'	86°19'	10	65	6.5
			11/18	44°17'	86°19'	10	65	6.5
			11/18	44°19'	86°18'	10	66	6.6
			11/25	44°31'	86°15'	17	73	4.3

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 17								
1	44°38'	86°17'	7/22	44°43'	86°12'	66	8	0.1
			8/3	44°43'	86°12'	78	8	0.1
			6/19	44°54'	86°02'	33	26	0.8
			6/23	44°53'	86°00'	37	29	0.8
			6/23	44°56'	85°57'	37	31	0.8
			6/30	45°05'	86°02'	44	33	0.8
			6/13	44°57'	85°48'	27	39	1.4
			7/6	45°09'	85°39'	50	50	1.0
2	44°39'	86°22'	6/8	45°01'	86°06'	22	29	1.3
			7/6	44°54'	85°59'	50	28	0.6
			6/25	44°56'	85°56'	39	30	0.8
			9/20	45°08'	86°04'	126	37	0.3
			9/2	45°02'	85°45'	108	42	0.4
			6/29	45°08'	85°40'	43	50	1.2
			7/14	45°08'	85°40'	58	50	0.9
			7/4	45°24'	84°55'	48	90	1.9
			7/4	45°24'	84°55'	48	90	1.9
			7/10	45°45'	85°00'	54	103	1.9
3	44°40'	86°28'	6/26	44°44'	86°09'	40	18	0.5
			6/30	44°44'	86°09'	44	18	0.4
			6/26	44°56'	85°53'	40	39	1.0
			6/26	45°09'	86°03'	40	40	1.0
			6/13	44°57'	85°48'	27	41	1.5
			6/29	45°05'	85°41'	43	48	1.1
			6/25	45°10'	85°39'	39	53	1.4
			7/10	45°10'	85°39'	54	53	1.0
			9/11	45°54'	84°50'	117	117	1.0
4	44°41'	86°34'	6/26	44°56'	85°52'	40	42	1.1
			7/8	44°58'	85°47'	52	45	0.9
			6/25	44°59'	85°46'	39	46	1.2
			6/24	45°04'	85°43'	38	50	1.3
			6/27	45°06'	85°40'	41	52	1.3
			6/24	45°10'	85°38'	38	57	1.5
			7/12	45°23'	84°58'	56	95	1.7
			7/5	45°25'	84°55'	49	97	2.0
5	44°42'	86°43'	8/9	45°23'	85°51'	84	64	0.8
			7/31	45°21'	85°13'	75	88	1.2
			8/4	45°44'	85°34'	79	91	1.2
			8/4	45°22'	85°06'	79	94	1.2
			8/23	45°22'	85°06'	98	94	1.0
			7/23	45°28'	85°05'	67	97	1.4
			7/28	45°46'	85°00'	72	112	1.6

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 17								
6	44°42'	86°46'	6/22	44°33'	86°14'	36	29	0.8
			7/3	45°00'	86°08'	47	38	0.8
			7/5	45°24'	85°51'	49	65	1.3
			7/4	45°23'	84°58'	48	103	2.1
			7/3	45°26'	84°56'	47	106	2.3
			7/13	45°39'	85°00'	57	109	1.9
			7/28	45°52'	84°49'	72	126	1.8
7	44°43'	86°52'	6/25	44°41'	86°15'	39	30	0.8
			7/22	44°43'	86°12'	66	33	0.5
			10/22	45°18'	85°20'	158	87	0.6
			7/11	45°44'	85°34'	55	95	1.7
			8/7	45°45'	85°32'	82	98	1.2
			7/25	45°22'	85°02'	69	104	1.5
			7/6	45°28'	84°55'	50	108	2.2
			7/29	45°43'	84°57'	73	118	1.6
8	44°44'	86°58'	9/4	44°39'	87°23'	110	21	0.2
			6/12	44°16'	87°31'	26	42	1.6
			8/27	44°14'	87°30'	102	43	0.4
			6/10	45°00'	86°09'	24	45	1.9
			8/22	45°03'	86°06'	97	48	0.5
			10/20	45°29'	86°46'	156	53	0.3
			6/22	45°42'	85°35'	36	96	2.7
9	44°44'	87°04'	8/28	44°38'	87°25'	103	19	0.2
			6/12	44°15'	87°31'	26	41	1.6
			9/3	44°43'	86°12'	109	42	0.4
			9/5	44°19'	86°18'	111	48	0.4
			10/17	44°08'	87°37'	153	52	0.3
			9/3	45°02'	85°45'	109	67	0.6
			9/2	45°42'	86°40'	108	71	0.7
10	44°45'	87°10'	6/12	44°24'	87°31'	26	31	1.2
			6/12	44°17'	87°32'	26	38	1.5
			6/12	44°17'	87°32'	26	38	1.5
			6/12	44°17'	87°32'	26	38	1.5
			8/31	43°43'	86°28'	106	79	0.7
May 16								
11	44°45'	87°14'	5/27	44°15'	87°31'	11	38	3.5
			5/28	44°12'	87°30'	12	41	3.4
			5/27	44°11'	87°31'	11	42	3.8
			5/27	44°11'	87°31'	11	42	3.8

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 16								
11	44°45'	87°14'	5/30	44°11'	87°31'	14	42	3.0
			6/26	44°09'	87°33'	41	46	1.1
			7/17	44°06'	86°28'	62	60	1.0
			9/4	43°18'	86°23'	111	109	1.0
12	44°46'	87°16'	6/21	44°18'	87°32'	36	35	1.0
			6/26	44°14'	87°30'	41	39	1.0
			5/25	44°11'	87°31'	9	41	4.6
			5/28	44°10'	87°33'	12	45	3.8
			5/28	44°07'	87°39'	12	52	4.3
			6/9	44°07'	87°39'	24	52	2.2
			8/7	44°14'	86°21'	83	59	0.7
June 23								
1	44°38'	86°18'	9/18	45°00'	86°07'	87	27	0.3
			7/17	45°11'	85°37'	24	51	2.1
			7/5	45°20'	85°15'	12	72	6.0
			7/28	45°42'	85°50'	35	77	2.2
			7/24	45°35'	85°07'	31	88	2.8
			7/18	45°26'	84°56'	25	90	3.6
			8/4	45°39'	85°01'	42	95	2.3
			8/29	45°42'	84°57'	67	100	1.5
			8/7	45°47'	84°45'	45	115	2.6
			8/12	45°48'	84°32'	50	126	2.5
2	44°39'	86°22'	9/2	45°04'	85°44'	71	43	0.6
			7/24	45°12'	85°33'	31	56	1.8
			7/16	45°09'	85°34'	23	65	2.8
			7/10	45°19'	85°15'	17	74	4.4
			7/23	44°56'	85°24'	30	78	2.6
			11/13	45°46'	85°26'	143	93	0.7
			8/9	45°39'	84°27'	47	135	2.9
3	44°40'	86°29'	7/14	45°00'	86°08'	21	29	1.4
			8/3	44°56'	85°52'	41	40	1.0
			7/14	45°22'	85°08'	21	85	4.0
			8/4	45°22'	85°08'	42	85	2.0
			7/23	45°33'	85°07'	30	90	3.0
			7/23	45°22'	85°03'	30	91	3.0
			7/23	45°35'	85°07'	30	92	3.1
			7/22	45°35'	85°07'	29	92	3.2

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 23								
4	44°40'	86°32'	9/25	45°08'	86°04'	94	39	0.4
			7/23	45°11'	85°37'	30	57	1.9
			7/16	45°20'	85°15'	23	80	3.5
			7/28	44°59'	85°29'	35	80	2.3
			7/22	45°23'	84°57'	29	93	3.2
5	44°41'	86°39'	8/8	45°08'	85°40'	46	57	1.2
			8/7	45°09'	85°34'	45	73	1.6
			7/23	45°16'	85°22'	30	76	2.5
			7/27	45°07'	85°23'	34	80	2.4
			7/23	45°18'	85°18'	30	81	2.7
			8/6	45°04'	85°23'	44	81	1.8
			7/23	45°00'	85°29'	30	84	2.8
			8/2	44°50'	85°28'	40	94	2.4
6	44°42'	86°47'	8/29	45°43'	86°40'	67	72	1.1
			8/30	45°43'	86°40'	68	72	1.1
			8/29	45°47'	86°25'	67	77	1.1
			8/28	45°51'	86°20'	66	82	1.2
			8/31	45°51'	86°20'	69	82	1.2
7	44°43'	86°53'	8/13	44°56'	87°11'	51	21	0.4
			10/30	45°05'	87°04'	129	27	0.2
			10/30	45°16'	85°22'	129	84	0.7
			8/25	46°04'	85°17'	63	121	1.9
8	44°43'	86°58'	8/17	44°48'	87°18'	55	17	0.3
			8/28	45°05'	87°03'	66	25	0.4
			9/1	45°00'	86°07'	70	46	0.7
			9/25	45°07'	86°04'	94	52	0.6
			10/30	45°36'	86°30'	129	65	0.5
			9/4	45°10'	85°39'	73	73	1.0
			8/31	45°51'	86°20'	69	84	1.2
			9/5	45°26'	85°13'	74	97	1.3
9	44°44'	87°04'	8/26	44°48'	87°19'	64	13	0.2
			8/10	45°00'	87°08'	48	20	0.4
			9/2	45°00'	87°08'	71	20	0.3
			10/9	45°00'	87°08'	108	20	0.2
			8/27	45°07'	87°04'	65	29	0.4
			8/21	45°17'	86°55'	59	40	0.7
			10/9	45°24'	86°57'	108	47	0.4
			10/31	45°30'	86°47'	130	55	0.4

