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R. A. Heath & B. S. Shakespeare

To cite this article: R. A. Heath & B. S. Shakespeare (1977) Recoveries of drift cards released from: Oil rigs around New Zealand, 1975–76 (note), *New Zealand Journal of Marine and Freshwater Research*, 11:2, 393-400, DOI: [10.1080/00288330.1977.9515685](https://doi.org/10.1080/00288330.1977.9515685)

To link to this article: <http://dx.doi.org/10.1080/00288330.1977.9515685>



Published online: 30 Mar 2010.



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# RECOVERIES OF DRIFT CARDS RELEASED FROM OIL RIGS AROUND NEW ZEALAND, 1975-76 (NOTE)

R. A. HEATH and B. S. SHAKESPEARE

New Zealand Oceanographic Institute, DSIR, P.O. Box 12 346,  
Wellington North, New Zealand

## ABSTRACT

Drift cards were released in batches of 50 every 2 d at drilling sites off the north and south Taranaki coast (May-October 1975), Banks Peninsula (July-August 1975), and in Tasman (January-March 1976) and Hawke Bays (November 1975-January 1976). The shortest distance "despatch to recovery" trajectories indicate that only in the South Taranaki Bight are the trajectories predominantly unidirectional, the surface drift being southwards on the west coast of the North Island south of Cape Egmont. The trajectories of cards despatched in both Tasman and Hawke Bays highlight the variable nature of the surface drift in these bays.

## INTRODUCTION

Most experiments with drift cards around New Zealand have involved dropping cards along ship or aircraft tracks to give near synoptic despatches in the area (Brodie 1960; Ridgway 1960, 1962; Garner 1961; Heath 1969). Therefore, these experiments seldom allowed study of the temporal variability within the surface drift; an exception was a study in Tasman Bay where the Fisheries Research Division's vessel *W. J. Scott* was involved with routine surveys, and results of several sets of drift card despatches within the bay could be compared (Heath 1973). Recently, however, drilling ships and rigs have stayed at fixed locations on the continental shelf around New Zealand for periods of several weeks, and studies of the variability in drift and trajectories by dropping drift cards at different times from the same place became possible. Through the courtesy of Shell-BP-Todd and Aquitaine Petroleum, batches of 50 drift cards were released approximately every 2 d from rigs operating off Banks Peninsula, Tasman Bay, in the North and South Taranaki Bights, and in Hawke Bay (Fig. 1, Table 1).

Obviously, this type of experiment gives no information on short period Eulerian variability in the flow. However, it gives some indication of the variation with time in the surface drift to be expected from each site and allows statistical calculation of an average speed.

TABLE 1—Number of drift cards released from various release positions during different periods in 1975 and 1976, and details of cards recovered

Release Position	Release Period	Number Released	Number Recovered	Recovery (%)
38° 29' S, 174° 25' E North Taranaki Bight	20 May–8 June 1975	500	39	8
39° 49' S 174° 07' E South Taranaki Bight	9 Aug–16 Sept 1975	1 000	196	20
39° 49' S 174° 07' E South Taranaki Bight	8–26 Oct 1975	500	112	22
39° 16' S 177° 19' E Hawke Bay	29 Nov 1975–8 Jan 1976	1 000	43	4
40° 21' S 173° 04' E Farewell Spit	24 Jan–1 March 1976	950	42	4
40° 43' S 173° 26' E Tasman Bay	3–25 March 1976	600	13	2
44° 11' S 172° 38' E Banks Peninsula	9 July–9 Aug 1975	500	1	0.2

#### METHOD OF ANALYSIS

Only in the trajectories of cards released in the South Taranaki Bight is there a pronounced trend (see Fig. 2). The results from other despatch areas have to be discussed in relation to previous work: the experiments thus highlight the variability. If sufficient drift cards were recovered from a site, the records are presented in graphic form. Speeds calculated from drift card trajectories are subject to errors arising from lack of knowledge of both the exact trajectory and of the time spent ashore before retrieval. Both of these uncertainties lead to underestimates of drift card speeds. To emphasise the scatter in the calculated speeds and distance travelled, plots are presented of the distance travelled versus the time from despatch to recovery, and histograms presented of the number of cards recovered in various speed ranges.

