

WAVE DATA RECORDING PROGRAMME

CAIRNS REGION



Beach Protection Authority of Queensland.

REPORT NO. W 01.1

WAVE DATA RECORDING PROGRAMME

CAIRNS REGION

REPORT NO. W01-1

Prepared by the Beach
Protection Authority.

November 1978.

All reasonable care and attention has been exercised in the collection, processing and compilation of the wave data included in this report. However, the accuracy and reliability of this information is not guaranteed in any way by the Beach Protection Authority and the Authority accepts no responsibility for the use of this information in any way whatsoever.

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ABSTRACT:-

This report provides summaries of primary analysis of raw wave data recorded in 18 metres of water offshore near Cairns in North Queensland. Data was recorded using a Datawell "Waverider" buoy and covers the period May 2, 1975 to September 3, 1978. The data is divided into seasonal groupings for analysis. No estimations of wave directional data have been provided.

OTHER AVAILABLE IN
THIS SERIES:-

Nil at date of issue.

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WAVE DATA RECORDING PROGRAMME

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1.0 INTRODUCTION

The Beach Protection Authority as part of its long term programme of investigating erosion problems along Queensland's coastline has been recording wave characteristics through a network of wave recording stations since 1968.

This report summarizes the primary analysis of wave data collected in the Cairns region. In addition brief details of the recording equipment, the method of handling raw data and the type of analysis employed are provided.

2.0 RECORDING EQUIPMENT

All wave recording installations operated by the Authority employ the "Waverider" system developed by Datawell b.v. of the Netherlands.

Each installation comprises a Waverider 6000 series buoy transmitting to a shore based WAREP Mark II receiver which in turn is coupled to an ANMA analogue recording unit.

This system utilizes a buoy mounted accelerometer to follow the water surface movements and transmits a frequency modulated analogue representation of these water level movements to a shore based recorder. Both analogue magnetic tape and pen chart records are maintained at the shore based station.

3.0 WAVE RECORDING AND ANALYSIS PROCEDURES

In general two recordings of water level each of 20 minutes duration were made each day with the timing of the recordings set at 0300 hours and 1500 hours respectively.

During cyclonic events or other periods of severe wave action the recording frequency was increased to 4 times daily. Twenty minute records were still maintained at such times.

The analogue magnetic tape recordings produced by the recording system were digitized for subsequent computer analysis to provide the following wave parameters:-

- | | |
|--|--|
| 1. Energy Density Spectrum | A representation of the distribution of wave energy over the component wave frequencies. |
| 2. Significant Wave Height (Hsig) | The average of the highest one third of waves in the record. |
| 3. Root Mean Square Wave Height (Hrms) | The root mean square of the wave heights from the record. |
| 4. Maximum Wave Height (Hmax) | The highest individual wave in the record. |
| 5. Peak Energy Period (Tp) | The wave period corresponding to the peak of the energy density spectrum. |
| 6. Significant Period (Tsig) | The average period of the highest one third waves in the record. |
| 7. Zero Crossing Period (Tz) | The average period of all waves in the record based on upward zero crossings. |
| 8. Crest Period (Tc) | The average period of all the waves in the recording based on successive crests. |

Digitization was carried out at the Brisbane Office and the digital records held on a 9 track digital tape compatible with the computing facilities available to the Authority. In this process the analogue tapes produced in the field are sampled electronically at half second intervals and this information together with necessary administration information is transferred to the digital tape by a machine (digitizer) which was specifically developed for this purpose.

As the digitized tapes of wave records were produced, routine and spectral analysis of individual records were performed to obtain the previously defined parameters using computer programs developed by the Maritime Services Board of New South Wales. These parameters are the basis for the summary plots and tables attached to this report.

In preparing the summary plots and tables, computer programs developed by the Authority were used to further process the results obtained from the analysis of the individual wave records. As part of this process, durations were assigned to each 20 minute record equivalent to half the recording interval on either side of the record. Where the period between successive records was longer than one day, the period was not included in the analysis.

4.0 RECORD LOSSES

Record losses can be divided into three categories - losses due to recording equipment failure, losses during routine processing and losses as a result of spurious records produced by twisted accelerometer cables within the Waverider buoy.

Losses in the first two categories are usually non-recoverable. Records produced when accelerometer cables are twisted, however, are generally recoverable. The twisting of the cables causes a low frequency component to be added to the analogue wave records at the recording stage. When analysis is carried out, this component is easily detected and may be eliminated during data editing following the completion of routine processing and spectral analysis of individual records. Such reinstatement however, is only carried out if the errors constitute a significant proportion of the total number of records.

Details of record losses in the Cairns region are included in Summary Sheet 1, "Details of Wave Recorder Installation".

5.0 DATA PRESENTATION

No attempt has been made to interpret the recorded data for design purposes or to apply corrections for refraction, diffraction and shoaling to obtain equivalent deep water waves. Before any use is made of this data it is therefore necessary to note the exact location of the buoy and the water depth in which the buoy was moored. This data is shown on Summary Sheet 1, "Details of the Wave Recording Installation".

Wherever major meteorological events such as cyclones have occurred during the recording period, these were noted and are summarized together with maximum wave height recorded and any other relevant comments in Summary Sheet 2, "Major Meteorological Events".

