I.O.S.

ADDITIONAL VISUAL WAVE OBSERVATIONS IN SCOTTISH WATERS 1976 – 1985

BY
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REPORT NO. 224
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WORMLEY

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CONTENTS

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L. Draper

INTRODUCTION

In 1967 the Scottish Development Department sought the assistance of the IOS (at that time the National Institute of Oceanography) in suggesting possible sources of wave data in Scottish waters (Draper, 1967, The Collection of Wave Data in Scottish Waters, unpublished). One recommendation was that a network of stations should be set up at which visual observations of wave conditions would be made by vessels on passage. The Scottish Wave Data Project was initiated in 1968 and reports were passed to the IOS by many vessels of several companies and organizations. In 1971 a preliminary analysis was undertaken of the reports received up to that time, but was not published. A further analysis was undertaken in mid 1976 of reports received up to that date and the combined results, for all stations reporting a minimum of about 500 observations, were published in IOS Report 29 (1976). In addition, two eastern stations E4 and E5 were also analysed, even though there were fewer than 500 observations, to give a comparative indication of conditions in that part of the North Sea. From that date some stations were abandoned for a variety of reasons, but six were continued.

For four stations, E4, N6, N10 and N11, where data were published in Report 29, all subsequent data have now been analyzed and previous data incorporated to yield more substantial presentations. For two stations E2 and E3 where there were inadequate data intially there is now a sufficient accumulation to yield a meaningful analysis. All data received are held by IOS and are available for study if required.

The methods of analysis and presentation are identical with those in Report 29, but for convenience are described below:

THE DATA AND METHOD OF ANALYSIS

The data presented here are exactly as reported by the observers. No editing of suspect data has been done at this stage. The reliability is commented upon in the discussion. The locations of the stations are shown on the map, and tables 1 and 2 give their names, latitudes and longitudes. The stations where adequate data for analysis were available in the first Report (No 29) are indicated by a circle around the location mark and by an asterisk in the tables, and those in this (second) Report (No 224) by an oblique stroke through the location mark and by ø in Table 2. At each station a vessel reports the wind speed and direction; tide speed and direction; sea (wave) height and period; swell height and period; whether daylight or dark. This analysis is concerned with the heights and periods of sea and swell separately. The results are presented in the form of a scatter diagram, expressed as occurrences in parts per thousand.

The method of analysis was as follows:

Two grids were drawn for each station, one for sea and one for swell. The heights in feet were plotted along the y axis and the periods in seconds along the x axis. For each report, consisting of a pair of numbers, height and period, a mark was made in the appropriate square. The following are examples of the conventions used in deciding into which square certain data should be recorded.

Figures on the report sheets: Height Feet	Period Seconds	Interpreted as:
-	-	both indeterminate
6	-	height 6 ft, period indeterminate
Nil	Nil	both zero
0	0	both zero
Nil	-	both zero
Calm		CALM
Rippled		"
No Swell		"
3/4	4/5	height 4 ft period 5 sec
3/5	4/6	height 4 ft period 5 sec
10/14	10/15	height 12 ft period 13 sec
3.4	4.5	height 4 ft period 5 sec
3.5	4.6	height 4 ft period 5 sec
3-4	4-5	height 4 ft period 5 sec
3-5	4-6	height 4 ft period 5 sec
-/-	-/-	ditto sign

When all the data had been recorded for one station, the total number of occurrences for each given height and period was found (total number of marks in each square). These figures were then expressed in parts per thousand of the total number of reports for the particular station (excluding reports in which one or both of the figures were indeterminate).

RESULTS

The results of this new analysis are presented as a series of figures, 37-48. As an illustration, on Scottish Station E2 Swell, Fig. 38, the most common occurrence appears to be of waves of 4 feet in height and of a period of 6 seconds. This occurred for 54 thousandths, or 5.4% of the time.

DISCUSSION

All the stations exhibit a known weakness of visual observations in reporting waves steeper than that which appears physically possible, (steepness is calculated as the height versus length of the waves; length is calculated from the reported wave period). This is almost certainly due to the difficulty in assessing period by eye in a wide spectrum sea. To illustrate this effect, a line of constant steepness of 1:10 is drawn on Figure 37. It has been shown (Ewing and Hogben, 1966) that when visual observations are made from a vessel carrying a wave recorder, the wave periods, and therefore the wavelengths, reported by experienced observers are usually spread over values equivalent to the wavelength calculated from the dominant instrumental period, down to a third of that wavelength.

