

THE GENERAL CURRENT PATTERNS OF KAMLOOPS LAKE
OBTAINED BY DROGUE TECHNIQUE

by

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I. Introduction

Currents have been measured by many investigators (Krauss, 1963, Hamblin and Rodgers 1967, Blanton and Ng, 1972), by tracking drogues set at predetermined depths which are marked on the surface by an easily identifiable target. The drogue method has proved to be quite successful and relatively inexpensive for lake or oceanic current study.

During the field season, 1974, drogue measurements were conducted at various locations (Figure 1), different depths and at different times on Kamloops Lake. Reasonable amounts of drogue tracking data were gathered from Kamloops Lake from June through November 1974, (Appendix 1).

II. Data reduction procedures

The technique of drogue tracking fixes the drogue position between time intervals by means of a navigational instrument such as a compass, sextant, radar, etc. Drogue positions are fixed as often as possible, so that the current stability or the variability index of a drogue track can be determined. There were only two position fixes for each drogue during each episode for Kamloops Lake. One fix was made at launching, and the other fix was made at recovery. The distance between the first and the last fix divided by the total time elapsed between the two fixes gives a vectoral average drogue speed.

In this study, due to shortcomings of individual drogue tracks for a specified period of time, all the data from the tracking of drogues from different episodes at 1, 13, 15, 20, 35, 40, 50 and 80 metres of depth were grouped into three zones (Figure 1), according to its initial launching location in the lake. The result of such grouping may give a better

estimation of the predominant current speed and direction pattern over that zone. As an attempt to find such a value for the current to represent the particular zone, individual drogue vectors from that zone were plotted about the compass rose (Figure 2, (a), (b), (c), (d) and (e)), and the resultant drogue vectors at various depths for the same zone, was obtained by the relationship of u, v components. The relationship of the u, v components are

$$V = S \sin \theta \quad \text{and} \quad U = S \cos \theta, \text{ the resultant is}$$

$$R = \sqrt{V^2 + U^2}, \text{ and the direction of the resultant of drogue vectors is}$$

$$\tan \theta = \frac{V}{U}$$

Results of drogue vectors for the three zones at various depth were plotted as shown in Figure 3 (a), (b), (c) and (d).

III. Results and Discussion

The current pattern of zone 1 at depths of 1 and 20 metres (Fig. 3 (a) and (b)) suggests a predominant pattern indicating that the current vectors are consistently toward the south-west direction. While the predominant currents over zones 2 at 1 m and zone 3 at 1 m, 20 m, and 35 m exhibit a north-east direction. Current patterns of zone 3 at depths of 13 and 15 metres show a south-west direction with its magnitude greater than every other depth of drogue speed of the three zones.

Data from the drogue trackings at 40, 50 and 80 metre levels were available at zone 1 only (Fig. 3(d)). It is indicative that the current speeds at this zone are in decreasing order, with respect to increasing depth.

The averaged drogue speed at different depths from different episodes were calculated as shown in Table 1. Also, included in Table 1 are maximum and minimum drogue speeds, and the standard deviation. The highest and the lowest observed drogue speeds, among all observations occurred at 1 metre and 50 metre depths respectively.

The overall average drogue speed, disregarding various depths, is 5.8 cm/sec, and the standard deviation is 4.3 cm/sec.

Table 1. Maximum, minimum, mean and standard deviation of drogue speeds at various depths.

Depth (m)	Mean Speed (cm/sec)	Standard Deviation (cm/sec)	Max. Speed (cm/sec)	Min. Speed (cm/sec)
1	6.7	4.4	19.5	1.1
13**	11.2	-	18.7	3.6
15	9.4	4.4	15.6	5.3
20	5.7	4.3	18.1	0.5
35	4.8	3.5	12.3	1.0
40*	5.6	-	5.9	5.1
50*	1.4	-	3.1	0.2
80	1.1	-	-	-

* At zone 1 only

** Two observations only

The wind data from the same period as drogue episodes were plotted in Figure 3, a, b, c, and d. Its magnitudes are shown beside the vector arrow. No attempts have been made to establish the relationship between the wind and the drogue in this study, because there are insufficient time intervals of drogue position fixes. However, there is an indication that the current directions at 1, 15, 20 and 35 metre depths at zone 3 seem to follow the same direction as the wind.

A drogue speed profile (Figure 4) was constructed, using data from Table 1. It shows that higher speeds of drogue occurred at somewhere between 15 metre and 40 metre depths.

In summary, from the overall pattern of the drogue plots (Figure 3 a, b, c, and d), it appears that current direction at zone 1 and zone 2 tends to follow the longitudinal axis toward the downstream side of the lake. Likewise, current direction at zone 3 indicates an opposite direction toward the upstream side of the lake.

In conclusion, based on the drogue plots, the regime of the current pattern of Kamloops Lake might be divided into two types which are:

- (a) The current pattern at zones 1 and 2 is subject to the influence of Thompson River inflow, and
- (b) The current pattern at zone 3 relies on the wind conditions.

REFERENCES

- Blanton, J.O. and Ng, H.Y.F. 1972. The circulation of the effluent from the Okanagan River as it enters Lake Skala. A report presented to the Study Director of the Canada-British Columbia Okanagan Basin Agreement.
- Hamblin, P.F. and Rodgers, G.K. 1967. The currents in the Toronto Region of Lake Ontario. Great Lakes Institute, University of Toronto.
- Krauss, J.A. 1963. Drogues and Neutral-Buoyant Floats. The Sea, Vol 2. John Wiley and Sons.

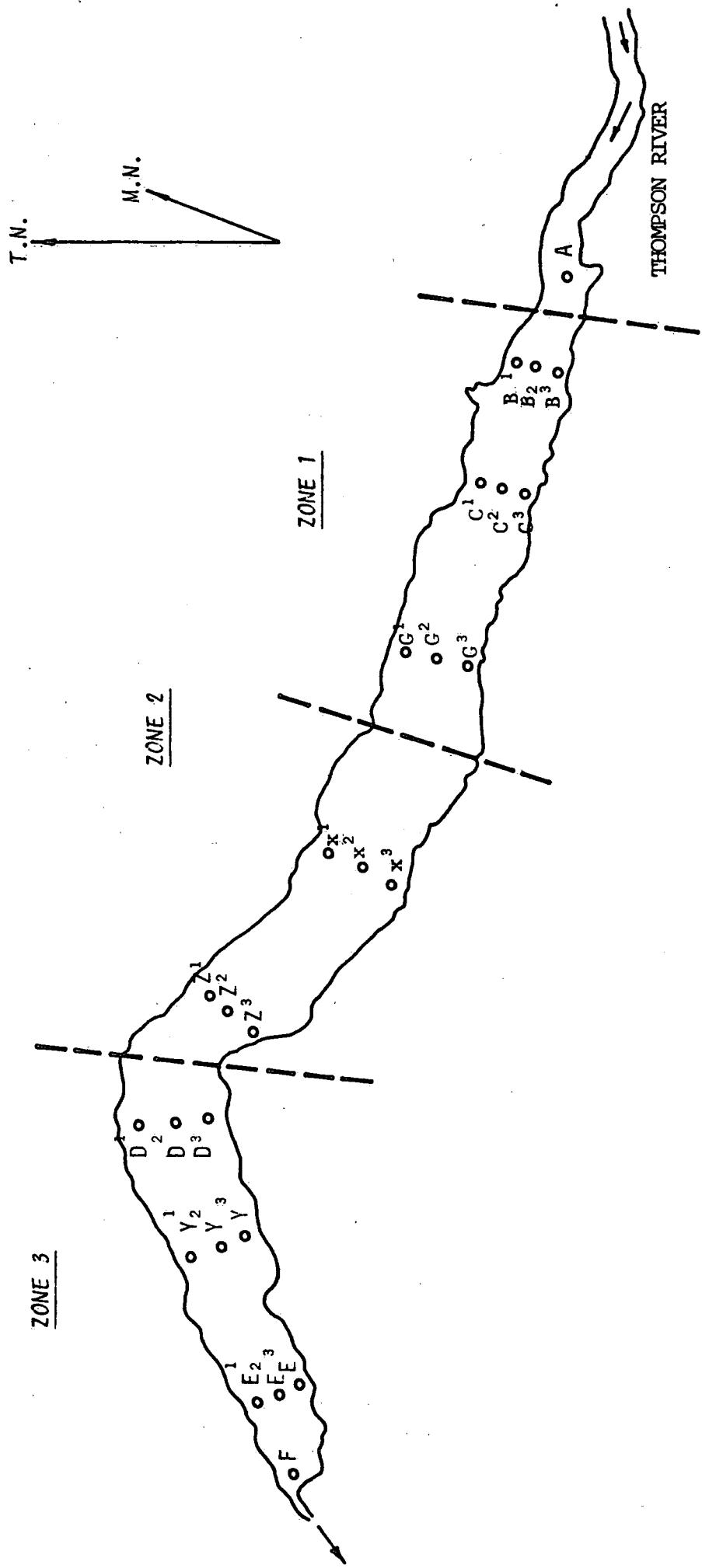


FIGURE 1: KAMLOOPS LAKE
DROGUE EXPERIMENT ZONE

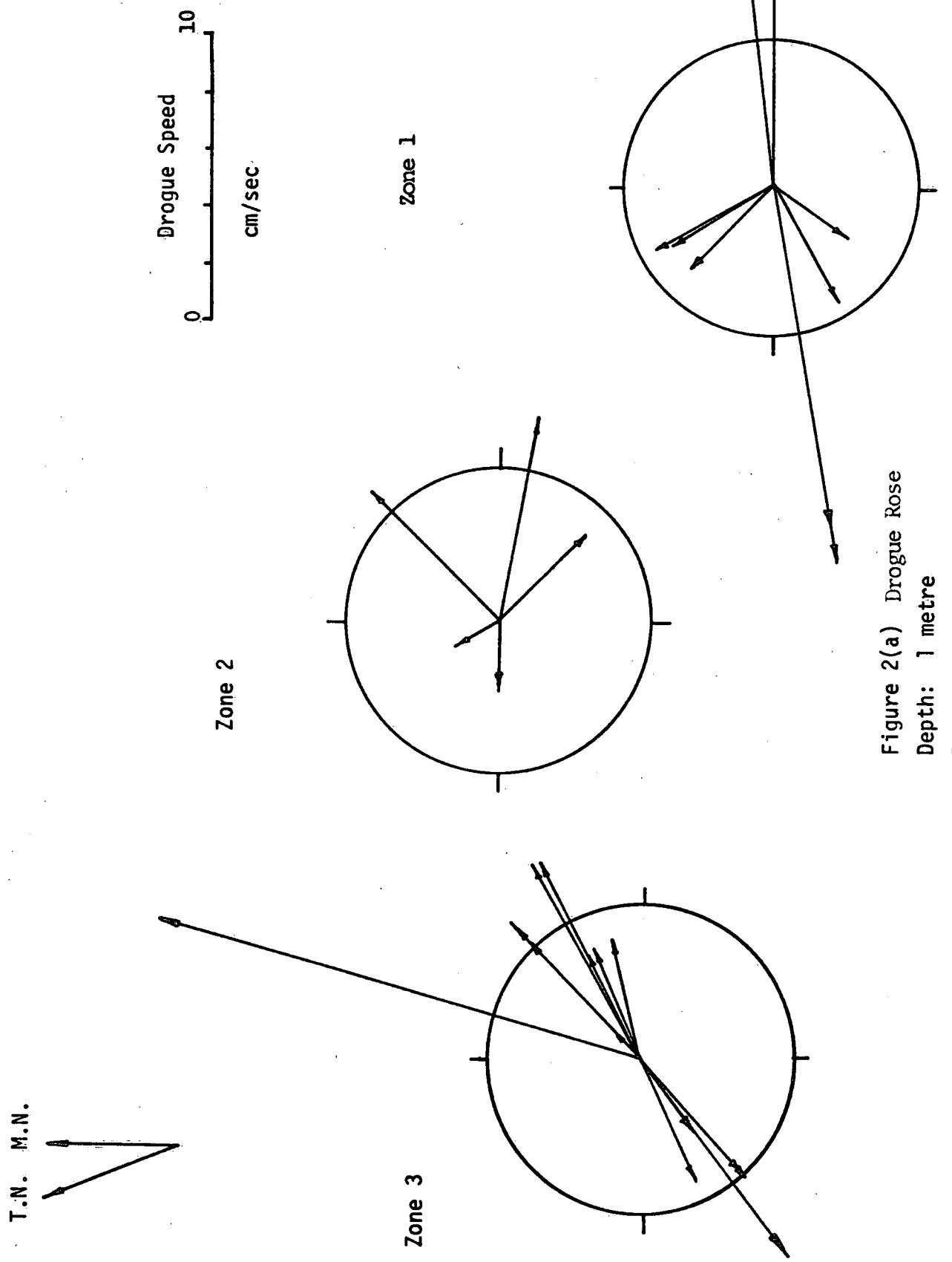


Figure 2(a) Drogue Rose
 Depth: 1 metre
 Date: June 14, 21, July 19, 30, Aug. 7, 1974