In addition to the above Summary Sheets the following tables and figures are presented to complete this report.

Table 1: Wave Statistics; Wave Period/Wave Height Occurrences, All Data, All Directions.

Table 2: Wave Statistics; Wave Period/Wave Height Occurrences, Summer Data, All Directions.

Table 3: Wave Statistics; Wave Period/Wave Height Occurrences, Winter Data, All Directions.

Figure 1: Locality Map.

Figure 2: Percentage (of time) Exceedance of Wave Heights (H_{sig}) for All Wave Periods.

Figure 3: Histogram Percentage (of time) Occurrence of Wave Heights (H_{sig}) for All Wave Periods.

Figure 4: Histogram Percentage (of time) Occurrence of Wave Periods (T_p) for All Wave Heights.

Figure 5: Wave Parameter Relationships.

Figure 6: Average Duration of Exceedance of Wave Heights (H_{sig}).

The above tables refer to data recorded in Summer and Winter. For the purposes of analysis Summer has been taken as the period from November 1 to April 30 in the following year. Winter covers the period May 1 to October 31 in any one year.

SUMMARY SHEET 1

DETAILS OF WAVE RECORDER INSTALLATION

Region:- Cairns Region

Buoy Location

Co-ordinates:- $16^{\circ} 41'35''$ East $145^{\circ} 42'30''$ South

Description:- 7 kilometres North East of Double Island
(See Figure 1)

Water Depth at buoy:- 18 metres relative to Australia Height Datum.

Location of Recording Station:- Yorkey's Knob, Mulgrave Shire.

Period of data collection:- May 2, 1975 to September 3, 1978.

Normal Recording Interval:- Two twenty minute records daily at
0300 hours and 1500 hours.

Total Number of Records Analysed:- 2058

Number of Records lost due to

Field equipment failure:- 337

Losses during analysis:- 21

Damaged Accelerometer Cables:- 11 (no records reinstated)

Periods during which four recordings
per day were taken:-

4th-5th March, 1976

31st January - 1st February, 1977.

30th January - 31st January, 1978.

Assesment of Data Quality:- Very Good.

SUMMARY SHEET 2

MAJOR METEOROLOGICAL EVENTS

CAIRNS REGION

Cyclone Name	Date	Estimated closest point of cyclone track to buoy	Maximum Hsig Recorded	Maximum Hmax Recorded
David	16 January 1976	700km South-East	0.64 m	1.20 m
Alan	31 January 1976	100km North	1.54 m	3.06 m
Beth	14 February 1976	200km East	0.60 m	1.22 m
Colin	26 February 1976	1000km East	0.77 m	1.39 m
Dawn	4 March 1976	100km East	0.69 m	1.16 m
Watorea	26 April 1976	200km East	Recorder not functioning	Recorder not functioning
Keith	30 January 1977	100km East	1.91 m	3.21 m
Nancy	12 February 1977	150km North	1.31 m	2.34 m
Otto	7 March 1977	200km East	1.33 m	2.62 m
Gwen	27 January 1978	150km South	0.73 m	1.28 m

Highest Significant Wave Height (Hsig) Recorded was 1.91 m on 31 January 1977 during cyclone "Keith".

Highest Wave Recorded (Hmax) was 3.21m on 31 January 1977 during cyclone "Keith".

WAVE STATISTICS
WAVE PERIOD/WAVE HEIGHT OCCURRENCES
ALL DATA, ALL DIRECTIONS

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)										TOTALS
	0 - 2.99	3 - 4.99	5 - 6.99	7 - 8.99	9 - 10.99	11 - 12.99	13 - 14.99	> 14.99			
0.00 - 0.2	17.50	12.00	13.00	7.00	1.00	1.00	0.50	0	0	52.00	
0.21 - 0.4	99.50	50.75	115.37	42.75	3.50	2.00	0	0	0	313.87	
0.41 - 0.6	22.50	121.12	92.87	58.50	7.00	0	0	0	0	302.00	
0.61 - 0.8	0	153.37	13.87	32.75	1.00	0.50	0	0	0	201.50	
0.81 - 1.0	0	116.00	2.50	6.50	0	0.50	0	0	0	125.50	
1.01 - 1.5	0	38.12	2.50	1.00	0	0	0	0	0	41.62	
1.51 - 2.0	0	0	0.75	0	0	0	0	0	0	0.75	
2.01 - 2.5	0	0	0	0	0	0	0	0	0	0.00	
TOTALS	139.50	491.37	240.87	148.50	12.50	4.00	0.50	0.00	0.00	1037.25	

Values in the above table are durations in days and have been rounded to the second decimal place.

