

SURFACE WATER MOVEMENT, WESTERN LAKE ERIE

JAMES L. VERBER

F. T. Stone Institute of Hydrobiology, The Ohio State University, Put-in-Bay

Controversy over the practicability of using drift bottles or cards for determining water movement has led to a long dispute. It is hoped that this paper will contribute some information toward the ending of the dispute. With the use of drift cards present findings show a close correlation between the wind and the surface current flow.

Since Harrington's (1895) first report on the currents of Lake Erie by using drift bottles, studies have been carried on intermittently. Olson (1951) used drift cards as a substitute for drift bottles, and the change was for the best, as drift cards are inexpensive and give greater accuracy to the surface flow because they are not exposed to the wind.

Olson's (1950) method of multiple release or putting cards out over a large area in a short period of time was varied by using a line release. This technique employed the principle of putting a solid line of cards several miles long in the lake. The longest line tried was 27 miles, on which over 500 cards were released or about one card every 260 feet. In the past two years over 3200 cards were released, with a 30% return.

TRIPS

Six line releases were made in 1950-51. Four show only one direction of flow while the other two show varying directions; in some cases opposing patterns were apparent.

When plotting the returns of the drift cards from many different locations the time adrift was correlated with the varying wind conditions over the period of time involved. Thus, if the reports from one trip showed one group of cards returned in 5 days from one location and another group of cards returned in 10 days from a different location it cannot be assumed that the same influences were exerted on both sets. Both sets of cards must be treated as individual groups under varying wind conditions during the period of time they were adrift.

Trip 1. On June 28, 1950, 290 cards were liberated in three groups, 60, 170 and 60 cards (fig. 1). The first returns were reported from Erieau, Ontario within 15 days; thereafter, cards were reported all along the north shore of Lake Erie as far as Long Point. About the first week in August cards were returned from the south side of Lake Erie near the city of Erie, Pa. and then down the shore as far as the southern edge of Buffalo. A distance of 250 miles was travelled in 38 days, a rate of 6.5 miles per day. This compares very favorably with the velocity measured in the open lake, using free floating vanes having an average of 6.2 miles per day. The wind during most of this period was from the west and southwest which is the prevailing wind direction over Lake Erie.

Trip 2. On July 22, 1950, 280 cards were liberated from Point Sheridan, Pelee Island, to Kingsville, Ontario (fig. 2). The first returns were from Kingsville on the 23rd of July, with cards from Point Pelee on the 25th and 26th of July. The wind was 6 to 8 mph from the south and east until the afternoon of the 24th. On the afternoon of the 24th the wind shifted to the northwest and increased from 12 to 20 mph.

From figure 2, it appears that the cards went across the channel, but, this is probably not the case. The cards undoubtedly went to the northwest but, having a longer distance to travel, were caught in the strong winds that came out of the northwest and thus were deposited on the tip of Point Pelee.



FIGURE 1.

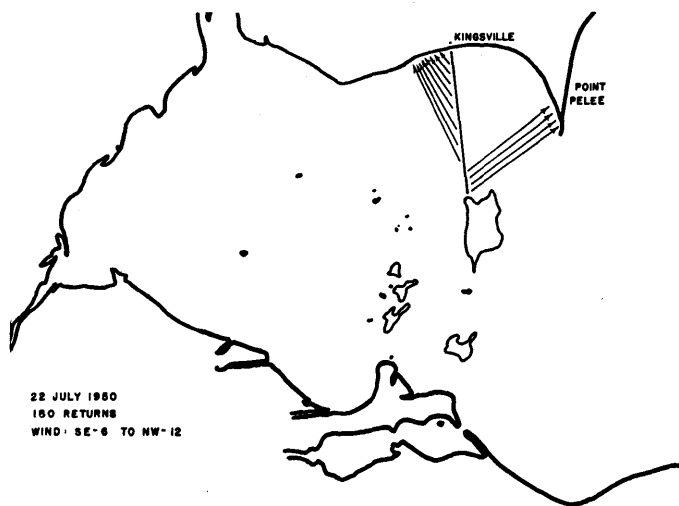


FIGURE 2.