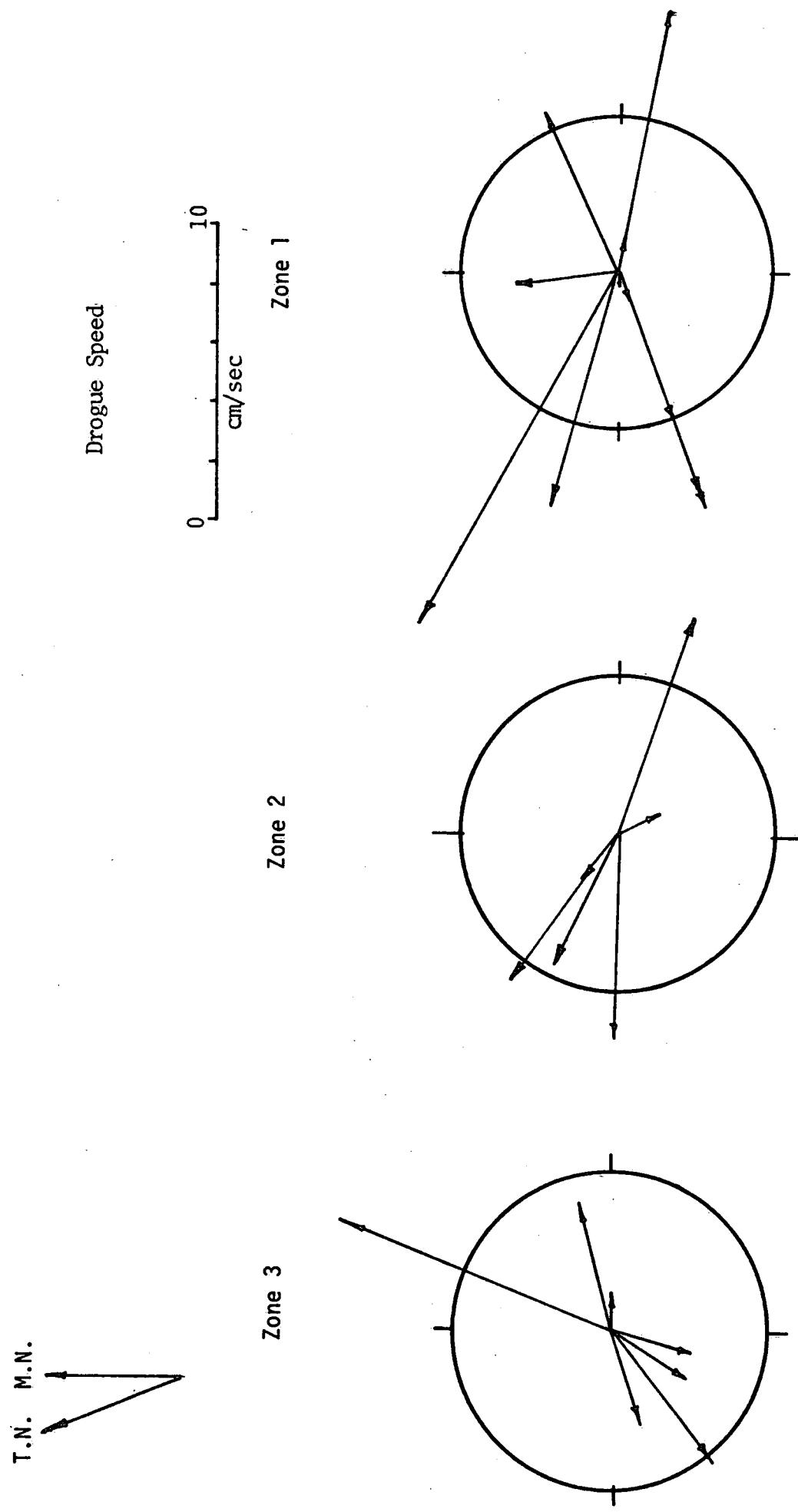


Figure 2(b) Drogue Rose

Depth: 20 metre

Date: June 21, July 19, 30, August 7, 8, 9, 13,
Sept. 11, Nov. 14, 1974

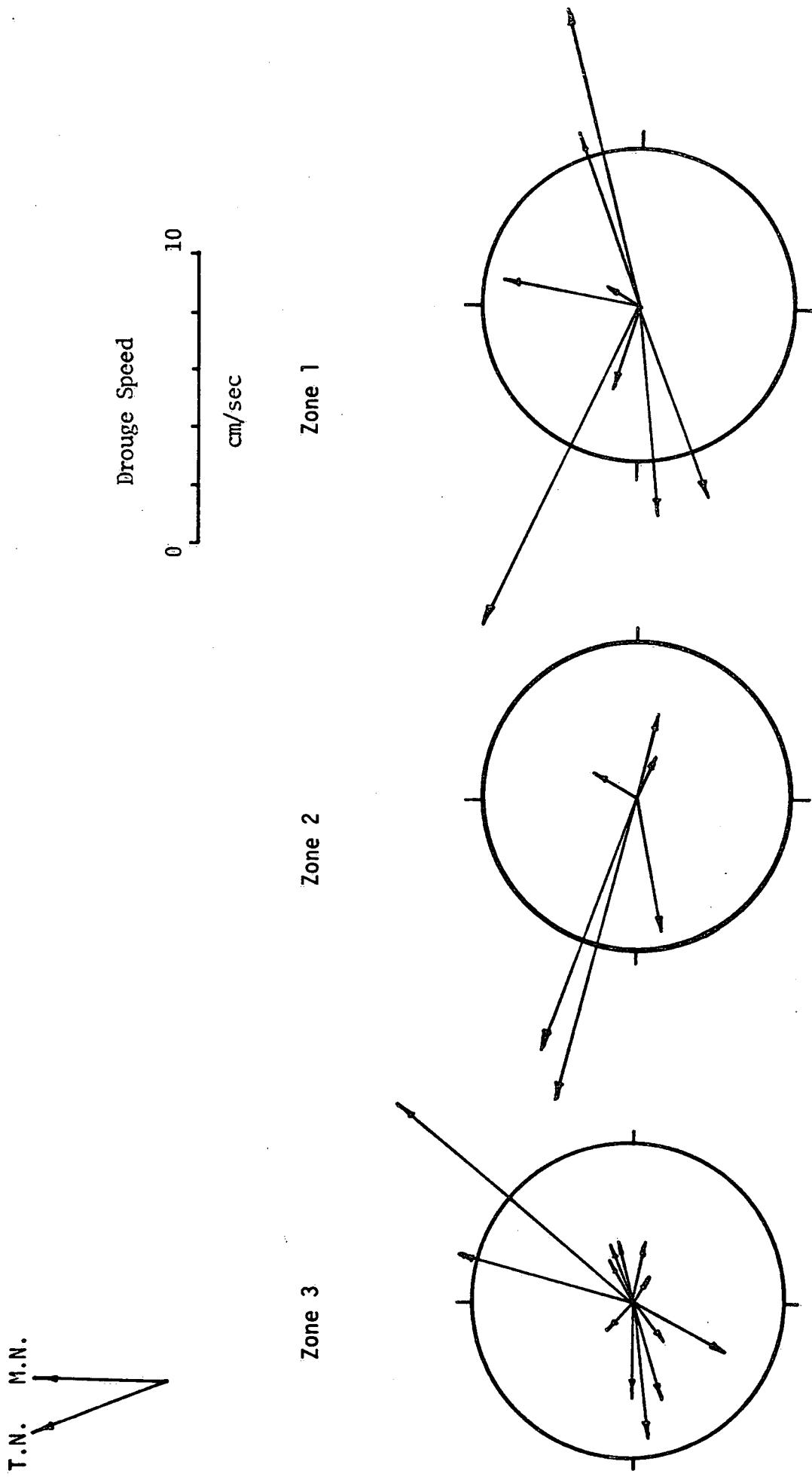


Figure 2(c) Drogue Rose
 Depth: 35 metre
 Date: July 19, 20, 30, August 8, 9, 13, 23
 Sept. 11, 1974

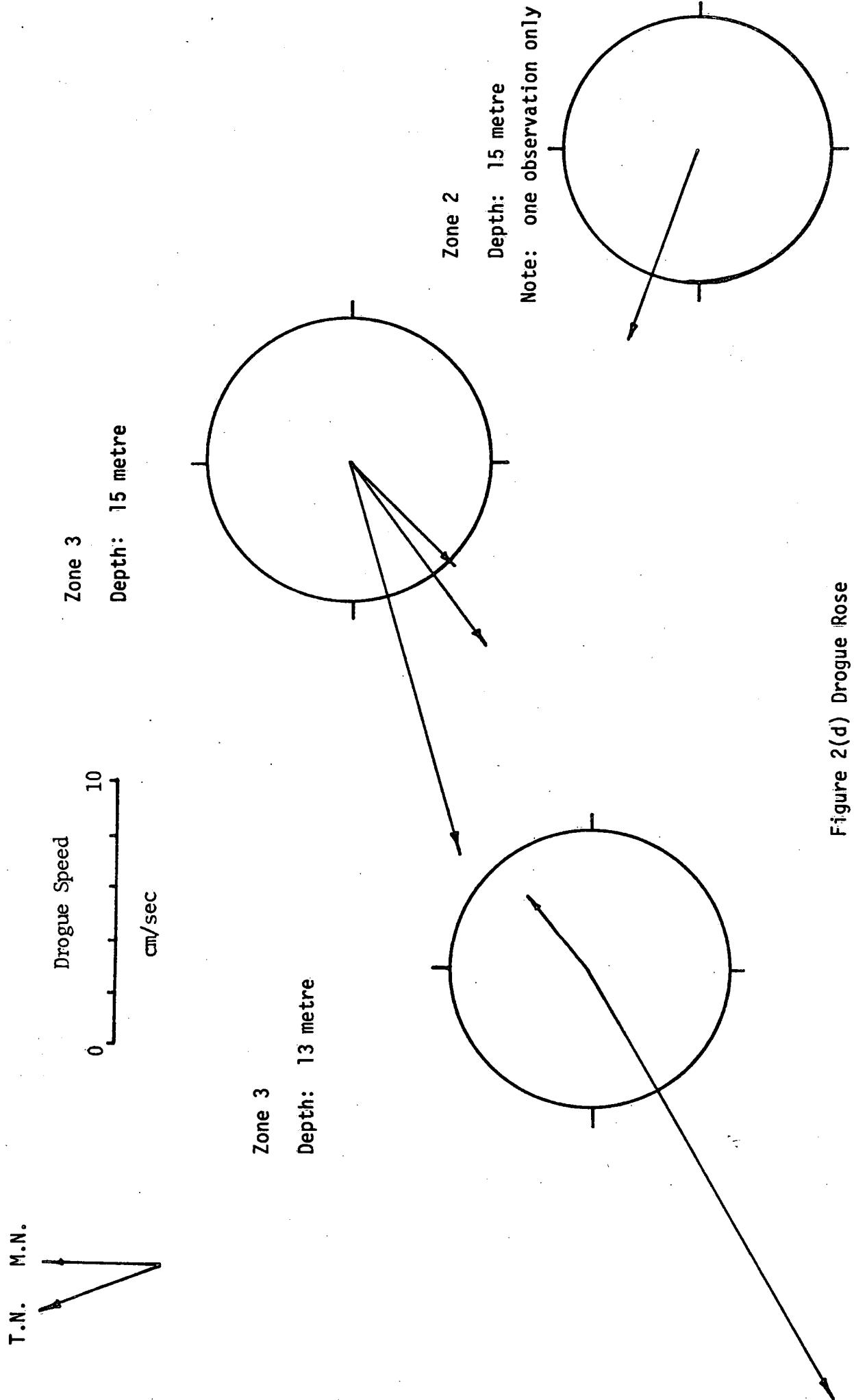
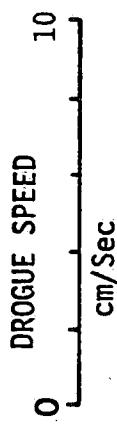
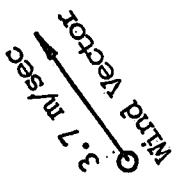
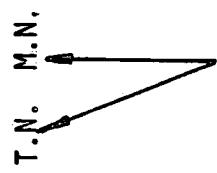
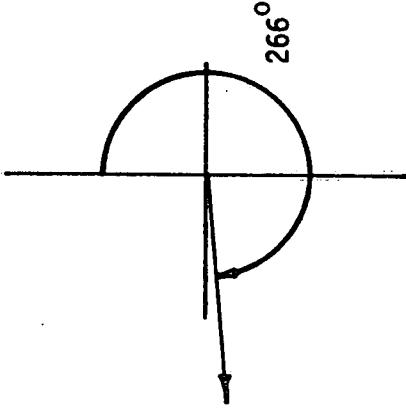


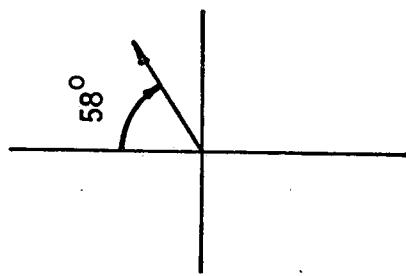
Figure 2(d) Drogue Rose
 Date July 24, August 23, 1974



ZONE 1



ZONE 2



ZONE 3

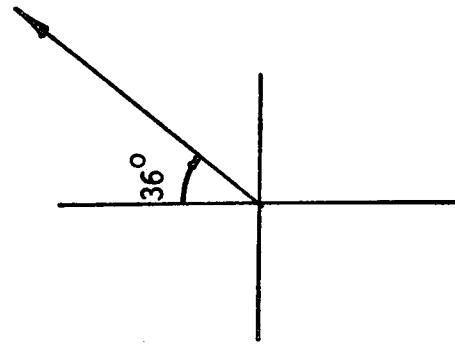
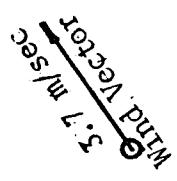
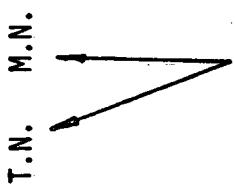
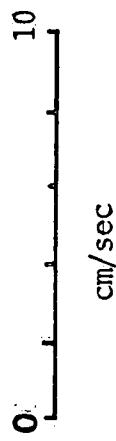


FIGURE 3 (a) DROGUE RESULTANT VECTOR

DEPTH: 1 Metre



DROGUE SPEED



Zone 3

Zone 2

Zone 1

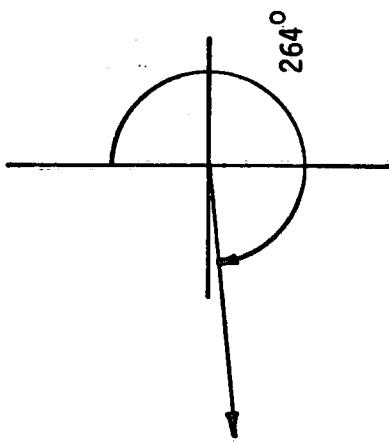
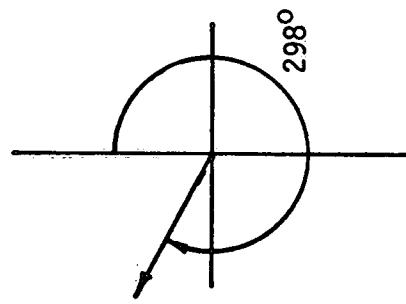
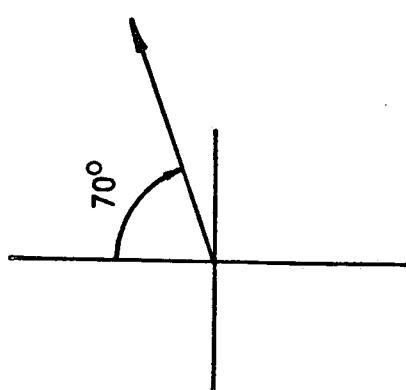
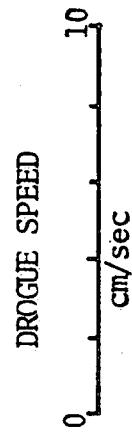
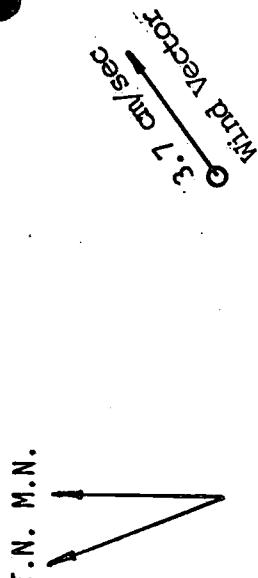
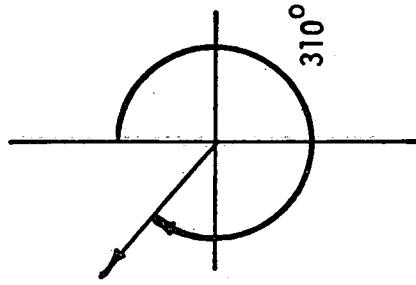


FIGURE 3 (b) DROGUE RESULTANT VECTOR
Depth: 20 Metre

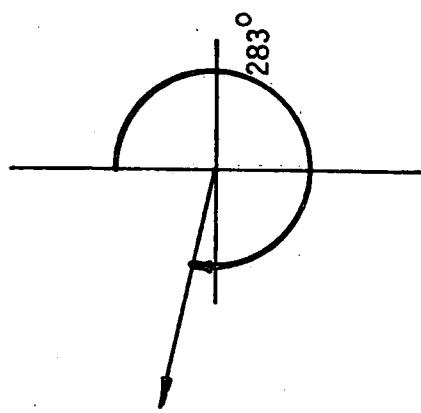
T.N. M.N.