TABLE 1

WAVE STATISTICS

WAVE PERIOD/WAVE HEIGHT OCCURRENCES

SUMMER DATA, ALL DIRECTIONS

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)										TOTALS
	0 - 2.99	3 - 4.99	5 - 6.99	7 - 8.99	9 - 10.99	11 - 12.99	13 - 14.99	> 14.99			
0.00 - 0.2	15.50	8.50	12.00	5.00	1.00	1.00	0.50	0	0	0	43.50
0.21 - 0.4	71.75	36.50	60.12	14.50	3.00	2.00	0	0	0	0	187.87
0.41 - 0.6	14.00	54.37	33.37	9.75	5.00	0	0	0	0	0	116.50
0.61 - 0.8	0	57.62	5.87	3.00	1.00	0.50	0	0	0	0	68.00
0.81 - 1.0	0	24.75	2.00	0.50	0	0.50	0	0	0	0	27.75
1.01 - 1.5	0	11.62	2.50	1.00	0	0	0	0	0	0	15.12
1.51 - 2.0	0	0	0.75	0	0	0	0	0	0	0	0.75
2.01 - 2.5	0	0	0	0	0	0	0	0	0	0	0.00
TOTALS	101.25	193.37	116.62	33.75	10.00	4.00	0.50	0.00	0.00	0.00	459.50

Values in the above table are durations in days and have been rounded to the second decimal place.