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 23								
10	44°44'	87°08'	9/1	44°54'	85°59'	70	58	0.8
			8/29	45°47'	86°25'	67	80	1.2
			9/11	45°51'	86°20'	80	86	1.1
			10/2	45°51'	86°20'	101	86	0.9
			9/5	45°21'	85°14'	74	101	1.4
			10/1	45°49'	85°23'	100	118	1.2
11	44°45'	87°15'	8/23	45°04'	87°07'	61	23	0.4
			9/7	45°24'	85°51'	76	81	1.1
			8/24	45°58'	85°45'	62	111	1.8
			10/12	46°02'	85°36'	111	118	1.1
			8/23	45°35'	85°07'	61	126	2.1
12	44°46'	87°18'	6/29	44°52'	87°12'	6	8	1.3
			10/24	45°09'	85°34'	123	101	0.8
			8/3	45°46'	85°41'	41	105	2.6
			8/31	45°49'	85°22'	69	123	1.8
			8/22	45°39'	85°00'	60	131	2.2
August 19								
1	44°38'	86°16'	8/22	44°43'	86°07'	3	13	4.3
			8/22	44°43'	86°07'	3	13	4.3
			8/28	44°46'	86°05'	9	16	1.8
			8/28	44°46'	86°05'	9	16	1.8
			8/28	44°46'	86°05'	9	16	1.8
			8/28	44°46'	86°05'	9	16	1.8
2	44°38'	86°19'	8/22	44°43'	86°09'	3	11	3.7
			8/22	44°43'	86°07'	3	14	4.7
			8/22	44°43'	86°07'	3	14	4.7
			8/29	44°43'	86°07'	10	14	1.4
			8/28	44°45'	86°05'	9	16	1.8
			8/28	44°45'	86°05'	9	16	1.8
3	44°40'	86°26'	9/3	45°00'	86°05'	15	29	1.9
			9/18	45°00'	86°05'	30	29	1.0
			11/12	45°00'	86°05'	85	29	0.3
			9/25	45°06'	86°04'	37	36	1.0
			9/8	45°04'	85°43'	20	45	2.3
			9/4	45°09'	85°39'	16	52	3.3
			10/2	45°09'	85°33'	44	66	1.5

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
4	44°40'	86°33'	8/28	44°54'	86°04'	9	28	3.1
			9/3	45°02'	85°45'	15	46	3.1
			9/2	45°04'	85°42'	14	49	3.5
			9/25	45°21'	85°11'	37	82	2.2
5	44°41'	86°38'	9/2	44°48'	86°05'	14	29	2.1
			9/1	44°54'	86°00'	13	36	2.8
			9/1	44°54'	86°00'	13	36	2.8
			9/1	44°54'	86°00'	13	36	2.8
			8/31	44°54'	85°59'	12	37	3.1
			8/31	44°54'	85°59'	12	37	3.1
			8/31	44°54'	85°59'	12	37	3.1
			9/2	44°54'	85°59'	14	37	2.6
			9/4	44°56'	85°50'	16	45	2.8
			9/4	44°56'	85°50'	16	45	2.8
6	44°42'	86°41'	8/31	44°56'	85°57'	12	40	3.3
			9/4	44°58'	85°47'	16	50	3.1
			10/15	44°58'	85°47'	57	50	0.9
			9/1	45°00'	85°46'	13	51	3.9
			9/1	45°00'	85°46'	13	51	3.9
			9/1	45°00'	85°46'	13	51	3.9
7	44°42'	86°47'	9/18	44°40'	86°15'	30	27	0.9
			9/18	44°40'	86°15'	30	27	0.9
8	44°43'	86°52'	9/11	44°36'	86°13'	23	34	1.5
			9/10	44°26'	86°14'	22	37	1.7
			9/11	44°21'	86°15'	23	40	1.7
			9/14	44°17'	86°18'	26	41	1.6
			9/14	44°14'	86°21'	26	43	1.7
9	44°45'	86°58'	10/3	44°54'	86°04'	45	46	1.0
			10/22	45°04'	85°42'	64	66	1.0
			11/26	45°11'	85°34'	99	77	0.8
			10/22	45°18'	85°19'	64	91	1.4
			11/5	45°18'	85°19'	78	91	1.2
10	44°45'	87°06'	11/10	44°30'	86°14'	83	46	0.6
			10/7	45°24'	85°50'	49	76	1.6
11	44°45'	87°10'	9/29	44°26'	86°15'	41	51	1.2
			10/18	45°20'	85°14'	60	105	1.8

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
12	44°46'	87°12'	9/12	44°38'	86°14'	24	49	2.0
			10/20	44°42'	86°12'	62	50	0.8
			11/4	45°00'	86°06'	77	59	0.8
			10/28	44°54'	86°00'	70	62	0.9
			11/15	45°06'	86°03'	88	64	0.7
			10/15	45°04'	85°59'	57	67	1.2
			10/8	45°09'	85°23'	50	99	2.0
13	44°46'	87°16'	8/24	44°55'	87°11'	5	12	2.4
			8/28	44°55'	87°11'	9	12	1.3
			8/28	44°55'	87°11'	9	12	1.3
			8/28	44°55'	87°11'	9	12	1.3
			11/5	44°55'	87°11'	78	12	0.2
September 22								
1	44°38'	86°17'	10/14	44°26'	86°15'	22	13	0.6
			10/10	44°01'	86°30'	18	44	2.4
			10/19	43°52'	86°25'	27	55	2.0
			10/7	43°47'	86°25'	15	61	4.1
			10/8	43°47'	86°25'	16	61	3.8
			10/9	43°38'	86°32'	17	71	4.2
			10/15	43°38'	86°32'	23	71	3.1
			10/10	43°33'	86°30'	18	77	4.3
			10/9	43°33'	86°30'	17	77	4.5
2	44°38'	86°20'	10/9	44°38'	86°15'	17	4	0.2
			10/10	44°38'	86°15'	18	4	0.2
			10/12	44°40'	86°15'	20	4	0.2
			10/14	44°42'	86°12'	22	8	0.4
			10/6	44°19'	86°18'	14	22	1.6
3	44°39'	86°26'	10/23	44°54'	86°03'	31	26	0.8
			10/30	44°56'	85°51'	38	40	1.1
			10/30	45°00'	85°46'	38	42	1.1
			10/22	44°56'	85°24'	30	82	2.7
			11/13	44°52'	85°32'	52	87	1.7
			11/20	44°49'	85°34'	59	89	1.5
4	44°41'	86°33'	11/18	44°35'	86°14'	57	18	0.3
			10/15	44°32'	86°14'	23	19	0.8
			10/21	45°05'	85°41'	29	52	1.8
			11/1	45°10'	85°38'	40	56	1.4

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 22								
5	44°42'	86°40'	10/8	44°36'	86°14'	16	22	1.4
			11/5	45°16'	85°21'	44	78	1.8
			10/22	45°18'	85°17'	30	81	2.7
			10/17	45°20'	85°15'	25	83	3.3
6	44°42'	86°45'	10/11	44°33'	86°14'	19	28	1.5
			10/8	44°44'	86°10'	16	30	1.9
			11/24	45°12'	85°34'	63	68	1.1
			10/29	45°14'	85°24'	37	78	2.1
			10/22	45°16'	85°23'	30	79	2.6
7	44°42'	86°51'	11/23	45°12'	85°34'	62	72	1.2
			10/21	45°20'	85°15'	29	89	3.1
			10/30	45°20'	85°15'	38	89	2.3
8	44°44'	86°57'	...	...	...	...	...	...
9	44°46'	87°03'	10/13	44°55'	87°12'	21	14	0.7
			10/9	45°05'	87°03'	17	22	1.3
			11/19	45°04'	85°42'	58	69	1.2
			11/26	45°11'	85°34'	65	79	1.2
10	44°46'	87°09'	11/3	44°34'	87°27'	42	21	0.5
			11/2	44°32'	87°28'	41	23	0.6
			11/2	44°32'	87°28'	41	23	0.6
			11/3	44°32'	87°28'	42	23	0.5
			10/2	44°24'	87°31'	10	33	3.3
			9/26	44°16'	87°32'	4	39	9.8
			10/8	44°10'	87°31'	16	45	2.8
			10/2	44°09'	87°33'	10	48	4.8
11	44°45'	87°10'	11/3	44°32'	87°28'	42	20	0.5
			11/3	44°32'	87°28'	42	20	0.5
			11/3	44°32'	87°28'	42	20	0.5
			11/3	44°32'	87°28'	42	20	0.5
			11/13	44°32'	87°28'	52	20	0.4
			10/1	44°30'	87°29'	9	23	2.6
			10/16	44°30'	87°29'	24	23	1.0
			11/5	44°30'	87°29'	44	23	0.5
12	44°47'	87°15'	9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0