Zone 1



Zone 2



Zone 3

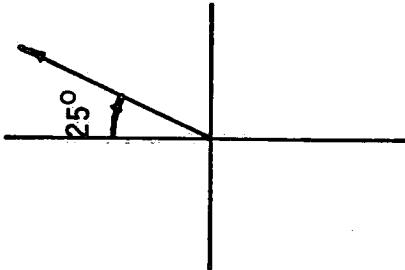


FIGURE 3 (c) DROGUE RESULTANT VECTOR
Depth: 35 Metre

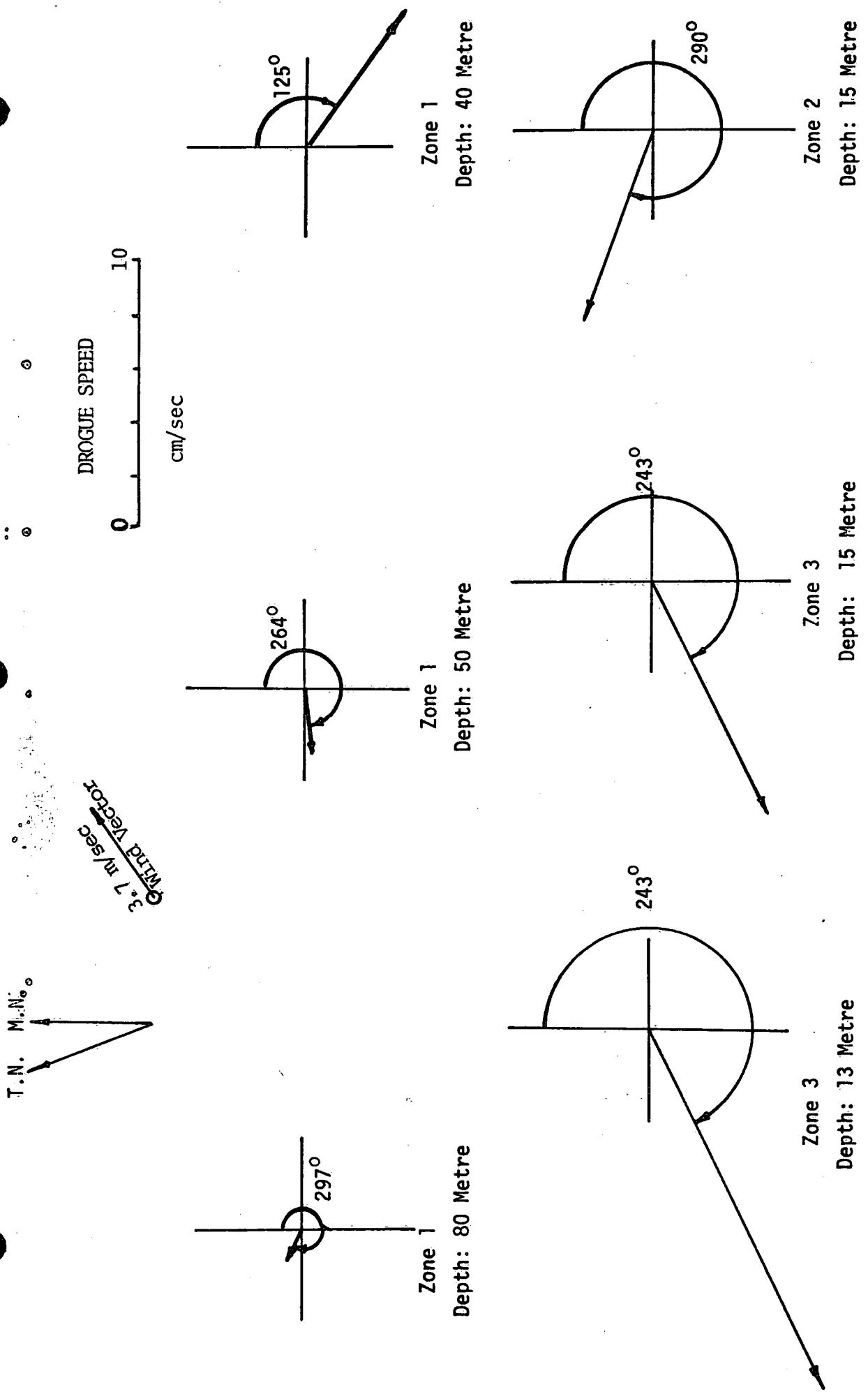
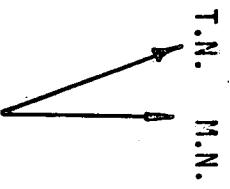


FIGURE 3 (d) DROGUE RESULTANT VECTOR

T.N.
M.N.



Zone 1

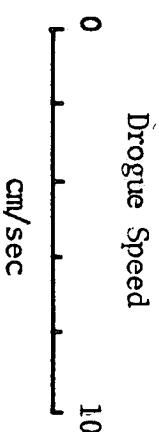
Depth: 80 metre

Note: one observation only

Zone 1

Depth: 50 metre

Q₂



Zone 1

Depth: 40 metre

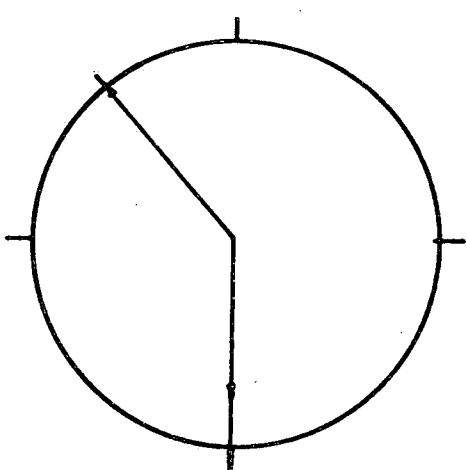
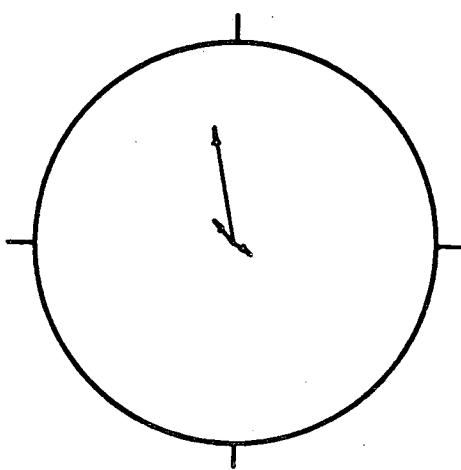
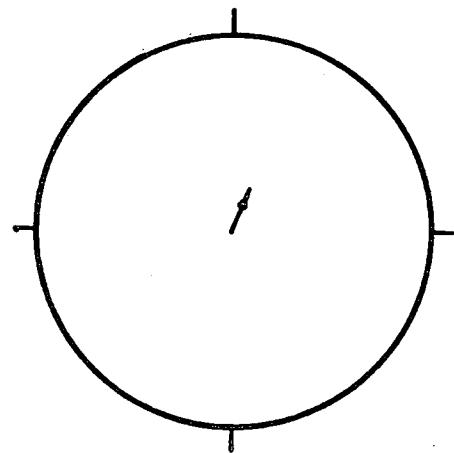
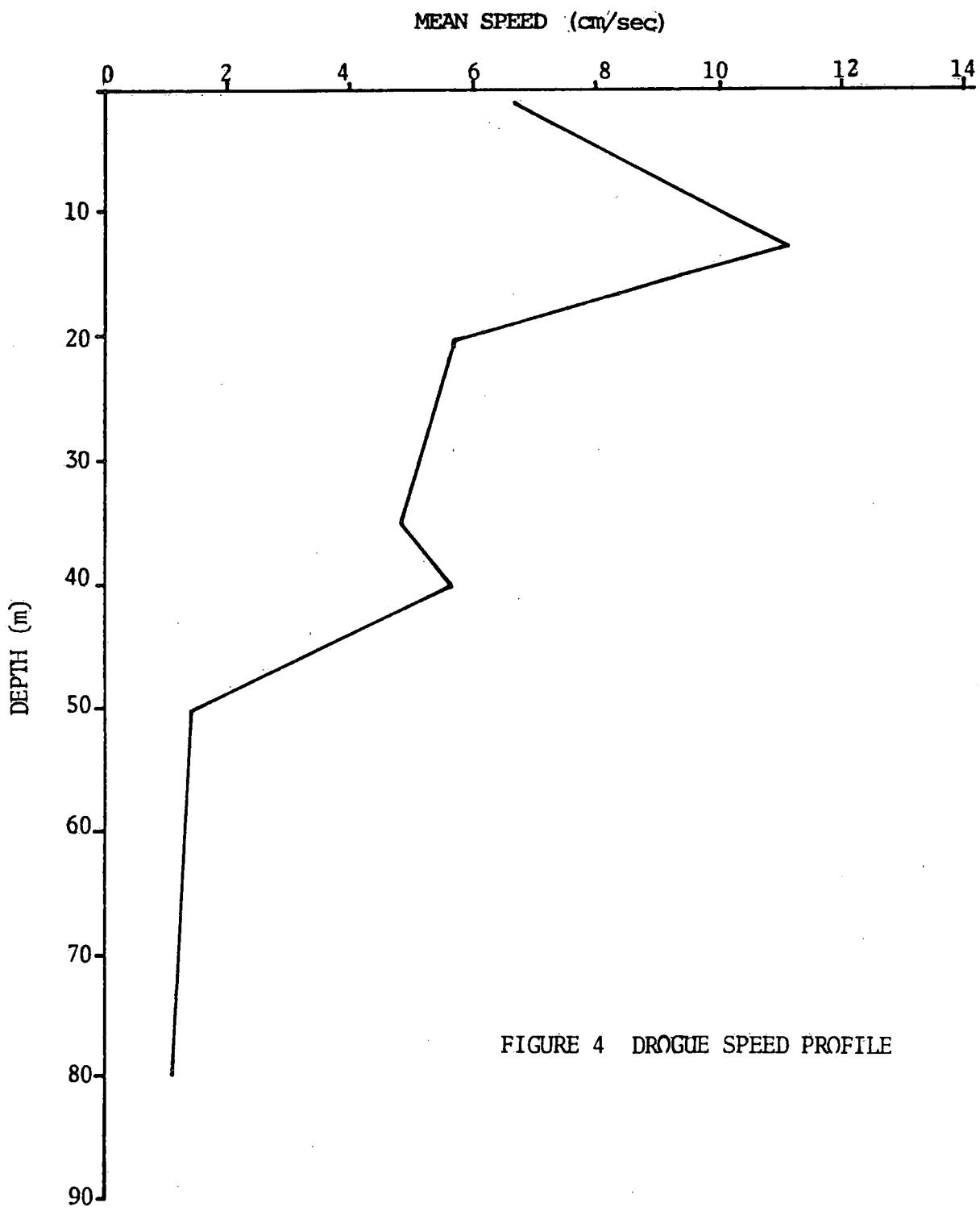


Figure 2(e) Drogue Rose

Date: Nov. 14, 1974



KAMLOOPS LAKE

APPENDIX 1

TABULATION OF DROGUE INFORMATION

DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DROGUE RECOVERED		TIME TRAVELED	SPEED (cm/sec)	WIND Dir. Deg.	Spd. m/s
			DISPLACEMENT (m)	BEARING (m. north)				
June 14, 74	C ₁	40	1043	230	5	5.8	270	1.6
"	C ₂	40	1152	090	5.42	5.9	270	1.6
"	C ₃	40	927	090	5.08	5.1	270	1.6
June 21, 74	B ₂	1	960	330	6.67	4.0	270	1.6
"	B ₂	20	2000	285	6.7	8.3	270	1.6
"	B ₂	40	-	-	-	-	270	1.6
July 19, 74	B ₂	1	2410	260	5	13.4	280	5.2
"	B ₂	20	2410	300	4.9	13.7	280	5.2
"	B ₂	35	2039	295	4.6	12.3	280	5.2
"	C ₂	1	1854	90	4.6	11.2	280	5.2
"	"	20	1483	100	4.6	9.0	280	5.2
"	"	35	1112	70	4.9	6.3	280	5.2
July 19, 74 °	G-2	1	556	2.15	5.1	8.0	280	5.2
"		20	1483	250	5.0	8.2	"	"
"		35	1298	265	4.9	7.4	"	"
July 19, 74	X ₂	20	1298	270	5.1	7.1	"	"
"		35	2039.4	285	5.1	11.1	"	"
July 24, 74	Z ₂	1	185	330	3.1	1.7	CALM	

KAMLOOPS LAKE

TABULATION OF DROGUE INFORMATION

DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DROGUE RECOVERED		TIME TRAVELED HR.	SPEED (cm/sec)	WIND Dir. Deg.	Spd. m/s
			DISPLACEMENT (m)	BEARING (m. North)				
July 24, 74	Z ₂	15	927	290	3.3	7.8	CALM	
"	"	35	185	030	3.1	1.7	" "	
"	D ₂	1	371	235	3.3	3.1	" "	
"	"	15	1850	255	3.3	15.6	" "	
"	"	35	371	270	3.1	3.3	" "	
"	Y ₂	1	556	245	3.3	4.7	" "	
"	Y ₂	25	371	220	3.2	3.2	" "	
"	Y ₂	35	556	265	3.2	4.8	" "	
"	E ₂	13	2224.8	240	3.3	18.7	" "	
"	E ₂	35	185	060	3.2	1.6	" "	
July 30, 74	B ₁	1	1112.4	315	5.5	5.6	260	3.9
"	"	20	3708	270	5.7	18.1	260	3.9
"	"	35					260	3.9
"	C ₁	1	927	240	5.6	4.6	260	3.9
"	"	20	1854	250	5.5	9.4	260	3.9
"	"	35	556	290	5.2	3.0	260	3.9

KAMLOOPS LAKE

TABULATION OF DROGUE INFORMATION

DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DISPLACEMENT (m)	DROGUE RECOVERED		TIME TRAVELED	SPEED (cm/sec)	WIND	
				BEARING (m. North)	Dir. Deg.			Spd. m/s	
July 30, 74	G ₁	1	2595.6	260	6.0	12.0	260	3.9	
"	"	20	1112.4	250	5.8	5.3	260	3.9	
"	"	35	1483	250	5.7	7.2	260	3.9	
	X ₁	20	371	310	5.4	1.9	260	3.9	
<hr/>									
Aug. 7, 74	B ₃	1	742	332	4.5	4.6	270	7.8	
	"	20	556	355	4.5	3.4	270	7.8	
	"	35	371	030	4.5	2.3	270	7.8	
	C ₃	1	3151.8	084	4.5	19.5	270	7.8	
	"	20							
	"	35	1668.6	075	4.3	10.8	270	7.8	
	G ₃	1	1483	084	4.6	9.0	270	7.9	
	"	20	927	065	4.3	6.0	270	7.9	
	"	35	742	010	4.3	4.8	270	7.9	
	X ₂	1	371	270	4.3	2.4	270	7.9	
		20	742	294	4.3	4.8	270	7.9	
Aug. 8, 74	X ₃	1	742	045	3.2	6.4	270	5.2	