#### RESULTS

##### NORTH TARANAKI BIGHT (38° 29' S, 174° 25' E; 20 May–8 June 1975)

Of the 500 cards released, only 39 were recovered; 32 of these, from the same release, were recovered on the coast 31 km north of the release position 17 d later. Two other cards were recovered 133 km and 226 km further north, but the remaining five cards moved south, four being recovered near Opunake and one on Mana Island (Fig. 1).

There is very little knowledge of the flow hereabouts and possibly it is very wind dependent. The present observations of some southwards trajectories are opposed to a reported general flow northward (Brodie

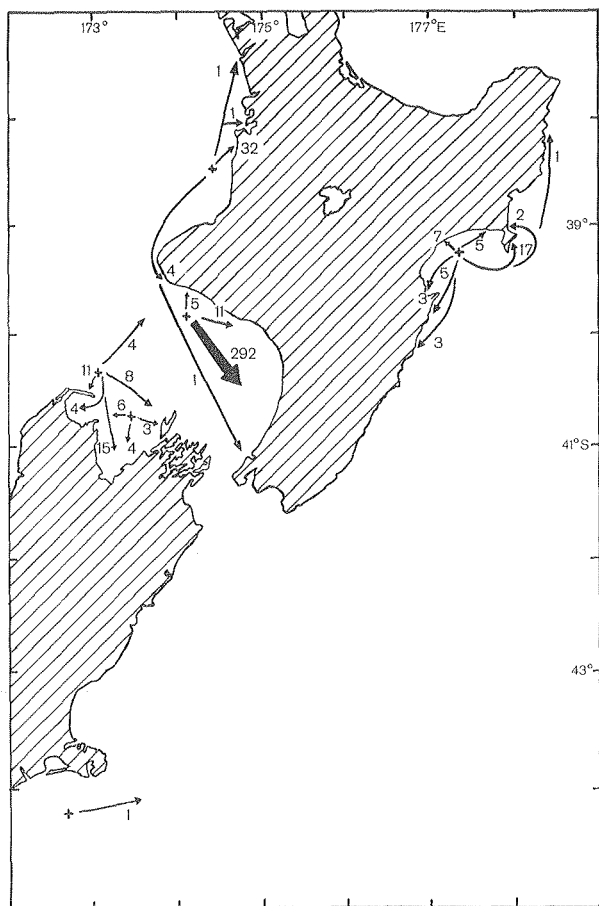


FIG. 1—Trajectories of drift cards released from oil rigs (+) around New Zealand, 1975–76. The number alongside the arrows is the number of cards recovered on that general trajectory.

1960; N. M. Ridgway, NZOI, pers. comm.), but support the drift card evidence of Garner (1961).

**SOUTH TARANAKI BIGHT** ( $39^{\circ} 49' S$ ,  $174^{\circ} 07' E$ ; 9 August–16 September and 8–26 October 1975)

Of the 1500 cards released, 308 were recovered. All but five of these had moved south; the five exceptions were found on the coast between Opunake and Hawera within 20 d of release.

Most of the cards were recovered between the Rangitikei River and Paremata, having travelled 111–150 km at a speed less than  $0.1 \text{ m.s}^{-1}$  (Fig. 2). The direction of surface drift over the lower part of the trajectories agrees with that found by Brodie (1960) and Heath (1969, 1973) and tends to indicate that the predominant surface drift on the west coast of the North Island south of Cape Egmont is towards the