A further cause of error in the estimation of wave period from a moving vessel may be that it is difficult to make adequate allowance for the relative speed of vessel and waves. This can give an increase or decrease in the apparent period. The estimation of height is not affected by this effect.

Fortunately, height is estimated using the size of the ship as a scale and it not quite so subjective, but when waves encounter a change in current they can become shorter and steeper if the current opposes them or longer and less steep if they travel in the same direction. This effect is likely to occur in many of these stations in restricted waters and may have produced a small spread in estimates of height.

An inspection of the figures reveals that in some cases the observers have a marked preference for even numbers; the explanation for this is presumably psychological, not oceanographic.

Although these data have obvious imperfections, they do report what the observer believed he saw. It seems likely that there are appreciable errors in the wave periods, but that heights are fairly representative. In spite of the imperfections they are valuable because they constitute the only tabulated wave information available for individual locations in near-shore Scottish waters. Already they have found many uses for transport, engineering and other purposes, for example in the estimation of

down-time for projected operations in specific remote areas. Another use has been for the calculation of the likelihood of the occurrence of moderately-severe conditions in a normally-quiet location planned to be used as an assembly area for large structures, such as oil platforms, or even for choosing towing routes for these structures through such waters.

This project is a good demonstration of how, for remote areas, long-duration low-cost studies are able to produce medium-quality data, but which nevertheless are incomparably better than having no data at all. The consistent, although apparently mundane, task undertaken by people who have a dedication to their profession is a resource which is often overlooked, but if sufficient fore-thought is applied, such projects can yield unique data with minimal effort. It is far more cost effective than waiting until a specific need arises and then having to install expensive equipment to gain data in a hurry; a low-key long-duration wide-area activity such as this can often give a potential operator a good enough idea of the severity of the waters to enable a sensible first-look decision to be made without resort to a dedicated data-gathering programme.

REFERENCES

EWING, J.A. and HOGBEN, N., 1966 Some wave and wind data from trawlers. Marine Observer, London, 36, 71.

DRAPER, L. and HERBERT, J.P., 1976 Visual wave observations in Scottish waters 1968-1976. IOS Report 29.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation of the dedication shown by the officers responsible for the collection of these data over the last seventeen years. The results are unique, are valuable for many planning purposes, and in demonstrating the severity of conditions in which these observing vessels operate. The willing cooperation of the various marine companies and organizations who have participated in this task is gratefully acknowledged. The author also wishes to express his thanks to Mr. M.C. Pollard who undertook the tedious task of abstracting the data from the report sheets, and to Mr. Campbell Webb who checked some of the calculations.

Scottish Wave Data Project

West Coast Recording and Observing Stations

W1*	South East of Pladda, Arran	55°24'N	5°05'W
W2	10 miles North East of Mull of Kintyre	55°27'N	6°00'W
W3	South of The Oa, Islay	55°33'N	6°17'W
W4	North West of Ardnamurchan	56°45'N	6°15'W
W5	By Hyskeir	56°55'N	6°41'W
W6	Open water East of Lochboisdale	57°08'N	7°10'W
W7*	5 miles East of Barra	56°58'N	7°17'W
W8*	15 miles North of Tiree	56°45'N	7°00'W
W9	Off Dubh Artach, 15 miles South West of Mull	56°08'N	6°34'W
W10	2 miles North West of the northern point of Colonsay	56°08'N	6°10'W
W11*	Open water East of Lochmaddy	57°36'N	7°00'W
W12*	South of Scalpay	57°49'N	6°40'W
W13*	South of Chicken Head	58°08'N	6°16'W
W14*	Midway between Shiant Islands and Rubha Reidh Lighthouse	57°51'N	6°04'W
W15*	West of Applecross Village	57°26'N	5°55'W
W16*	In the vicinity of Sleat Point	57°02'N	5°53'W
W17*	Between entrance to West Loch Tarbert and north end of Gigha	55°44'N	5°39'W
W18*	3 miles south of Chuirn Island (Islay)	55°37'N	6°00'W
W19	Mid-Minch between Stornoway and the Summer Isles	58°03'N	5°50'W
W20	Off Ru Coigach	58°05'N	5°30'W
W21	Off Ru Stoer	58°14'N	5°28'W

* Data presented in the 1976 Report (No 29)
(none of these data is presented in this Report)

