

PROPERTY OF BOGS LIBRARY

SURFACE CURRENT OBSERVATIONS - BEAUFORT SEA, 1972

By

Peter Barnes and Richard Garlow

U. S. Geological Survey

OPEN FILE REPORT

75-619

This report is preliminary and has
not been edited or reviewed for
conformity with Geological Survey
standards

PROPERTY OF
LIBRARY
STATE OF ALASKA
DIVISION OF
GEOLOGICAL SURVEY

SURFACE CURRENT OBSERVATIONS - BEAUFORT SEA, 1972

by Peter Barnes and Richard Garlow

Sediment transport via water and ice in the Beaufort Sea off northern Alaska is related to the movement of the surficial waters. As development proceeds along the north slope of Alaska, a knowledge of the potential drift trajectories of water, ice, sediment and pollutants will be needed. In an attempt to better define the probable paths and rates of transport, 4200 surface drift cards were dropped during the U. S. Coast Guard WEBSEC cruise of August and September, 1972 (Hufford and others, 1974). The results of this release are the subject of this report. Because the data presented here will be used primarily by those interested in solving problems of transport, the emphasis has been placed on data presentation rather than a detailed analysis of the circulation.

The drifter used in this study consisted of a 10 by 15 cm printed orange card encased in a 6 mil clear plastic envelope (Figure 1). A 1/2 inch steel washer was sealed in the bottom of the drifter as ballast. In order to reduce the direct effect of wind on the cards, the air trapped in the envelope was adjusted prior to sealing such that less than 2 cm of freeboard existed. Problems were encountered in achieving an adequate seal and an estimated 5 percent drifters sank when launched. Others have been quite sturdy; surviving several arctic winters with more than 20% of the returns being found in 1975.

Drifter release and recovery data are summarized in Table 1. The low rate of return (1.8%) is expected in this remote area. The 1970 population of the North Slope Borough was 3,385. With the additional installations

Sender LT. WILLIAM WADE

Address FPO BOX 33

SEATTLE, WASH 98790
Zip Code

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR

INT 413



POSTAGE WILL BE PAID BY —

OFFICE OF MARINE GEOLOGY
United States Geological Survey
345 Middlefield Road, Menlo Park,
California 94025

Attention: Dr. P. W. Barnes

4908

ТЕКУЩИЕ ИССЛЕДОВАНИЯ ОКЕАНА

OCEAN CURRENT SURVEY 4909

LOCATION WHERE CARD WAS FOUND: 70-10.4N 146-48W

DATE FOUND: JULY 17 1973
Month Day Year

CARD WAS FOUND: On Beach ☒ In Water ☐
In or On Ice ☐

REMARKS: LOCATED WELL
BELOW HIGH WATER LINE.
ICE WAS APPROX 10 MILES
OFF SHORE

Your assistance will help us determine the movement of ocean currents along the north coast of Alaska. Thank You

CHUKCHI SEA

Pt Barrow Dease Inlet Smith Bay Cape Halkett Harrison Bay Thetis I. Pingok I. Cross I. Marshall I. Flaxman I. Camden Bay Barter I. Demarcation Pt

Icy Cape Pt Franklin

Colville River

CHUKCHI SEA

BEAUFORT SEA

U.S. CANADA

0 40 80 MILES

GPO 791-003

MARK CARD LOCATION ON MAP

Figure 1. Reproduction of drift card used in this survey. Post Paid card was placed in 6 mil plastic envelope with 1/2 inch washer and heat sealed.

at Prudhoe Bay, the present population is estimated near 5,000. More cards were returned (5.2%) from the nearshore releases; a situation common to surveys of this type (Kolpack, 1971; Conomos and others, 1971). In view of the sparse population of the north slope of Alaska and the short season when beaches are not snow and ice covered the recovery rate is considered very good. Recoveries have come predominately from the existing population centers; Barrow, Prudhoe Bay, Barter Island and the DEW line sites. The late summer (September) release of many of the drifters limited the time for transit to the beaches prior to freezeup when surface water motion ceases and the drifters could have been incorporated into the coastal ice or the polar pack. Although cards have been found and returned for three consecutive summers, there is no data suggesting drifters were not already ashore before freezeup in 1972.

The direction of drifter movement as summarized in Table 2 and on Figure 2, shows a dominance (79%) of westerly movement. About half of the recovery points were essentially onshore from their release points (distance to shore \geq half distances traveled parallel to shore). If the onshore movements are not considered as part of the directional data, the ratio of west to east drifters remains about the same with about 80% of the drifters moving west.

Velocity data are sparse, with only 9 useable recoveries occurring prior to freezeup in 1972 (Table 3). Rates of drift range from less than 1 cm/sec to almost 38 cm/sec. The lowest velocities were seen in those two cards which drifted essentially onshore. Drifters traveled westerly at the highest velocities with an average drift rate of 18 cm/sec (1/3 knot).