Table 19. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)
[Asterisk indicates recovery in 1956]

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 22								
12	44°47'	87°15'	9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
			9/24	44°47'	87°19'	2	4	2.0
13	44°46'	87°17'	9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			9/24	44°46'	87°19'	2	2	1.0
			10/1	44°46'	87°19'	9	2	0.2
			10/14	44°46'	87°19'	22	2	0.1
November 4								
1	44°38'	86°18'	11/18	44°55'	85°58'	14	28	2.0
			*1/3	44°55'	85°58'	60	28	0.5
2	44°39'	86°20'	11/26	45°17'	85°20'	22	67	3.1
3	44°39'	86°25'	*1/27	45°19'	85°17'	84	72	0.9
			12/9	45°22'	85°00'	35	86	2.5
4	44°41'	86°40'	11/19	45°10'	85°39'	15	61	4.1
			11/20	45°11'	85°35'	16	66	4.1
5	44°42'	86°54'	11/24	45°11'	85°35'	20	74	3.7
			11/26	45°11'	85°35'	22	74	3.4
6	44°45'	87°07'	...	...	...	...	...	...
7	44°45'	87°10'	12/29	44°35'	86°14'	55	48	0.9
			12/31	44°57'	85°48'	57	70	1.2
8	44°46'	87°16'	12/17	44°51'	87°15'	43	6	0.1
			11/10	45°01'	87°08'	6	19	3.2
			11/10	45°01'	87°08'	6	19	3.2
			11/10	45°01'	87°08'	6	19	3.2
			11/10	45°01'	87°08'	6	19	3.2
			11/10	45°01'	87°08'	6	19	3.2
			11/10	45°01'	87°08'	6	19	3.2
			11/11	45°01'	87°08'	7	19	2.7
			11/11	45°01'	87°08'	7	19	2.7
			11/11	45°01'	87°08'	7	19	2.7

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 17								
1	44°38'	86°17'	6/10	44°56'	85°52'	24	38	1.6
			6/9	44°56'	85°52'	23	38	1.6
			6/9	44°56'	85°52'	23	38	1.6
			6/13	44°57'	85°48'	27	40	1.5
			6/13	44°57'	85°48'	27	40	1.5
			6/13	44°57'	85°48'	27	40	1.5
			6/26	44°58'	85°47'	40	40	1.0
			8/23	45°04'	85°43'	98	45	0.5
			6/30	45°06'	85°41'	44	47	1.1
2	44°39'	86°22'	6/14	44°56'	85°53'	28	37	1.3
			9/25	45°07'	86°03'	131	37	0.3
			6/13	44°57'	85°48'	27	39	1.4
			6/13	44°57'	85°48'	27	39	1.4
3	44°40'	86°28'	6/26	44°55'	85°57'	40	32	0.8
			6/8	45°01'	86°05'	22	33	1.5
			6/13	44°57'	85°48'	27	42	1.6
			6/13	44°57'	85°48'	27	42	1.6
			6/26	44°57'	85°48'	40	42	1.1
			6/24	44°59'	85°47'	38	43	1.1
			6/24	45°08'	85°38'	38	54	1.4
4	44°41'	86°34'	6/10	44°57'	85°57'	24	37	1.5
			6/25	44°57'	85°57'	39	37	0.9
			6/25	44°56'	85°52'	39	43	1.1
			6/13	44°57'	85°48'	27	45	1.6
			6/13	44°57'	85°48'	27	45	1.6
			6/26	44°57'	85°48'	40	45	1.1
			7/1	44°59'	85°46'	45	46	1.0
5	44°42'	86°43'	9/25	45°08'	86°03'	131	44	0.3
			7/29	45°11'	85°31'	73	74	1.0
6	44°42'	86°46'	6/29	45°01'	86°06'	43	39	0.9
			7/21	45°35'	85°37'	65	84	1.3
			7/6	45°22'	84°56'	50	103	2.1
			7/8	45°26'	84°56'	52	103	2.0
			7/20	45°24'	84°54'	64	107	1.7
			7/26	45°40'	85°00'	70	110	1.6
			8/8	45°46'	85°00'	83	115	1.4
7	44°43'	86°52'	7/27	45°36'	85°31'	71	86	1.2
			8/12	45°01'	85°36'	87	93	1.1
			7/30	45°31'	85°06'	74	104	1.4

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
May 17								
8	44°44'	86°58'	8/5	44°37'	86°14'	80	36	0.5
			8/30	44°37'	86°14'	105	36	0.3
			8/6	43°47'	86°27'	81	71	0.9
9	44°44'	87°04'	9/4	44°24'	86°15'	110	48	0.4
			8/31	44°14'	86°21'	106	51	0.5
			9/4	44°07'	86°27'	110	54	0.5
			11/26	44°05'	86°30'	193	55	0.3
			9/1	44°01'	86°30'	107	58	0.5
			9/10	44°01'	86°30'	116	58	0.5
			9/17	44°56'	85°57'	123	58	0.5
			10/22	42°31'	86°15'	158	158	1.0
10	44°45'	87°10'	9/1	44°34'	86°13'	107	50	0.5
			8/19	44°20'	86°17'	94	54	0.6
			8/21	44°10'	86°24'	96	58	0.6
			8/2	43°51'	86°26'	77	63	0.8
May 16								
11	44°45'	87°14'	5/26	44°14'	87°30'	10	41	4.1
			5/29	44°13'	87°30'	13	42	3.2
			5/27	44°11'	87°31'	11	43	3.9
			5/30	44°11'	87°31'	14	43	3.1
			5/30	44°10'	87°32'	14	45	3.2
			8/10	44°10'	87°32'	86	45	0.5
			5/27	44°09'	87°34'	11	46	4.2
			5/28	44°09'	87°34'	12	46	3.8
12	44°46'	87°16'	5/25	44°13'	87°30'	9	41	4.6
			5/29	44°13'	87°30'	13	41	3.2
			5/30	44°13'	87°30'	14	41	2.9
			5/27	44°09'	87°33'	11	45	4.1
			6/22	44°06'	87°39'	37	51	1.4
June 23								
1	44°38'	86°18'	6/29	44°40'	86°16'	6	3	0.5
			6/27	44°36'	86°14'	4	5	1.3
			6/26	44°42'	86°14'	3	7	2.3
			6/26	44°42'	86°14'	3	7	2.3
			6/26	44°42'	86°14'	3	7	2.3
			6/27	44°42'	86°14'	4	7	1.8
			7/11	44°42'	86°14'	18	7	0.4
			7/10	45°22'	84°59'	17	84	4.9

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 23								
2	44°39'	86°22'	7/23	45°42'	85°35'	30	84	2.8
			7/22	45°44'	85°35'	29	85	2.9
			7/9	45°23'	84°55'	16	90	5.6
			7/22	45°23'	84°55'	29	90	3.1
			7/10	45°45'	84°56'	17	108	6.4
			7/10	45°45'	84°56'	17	108	6.4
			7/8	45°46'	84°47'	15	115	7.7
3	44°40'	86°29'	7/7	45°00'	86°10'	14	28	2.0
			9/18	45°00'	86°10'	87	28	0.3
			7/16	44°57'	85°56'	23	33	1.4
			7/3	45°04'	86°01'	10	35	3.5
			7/24	45°22'	85°07'	31	83	2.7
			7/13	45°22'	85°04'	20	86	4.3
			8/4	45°27'	85°04'	42	88	2.1
4	44°40'	86°32'	8/10	45°07'	85°40'	48	53	1.1
			8/2	45°24'	85°51'	40	61	1.5
			8/1	45°43'	85°35'	39	90	2.3
			8/23	45°22'	85°02'	61	91	1.5
			7/10	45°23'	84°59'	17	94	5.5
			7/18	45°35'	85°07'	25	94	3.8
			7/22	45°26'	84°56'	29	96	3.3
5	44°41'	86°39'	8/24	45°04'	85°59'	62	41	0.7
			7/21	45°13'	85°33'	28	66	2.4
			7/15	45°08'	85°36'	22	77	3.5
			7/19	45°20'	85°15'	26	84	3.2
			7/23	45°35'	85°07'	30	97	3.2
			7/24	45°25'	84°55'	31	100	3.2
6	44°42'	86°47'	8/17	45°04'	85°45'	55	57	1.0
			7/26	45°06'	85°41'	33	61	1.8
			8/7	45°09'	85°40'	45	63	1.4
			7/26	45°19'	85°17'	33	85	2.6
7	44°43'	86°53'	8/8	45°09'	85°40'	46	67	1.5
			8/11	45°00'	85°30'	49	75	1.5
8	44°43'	86°58'	9/4	45°04'	86°01'	73	53	0.7
			7/24	45°11'	85°37'	31	74	2.4
			7/31	45°17'	85°21'	38	88	2.3
			8/12	45°20'	85°15'	50	95	1.9
			8/7	45°22'	85°07'	45	102	2.3