TABLE 1

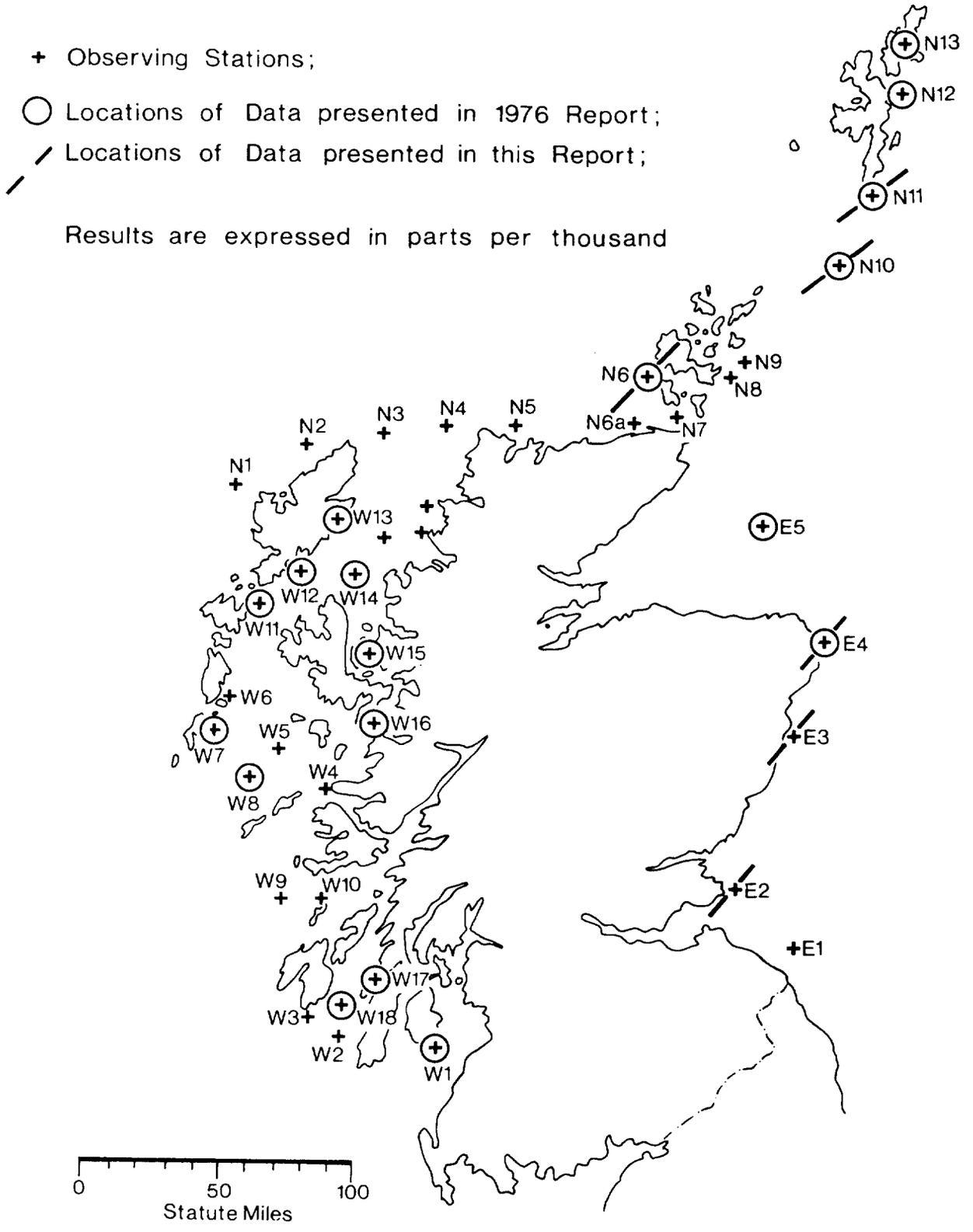
Scottish Wave Data Project
East/North Coasts Recording and Observing Stations

E1	Off St. Abb's Head	56°00'N	2°00'W
E2 ø	Off Fife Ness	56°17'N	2°32'W
E3 ø	Off Stonehaven	56°58'N	2°08'W
E4*ø	Off Peterhead	57°30'N	1°43'W
E5*	Midway in Moray Firth (on line Duncansby Head to Rattray Head)	58°10'N	2°22'W
N1	10 miles East of Flannan Isles	58°20'N	7°16'W
N2	10 miles West of Butt of Lewis	58°28'N	6°32'W
N3	10 miles East of Butt of Lewis	58°33'N	5°55'W
N4	10 miles West of Cape Wrath	58°38'N	5°20'W
N5	10 miles East of Cape Wrath	58°39'N	4°42'W
N6*ø	West of the Old Man of Hoy	58°53'N	3°27'W
N6a	NW of Dunnet Head	58°42'N	3°33'W
N7	Midway in the Pentland Firth	58°44'N	3°12'W
N8	Off Copinsay Light, Orkney	58°55'N	2°36'W
N9	Off Auskerry Light, Orkney	59°02'N	2°32'W
N10*ø	Off Fair Isle	59°32'N	1°34'W
N11*ø	Off Sumburgh, Shetland	59°49'N	1°12'W
N12*	In Whalsay Sound, Shetland	60°20'N	1°03'W
N13*	Between Fetlar and Gutcher, Shetland	60°38'N	0°27'W

* Data presented in the 1976 Report (No 29)
ø Data presented in this report

For other stations, the total amount of data available is inadequate for meaningful analysis.