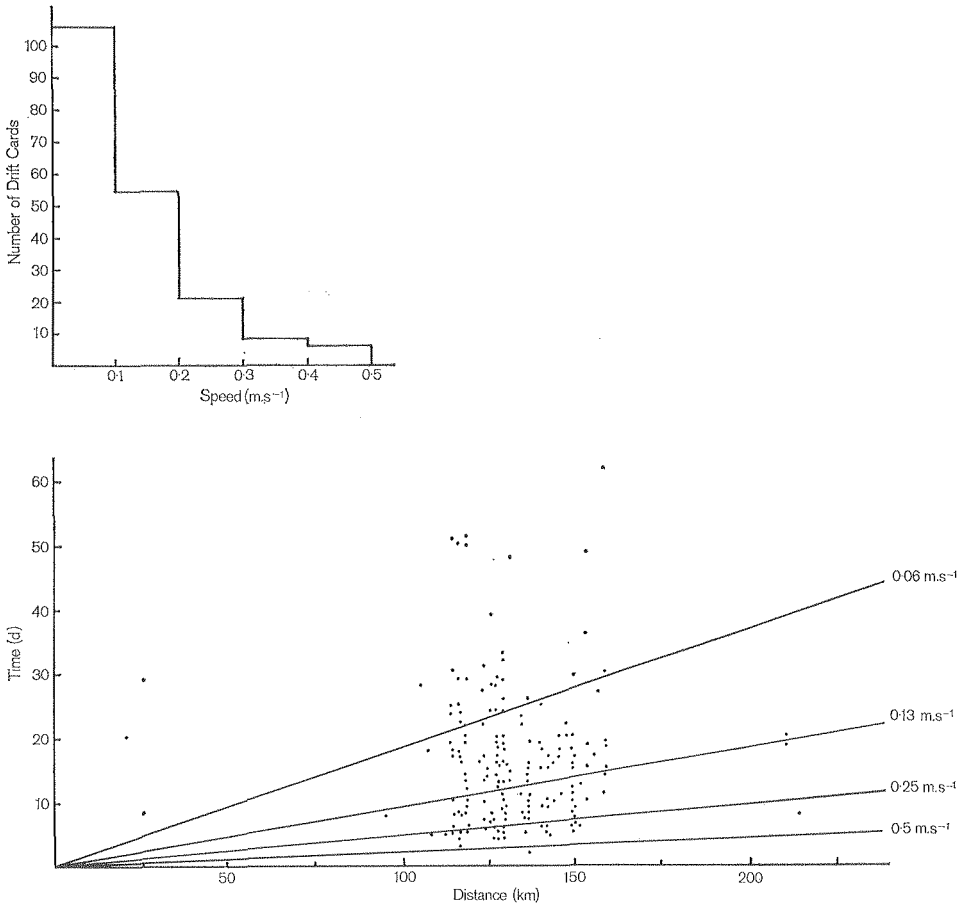


FIG. 2.—Data for drift cards despatched from  $39^{\circ} 49' S$ ,  $174^{\circ} 07' E$  in the South Taranaki Bight, 9 August–26 October 1975: (*upper*) histogram of the number of cards recovered within specific speed limits, and (*lower*) time to recovery against the shortest distance travelled.

south. The most frequent winds in this area are from the north (see, e.g., Garnier 1958, fig. 19), and it would be the surface drift produced by these winds and the D'Urville Current (Brodie 1960) which lead to the observed south-going drift.

The small number of recoveries north of the Rangitikei River (Figs 1, 2), 11 in all, tends to indicate there is no appreciable onshore drift component: in the area are well-frequented beaches from which recoveries could be expected if the cards had come ashore.