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 23								
9	44°44'	87°04'	10/1	44°08'	87°36'	100	49	0.5
			8/10	45°03'	85°45'	48	69	1.4
			8/20	45°10'	85°39'	58	76	1.3
			10/21	45°40'	85°36'	120	96	0.8
			9/3	44°46'	85°30'	72	117	1.6
10	44°44'	87°08'	9/25	45°07'	86°04'	94	58	0.6
			10/16	45°47'	86°25'	115	80	0.7
			8/22	45°44'	85°34'	60	103	1.7
			8/18	45°41'	85°30'	56	112	2.0
			9/30	45°46'	84°44'	99	145	1.5
11	44°45'	87°15'	6/27	44°49'	87°17'	4	4	1.0
			8/22	44°54'	86°05'	60	58	1.0
			7/29	45°12'	85°32'	36	90	2.5
			8/9	45°38'	85°36'	47	101	2.1
			8/9	45°38'	85°36'	47	101	2.1
			8/31	45°55'	85°55'	69	103	1.5
12	44°46'	87°18'	7/2	44°44'	87°20'	9	3	0.3
			7/3	44°44'	87°20'	10	3	0.3
			7/3	44°44'	87°20'	10	3	0.3
			7/3	44°44'	87°20'	10	3	0.3
August 19								
1	44°38'	86°16'	8/22	44°54'	86°04'	3	22	7.3
			9/2	45°03'	85°45'	14	40	2.9
			9/2	45°03'	85°45'	14	40	2.9
2	44°38'	86°19'	8/28	45°04'	85°43'	9	42	4.7
			8/30	45°04'	85°43'	11	42	3.8
			8/30	45°04'	85°43'	11	42	3.8
			8/30	45°04'	85°43'	11	42	3.8
			8/30	45°04'	85°43'	11	42	3.8
			9/2	45°04'	85°43'	14	42	3.0
			9/2	45°04'	85°43'	14	42	3.0
			10/29	45°04'	85°43'	71	42	0.6
3	44°40'	86°26'	8/25	45°03'	86°00'	6	34	5.7
			9/1	45°10'	85°38'	13	53	4.1
			9/1	45°23'	85°51'	13	58	4.5
			8/31	45°12'	85°24'	12	66	5.5
			9/1	45°09'	85°24'	13	68	5.2

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
4	44°40'	86°33'	9/7	44°44'	86°08'	19	20	1.1
			9/1	45°10'	85°38'	13	56	4.3
			9/1	45°23'	85°51'	13	65	5.0
			9/3	45°08'	85°23'	15	72	4.8
			9/10	45°20'	85°15'	22	79	3.6
5	44°41'	86°38'	10/28	44°41'	86°15'	70	19	0.3
			9/5	44°26'	86°15'	17	27	1.6
			9/5	44°23'	86°15'	17	28	1.6
			10/4	44°23'	86°15'	46	28	0.6
			9/5	44°19'	86°17'	17	31	1.8
			9/3	44°15'	86°20'	15	34	2.3
			9/2	44°13'	86°21'	14	35	2.5
6	44°42'	86°41'	9/1	44°28'	86°15'	13	27	2.1
			9/11	44°23'	86°15'	23	31	1.3
			9/9	44°15'	86°20'	21	36	1.7
			9/11	44°15'	86°20'	23	36	1.6
7	44°42'	86°47'	9/5	44°23'	86°15'	17	35	2.1
			9/4	44°21'	86°16'	16	36	2.3
			9/4	44°18'	86°18'	16	37	2.3
			9/3	44°15'	86°20'	15	39	2.6
			9/3	44°15'	86°20'	15	39	2.6
8	44°43'	86°52'	9/1	44°42'	86°12'	13	34	2.6
			9/1	44°42'	86°12'	13	34	2.6
			9/10	44°42'	86°12'	22	34	1.5
9	44°45'	86°58'	9/7	44°53'	86°00'	19	50	2.6
			9/5	44°54'	85°58'	17	51	3.0
10	44°45'	87°06'	...	...	...	...	...	...
11	44°45'	87°10'	9/24	45°03'	86°07'	36	55	1.5
12	44°46'	87°12'	9/25	45°07'	86°03'	37	62	1.7
			10/10	45°45'	85°34'	52	105	2.0
			10/30	45°35'	85°07'	72	117	1.6
13	44°46'	87°16'	8/23	44°55'	87°10'	4	12	3.0
			8/23	44°55'	87°10'	4	12	3.0
			8/23	44°55'	87°10'	4	12	3.0
			8/23	44°55'	87°10'	4	12	3.0

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
August 19								
13	44°46'	87°16'	8/23	44°55'	87°10'	4	12	3.0
			8/23	44°55'	87°10'	4	12	3.0
			8/24	44°55'	87°10'	5	12	2.4
			8/22	44°57'	87°11'	3	17	5.7
September 22								
1	44°38'	86°17'	10/2	44°10'	86°25'	10	32	3.2
			10/1	44°07'	86°26'	9	36	4.0
			9/28	44°06'	86°28'	6	38	6.3
			10/9	43°49'	86°27'	17	59	3.5
2	44°38'	86°20'	9/29	44°17'	86°19'	7	24	3.4
			9/28	44°16'	86°20'	6	26	4.3
			9/28	44°16'	86°20'	6	26	4.3
			10/2	44°16'	86°20'	10	26	2.6
			9/29	44°14'	86°21'	7	28	4.0
			10/2	44°14'	86°21'	10	28	2.8
			9/28	44°13'	86°22'	6	29	4.8
			10/2	44°13'	86°22'	10	29	2.9
3	44°39'	86°26'	10/23	45°42'	84°56'	31	103	3.3
4	44°41'	86°33'	10/9	44°39'	86°15'	17	15	0.9
			11/5	45°22'	85°12'	44	82	1.9
5	44°42'	86°40'	10/9	44°38'	86°15'	17	21	1.2
			10/9	44°38'	86°15'	17	21	1.2
			10/12	44°37'	86°15'	20	21	1.1
			10/12	44°37'	86°15'	20	21	1.1
			10/9	44°35'	86°14'	17	23	1.4
			10/14	44°35'	86°14'	22	23	1.0
			11/6	45°22'	85°12'	45	85	1.9
			10/14	45°34'	85°08'	22	96	4.4
6	44°42'	86°45'	10/12	44°37'	86°15'	20	27	1.4
			10/15	44°35'	86°14'	23	28	1.2
			10/9	44°34'	86°14'	17	29	1.7
7	44°42'	86°51'	10/9	44°38'	86°15'	17	31	1.8
			10/9	44°38'	86°15'	17	31	1.8
			10/12	44°38'	86°15'	20	31	1.6
8	44°44'	86°57'	...	...	...	...	...	...

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 22								
9	44°46'	87°03'	10/23	44°15'	86°21'	31	50	1.6
			11/12	44°02'	86°30'	51	57	1.1
10	44°46'	87°09'	9/30	44°24'	87°31'	8	31	3.9
			10/16	44°23'	87°32'	24	32	1.3
			10/6	44°21'	87°32'	14	34	2.4
			9/29	44°18'	87°33'	7	38	5.4
			10/2	44°18'	87°33'	10	38	3.8
			10/9	44°18'	87°33'	17	38	2.2
11	44°45'	87°10'	9/24	44°42'	87°21'	2	9	4.5
			9/24	44°42'	87°21'	2	9	4.5
			9/24	44°42'	87°21'	2	9	4.5
			9/24	44°41'	87°22'	2	10	5.0
			9/24	44°41'	87°22'	2	10	5.0
			9/24	44°41'	87°22'	2	10	5.0
			9/24	44°41'	87°22'	2	10	5.0
			10/12	44°30'	87°29'	20	23	1.2
12	44°47'	87°15'	9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
			9/24	44°48'	87°18'	2	4	2.0
13	44°46'	87°17'	9/24	44°45'	87°20'	2	3	1.5
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
			9/25	44°44'	87°20'	3	4	1.3
November 4								
1	44°38'	86°18'	...	...	...	...	...	...
2	44°39'	86°20'	...	...	...	...	...	...