KAMLOOPS LAKE

TABULATION OF DROGUE INFORMATION

DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DROGUE RECOVERED		TIME TRAVELED (Hr.)	SPEED (cm/sec)	WIND DIR. Deg.	Spd. m/s
			DISPLACEMENT (m)	BEARING (m. North)				
Aug. 8, 74		20	742	305	3.3	6.3	270	5.2
		35	1112	290	3.3	9.4	270	5.2
	Z ₃	1	556	135	3.4	4.5	270	5.2
		20	927	108	3.3	7.8	270	5.2
		35	185	117	3.4	1.5	270	5.2
	Z ₁	1	927	100	3.6	7.2	270	5.2
		20	185	154	3.4	1.5	270	5.2
		35	371	103	3.4	3.0	270	5.2
Aug. 9, 74	D ₃	1	1298	060	4.6	7.8	270	3.1
	"	20	742	075	4.7	4.4	"	"
	"	35	371	098	4.7	2.2	"	"
	D ₂	1	1298	062	4.5	8.0	"	"
	"	20	927	232	4.9	5.3	"	"
	"	35	556	255	4.6	3.4	"	"

KAMLOOPS LAKE

TABULATION OF DROGUE INFORMATION

DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DISPLACEMENT (m)	DROGUE RECOVERED	BEARING (m. north)	TIME TRAVELED	SPEED (cm/sec)	WIND	
								Dir. Deg.	Spd. m/s
Aug. 9, 74	D ₁	1	185		047	4.7	1.1	270	3.1
		20	556		254	4.7	3.3	"	"
Aug. 13, 74	Y ₃	1	1112		045	5.1	6.1	270	5.2
		20	185		090	5.4	1.0	"	"
		35	371		065	5.5	1.9	"	"
	Y ₂	1	742		062	5.0	4.1	"	"
		20	556		195	5.3	2.9	"	"
		35	185		120	5.2	1.0	"	"
	Y ₁	1	742		065	4.9	4.2	"	"
		20	556		212	5.2	3.0	"	"
		35	185		315	4.9	1.1	"	"
Aug. 23, 74	E ₃	1	556		227	3.0	5.2	CALM	
		13	371		050	2.9	3.6	"	
	E ₂	1	927		323	3.0	8.6	"	
		15	556		225	2.9	5.3	"	
		35	371		208	2.9	3.6	"	

KAMLOOPS LAKE

TABULATION OF DROGUE INFORMATION

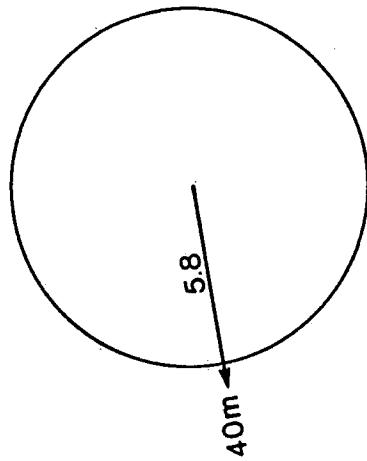
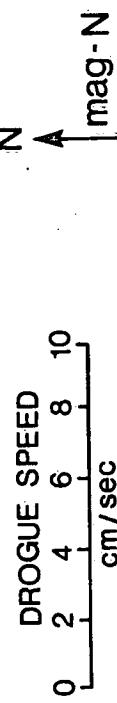
DATE	DROGUES INITIAL LOCATION	DEPTH (m)	DISPLACEMENT (m)	DROGUE RECOVERED	BEARING (m. north)	TIME TRAVELED HR.	SPEED (cm/sec)	WIND	
								Dtr. Deg.	Spd. m/s
Aug. 23, 74	E ₁	1	556	227	227	3.0	5.2	CALM	
		15	927	234	234	2.9	8.9	"	
		35	185	234	234	3.0	1.7	"	
Sept. 11, 74	Y ₃	1	556	45	45	2.4	6.4	270	6.2
		20	927	22	22	2.6	9.9	270	6.2
		35	927	40	40	2.4	10.7	270	6.2
Sept. 11, 74	Y ₂	1	1854	16	16	2.9	17.8	270	6.2
		20							
		35	556	45	45	2.5	6.2	270	6.2
Nov. 14, 74	C ₁	1	371	75	75	2.5	4.1	270	6.2
		20							
		35	185	13	13	2.4	2.1	270	
Nov. 14, 74	C ₂	20						NO DATA	
		50						3.1	NO DATA
		260						0.5	NO DATA

KAMLOOPS LAKE

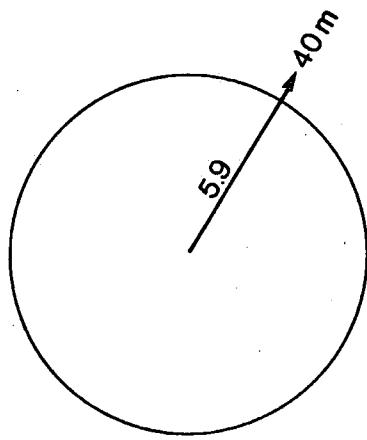
TABULATION OF DROGUE INFORMATION

Appendix 2

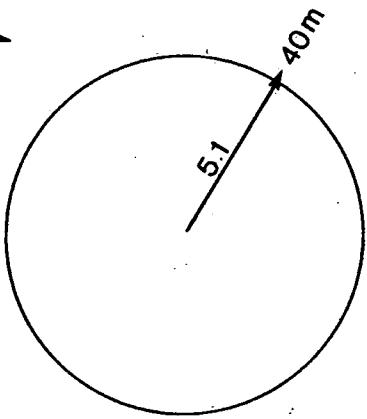
DROGUE VECTORS



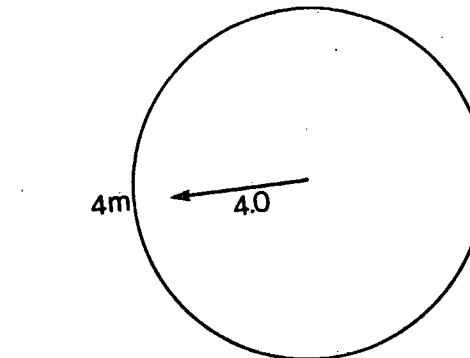
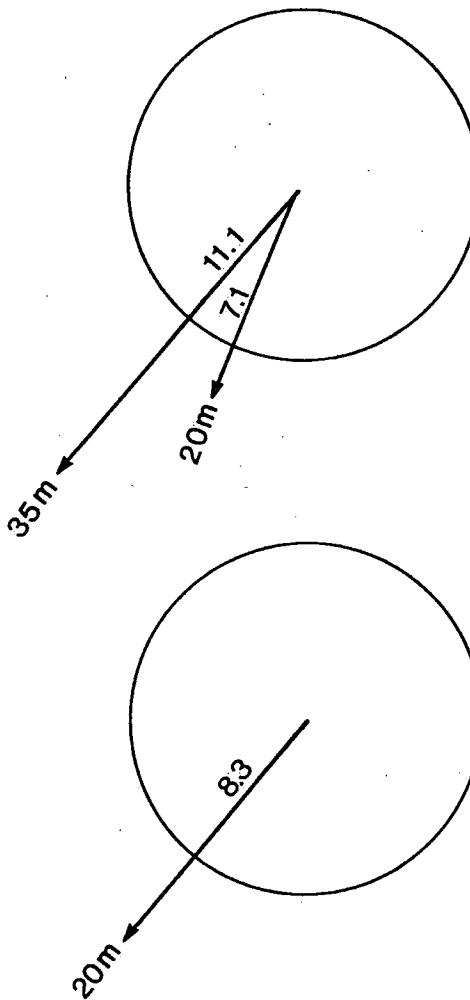
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Date: June 14, 1974



Initial location: C2
Date: June 14, 1974



Initial location: C3
Date: June 14, 1974

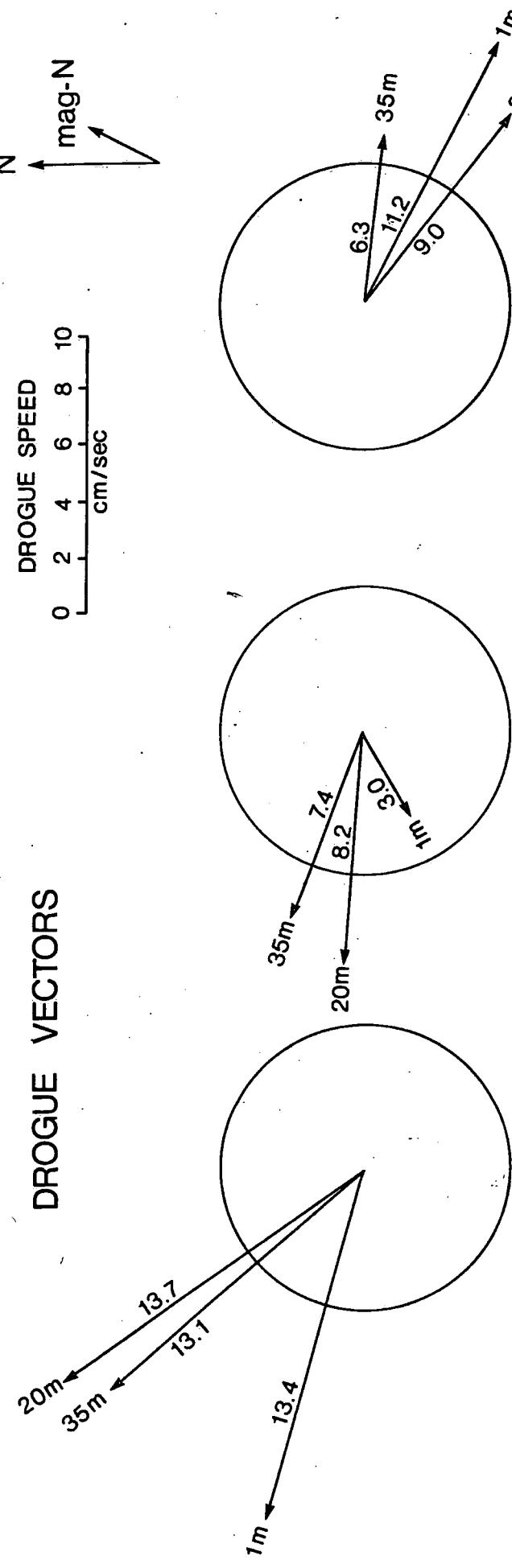
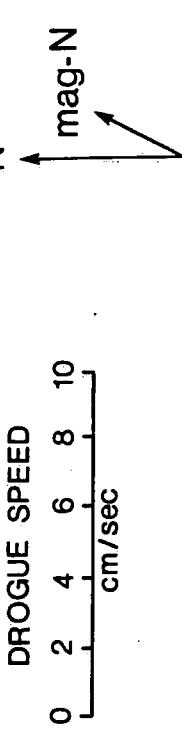


Initial location: B2
Date: June 21, 1974

Initial location: B2
Date: June 21, 1974

Initial location: X2
Date: July 19, 1974

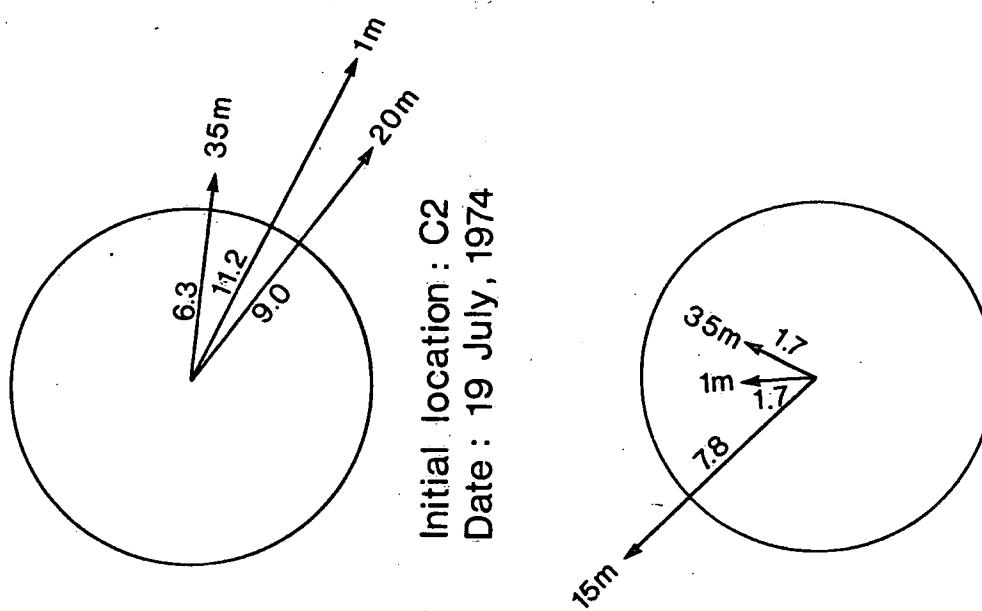
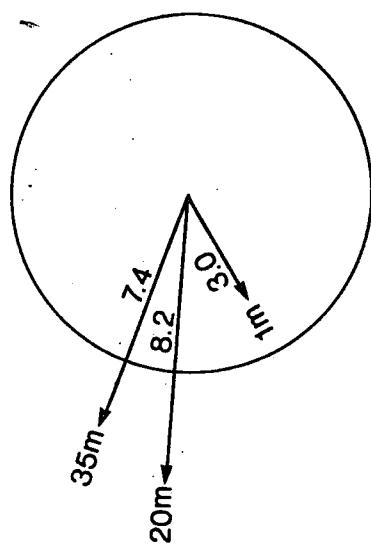
DROGUE VECTORS



Initial location : B2
Date : 19 July, 1974

Initial location : G2
Date : 19 July, 1974

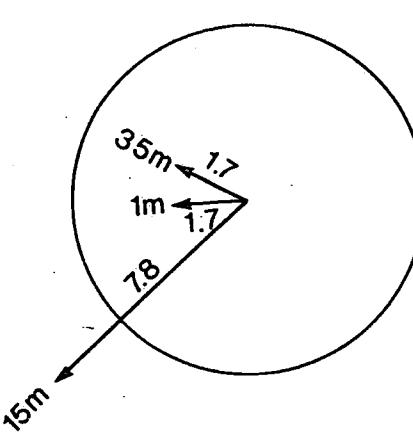
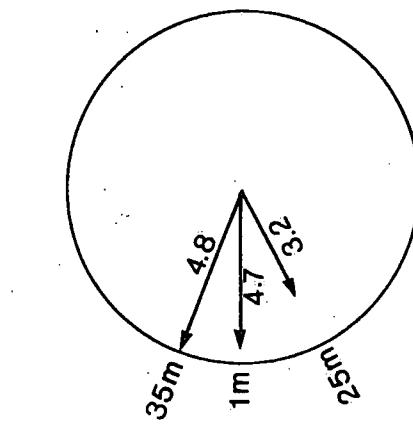
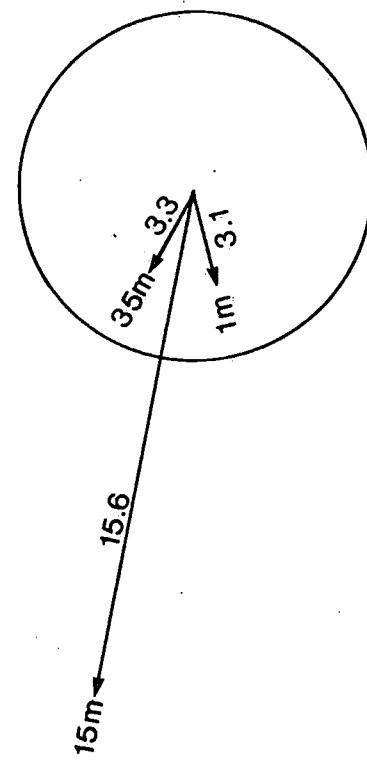
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Date : 19 July, 1974