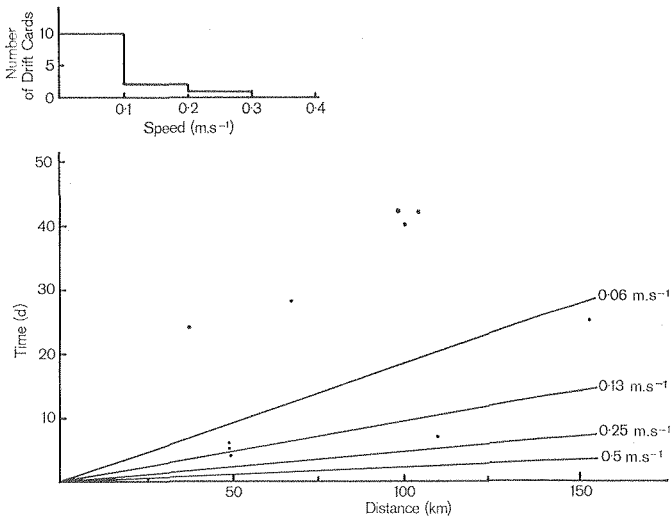


FIG. 3—Data for drift cards despatched from  $40^{\circ} 21' S$ ,  $173^{\circ} 04' E$  off Farewell Spit, 26 January–1 March 1976: (*upper*) histogram of the number of cards recovered within specific speed limits, and (*lower*) time to recovery against the shortest distance travelled.

#### FAREWELL SPIT ( $40^{\circ} 21' S$ , $173^{\circ} 04' E$ ; 24 January–1 March 1976)

Of 950 cards released, only 42 were recovered: 4 in Golden Bay, 15 in Tasman Bay, 11 on Farewell Spit, 8 near D'Urville Island, and 4 near New Plymouth (Fig. 1). On these records, the predominant drift is southwards towards Tasman Bay rather than towards the east. This agrees with previous results (Heath 1969), which showed that the D'Urville Current extends northward to  $40^{\circ} S$  before turning eastwards into Cook Strait. However, other experiments (Brodie 1960, Heath 1973) showed that most cards released immediately north of Farewell Spit travelled eastwards into Cook Strait.

Most of the drift card speeds were less than  $0.1 \text{ m}\cdot\text{s}^{-1}$  (Fig. 3).

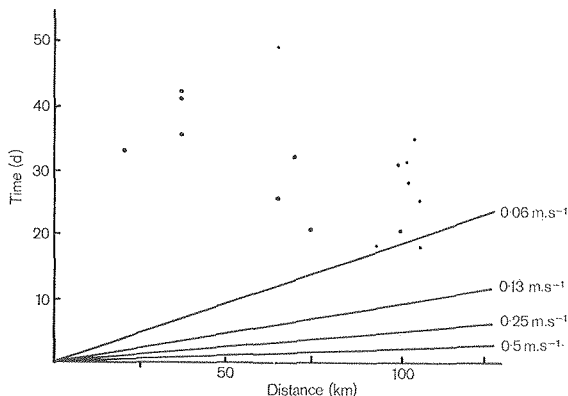
#### TASMAN BAY ( $40^{\circ} 43' S$ , $173^{\circ} 26' E$ ; 3–25 March 1976)

Of 600 cards released, only 13 were recovered: 6 in Golden Bay, 4 in Tasman Bay, and 3 near D'Urville Island (Fig. 1).

Heath (1973) showed that the surface drift in Tasman Bay is strongly influenced by the wind. The present release and recovery period in March and April lies in the period where the predominant winds change from south-going (October to March) to north-going (April to August). This strong wind influence might be the reason for the variability in surface drift and the very low recovery rate (2%).

All the drift card speeds were less than  $0.1 \text{ m}\cdot\text{s}^{-1}$  (Fig. 4).

FIG. 4—Data for drift cards despatched from  $40^{\circ}43'S$ ,  $173^{\circ}26'E$  in Tasman Bay, 3–25 March 1976: time to recovery against the shortest distance travelled.



HAWKE BAY ( $39^{\circ}16'S$ ,  $177^{\circ}19'E$ ; 29 November 1975–8 January 1976)

Of 1000 cards released, 67 were recovered: 20 on the open coast north of Hawke Bay, 17 within Hawke Bay (evenly divided between north-west, east, and south of the release point), and 6 on the open coast south of Hawke Bay (Fig. 1).