Table 20. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Frankfort, Michigan-Sturgeon Bay, Wisconsin transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
November 4								
3	44°39'	86°25'	11/13	45°04'	85°44'	9	45	5.0
			11/13	45°04'	85°44'	9	45	5.0
4	44°41'	86°40'	11/25	45°18'	85°18'	21	80	3.8
			11/25	45°18'	85°18'	21	80	3.8
5	44°42'	86°54'	11/27	45°30'	85°46'	23	78	3.4
6	44°45'	87°07'	11/6	45°03'	87°08'	2	22	11.0
			11/6	45°03'	87°08'	2	22	11.0
7	44°45'	87°10'	11/14	44°51'	87°14'	10	8	0.8
			11/14	44°51'	87°14'	10	8	0.8
			11/10	44°54'	87°13'	6	10	1.7
			11/9	44°55'	87°13'	5	11	2.2
			11/11	44°56'	87°11'	7	13	1.9
			11/15	44°56'	87°11'	11	13	1.2
			11/24	44°56'	87°11'	20	13	0.7
			11/24	44°56'	87°11'	20	13	0.7
			11/24	44°56'	87°11'	20	13	0.7
			11/24	44°56'	87°11'	20	13	0.7
8	44°46'	87°16'	11/6	44°50'	87°16'	2	4	2.0
			11/6	44°50'	87°16'	2	4	2.0
			11/6	44°50'	87°16'	2	4	2.0
			11/6	44°50'	87°16'	2	4	2.0
			11/6	44°50'	87°16'	2	4	2.0
			11/6	44°50'	87°16'	2	4	2.0
			11/15	44°50'	87°16'	11	4	0.4

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
1	45°20'	85°16'	6/24	45°22'	85°08'	19	9	0.5
			6/23	45°28'	85°05'	18	13	0.7
			7/8	45°28'	85°05'	33	13	0.4
			7/9	45°28'	85°05'	34	13	0.4
			6/24	45°24'	84°53'	19	19	1.0
			6/24	45°24'	84°53'	19	19	1.0
			6/24	45°35'	85°07'	19	19	1.0
			7/11	45°38'	85°04'	36	23	0.6
			6/22	45°41'	84°58'	17	32	1.9
2	45°21'	85°21'	7/24	45°21'	85°10'	49	8	0.2
			9/11	45°21'	85°10'	98	8	0.1
			6/24	45°22'	85°05'	19	12	0.6
			7/5	45°21'	85°02'	30	15	0.5
			7/23	45°21'	85°02'	48	15	0.3
			6/23	45°26'	84°58'	18	19	1.1
			6/23	45°23'	84°55'	18	21	1.2
			7/2	45°23'	84°55'	27	21	0.8
			6/24	45°25'	84°55'	19	22	1.2
			6/24	45°00'	85°29'	19	26	1.4
3	45°24'	85°26'	6/26	45°11'	85°23'	21	15	0.7
			6/26	45°11'	85°23'	21	15	0.7
			6/24	45°06'	85°22'	19	21	1.1
			6/22	45°25'	84°55'	17	25	1.5
			6/23	45°25'	84°55'	18	25	1.4
			6/23	45°25'	84°55'	18	25	1.4
			6/24	45°02'	85°23'	19	25	1.3
			6/25	45°00'	85°23'	20	28	1.4
4	45°25'	85°32'	7/3	45°18'	85°20'	28	13	0.5
			7/10	45°18'	85°20'	35	13	0.4
			7/4	45°16'	85°22'	29	13	0.4
			6/24	45°20'	85°15'	19	15	0.8
			6/23	45°23'	84°56'	18	29	1.6
			6/23	45°23'	84°56'	18	29	1.6
			7/2	45°23'	84°56'	27	29	1.1
5	45°28'	85°36'	7/2	45°16'	85°22'	27	19	0.7
			7/9	45°14'	85°23'	34	20	0.6
			7/21	45°23'	84°58'	46	32	0.7
			7/28	45°46'	85°05'	53	32	0.6
			7/29	45°43'	84°56'	54	37	0.7
			8/12	45°39'	84°30'	68	67	1.0

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
6	45°31'	85°43'	6/26	45°17'	85°21'	21	23	1.1
			7/11	45°46'	84°46'	36	51	1.4
			7/19	45°46'	84°46'	44	51	1.2
			7/18	45°46'	84°43'	43	54	1.3
			8/23	45°52'	84°42'	79	58	0.7
			7/11	45°42'	84°32'	36	66	1.8
7	45°32'	85°48'	7/30	45°24'	85°51'	55	12	0.2
			8/9	45°41'	85°35'	65	14	0.2
			7/11	45°44'	85°34'	36	17	0.5
			7/11	45°16'	85°22'	36	28	0.8
			8/7	45°46'	84°46'	63	61	1.0
8	45°35'	85°53'	7/3	45°24'	85°51'	28	14	0.5
			8/9	45°23'	85°50'	65	15	0.2
			7/26	45°35'	85°32'	51	17	0.3
			7/27	45°45'	85°34'	52	19	0.4
			7/4	45°14'	85°24'	29	34	1.2
			7/2	45°35'	85°07'	27	37	1.4
			7/28	45°45'	84°58'	53	55	1.0
9	45°37'	85°59'	7/9	45°35'	85°35'	34	20	0.6
			7/9	45°35'	85°35'	34	20	0.6
			7/17	45°16'	85°21'	42	38	0.9
			8/5	45°23'	84°58'	61	52	0.9
			7/9	45°58'	84°57'	34	58	1.7
			7/26	45°43'	84°57'	51	59	1.2
			7/23	45°47'	84°47'	48	65	1.4
			8/5	45°48'	84°30'	61	77	1.3
10	45°41'	86°04'	7/14	46°05'	85°26'	39	41	1.1
			8/4	45°22'	85°07'	60	51	0.9
11	45°43'	86°08'	7/2	45°24'	85°51'	27	26	1.0
			7/12	45°24'	85°51'	37	26	0.7
			9/5	45°32'	86°40'	92	28	0.3
			8/11	45°20'	85°15'	67	50	0.7
			7/25	45°46'	85°00'	50	58	1.2
			7/21	45°23'	84°56'	46	62	1.3
12	45°46'	86°10'	8/6	45°35'	86°38'	62	28	0.5
			10/26	45°35'	86°38'	143	28	0.2
			11/14	45°35'	86°38'	162	28	0.2
			8/23	45°35'	86°38'	79	28	0.4
			7/23	45°22'	85°02'	48	61	1.3
			7/9	44°59'	85°29'	34	66	1.9

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
13	45°51'	86°12'	8/23	45°48'	86°21'	79	8	0.1
			8/23	45°48'	86°21'	79	8	0.1
			8/23	45°48'	86°21'	79	8	0.1
			8/23	45°48'	86°21'	79	8	0.1
			11/13	45°48'	86°21'	161	8	1/0.0
			7/23	45°56'	84°55'	48	62	1.3
			7/10	45°38'	85°03'	35	62	1.8
14	45°52'	86°12'	6/26	45°50'	86°21'	21	8	0.4
			7/14	45°48'	86°21'	39	9	0.2
			8/23	45°47'	86°22'	79	10	0.1
			8/6	45°34'	86°38'	62	29	0.5
15	45°54'	86°14'	6/7	45°55'	86°19'	2	4	2.0
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
			6/9	45°51'	86°20'	4	6	1.5
July 14								
1	45°20'	85°19'	8/10	45°21'	85°12'	27	5	0.2
			7/17	45°22'	85°10'	3	8	2.7
			7/22	45°22'	85°10'	8	8	1.0
			7/23	45°22'	85°10'	9	8	0.9
			7/26	45°22'	85°10'	12	8	0.7
			9/11	45°22'	85°10'	59	8	0.1
2	45°21'	85°22'	10/4	45°22'	85°06'	82	14	0.2
			7/22	45°22'	85°03'	8	16	2.0
			7/23	45°22'	85°03'	9	16	1.8
			7/24	45°22'	85°03'	10	16	1.6
			7/24	45°22'	85°03'	10	16	1.6
			7/24	45°22'	85°03'	10	16	1.6
			7/24	45°22'	85°03'	10	16	1.6
			8/4	45°23'	84°57'	21	19	0.9
			8/4	45°23'	84°57'	21	19	0.9
3	45°24'	85°27'	10/29	45°16'	85°22'	107	9	0.1
			9/1	45°06'	85°36'	49	23	0.5
			8/20	45°47'	84°46'	37	46	1.2
			8/17	45°45'	84°41'	34	51	1.5

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 14								
4	45°26'	85°32'	7/24	45°22'	85°10'	10	18	1.8
			7/24	45°22'	85°10'	10	18	1.8
			7/24	45°22'	85°10'	10	18	1.8
			7/24	45°22'	85°10'	10	18	1.8
			7/24	45°22'	85°10'	10	18	1.8
			8/4	45°22'	85°08'	21	20	1.0
			8/4	45°22'	85°08'	21	20	1.0
			7/23	45°28'	85°05'	9	21	2.3
			7/24	45°21'	85°03'	10	24	2.4
5	45°29'	85°38'	7/27	45°22'	85°02'	13	30	2.3
			7/30	45°22'	85°02'	16	30	1.9
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
			8/4	45°22'	85°02'	21	30	1.4
6	45°31'	85°42'	7/23	45°11'	85°38'	9	24	2.7
			7/24	45°11'	85°38'	10	24	2.4
			7/24	45°11'	85°38'	10	24	2.4
			7/30	45°11'	85°38'	16	24	1.5
			7/30	45°11'	85°38'	16	24	1.5
			8/8	45°11'	85°38'	25	24	1.0
			8/8	45°11'	85°38'	25	24	1.0
			8/21	45°12'	85°34'	38	24	0.6
7	45°34'	85°48'	8/7	45°36'	85°37'	24	9	0.4
			8/8	45°16'	85°23'	25	28	1.1
			7/24	45°19'	85°16'	10	30	3.0
			7/24	45°19'	85°16'	10	30	3.0
			7/26	45°19'	85°16'	12	30	2.5
			10/8	45°19'	85°16'	86	30	0.3
			8/11	45°20'	85°15'	28	31	1.1
			8/10	45°27'	85°04'	27	36	1.3
8	45°35'	85°56'	8/16	45°39'	85°01'	33	44	1.3
			8/10	45°39'	85°00'	27	45	1.7
			8/7	45°45'	85°00'	24	51	2.1
			8/7	45°45'	85°00'	24	51	2.1
			8/7	45°45'	85°00'	24	51	2.1
			8/8	45°45'	85°00'	25	51	2.0