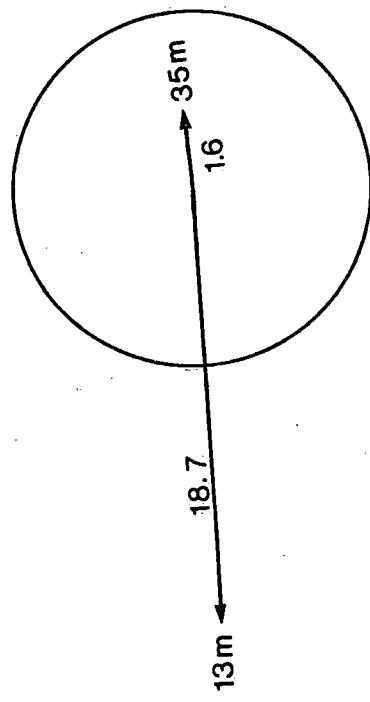
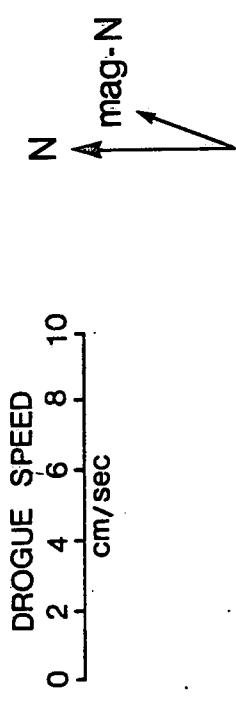
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Date : 24 July, 1974

Initial location: Y2
Date : 24 July, 1974

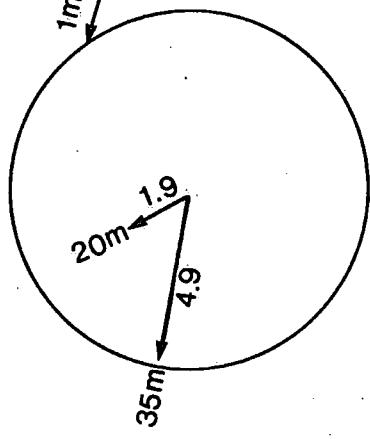
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Date: 24 July, 1974



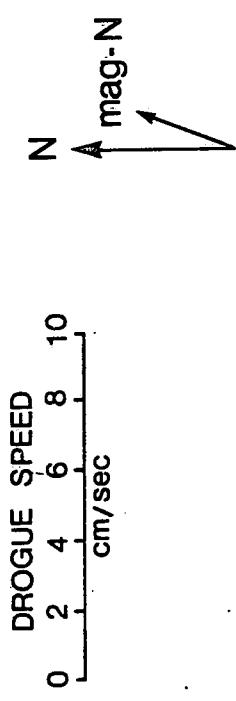
DROGUE VECTORS



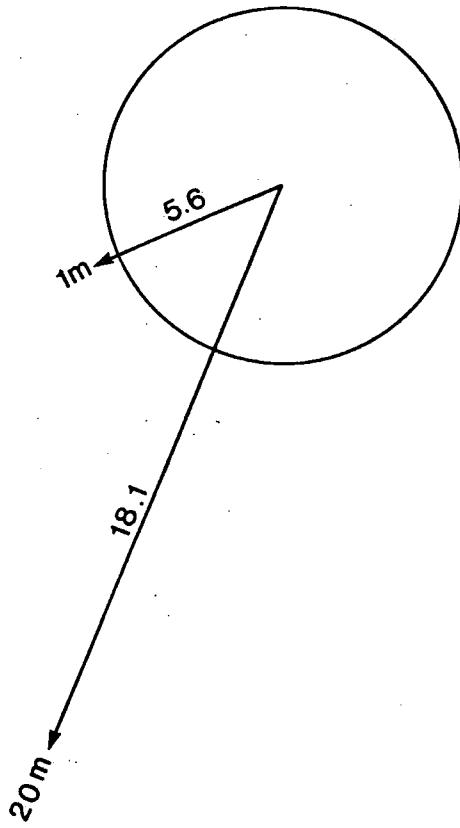
Initial location: E2
Date: 24 July, 1974



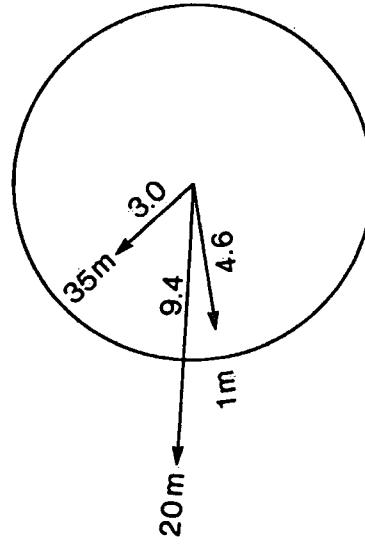
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Date: 30 July, 1974



Initial location: G1
Date: 30 July, 1974

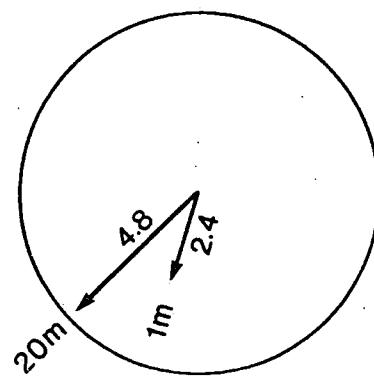
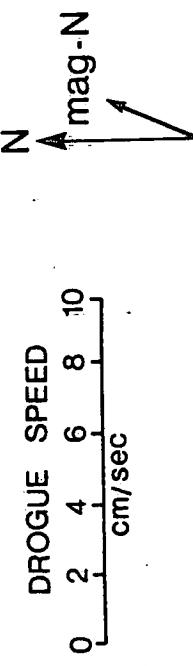


Initial location: B1
Date: 30 July, 1974

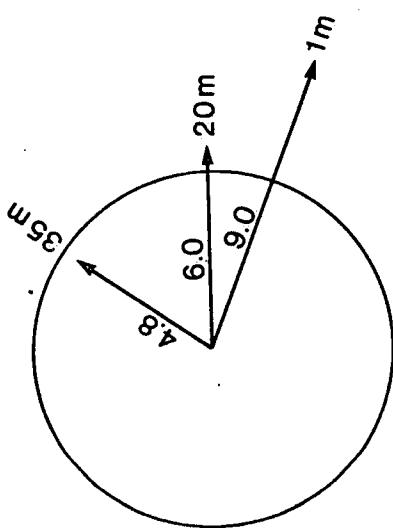


Initial location: C1
Date: 30 July, 1974

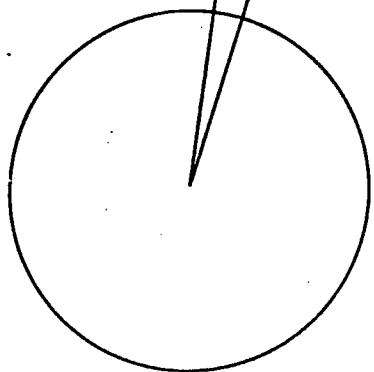
DROGUE VECTORS



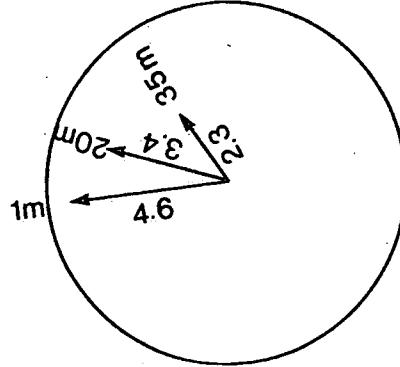
Initial location: X2
Date: 7 Aug., 1974



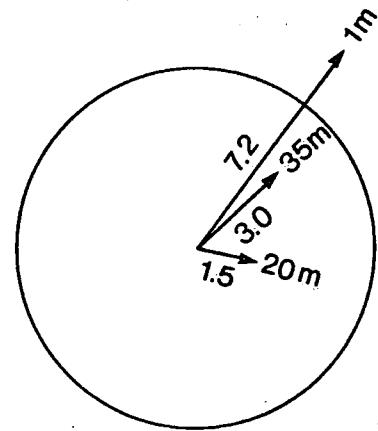
Initial location: G3
Date: 7 Aug., 1974



Initial location: C3
Date: 7 Aug., 1974

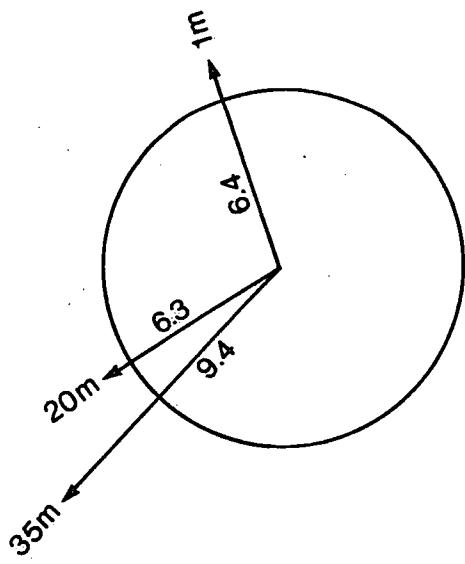
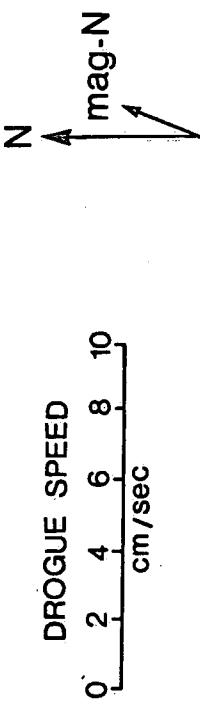


Initial location: Z3
Date: 8 Aug., 1974

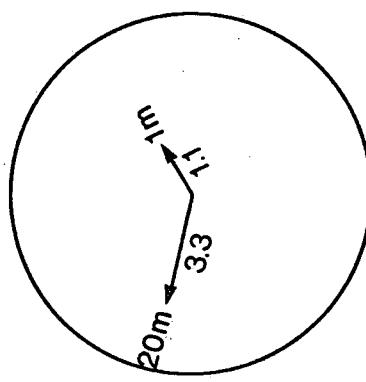


Initial location: B3
Date: 8 Aug., 1974

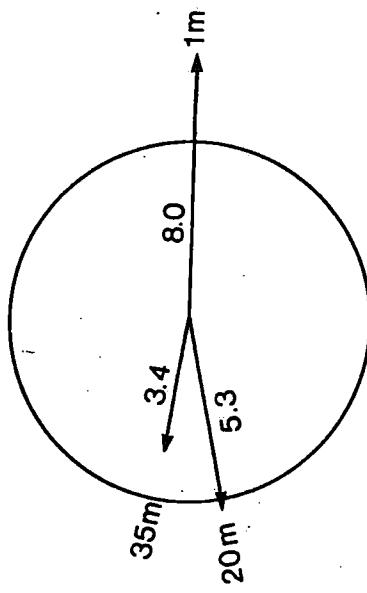
DROGUE VECTORS



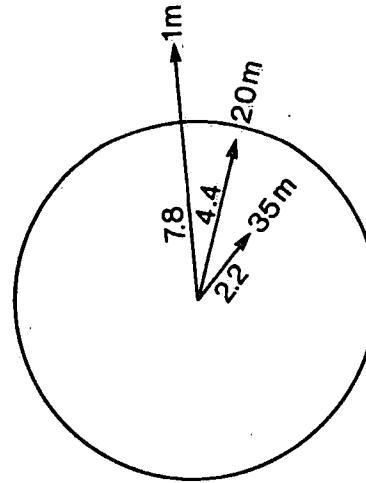
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Date: 8 Aug., 1974



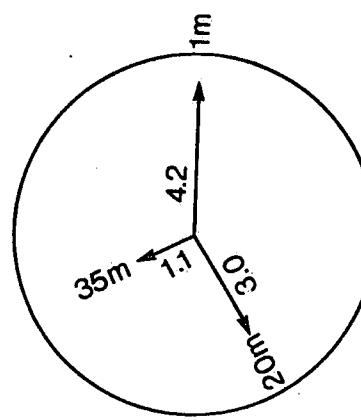
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Date: 9 Aug., 1974



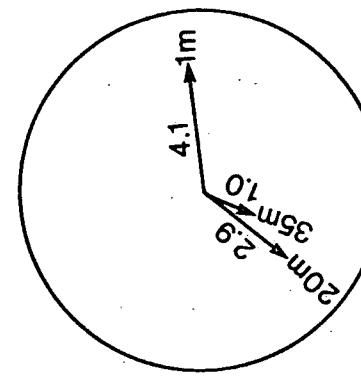
Initial location: D2
Date: 9 Aug., 1974



Initial location: D3
Date: 9 Aug., 1974

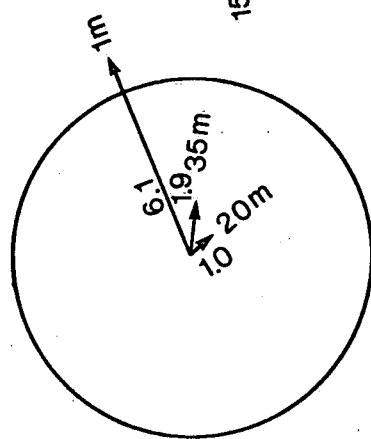
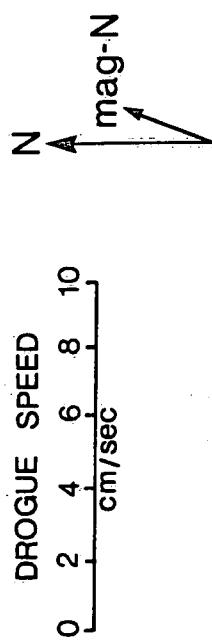