TABLE 2

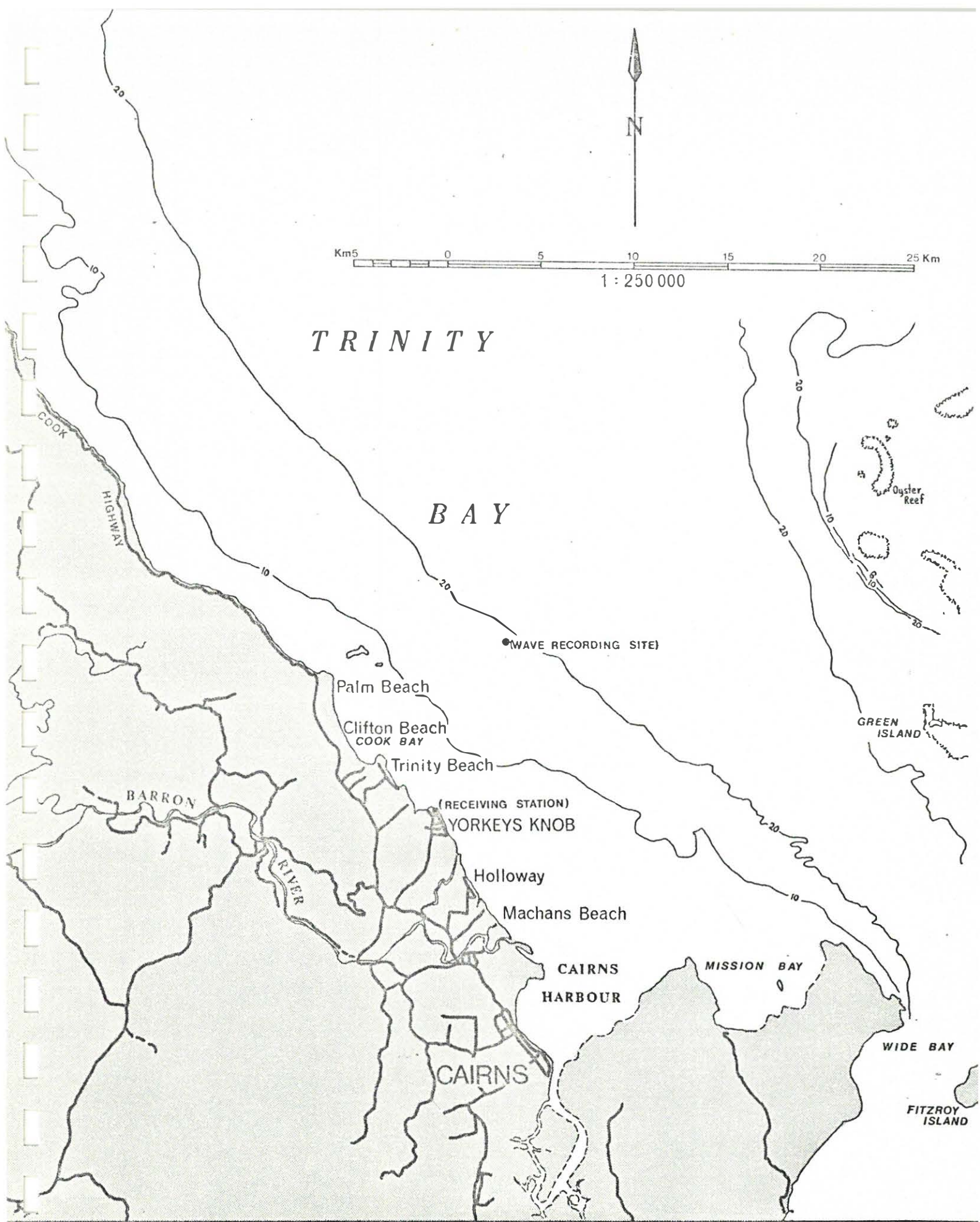
WAVE STATISTICS

WAVE PERIOD/WAVE HEIGHT OCCURRENCES

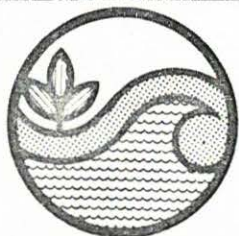
WINTER DATA, ALL DIRECTIONS

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)										TOTALS
	0 - 2.99	3 - 4.99	5 - 6.99	7 - 8.99	9 - 10.99	11 - 12.99	13 - 14.99	> 14.99			
0.00 - 0.2	2.00	3.50	1.00	2.00	0	0	0	0	0	0	8.50
0.21 - 0.4	27.75	14.25	55.25	28.25	0.50	0	0	0	0	0	126.00
0.41 - 0.6	8.50	66.75	59.50	49.25	2.00	0	0	0	0	0	186.00
0.61 - 0.8	0	95.75	8.00	29.75	0	0	0	0	0	0	133.50
0.81 - 1.0	0	90.75	0.50	6.00	0	0	0	0	0	0	97.25
1.01 - 1.5	0	26.00	0	0	0	0	0	0	0	0	26.00
1.51 - 2.0	0	0	0	0	0	0	0	0	0	0	0.00
2.01 - 2.5	0	0	0	0	0	0	0	0	0	0	0.00
TOTALS	38.25	297.00	124.25	115.25	2.50	0.00	0.00	0.00	0.00	0.00	577.25

Values in the above table are durations in days and have been rounded to the second decimal place.