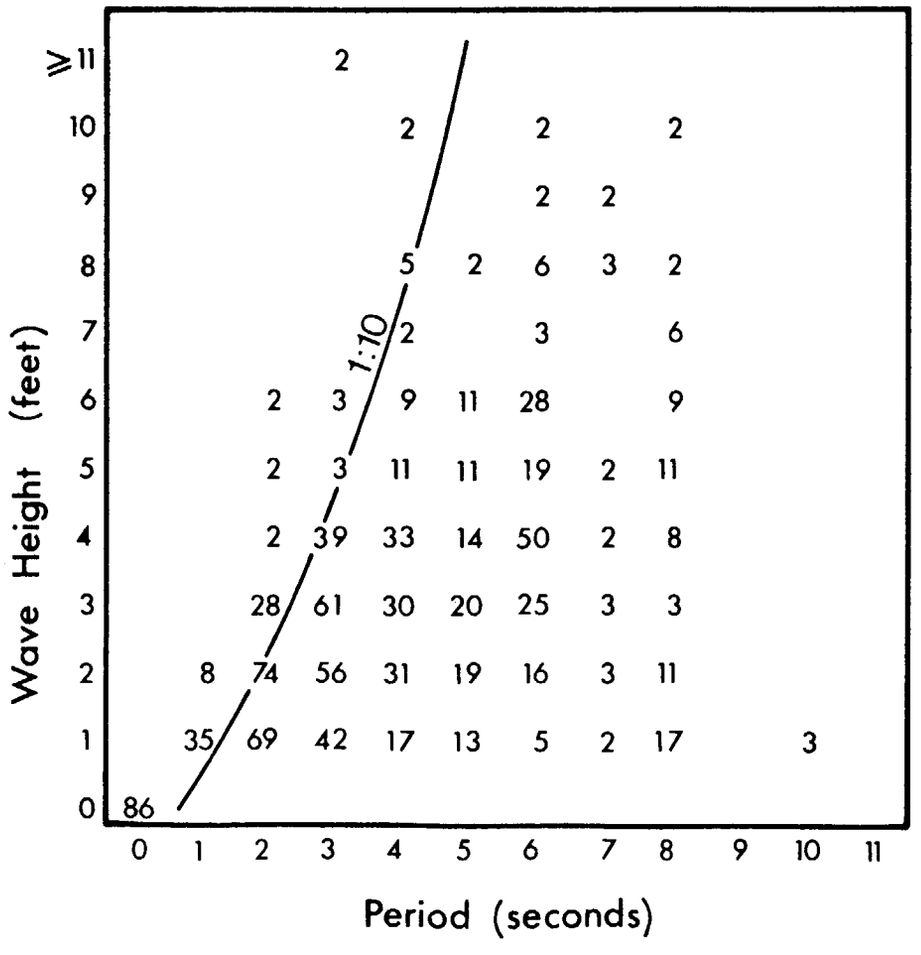
TABLE 2



LOCATION MAP OF THE STATIONS

Sc Stn. E2 1968 - 1985

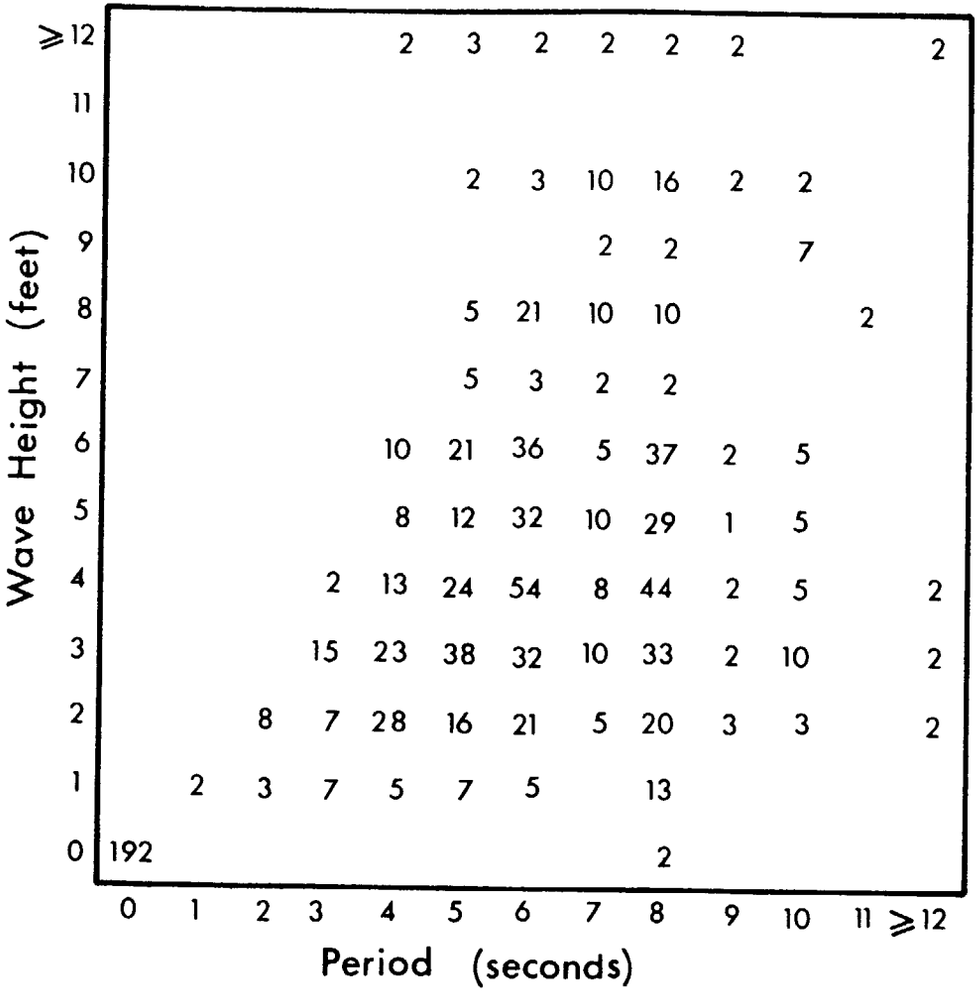