Initial location : Y1
Date: 13 Aug., 1974

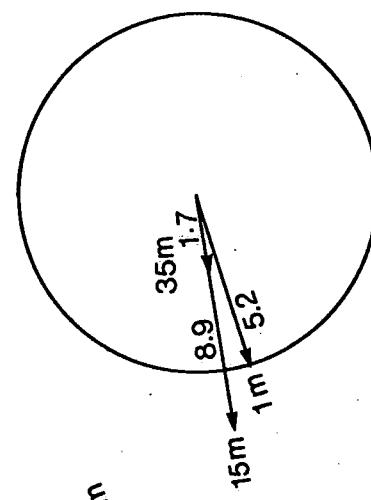


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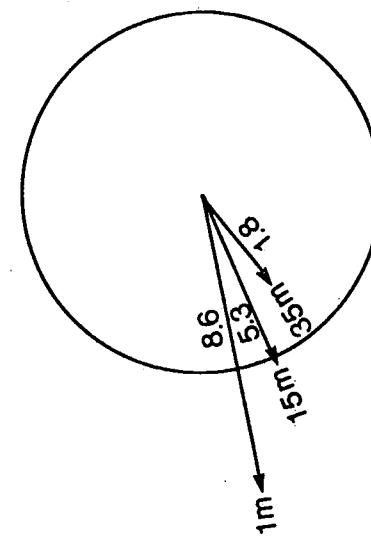
DROGUE VECTORS



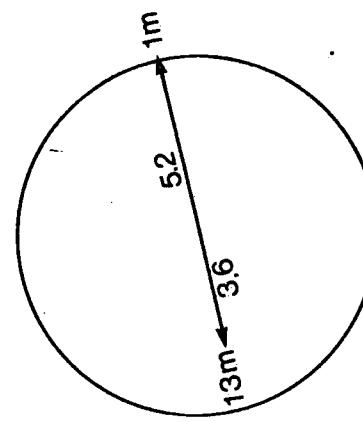
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Date: 13 Aug., 1974



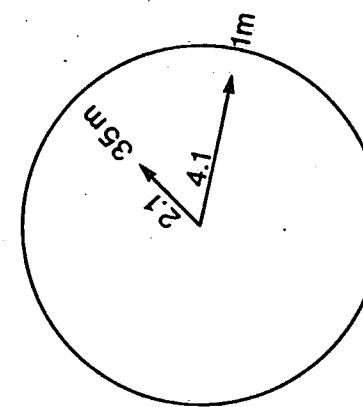
Initial location: E1
Date: 23 Aug., 1974



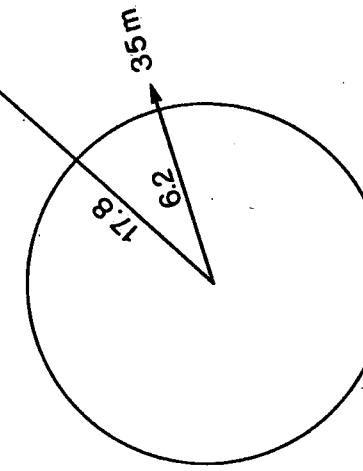
Initial location: E2
Date: 23 Aug., 1974



Initial location: E3
Date: 23 Aug., 1974

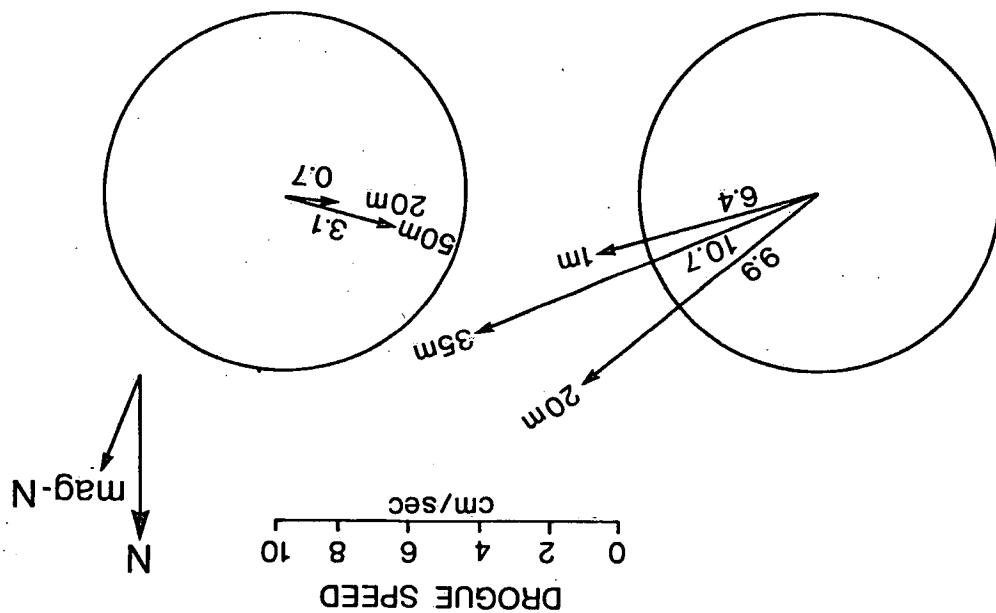


Initial location: Y1
Date: 11 Sept., 1974



Initial location: Y2
Date: 11 Sept., 1974

DROGUE VECTORS



Calculation of Richardson Number

In connection with this drogue study a classical parameter of Richardson number, R_i , (see Hutchinson, 1957 for discussion) describing the turbulence and stratification of the lake, is calculated for supplemental information. The Richardson number is defined as

$$R_i = \frac{gE}{(\partial u / \partial z)^2}$$

where g = the gravitational acceleration,
 E = the stability of stratification given by $\frac{1}{\rho} \frac{\delta \rho}{\delta z}$ where $\delta \rho / \delta z$ is the density gradient of the water column and ρ is the density attained at the layer considered, and $\frac{\partial u}{\partial z}$ = the velocity gradient.

A small value of the expression on the right hand side indicates maintenance or increase of turbulence whereas a large value indicates suppression or extinction of turbulence.

The calculation of the R_i was performed by using the drogue from Appendix I and the temperature data from Appendix 3. The temperature data were obtained from the monitor cruises. There was no temperature measurement during each episode of drogue experiment. Appendix 3 showed the closest dates of temperature taken with that of drogue experiments.

Results of the Richardson number calculation at different locations in the lake and at different times, are shown in Table 2.

REFERENCES

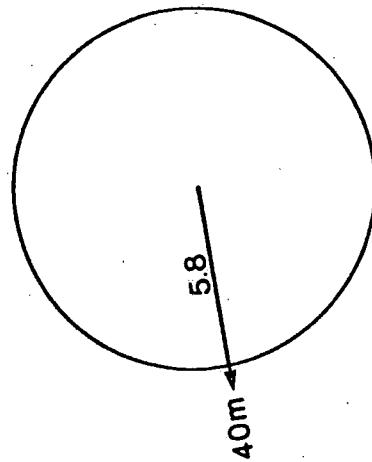
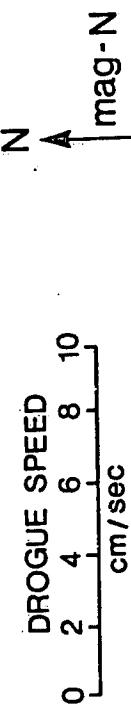
- Blanton, J.O. and Ng, H.Y.F. 1972. The circulation of the effluent from the Okanagan River as it enters Lake Skala. A report presented to the Study Director of the Canada-British Columbia Okanagan Basin Agreement.
- Hamblin, P.F. and Rodgers, G.K. 1967. The currents in the Toronto Region of Lake Ontario. Great Lakes Institute, University of Toronto.
- Krauss, J.A. 1963. Drogues and Neutral-Buoyant Floats. The Sea, Vol 2. John Wiley and Sons.
- Hutchinson, G.E.. 1957. A treatise on limnology. Volume I: Geography, Physics and Chemistry. John Wiley and Sons, New York. 1015 p.

Table 2.

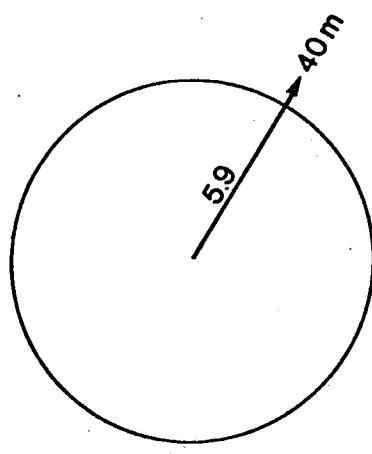
RICHARDSON NUMBER OF KAMLOOPS LAKE

<u>Date</u>	<u>Location</u>	<u>Depth At (m)</u>	<u>Ri</u>
21-6-74	B2	20-40	43
19-7-74	B2	20-35	80
19-7-74	C2	20-35	22
19-7-74	G2	20-35	276
19-7-74	X2	20-35	21
24-7-74	Z2	15-35	6
24-7-74	D2	15-35	3
24-7-74	Y2	25-35	48
24-7-74	E2	13-35	3
30-7-74	C1	20-35	13
30-7-74	G1	20-35	103
7-8-74	B3	20-35	1096
7-8-74	G3	20-35	848
8-8-74	X3	20-35	42
8-8-74	Z3	20-35	65
8-8-74	Z1	20-35	181
9-8-74	D3	20-35	77
9-8-74	D2	20-35	103
13-8-74	Y3	20-35	654
13-8-74	Y2	20-35	147
13-8-74	Y1	20-35	147
23-8-74	E2	15-35	448
23-8-74	E1	15-35	25
11-9-74	Y3	20-35	1274

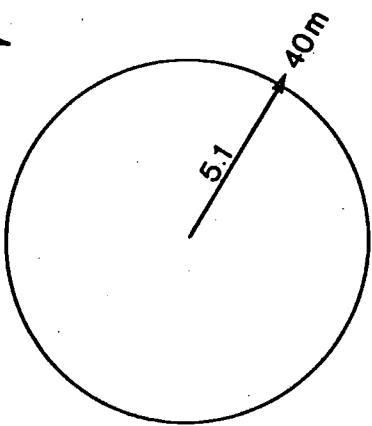
Appendix 2 DROGUE VECTORS



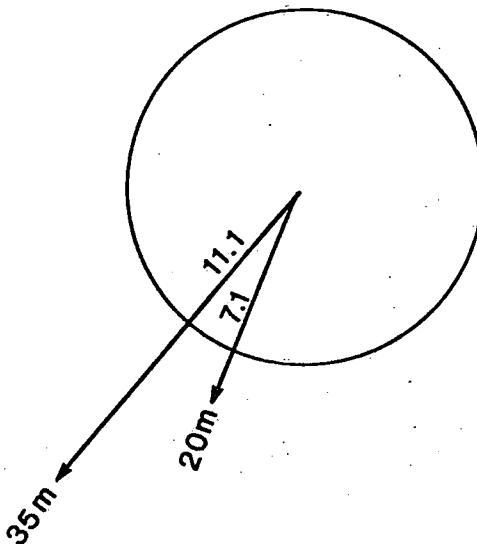
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Date: June 14, 1974



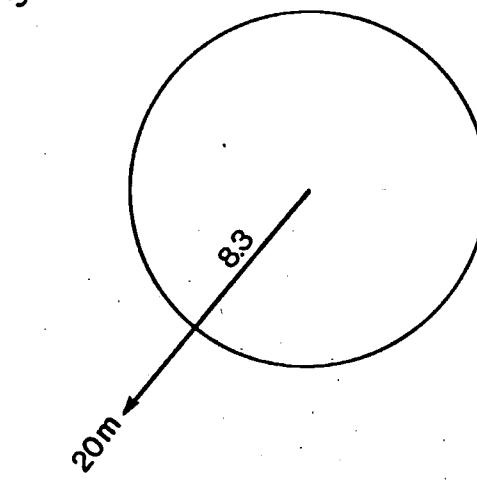
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Date: June 14, 1974



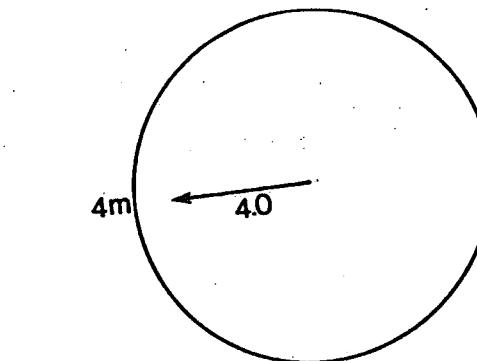
Initial location: C3
Date: June 14, 1974



Initial location: X2
Date: July 19, 1974

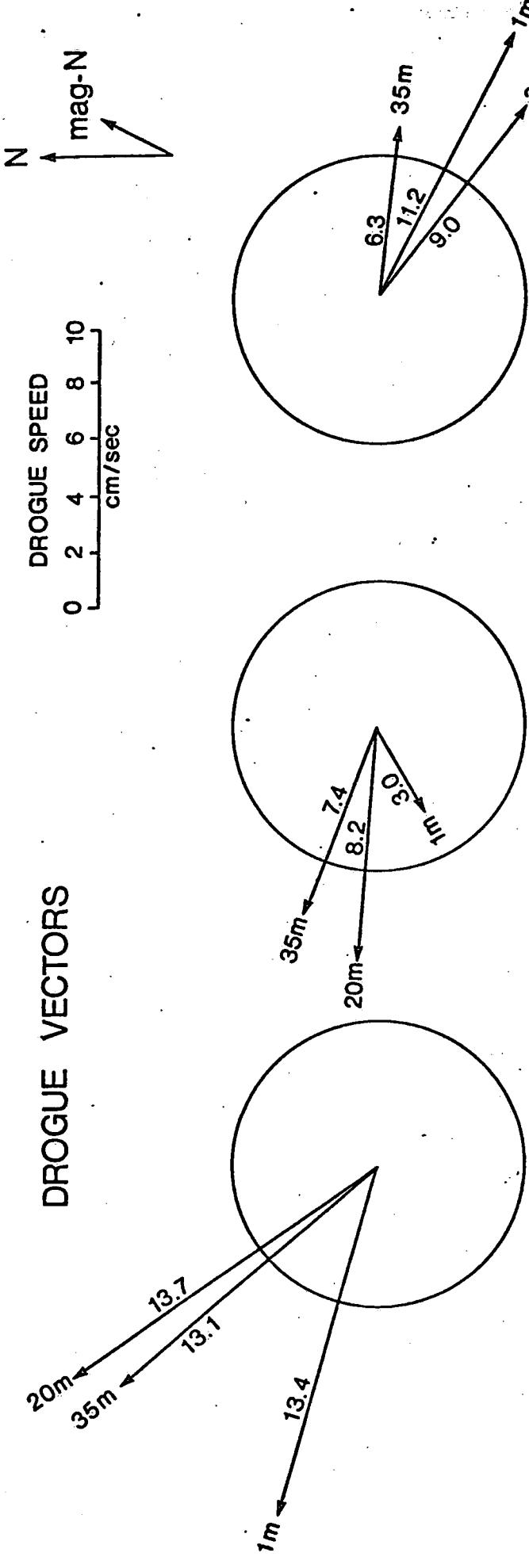
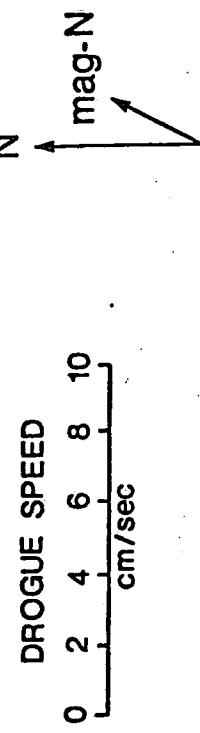