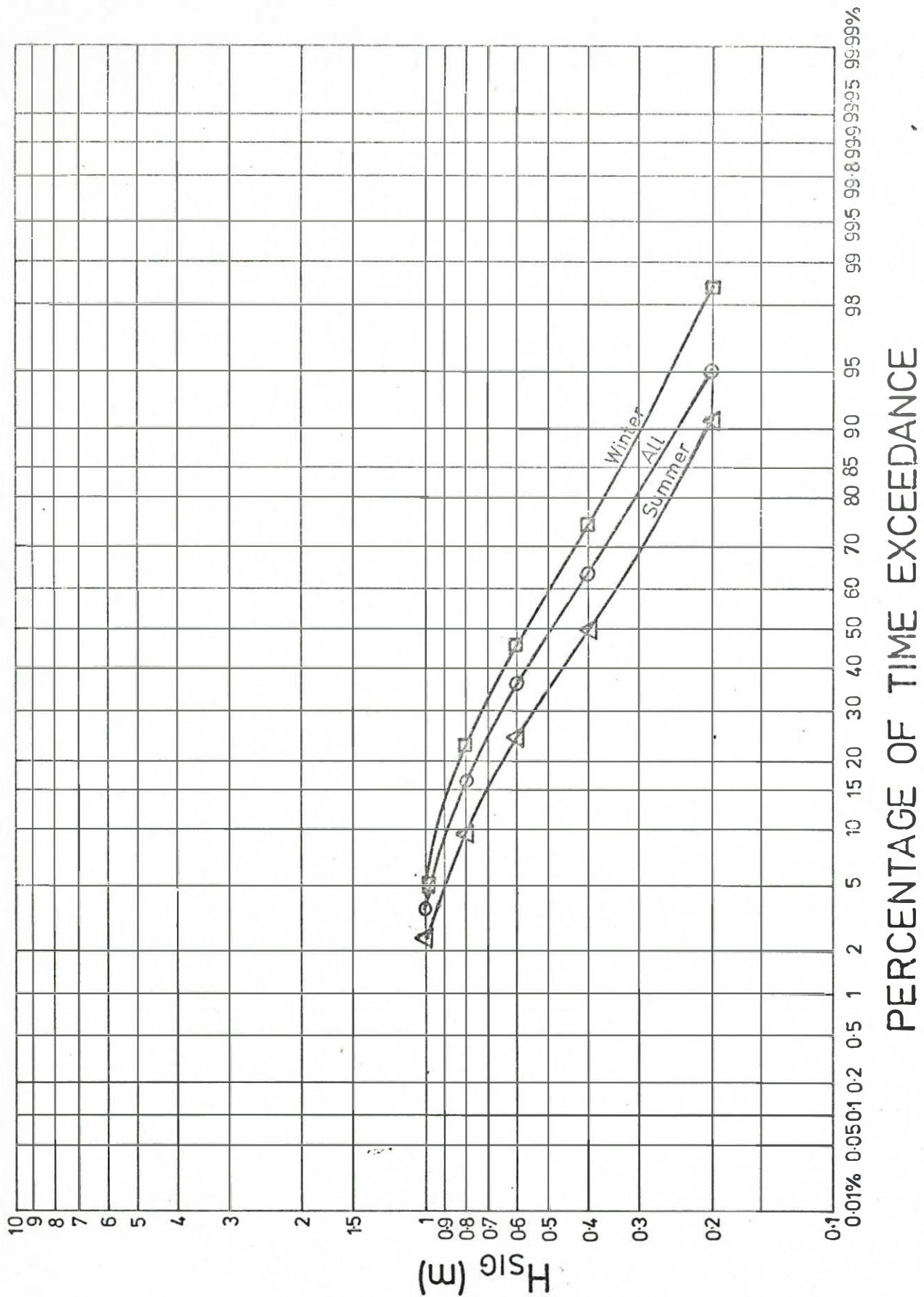


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LOCALITY MAP

Figure 1
W 01-1

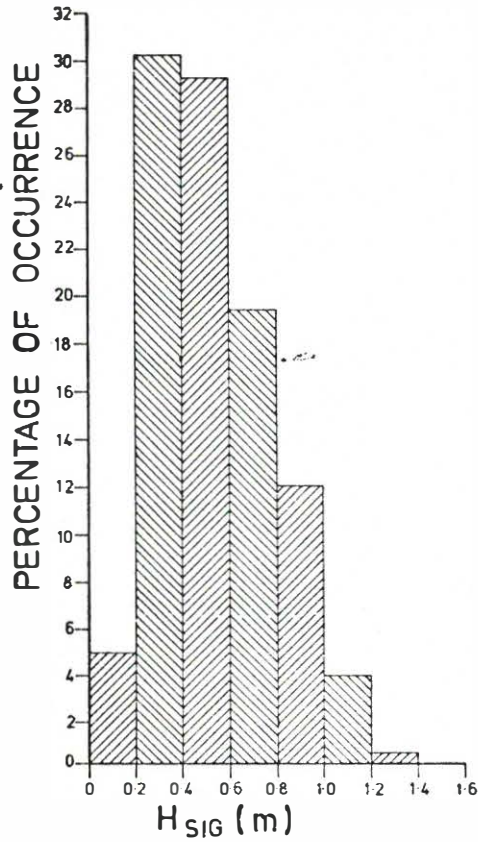


PERCENTAGE (OF TIME) EXCEEDANCE
OF WAVE HEIGHTS (H_{sig}) FOR ALL
WAVE PERIODS

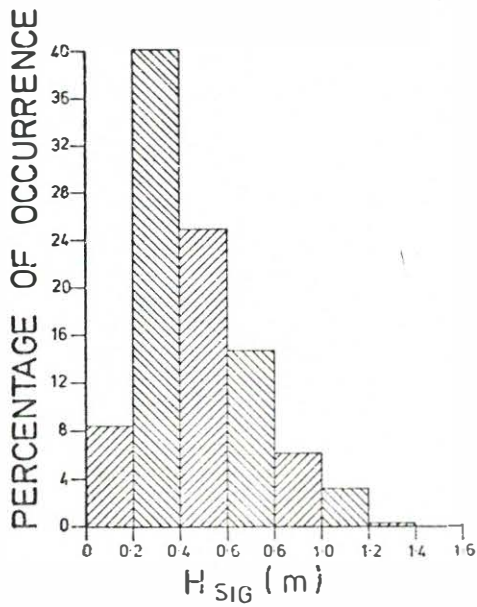
MAY 2, 1975 to SEPTEMBER 3, 1978

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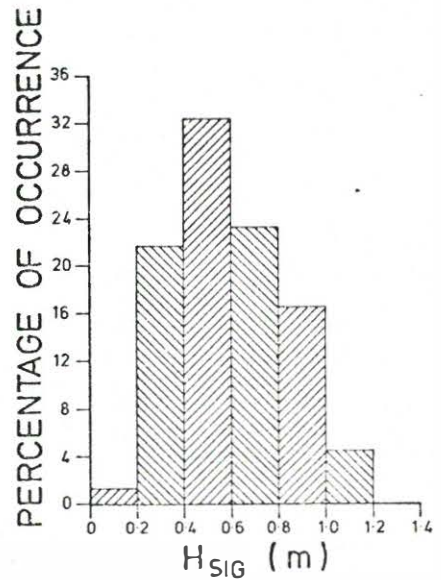
Figure 2
W01-1