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 14								
9	45°39'	86°00'	9/3	45°37'	85°37'	51	19	0.4
			10/21	45°39'	85°37'	99	19	0.2
			10/21	45°39'	85°37'	99	19	0.2
			8/7	45°13'	85°34'	24	37	1.5
			10/4	45°17'	85°22'	82	40	0.5
10	45°42'	86°05'	7/27	45°37'	85°38'	13	23	1.8
			8/9	45°37'	85°38'	26	23	0.9
			8/9	45°37'	85°38'	26	23	0.9
			10/16	45°40'	85°37'	94	23	0.2
			9/7	45°20'	85°15'	55	47	0.9
			11/5	45°45'	84°54'	114	61	0.5
			9/5	45°47'	84°47'	53	66	1.2
11	45°43'	86°08'	9/23	45°45'	85°42'	71	21	0.3
			8/5	45°41'	85°36'	22	25	1.1
			10/2	45°22'	85°00'	80	59	0.7
12	45°48'	86°10'	10/3	45°56'	84°55'	81	62	0.8
			9/4	45°34'	85°07'	52	62	1.2
13	45°51'	86°12'	8/7	45°58'	85°46'	24	22	0.9
			11/13	45°49'	85°23'	122	40	0.3
			9/2	45°45'	84°54'	50	63	1.3
14	45°53'	86°13'	9/6	45°57'	86°08'	54	6	0.1
			9/25	45°35'	85°36'	73	37	0.5
			8/20	46°03'	85°09'	37	54	1.5
			8/30	45°28'	85°05'	47	63	1.3
15	45°55'	86°14'	8/2	45°58'	86°07'	19	6	0.3
			7/31	45°57'	85°59'	17	12	0.7
			8/6	45°56'	85°56'	23	13	0.6
			8/7	45°56'	85°56'	24	13	0.5
			8/11	45°56'	85°56'	28	13	0.5
			7/30	45°58'	85°53'	16	19	1.2
			8/7	45°58'	85°46'	24	24	1.0
September 5								
1	45°20'	85°18'	9/20	45°14'	85°24'	15	9	0.6
			10/9	45°26'	85°00'	34	15	0.4
			11/19	45°08'	85°34'	75	19	0.3
			10/31	45°35'	85°06'	56	21	0.4
			10/13	45°39'	85°01'	38	26	0.7

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 5								
2	45°21'	85°20'	10/9	45°39'	85°00'	34	29	0.9
			10/2	45°41'	85°00'	27	30	1.1
			10/26	45°41'	85°00'	51	30	0.6
			11/18	45°43'	84°56'	74	33	0.4
3	45°23'	85°25'	9/11	45°18'	85°20'	6	7	1.2
			10/1	45°18'	85°20'	26	7	0.3
			10/22	45°18'	85°20'	47	7	0.1
			10/23	45°18'	85°20'	48	7	0.1
			11/5	45°18'	85°20'	61	7	0.1
			11/10	45°18'	85°20'	66	7	0.1
			10/22	45°17'	85°21'	47	8	0.2
			9/9	45°15'	85°22'	4	9	2.3
4	45°26'	85°30'	9/16	45°22'	85°09'	11	17	1.5
			9/16	45°22'	85°09'	11	17	1.5
			9/17	45°22'	85°09'	12	17	1.4
			10/16	45°22'	85°09'	41	17	0.4
			9/17	45°28'	85°05'	12	20	1.7
			9/25	45°40'	85°00'	20	29	1.5
5	45°28'	85°35'	9/18	45°41'	85°36'	13	16	1.2
			9/18	45°41'	85°36'	13	16	1.2
			10/9	45°36'	85°06'	34	24	0.7
6	45°30'	85°40'	9/25	45°34'	85°34'	20	7	0.4
			10/21	45°34'	85°34'	46	7	0.2
			10/21	45°40'	85°36'	46	11	0.2
			10/21	45°40'	85°36'	46	11	0.2
			9/18	45°41'	85°36'	13	13	1.0
7	45°34'	85°47'	11/12	45°30'	85°06'	68	34	0.5
			10/9	45°27'	85°05'	34	35	1.0
			10/9	45°27'	85°05'	34	35	1.0
8	45°36'	85°52'	9/25	45°56'	86°17'	20	30	1.5
9	45°38'	85°58'	...	...	...	...	...	...
10	45°41'	86°03'	10/15	45°58'	85°52'	40	22	0.6
			10/20	45°45'	85°31'	45	27	0.6

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 5								
11	45°43'	86°07'	9/14	45°55'	86°17'	9	16	1.8
			9/9	45°57'	86°13'	4	17	4.3
			9/25	45°58'	85°54'	20	20	1.0
			9/25	45°58'	85°54'	20	20	1.0
			9/14	45°58'	85°50'	9	23	2.6
12	45°46'	86°10'	9/19	45°55'	86°17'	14	12	0.9
			9/24	45°47'	86°25'	19	13	0.7
			10/30	45°35'	86°31'	55	22	0.4
			10/9	45°21'	86°52'	34	44	1.3
			9/24	45°20'	86°52'	19	46	2.4
			9/22	45°14'	87°02'	17	60	3.5
13	45°51'	86°11'	9/9	45°58'	85°53'	4	18	4.5
			10/12	45°36'	86°41'	37	31	0.8
			11/6	45°48'	86°46'	62	44	0.7
14	45°53'	86°14'	9/24	45°57'	86°11'	19	5	0.3
			11/16	45°36'	86°37'	72	29	0.4
			9/22	45°13'	87°01'	17	63	3.7
			10/1	45°11'	87°02'	26	63	2.4
			10/9	45°11'	87°02'	34	63	1.9
15	45°56'	86°15'	9/9	45°56'	86°17'	4	2	0.5
			9/9	45°56'	86°17'	4	2	0.5
			9/9	45°57'	86°13'	4	3	0.8
			9/9	45°57'	86°13'	4	3	0.8
			9/9	45°57'	86°13'	4	3	0.8
			9/9	45°57'	86°13'	4	3	0.8
			9/14	45°57'	86°13'	9	3	0.3
			9/24	45°20'	86°53'	19	51	2.7
October 19								
1	45°20'	85°18'	10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/22	45°18'	85°20'	3	3	1.0
			10/23	45°18'	85°20'	4	3	0.8

Table 21. --Release and recovery points of drift bottles with metal drags that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
October 19								
2	45°22'	85°20'	10/29	45°05'	85°23'	10	21	2.1
			11/1	45°05'	85°23'	13	21	1.6
3	45°24'	85°25'	...	...	...	...	...	...
4	45°27'	85°30'	10/29	45°16'	85°22'	10	13	1.3
			10/25	45°12'	85°24'	6	18	3.0
5	45°30'	85°36'	10/29	45°14'	85°24'	10	21	2.1
			11/13	45°46'	85°24'	25	22	0.9
			11/12	45°53'	84°54'	24	44	1.8
6	45°32'	85°42'	11/5	45°41'	84°59'	17	36	2.1
			11/6	45°41'	84°59'	18	36	2.0
			11/13	45°41'	84°59'	25	36	1.4
7	45°34'	85°47'	11/1	45°26'	85°02'	13	37	2.8
8	45°36'	85°52'	11/14	45°36'	85°30'	26	19	0.7
			11/11	45°45'	84°48'	23	57	2.5
9	45°39'	85°58'	11/13	45°37'	85°37'	25	16	0.6
			11/5	45°35'	85°07'	17	42	2.5
10	45°42'	86°03'	11/13	45°38'	85°36'	25	22	0.9
11	45°44'	86°07'	10/29	45°35'	85°35'	10	28	2.8
			10/29	45°35'	85°35'	10	28	2.8
12	45°48'	86°10'	11/19	46°01'	85°02'	31	55	1.8
13	45°52'	86°10'	10/30	45°59'	85°49'	11	19	1.7
14	45°54'	86°13'	10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/23	45°57'	86°02'	4	9	2.3
			10/25	45°57'	86°09'	6	5	0.8