SEA



Tot Obs 637

Fig. 37

Sc Stn. E2 1968 - 1985
SWELL



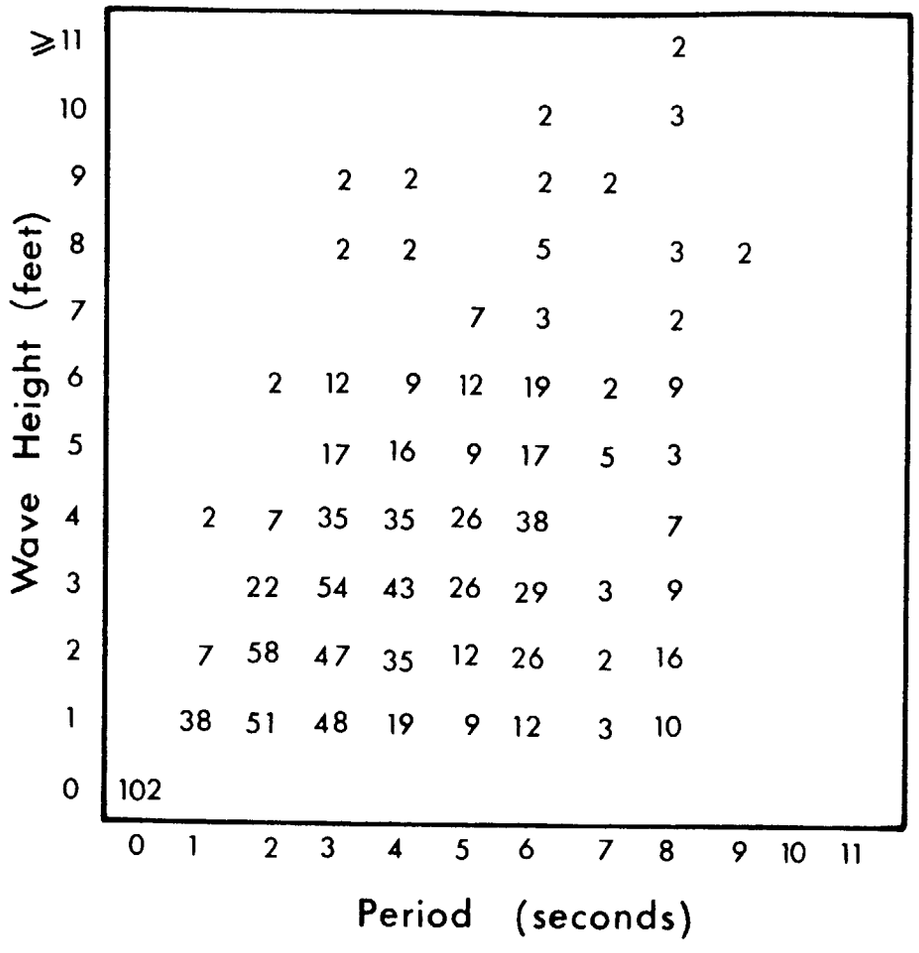
Greatest height 20ft (2 occurrences)