The one rate of drift calculated for an easterly direction (7.5 cm/sec) was less than 1/2 the average westerly rate.

Discussion

Although the data are limited and do not justify a detailed analysis, several general observations are in order. The surface currents are reportedly variable (U. S. Hydrographic Office, 1968). East of the Sagavanirktok River the drifters predominately moved eastward while all recoveries west of the Sagavanirktok invariably were to the west of their respective release points (Figure 2). Thus it would appear that a divergence in surface current drift existed in 1972 on the inner shelf off the Sagavanirktok River delta. The onshore surface water east of the delta flow toward Barter Island and water west of the delta flowed toward Barrow.

Curiously, the oceanographic values reported by Hufford and others (1974) show a change in character in this same area. Located off the Sagavanirktok are the salinity and temperature minimums and ice and dissolved oxygen maximums (Hufford and others, 1974). East of 146° upwelling is evident (Hufford and others, 1974). To the west an intrusion of Bering sea water is postulated along the shelf break with a compensating westerly flow on the inner shelf (Mountain, 1974).

In a more intensive study of surface currents in the Canadian Beaufort Sea, using much more elaborate drifters, MacNeill and Garrett (1974) found surface currents generally moving at about 5% of the wind speed and within 45° to the right of the wind direction. The drifter velocities that these workers reported are similar to the velocities that we observed (Table 3). However, velocities reported in Table 3 are not based on a sufficient number of data to warrant comparisons with wind data.

REFERENCES

- Conomos, T. J., McCulloch, D. S., Peterson, D. H., and Carlson, P. R.,
1971, Drift of surface and near-bottom waters of the San Francisco
Bay system, California: March 1970 through April 1971; U. S.
Geological Survey, Misc. Field Studies Map MF-33.
- Hufford, G. S., Fortier, S. H., Wolfe, D. E., Doster, J. F., Nobel, D. L.,
1974, Physical Oceanography of the Western Beaufort Sea, in WEBSEC
71-72, An Ecological Survey in the Beaufort Sea, U. S. Coast Guard
Oceanographic Report No. CG 373-64. pl-176.
- Kolpack, R. L., 1971, Oceanography of the Santa Barbara Channel, in
Biological and Oceanographical Survey of the Santa Barbara Channel
Oil Spill 1969-1970, R. L. Kolpack (ed.), v. II, pp. 90-180.
- MacNeill, Margaret, and Garrett, John, 1974, Open water surface currents;
Interim report of Beaufort Sea Project, Study D3, Beaufort Sea Project,
Federal Building, Victoria, B. C., 50 pp.
- Mountain, D. G., 1974, Preliminary analysis of Beaufort shelf circulation
in summer, in The Coast and Shelf of the Beaufort Sea, J. C. Reed
and J. E. Sater (eds.), Arctic Inst. of North Am., Arlington, Va.,
pp. 27-48.
- U. S. Navy Hydrographic Office, 1968, Oceanographic Atlas for the Polar
Seas - Part II Arctic: H. O. Pub. No. 705, 149 pp.

Table 1. Drifter release and recovery data

<u>Date released</u>	<u>Number released</u>	<u>Number recovered</u>	<u>Percent recovered</u>
8 August - 11 September	2925 (released from ice breaker in waters <u>deeper</u> than 20 meters)	9	0.3%
21 August - 6 September	1275 (released from coastal vessel in water depths less than 20 meters)	66	5.2%
TOTALS	4200	75	1.8%

Table 2. Summary of drifter movements

Direction of movement	number	percent
Easterly	16	21
Westerly	59	79
<hr/>		
East along coast	8	11 (22%)
Onshore	38	50 (-)
West along coast	29	39 (78%)

Table 3. Drifter speed comparison and data 1972

<u>Release Date</u>	<u>Recovery Date</u>	<u>Days adrift</u>	<u>Distance (miles)</u>	<u>Rate (mi/day)</u>	<u>Rate (cm/sec)</u>	<u>Direction</u>	<u>Recovery Location</u>
21 Aug	22 Aug	1+	15	15+	32.0+	West	Lagoon
21 Aug	27 Aug	6	17.5	2.9	6.3	West	Lagoon
21 Aug	27 Aug	6	24	4	8.6	West	Oliktok
23 Aug	26 Aug	3	17	5.7	12.0	West	Kup. R.
23 Aug	28 Aug	5	8	0.62	1.3	South (onshore)	Prudhoe Bay
23 Aug	9 Sept	16	7	0.44	0.9	South (onshore)	Prudhoe Bay
29 Aug	19 Sept	21	73	3.5	7.5	East	Barter
3 Sept	11 Sept	8	107	13.3	29.0	West	Cape Simpson
6 Sept	9 Sept	3	53	17.7	38.0	West	Barrow