1/ Less than 0.05

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
1	45°20'	85°16'	6/15	45°20'	85°15'	10	1	0.1
			6/15	45°20'	85°15'	10	1	0.1
			6/15	45°18'	85°17'	10	1	0.1
			6/15	45°18'	85°17'	10	1	0.1
			6/15	45°17'	85°21'	10	6	0.6
			7/3	45°16'	85°23'	28	10	0.4
			7/2	45°11'	85°23'	27	14	0.5
			6/21	45°24'	84°53'	16	20	1.3
			6/22	45°43'	84°56'	17	31	1.8
2	45°21'	85°21'	6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
			6/22	45°11'	85°35'	17	17	1.0
3	45°24'	85°26'	6/22	45°23'	84°54'	17	24	1.4
			6/22	45°23'	84°54'	17	24	1.4
			6/22	45°23'	84°54'	17	24	1.4
			6/23	45°23'	84°54'	18	24	1.3
			6/23	45°23'	84°54'	18	24	1.3
			6/23	45°23'	84°54'	18	24	1.3
			6/23	45°03'	85°23'	18	25	1.4
			6/25	45°00'	85°23'	20	28	1.4
4	45°25'	85°32'	7/4	45°09'	85°32'	29	20	0.7
			6/26	45°03'	85°23'	21	28	1.3
			6/23	45°23'	84°55'	18	29	1.6
			6/23	45°23'	84°55'	18	29	1.6
			6/25	45°01'	85°23'	20	30	1.5
			6/25	45°01'	85°23'	20	30	1.5
			6/30	45°01'	85°23'	25	30	1.2
			6/22	44°59'	85°24'	17	31	1.8
5	45°28'	85°36'	7/23	45°22'	85°08'	48	25	0.5
			6/30	45°22'	85°01'	25	29	1.2
			6/23	45°23'	84°56'	18	32	1.8
			6/23	45°23'	84°56'	18	32	1.8
			6/22	45°24'	84°53'	17	33	1.9
			6/22	45°24'	84°53'	17	33	1.9

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
6	45°31'	85°43'	6/25	45°14'	85°24'	20	26	1.3
			6/25	45°14'	85°24'	20	26	1.3
			6/25	45°14'	85°24'	20	26	1.3
			6/24	45°12'	85°24'	19	28	1.5
			7/2	45°12'	85°24'	27	28	1.0
			6/23	45°07'	85°23'	18	33	1.8
			6/24	45°07'	85°23'	19	33	1.7
7	45°32'	85°48'	8/7	45°27'	85°53'	63	9	0.1
			9/18	45°45'	84°57'	105	43	0.4
			7/2	45°45'	84°57'	27	43	1.6
			7/6	45°46'	84°58'	31	43	1.4
8	45°35'	85°53'	7/3	45°38'	85°03'	28	40	1.4
			7/13	45°43'	84°56'	38	46	1.2
			10/16	45°44'	84°56'	133	47	0.4
			7/2	45°44'	84°56'	27	47	1.7
			7/6	45°45'	84°55'	31	47	1.5
			7/24	45°48'	84°33'	49	75	1.5
			10/6	45°40'	84°30'	123	82	0.7
9	45°37'	85°59'	7/3	45°29'	85°06'	28	44	1.6
			7/22	45°44'	84°56'	47	52	1.1
			7/22	45°52'	84°48'	47	65	1.4
			7/15	45°51'	84°37'	40	75	1.9
10	45°41'	86°04'	7/3	45°24'	85°52'	28	21	0.8
			7/20	45°35'	85°33'	45	24	0.5
			8/7	45°58'	85°48'	63	25	0.4
			7/13	45°45'	85°30'	38	29	0.8
			7/6	45°45'	84°58'	31	55	1.8
			7/30	45°47'	84°44'	55	69	1.3
			7/24	45°46'	84°41'	49	71	1.4
11	45°43'	86°08'	9/8	45°27'	85°53'	95	23	0.2
			7/25	45°24'	84°54'	50	53	1.1
12	45°46'	86°10'	8/17	45°42'	86°40'	73	38	0.5
			8/17	45°42'	86°40'	73	38	0.5
13	45°51'	86°12'	7/4	45°52'	86°20'	29	6	0.2
			7/27	45°49'	86°21'	52	8	0.2
			7/27	45°49'	86°21'	52	8	0.2

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
June 5								
14	45°52'	86°12'	7/16	45°52'	86°20'	41	6	0.1
			7/16	45°52'	86°20'	41	6	0.1
			7/17	45°52'	86°20'	42	6	0.1
			7/17	45°52'	86°20'	42	6	0.1
			7/17	45°52'	86°20'	42	6	0.1
			7/18	45°52'	86°20'	43	6	0.1
			7/18	45°52'	86°20'	43	6	0.1
			7/27	45°52'	86°20'	52	6	0.1
			7/4	45°50'	86°21'	29	7	0.2
15	45°54'	86°14'	6/6	45°56'	86°17'	1	3	3.0
			6/7	45°57'	86°10'	2	5	2.5
			6/8	45°57'	86°10'	3	5	1.7
			6/8	45°57'	86°10'	3	5	1.7
			6/8	45°57'	86°10'	3	5	1.7
			6/8	45°57'	86°10'	3	5	1.7
			6/9	45°53'	86°20'	4	5	1.3
			6/10	45°53'	86°20'	5	5	1.0
			6/10	45°53'	86°20'	5	5	1.0
			6/10	45°53'	86°20'	5	5	1.0
July 14								
1	45°20'	85°19'	7/16	45°22'	85°10'	2	6	3.0
			7/17	45°22'	85°10'	3	6	2.0
			8/21	45°22'	85°10'	38	6	0.2
			8/11	45°22'	85°10'	28	7	0.3
			7/23	45°22'	85°07'	9	8	0.9
			7/23	45°22'	85°07'	9	9	1.0
			7/23	45°22'	85°07'	9	10	1.1
2	45°21'	85°22'	7/19	45°19'	85°18'	5	4	0.8
			7/19	45°19'	85°18'	5	4	0.8
			7/19	45°19'	85°18'	5	4	0.8
			7/21	45°19'	85°18'	7	4	0.6
			7/25	45°19'	85°18'	11	4	0.4
			7/20	45°19'	85°18'	6	4	0.7
			7/20	45°19'	85°16'	6	5	0.8
			7/30	45°21'	85°13'	16	7	0.4
			8/5	45°22'	85°03'	22	15	0.7
			7/20	45°19'	85°16'	6	19	3.2
3	45°24'	85°27'	7/24	45°38'	85°04'	10	25	2.5
			8/7	45°46'	85°00'	24	33	1.4
			8/6	45°45'	84°47'	23	43	1.9

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 14								
3	45°24'	85°27'	8/6	45°45'	84°47'	23	43	1.9
			9/12	45°45'	84°47'	60	43	0.7
4	45°26'	85°32'	7/23	45°22'	85°07'	9	21	2.3
			7/23	45°22'	85°07'	9	21	2.3
			8/4	45°22'	85°07'	21	21	1.0
			8/3	45°22'	85°03'	20	25	1.3
			7/23	45°23'	84°59'	9	26	2.9
			7/24	45°23'	84°55'	10	28	2.8
			8/11	45°23'	84°55'	28	28	1.0
5	45°29'	85°38'	7/24	45°17'	85°22'	10	19	1.9
			7/24	45°15'	85°24'	10	20	2.0
			7/25	45°19'	85°18'	11	20	1.8
			7/31	45°15'	85°24'	17	20	1.2
			8/21	45°19'	85°18'	38	20	0.5
			7/23	45°20'	85°15'	9	21	2.3
			7/24	45°20'	85°15'	10	21	2.1
			7/23	45°22'	85°07'	9	27	3.0
6	45°31'	85°42'	7/24	45°16'	85°22'	10	24	2.4
			7/31	45°18'	85°20'	17	24	1.4
			8/7	45°17'	85°21'	24	24	1.0
			7/23	45°19'	85°16'	9	26	2.9
			7/24	45°19'	85°16'	10	26	2.6
7	45°34'	85°48'	7/23	45°20'	85°15'	9	31	3.4
			7/23	45°20'	85°15'	9	31	3.4
			7/24	45°20'	85°15'	10	31	3.1
			7/24	45°19'	85°17'	10	31	3.1
			7/24	45°19'	85°17'	10	31	3.1
			7/24	45°19'	85°17'	10	31	3.1
			7/24	45°19'	85°17'	10	31	3.1
			7/24	45°21'	85°14'	10	32	3.2
			7/24	45°21'	85°14'	10	32	3.2
8	45°35'	85°56'	9/4	45°45'	85°35'	52	20	0.4
			8/8	45°36'	85°05'	25	41	1.6
			8/7	45°38'	85°04'	24	43	1.8
			8/5	45°26'	85°03'	22	45	2.0
			9/4	45°39'	85°01'	52	45	0.9
			8/4	45°22'	85°03'	21	46	2.2
			8/16	45°22'	85°03'	33	46	1.4