Tot Obs 614

Fig. 38

Sc Stn. E3 1968 - 1985

SEA

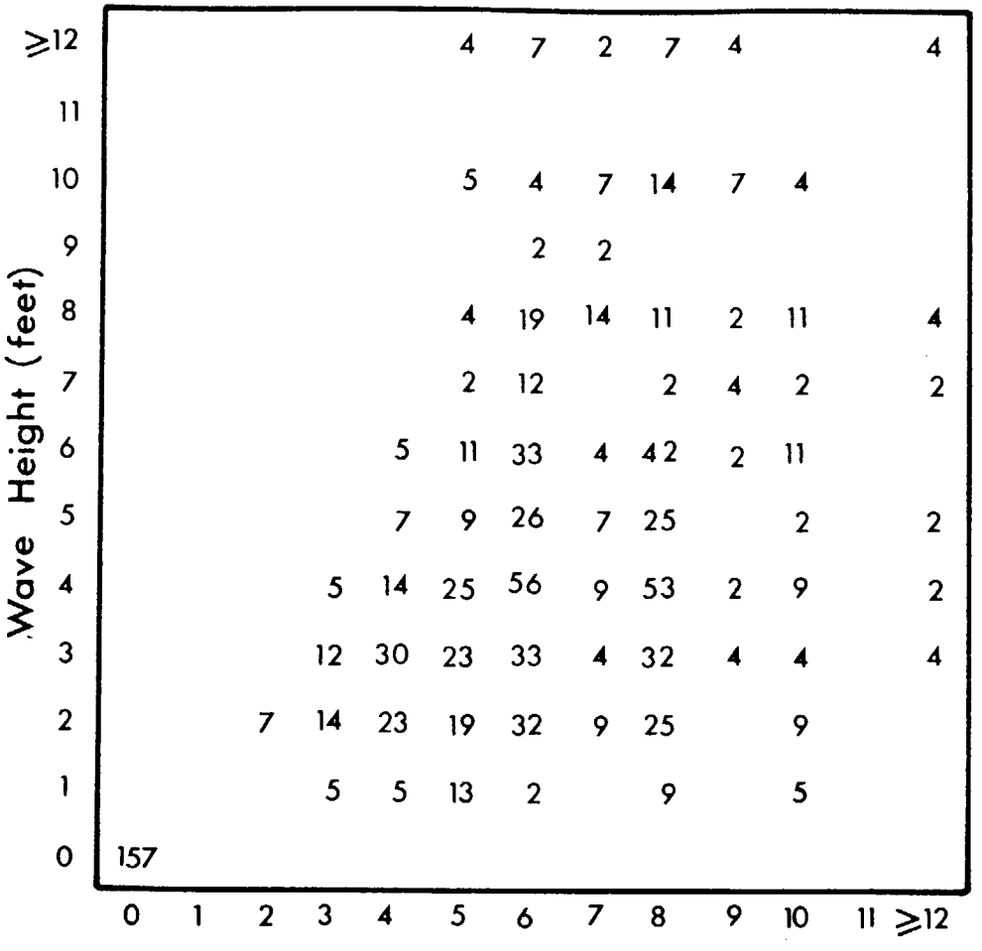


Tot Obs 578

Fig. 39

Sc Stn. E3 1968-1985

SWELL



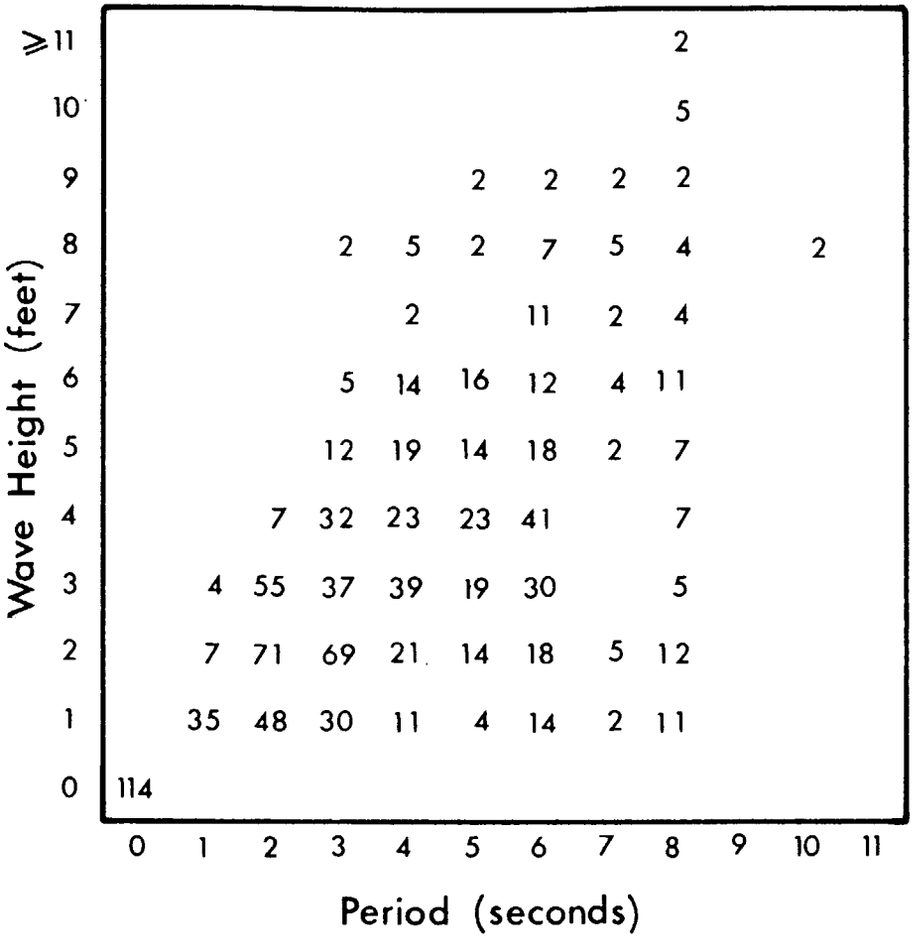
Greatest height 15ft.