Trip 3. On August 4, 1950, 580 cards were released from the tip of Kelleys Island to Point Pelee, Ontario (fig. 3). The first returns came from Cedar Point and Rye Beach on August 7th. The wind was northwest 8 to 12 mph until the afternoon of the 6th and it then shifted to the northeast until the evening of the 7th. The second group of returns came from Marblehead and the south side of Kelleys Island, on the 10th and 12th. The wind on the night of the 7th shifted to the south and southwest until the 10th of August, the northeast wind probably accounts

for the shift of the cards to the west side of Kelleys Island and the cards found on Marblehead peninsula. The wind then shifting to the south accounts for the cards on the southwest side of Kelleys Island. From the 10th to the 14th the wind again shifted to the northeast. The cards moving to the northeast were related to the southwest wind, and were found after 12 to 18 days adrift.

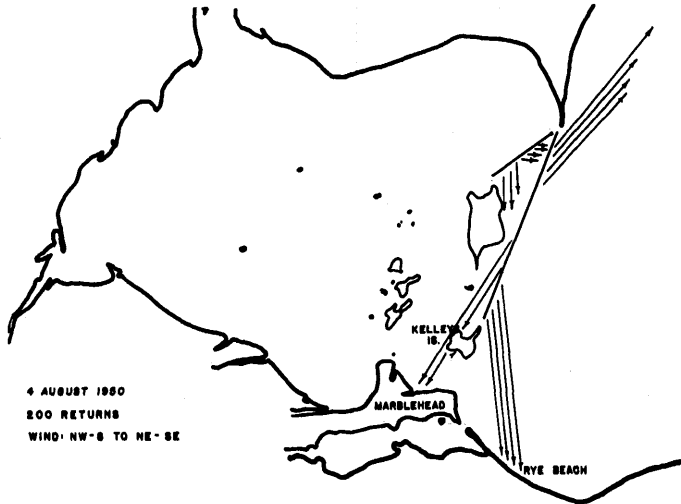


FIGURE 3.

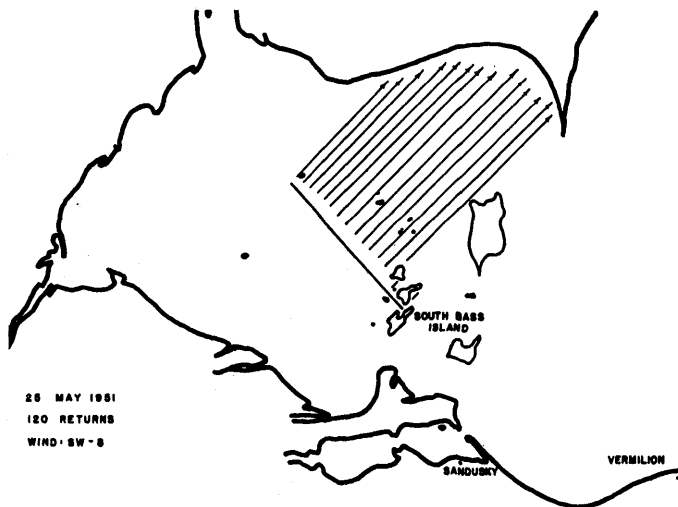


FIGURE 4.

Trip 4. On May 25, 1951, 350 cards were released in a straight line from Peach Point bar on South Bass Island to a point about 1 mile south of West Sister Island (fig. 4). The total distance was about 17 miles. The first returns were reported on the 27th of May. The wind was from the southwest 8 to 17 mph until the 28th of May. From the 28th to the 29th the wind shifted to the north-

west. About 5 cards were returned later from the south shore of Lake Erie, from Sandusky to Vermilion, Ohio. These cards were adrift 19 days and were caught in the winds from the northwest which followed the southwest blow.