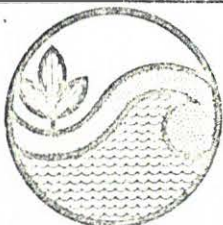
ALL DATA



SUMMER DATA



WINTER DATA



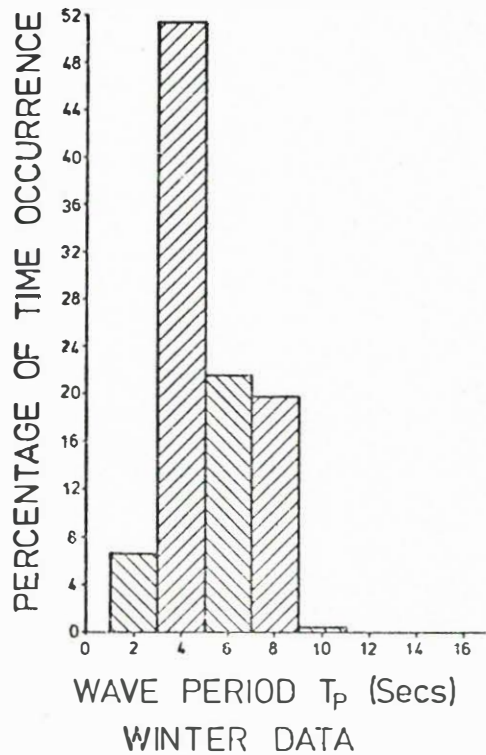
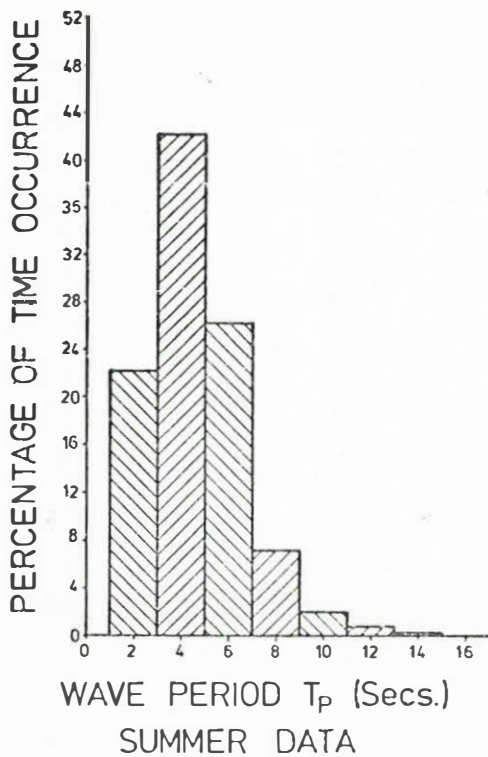
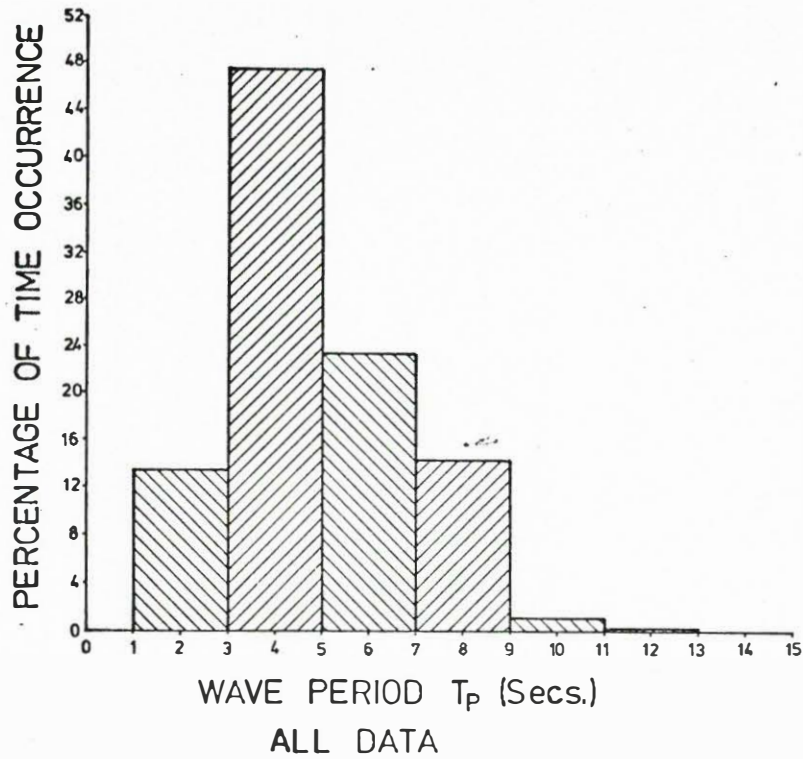
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HISTOGRAM PERCENTAGE (OF TIME)
 OCCURRENCE OF WAVE HEIGHTS (H_{SIG})
 FOR ALL WAVE PERIODS