Initial location: B2
Date: June 21, 1974

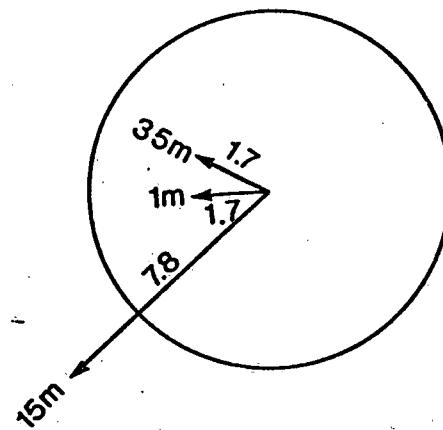


Initial location: B1
Date: June 21, 1974

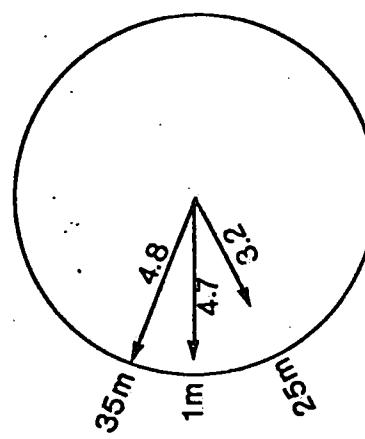
DROGUE VECTORS



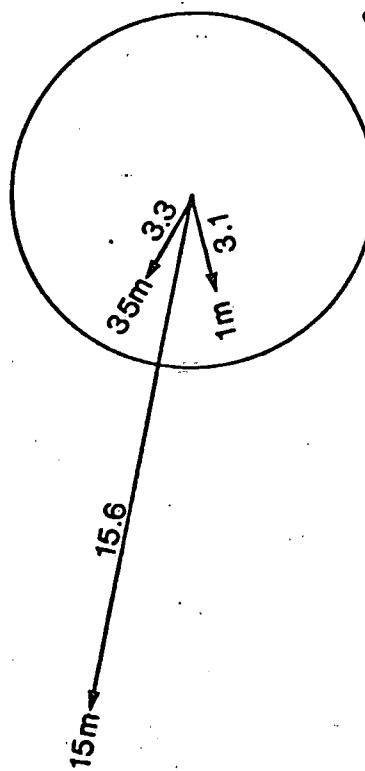
Initial location : C2
Date: 19 July, 1974



Initial location : G2
Date: 19 July, 1974



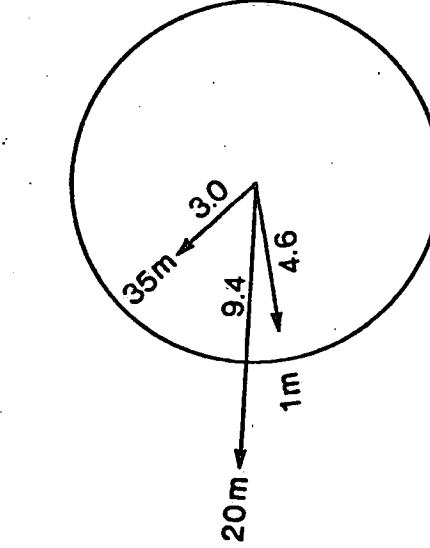
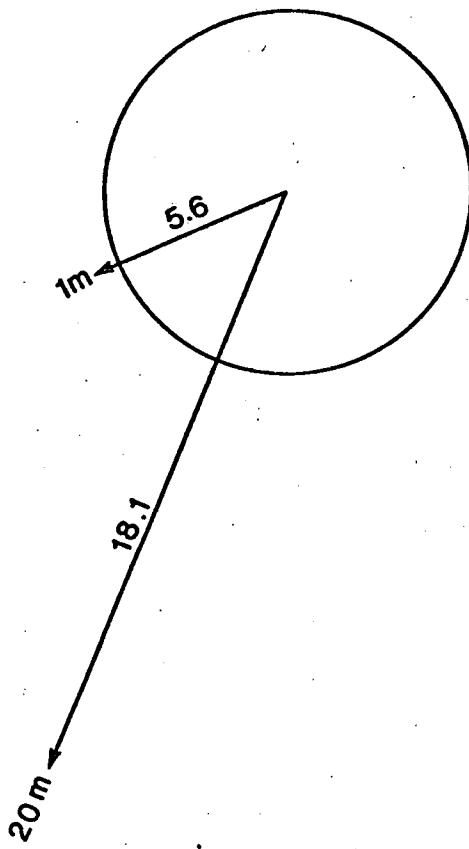
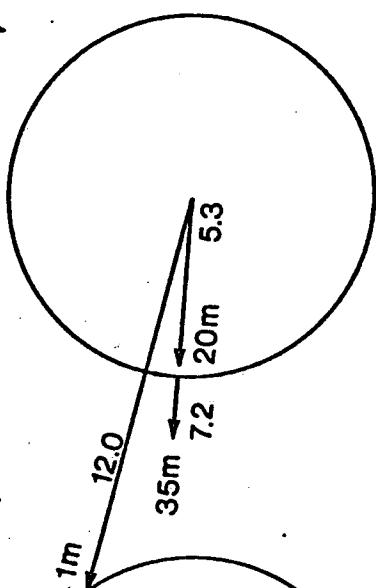
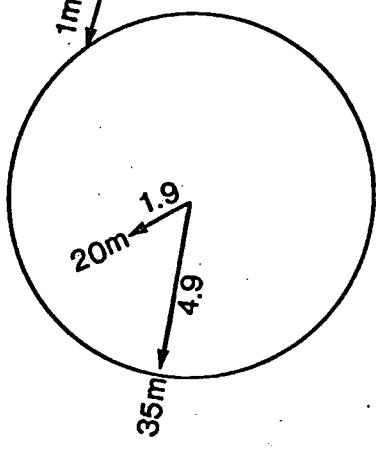
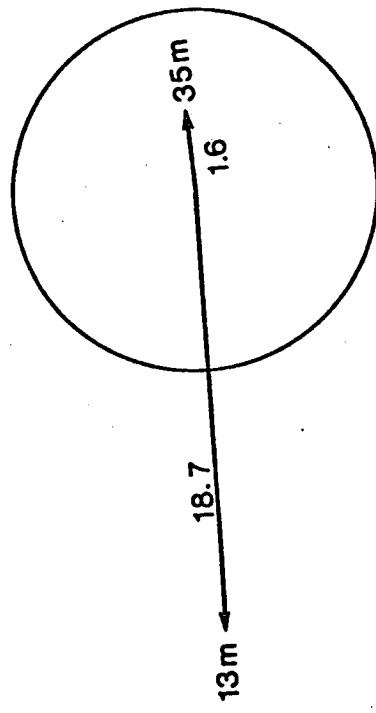
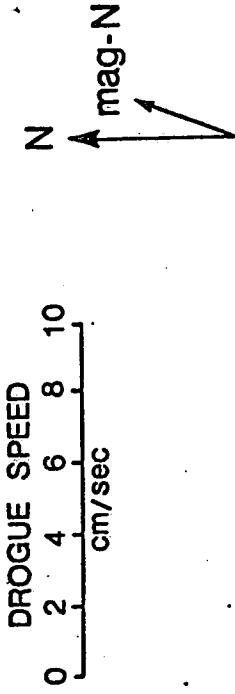
Initial location: Y2
Date : 24 July, 1974



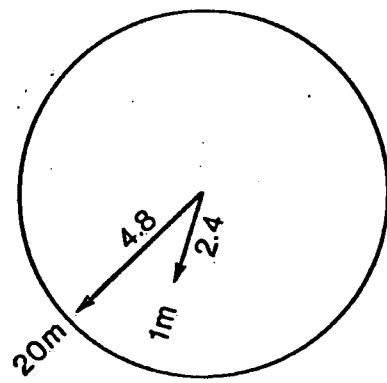
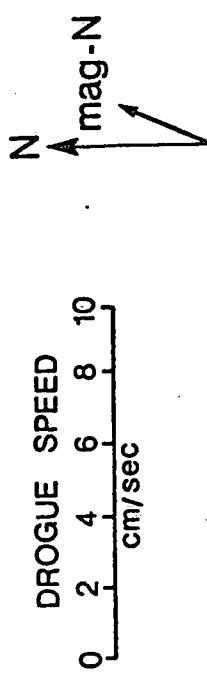
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Date : 24 July, 1974

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Date: 24 July, 1974

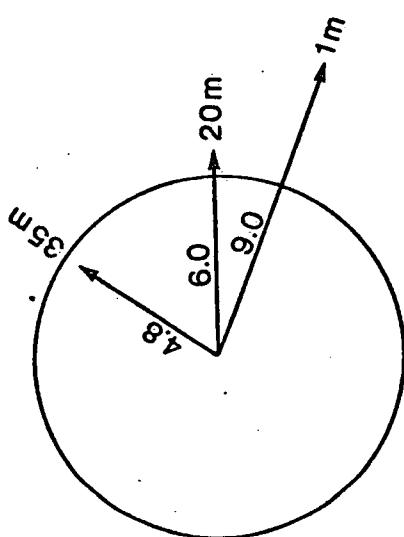
DROGUE VECTORS



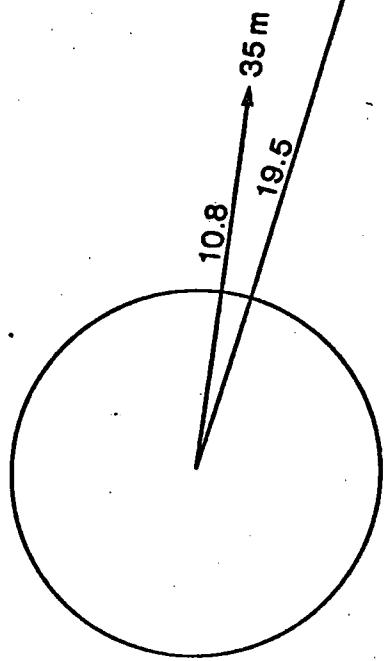
DROGUE VECTORS



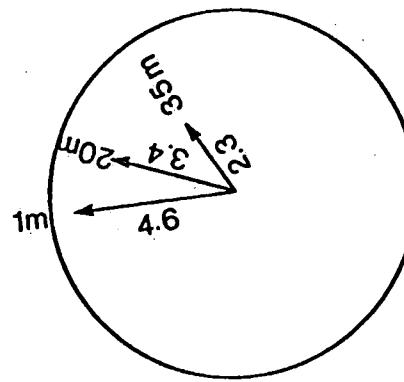
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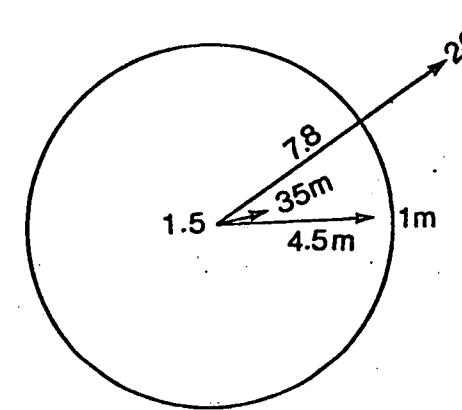
Initial location: G3
Date: 7 Aug., 1974



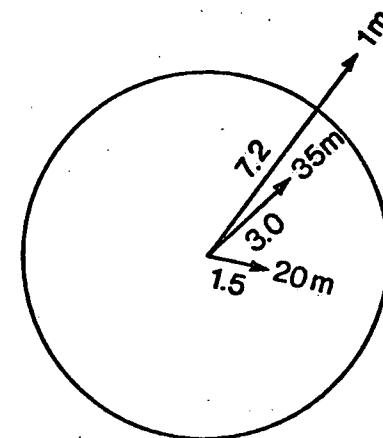
Initial location: C3
Date: 7 Aug., 1974



Initial location: B3
Date: 7 Aug., 1974

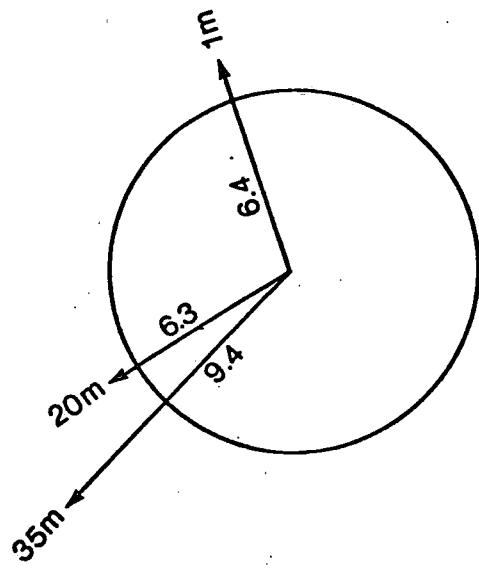
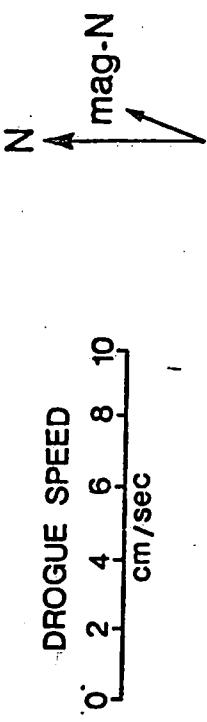


Initial location: Z3
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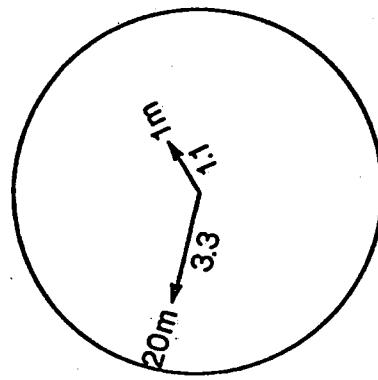