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
July 14								
9	45°39'	86°00'	8/7	45°35'	85°06'	24	48	2.0
			8/8	45°40'	85°00'	25	50	2.0
			8/8	45°40'	85°00'	25	50	2.0
			8/3	45°45'	84°58'	20	51	2.6
			10/30	45°45'	84°58'	108	51	0.5
			8/4	45°43'	84°56'	21	53	2.5
			8/6	45°43'	84°56'	23	53	2.3
			8/26	45°43'	84°56'	43	53	1.2
10	45°42'	86°05'	7/25	45°38'	85°37'	11	23	2.1
			7/23	45°44'	85°34'	9	25	2.8
			9/4	45°46'	85°34'	52	25	0.5
			9/25	45°35'	85°37'	73	25	0.3
			9/28	45°35'	85°37'	76	25	0.3
			11/21	45°46'	85°34'	130	25	0.2
			8/7	45°45'	85°30'	24	29	1.2
11	45°43'	86°08'	9/22	45°46'	85°42'	70	21	0.3
			9/3	45°49'	85°23'	51	37	0.7
12	45°48'	86°10'	8/21	45°26'	85°02'	38	60	1.6
			8/21	45°26'	85°00'	38	63	1.7
			11/21	45°42'	84°34'	130	83	0.6
13	45°51'	86°12'	7/31	45°56'	85°56'	17	15	0.9
			7/30	45°50'	85°31'	16	34	2.1
			7/30	45°50'	85°31'	16	34	2.1
			8/8	46°06'	85°26'	25	42	1.7
			8/27	46°06'	85°26'	44	42	1.0
14	45°53'	86°13'	8/24	45°58'	86°03'	41	10	0.2
			8/7	45°57'	86°00'	24	11	0.5
			8/9	45°56'	85°56'	26	14	0.5
			8/9	45°56'	85°56'	26	14	0.5
			8/28	45°56'	85°56'	45	14	0.3
			9/2	45°56'	85°56'	50	14	0.3
15	45°55'	86°14'	7/17	45°57'	86°14'	3	2	0.7
			7/17	45°57'	86°14'	3	2	0.7
			7/17	45°57'	86°14'	3	2	0.7
			7/17	45°57'	86°14'	3	2	0.7
			8/15	45°57'	86°14'	32	2	0.1
			8/15	45°57'	86°14'	32	2	0.1
			8/24	45°57'	86°10'	41	4	0.1
			8/15	45°58'	86°07'	32	6	0.2
			9/11	46°06'	85°25'	59	47	0.8

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 5								
1	45°20'	85°18'	9/5	45°18'	85°18'	1/2	2	4.0
			9/5	45°18'	85°18'	1/2	2	4.0
			9/5	45°18'	85°18'	1/2	2	4.0
			9/5	45°18'	85°18'	1/2	2	4.0
			9/5	45°18'	85°18'	1/2	2	4.0
			9/6	45°18'	85°18'	1	2	2.0
2	45°21'	85°20'	9/8	45°22'	85°07'	3	11	3.7
			9/8	45°22'	85°07'	3	11	3.7
			9/11	45°22'	85°10'	6	9	1.5
			9/11	45°22'	85°10'	6	9	1.5
			10/2	45°21'	85°13'	27	6	0.2
3	45°23'	85°25'	9/9	45°19'	85°18'	4	7	1.8
			11/25	45°19'	85°18'	81	7	0.1
			9/21	45°20'	85°16'	16	9	0.6
			9/21	45°20'	85°16'	16	9	0.6
			9/21	45°20'	85°16'	16	9	0.6
			9/13	45°23'	85°08'	8	14	1.8
4	45°26'	85°30'	9/14	45°22'	85°07'	9	19	2.1
			9/17	45°36'	85°07'	12	22	1.8
			10/10	45°41'	84°59'	35	30	0.9
			9/29	45°42'	84°57'	24	32	1.3
			10/11	45°45'	84°54'	36	40	1.1
5	45°28'	85°35'	9/22	45°45'	84°50'	17	45	2.6
			9/22	45°45'	84°50'	17	45	2.6
			11/10	45°45'	84°50'	66	45	0.7
6	45°30'	85°40'	9/25	45°39'	85°37'	20	11	0.6
			9/25	45°39'	85°37'	20	11	0.6
			9/25	45°39'	85°37'	20	11	0.6
			10/16	45°39'	85°37'	41	11	0.3
			9/18	45°41'	85°37'	13	13	1.0
7	45°34'	85°47'	10/21	45°36'	85°40'	46	8	0.2
			10/29	45°35'	85°34'	54	11	0.2
			11/14	45°36'	85°30'	70	16	0.2
8	45°36'	85°52'	11/27	45°24'	85°52'	83	14	0.2
9	45°38'	85°58'	9/18	45°40'	85°36'	13	17	1.3
			9/25	45°35'	85°33'	20	21	1.1
			9/25	45°35'	85°33'	20	21	1.1
			9/25	45°58'	86°06'	20	23	1.2

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
September 5								
10	45°41'	86°03'	9/18	45°41'	85°36'	13	21	1.6
11	45°43'	86°07'	9/17	45°55'	85°55'	12	17	1.4
12	45°46'	86°10'	9/14	45°57'	86°00'	9	14	1.6
			9/19	45°58'	85°52'	14	19	1.4
			9/25	45°58'	85°52'	20	19	1.0
13	45°51'	86°11'	11/13	45°52'	86°20'	69	7	0.1
			9/25	45°54'	86°20'	20	8	0.4
			9/17	45°48'	86°21'	12	9	0.8
14	45°53'	86°14'	10/10	45°45'	86°31'	35	19	0.5
15	45°56'	86°15'	9/6	45°56'	86°15'	1	2	2.0
			9/6	45°56'	86°15'	1	2	2.0
			9/6	45°56'	86°15'	1	2	2.0
			9/6	45°56'	86°15'	1	2	2.0
			9/7	45°58'	86°13'	2	3	1.5
			9/7	45°58'	86°13'	2	3	1.5
			9/7	45°58'	86°13'	2	3	1.5
October 19								
1	45°20'	85°18'	10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
			10/22	45°18'	85°19'	3	2	0.7
2	45°22'	85°20'	11/12	45°10'	85°23'	24	17	0.7
			10/29	45°07'	85°23'	10	20	2.0
			11/1	45°07'	85°23'	13	20	1.5
			10/28	45°05'	85°23'	9	22	2.4
3	45°24'	85°25'	11/13	45°10'	85°24'	25	17	0.7
			10/29	45°07'	85°23'	10	20	2.0
			10/29	45°07'	85°23'	10	20	2.0
			11/1	45°07'	85°23'	13	20	1.5
			11/6	45°07'	85°23'	18	20	1.1
4	45°27'	85°30'	10/26	45°17'	85°22'	7	14	2.0
			10/29	45°14'	85°24'	10	16	1.6
			10/29	45°14'	85°24'	10	16	1.6

Table 22. --Release and recovery points of sand-ballasted drift bottles that were released in 1955 on the Charlevoix, Michigan-Manistique, Michigan transect (cont'd)

Releases			Recoveries					
Station	Latitude (North)	Longitude (West)	Date	Latitude (North)	Longitude (West)	Days adrift	Miles covered	Miles per day
October 19								
4	45°27'	85°30'	10/29	45°14'	85°24'	10	16	1.6
			11/11	45°14'	85°24'	23	16	0.7
			10/29	45°12'	85°24'	10	18	1.8
5	45°30'	85°36'	11/12	45°22'	85°06'	24	26	1.1
			10/30	45°25'	84°53'	11	34	3.1
6	45°32'	85°42'	10/25	45°33'	85°08'	6	28	4.7
			10/27	45°35'	85°08'	8	28	3.5
			10/28	45°33'	85°08'	9	28	3.1
			10/30	45°35'	85°08'	11	28	2.5
			10/30	45°35'	85°08'	11	28	2.5
			10/30	45°35'	85°08'	11	28	2.5
			11/20	45°39'	85°03'	32	32	1.0
7	45°34'	85°47'	11/9	45°34'	85°35'	21	10	0.5
			11/14	45°34'	85°35'	26	10	0.4
8	45°36'	85°52'	10/29	45°35'	85°32'	10	16	1.6
			10/29	45°35'	85°32'	10	16	1.6
			10/29	45°35'	85°32'	10	16	1.6
			10/29	45°35'	85°32'	10	16	1.6
			10/29	45°35'	85°32'	10	16	1.6
			10/29	45°35'	85°32'	10	16	1.6
9	45°39'	85°58'	11/15	45°37'	85°37'	27	17	0.6
10	45°42'	86°03'	...	...	...	...	...	...
11	45°44'	86°07'	...	...	...	...	...	...
12	45°48'	86°10'	...	...	...	...	...	...
13	45°52'	86°10'	10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
			10/27	45°56'	85°57'	8	11	1.4
14	45°54'	86°13'	10/29	45°57'	86°11'	10	4	0.4
			10/29	45°57'	86°11'	10	4	0.4
			10/27	45°57'	86°08'	8	5	0.6

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