MAY 2, 1975 to SEPTEMBER 3, 1978

Wave Data Recording Programme
 Cairns Region

Figure 3
 WO 1-1



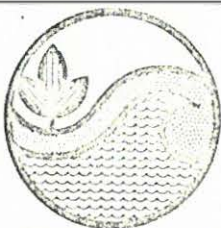
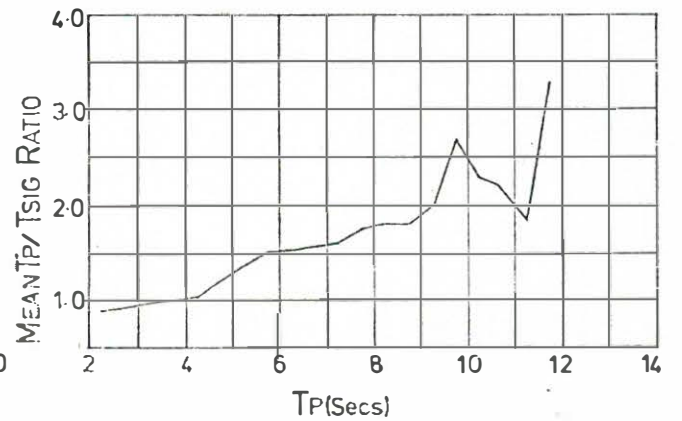
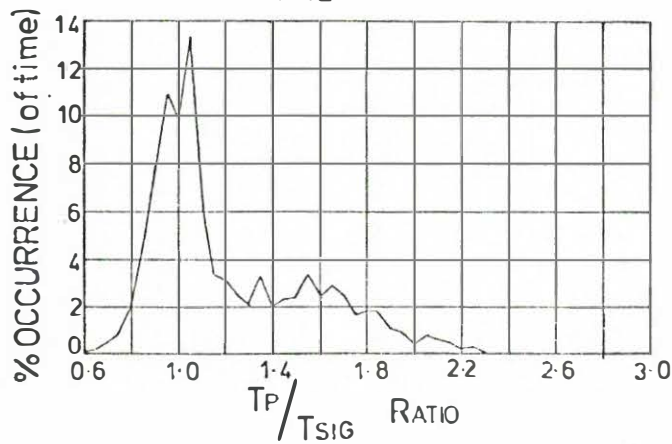
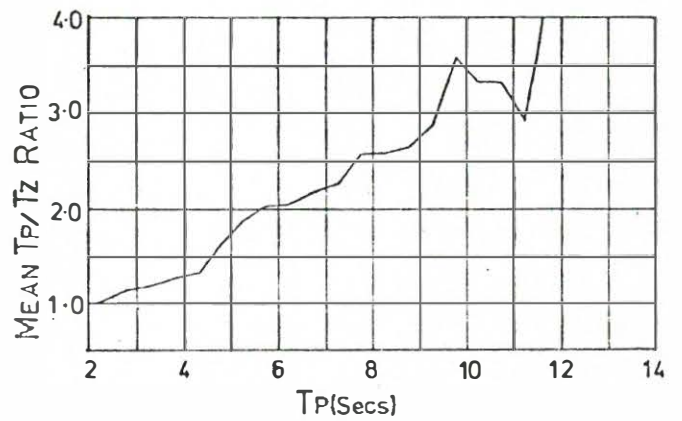
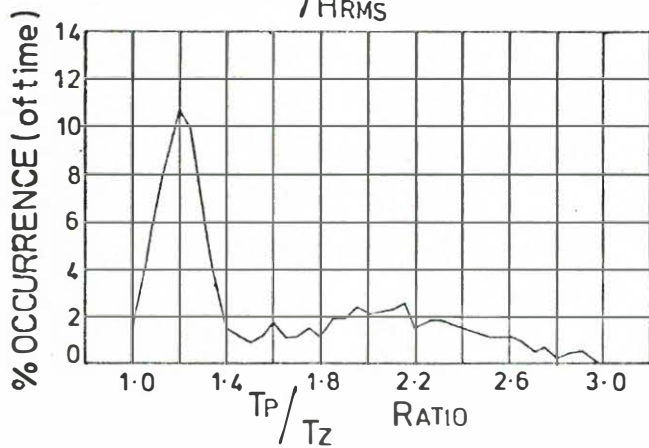
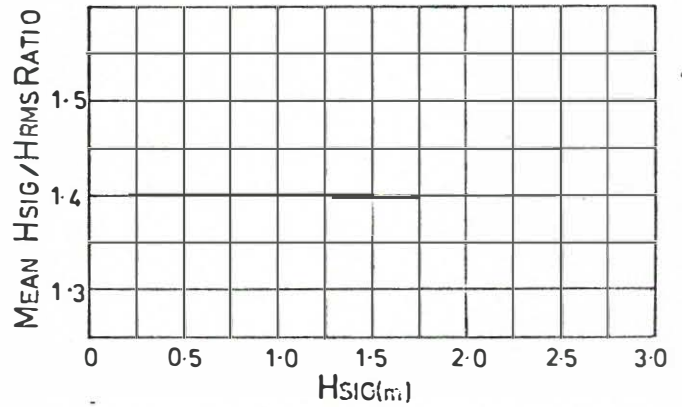
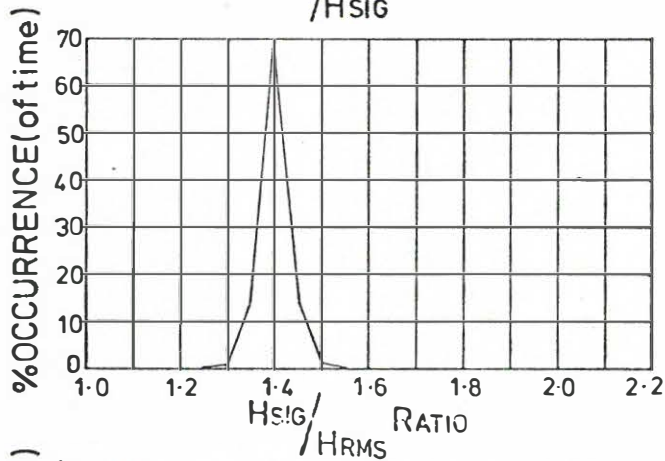
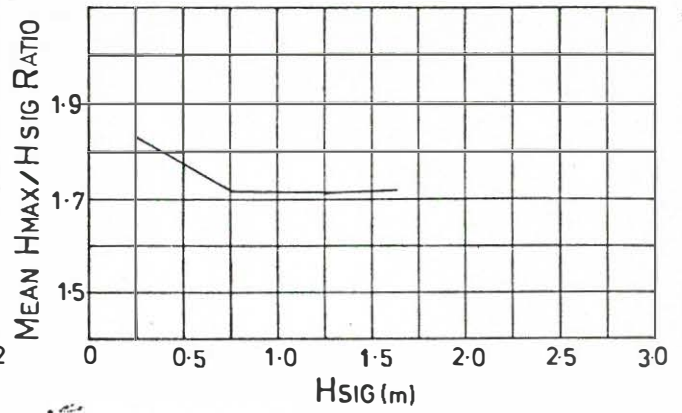
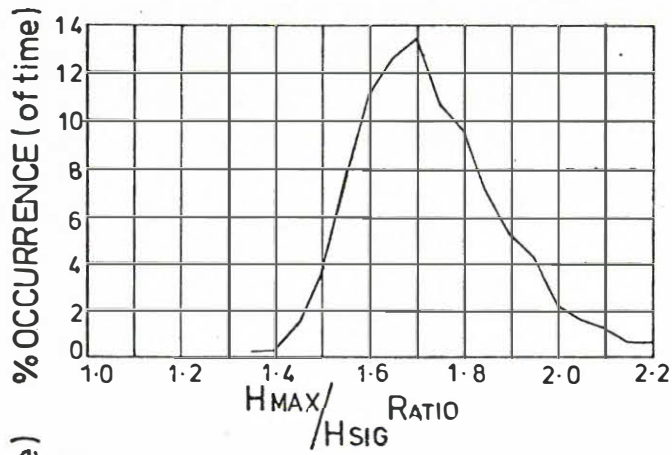
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HISTOGRAM PERCENTAGE (OF TIME)
OCCURRENCE OF WAVE PERIODS (T_p)
FOR ALL WAVE HEIGHTS