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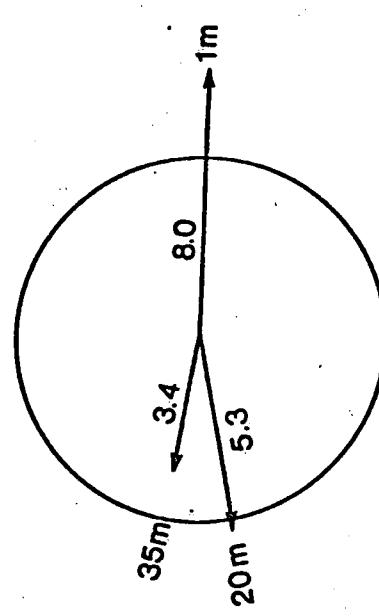
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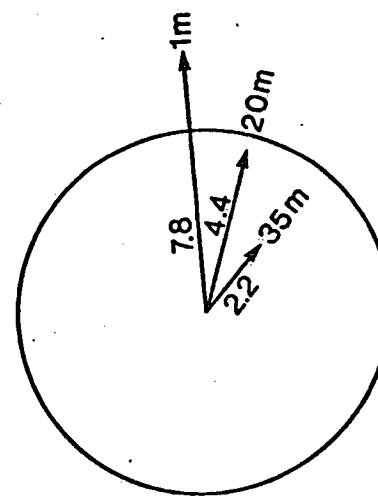
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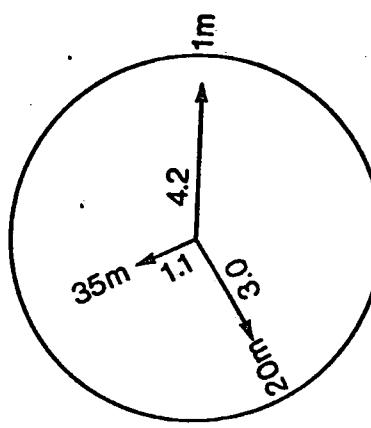
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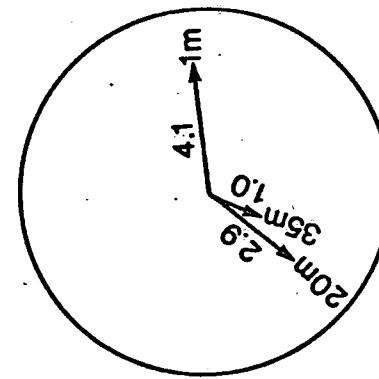
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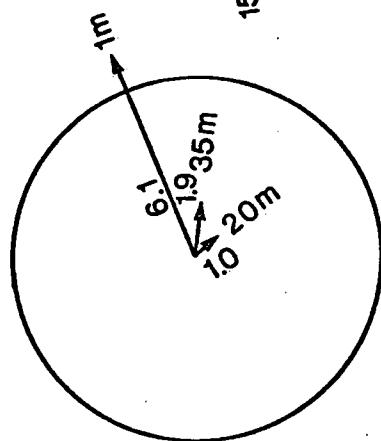
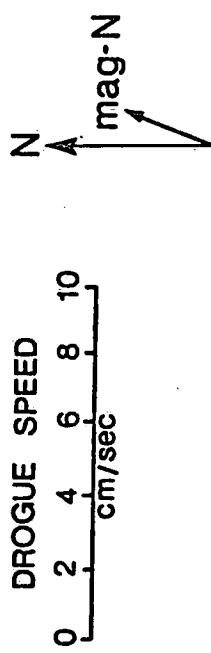


Initial location: Y1
Date: 13 Aug., 1974

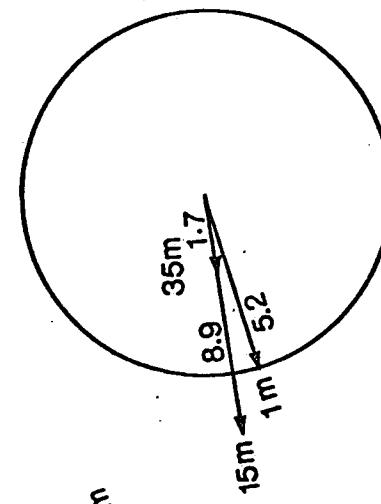


Initial location: Y2
Date: 13 Aug., 1974

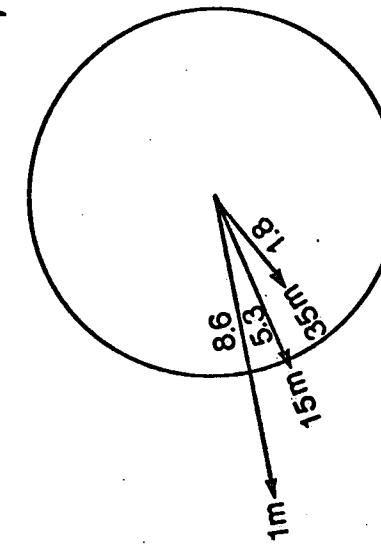
DROGUE VECTORS



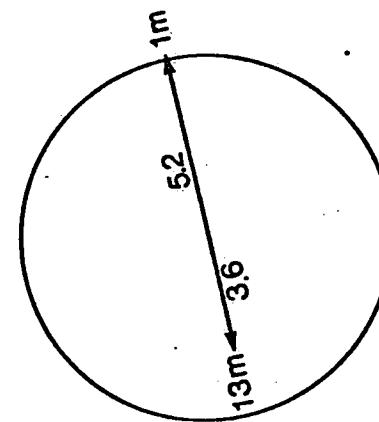
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Date: 13 Aug., 1974



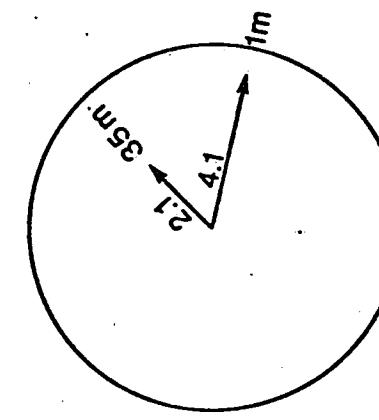
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Date: 23 Aug., 1974



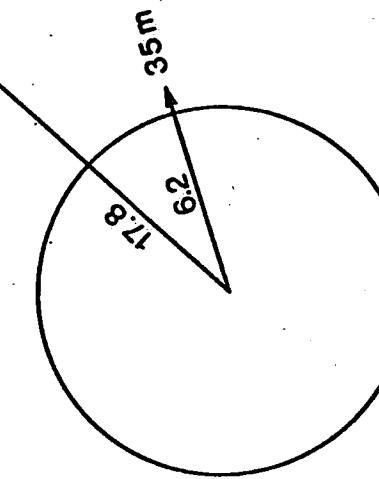
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Date: 23 Aug., 1974



Initial location: E3
Date: 23 Aug., 1974



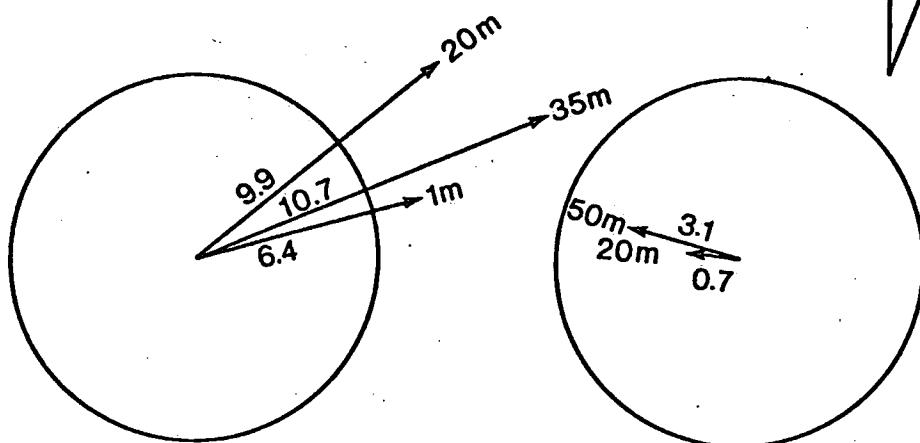
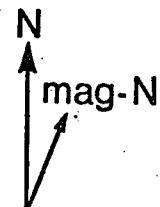
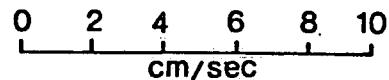
Initial location: Y1
Date: 11 Sept., 1974



Initial location: Y2
Date: 11 Sept., 1974

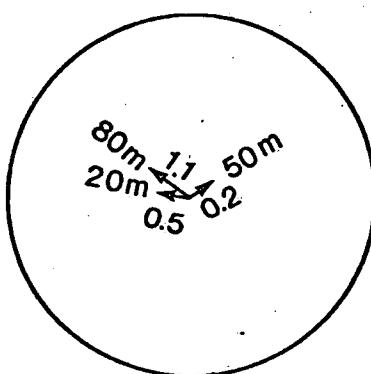
DROGUE VECTORS

DROGUE SPEED

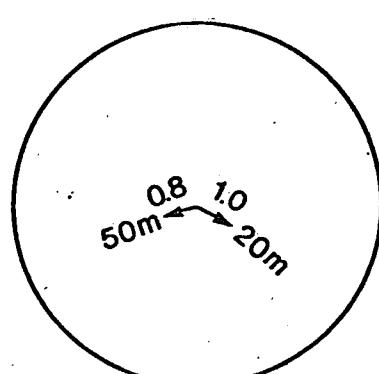


Initial location: Y3
Date: 11 Sept., 1974

Initial location: C1
Date: 14 NOV., 1974

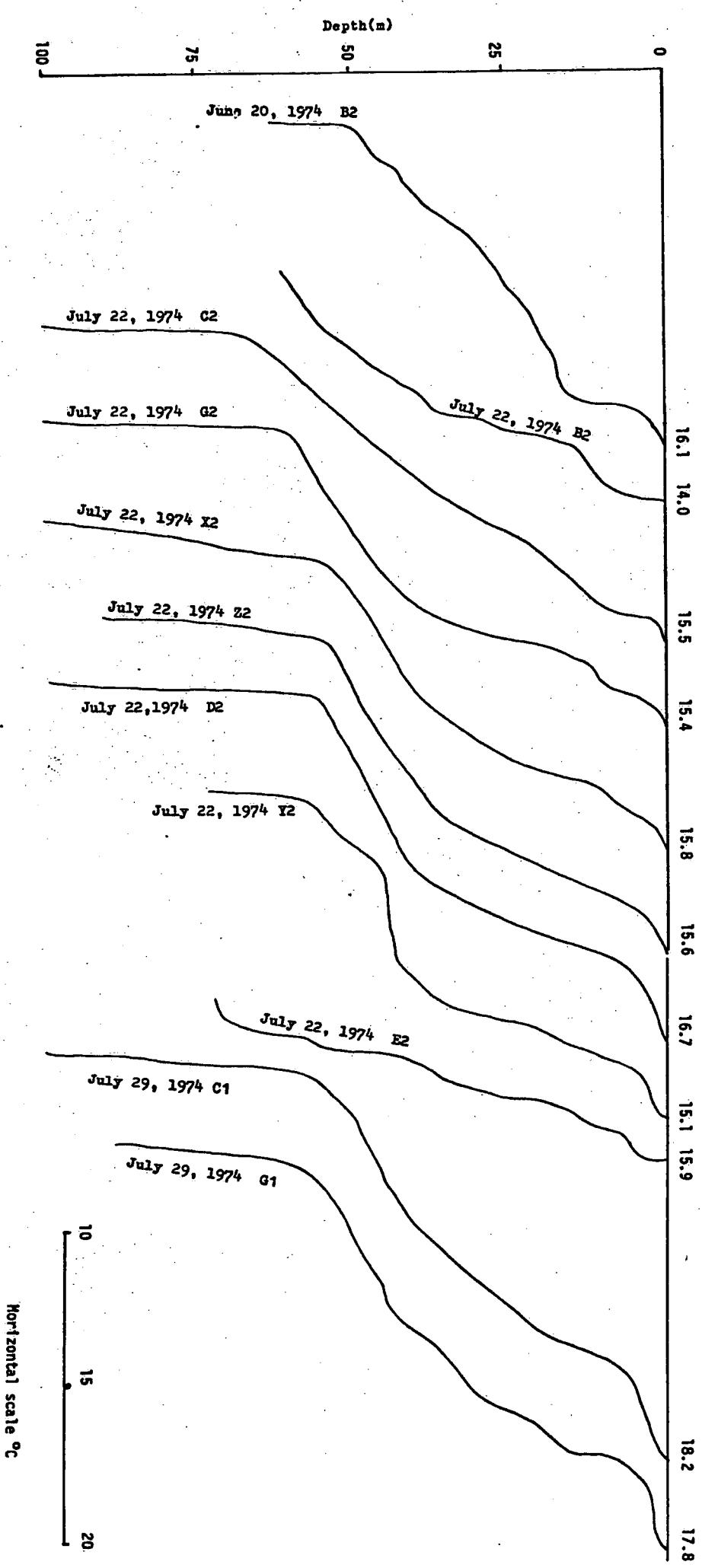


Initial location: C2
Date: 14 NOV., 1974



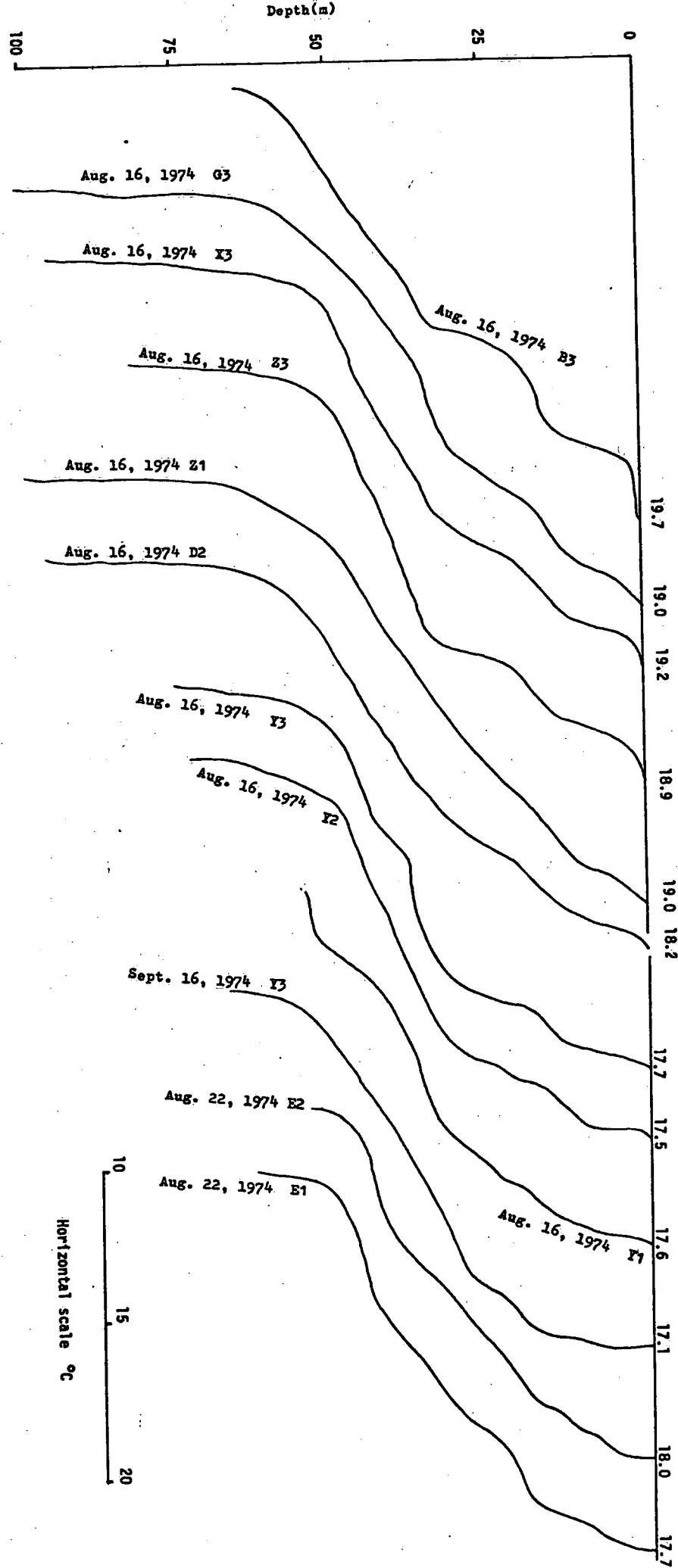
Initial location: C3
Date: 14 NOV., 1974

Appendix 3. Temperature profiles used for calculation of Richardson number.



Note: The number shown on the top of each profile is the surface temperature ($^{\circ}\text{C}$)

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