Previous drift card experiments in Hawke Bay (Ridgway 1960, 1962) showed that the westwards surface drift into the centre of the bay separates into two currents, one flowing clockwise around the shoreline in the northern half of the bay and then northwards along the open coast, and the other anticlockwise around the southern half of the bay and southwards along the open coast. This type of circulation system is supported by hydrological measurements (Ridgway & Stanton 1969).

The present release point is near the centre line where the westwards inflow is thought to bifurcate (see Ridgway 1960, fig. 4) and the variability in trajectories might therefore have been expected. Wind velocities were recorded when the cards were released. Cards released during wind conditions with an offshore component generally moved into the northern (clockwise) circulation system while cards released during onshore winds moved into the southern (anticlockwise) circulation system. Again, most of the drift card speeds were less than  $0.1 \text{ m}\cdot\text{s}^{-1}$  (Fig. 5).

BANKS PENINSULA ( $44^{\circ}11'S$ ,  $172^{\circ}38'E$ ; 9 July–9 August 1975)

Of 500 cards released, only 1 was recovered, and this travelled 830 km east to reach the Chatham Islands in 128 d.

## DISCUSSION

The cards released in the South Taranaki Bight gave the only indication of a unidirectional surface drift. Variability in the trajectories of

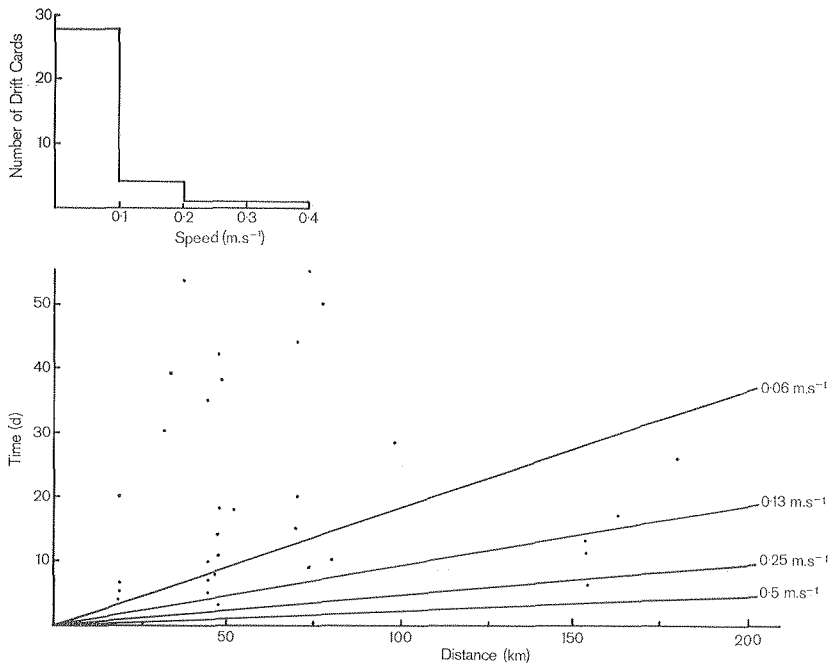


FIG. 5.—Data for drift cards despatched from 39° 16' S, 177° 19' E in Hawke Bay, 29 November 1975–8 January 1976: (*upper*) histogram of the number of cards recovered within specific speed limits, and (*lower*) time to recovery against the shortest distance travelled.

cards for which the despatch to recovery time was only a few days is expected and results from direct wind drift produced by prolonged winds in one direction. However, most recoveries took longer than 6–10 d, which is the typical period for passage of weather systems over New Zealand; thus the variability was not produced solely by prolonged surface drift in one direction, but may have arisen because variable wind-induced surface drifts pushed cards from one oceanic circulation system to another.

#### ACKNOWLEDGMENTS

We would like to thank the ship's personnel of the oil rigs *Penrod 74* and *Glomar Tasman* from which the cards were dropped, the companies who operated these rigs (Hunt International Petroleum, Bocal Oil Exploration Pty. Ltd.), and the companies for whom the rigs were being operated (Shell-BP-Todd and Acquitaine Petroleum). We are most grateful also to the members of the public who returned the cards.



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