MAY 2, 1975 to SEPTEMBER 3, 1978.

Wave Data Recording Program
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Figure 4
W01-1

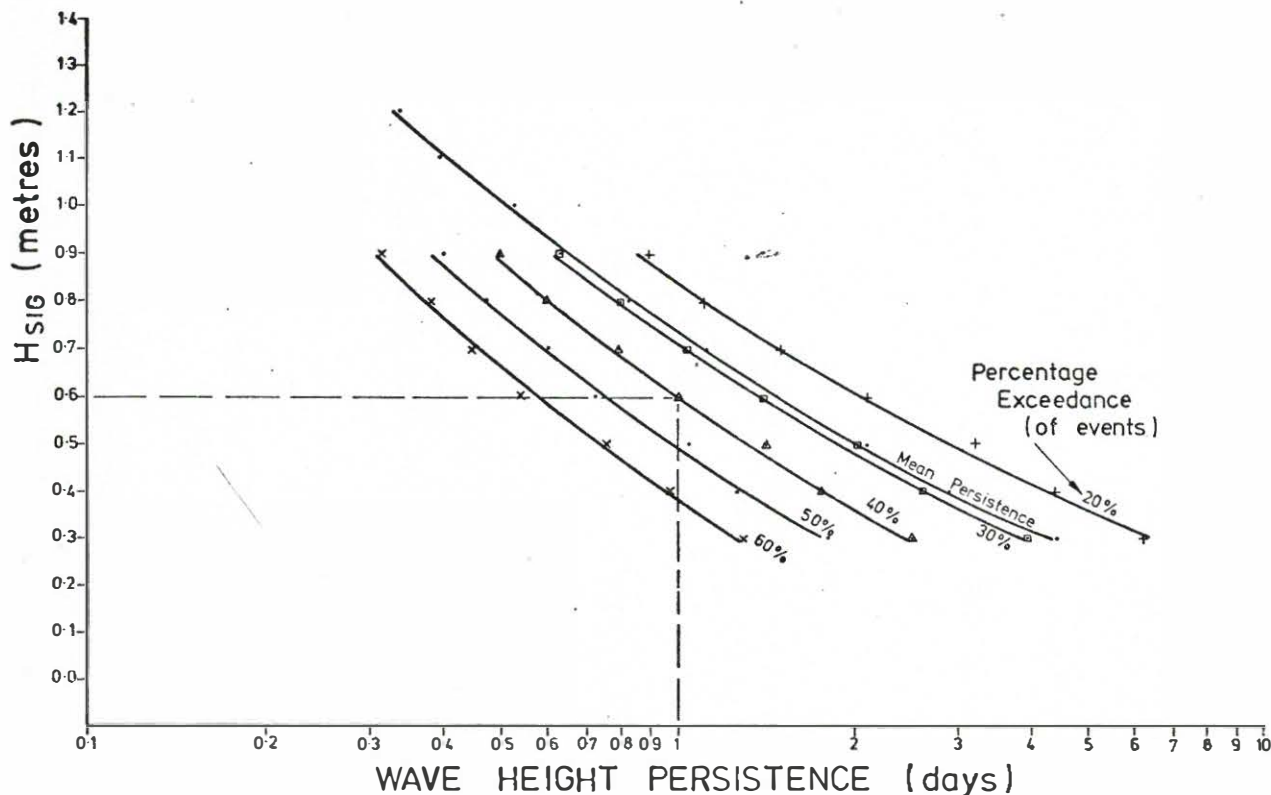


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WAVE PARAMETER RELATIONSHIPS
MAY 2, 1975 TO SEPTEMBER 3, 1978

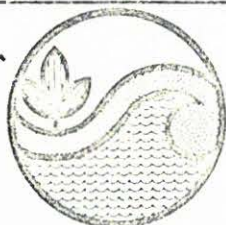
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Figure 5
W01-1



Note :-

- 1/ Wave height persistence is the duration for which a given significant wave height is continuously exceeded. As an example, given a 0.6 metre significant wave height, there is a 40% probability that this wave height or greater will persist for more than one day.
- 2/ The mean persistence line plotted represents the average persistence of all events having a given significant wave height or greater.

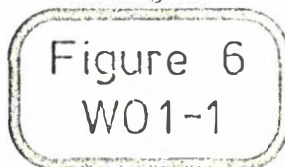


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AVERAGE DURATION OF
EXCEEDANCE OF WAVE
HEIGHTS (H_{sig})

MAY 2, 1975 to SEPTEMBER 3, 1978

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