Tot Obs 571

Fig. 40

Sc Stn. E4 1968 - 1985

SEA

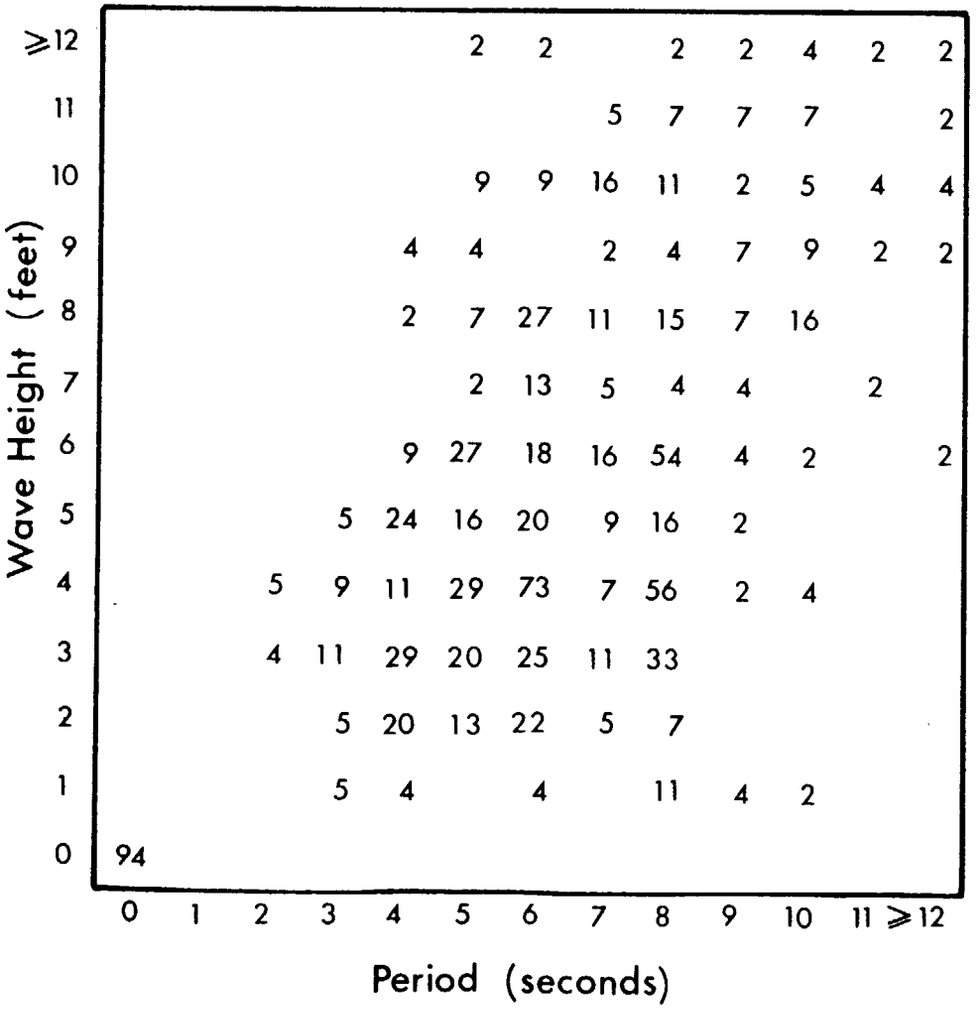


Tot Obs 569

Fig. 41

Sc Stn. E4 1968 – 1985