Trip 5. The same number of cards were released on May 31, 1951 over the same route as of 6 days previous (fig. 5). The first returns were from the 7th to the

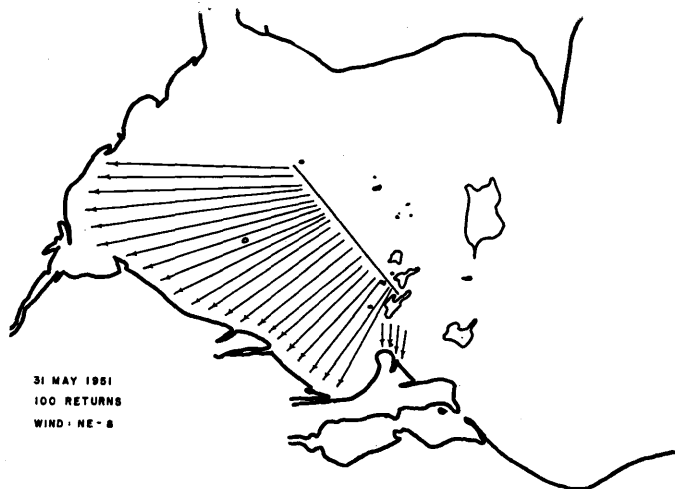


FIGURE 5.

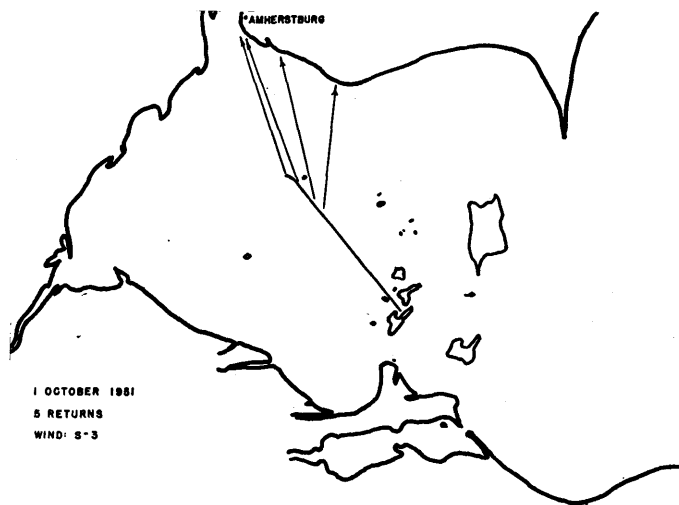


FIGURE 6.

10th of June. On the 1st of June the wind was southwest, shifting to east on the 2nd. From the 4th to the 8th a northeast wind increased in velocity from 7 mph to 27 mph on the 7th and 8th of June, on the 9th the wind moved back to the east. There is little to say except that the returns show that the pattern of card movement is the complete reverse from the previous picture. There now appears to be a strong correlation between surface water movement and wind direction.

Trip 6. On October 1, 1951, 186 cards were released over the same route as Trips 4 and 5 (fig. 6). There were only 5 returns. This small number of returns is due to the lateness of the year and the fact that few people are on the beaches at that time of year. Nevertheless, the returns are interestingly different from the others. The first returns were from a point 8 miles east of Amherstburg, Ontario on the 8th of October. The wind was from the south until the 5th, and then moved around the compass until the 8th, and finally came from the southwest on the 9th, and stayed at this point for several days.

Three times cards were put out in the same manner along the same route and each time the cards landed in a different location. The wind direction in each case was in the direction of drift card movement. Drift bottles can move in an opposite direction to the wind with the current (Schmidt, 1913). Drift cards can also move against the wind with the current. However, surface currents cannot maintain their courses against the wind. The energy exerted by the wind upon the surface quickly overcomes the opposing force and changes the direction of flow, bringing it under wind control.

SUMMARY

Three important conclusions about the surface currents in western Lake Erie have been obtained by using drift cards.

1. Drift cards show surface water movement but no stable flow pattern can be established by using drift cards.
2. The drift cards averaged 6.5 miles per day which agrees with velocities measured in the open lake using free floating vanes.
3. There is a direct correlation between wind movement and surface flow in western Lake Erie. From indications of 3200 cards liberated, the surface water is wind controlled.

REFERENCES

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