SWELL



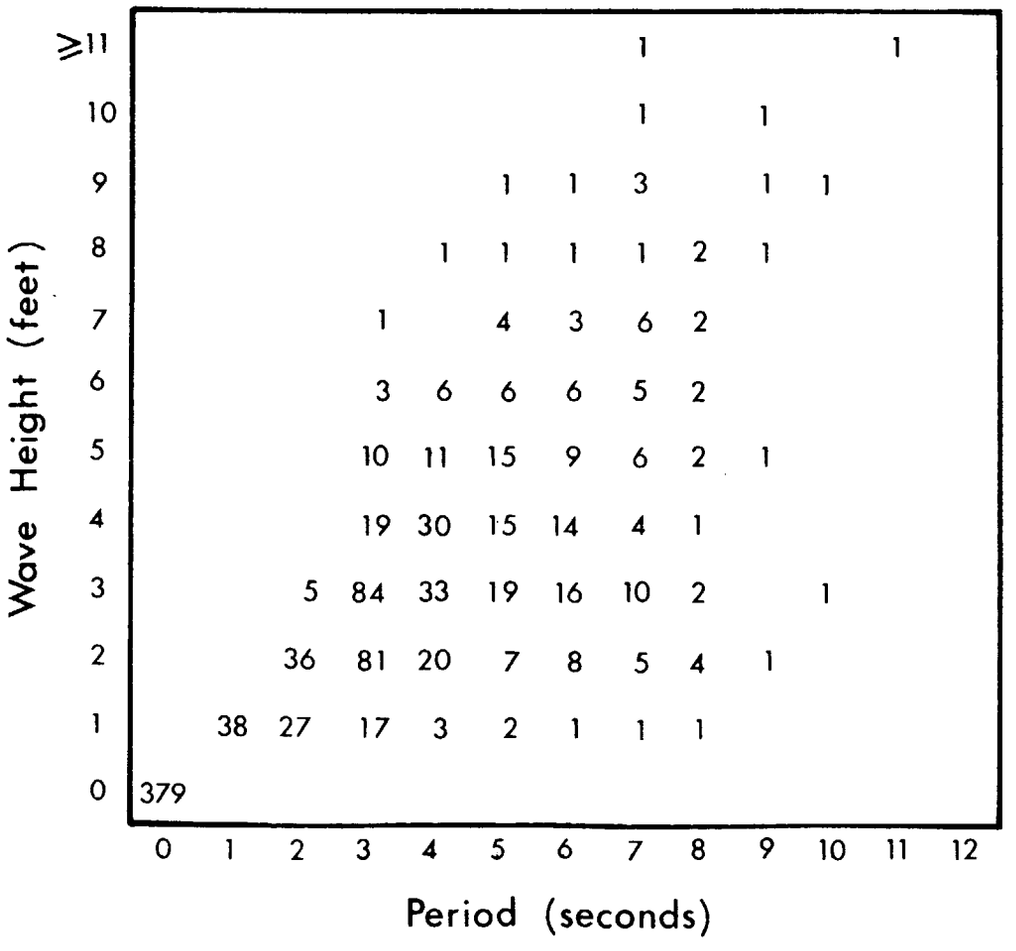
Greatest height 18ft

Tot Obs 550

Fig. 42

Sc Stn. N6 1968-1985

SEA

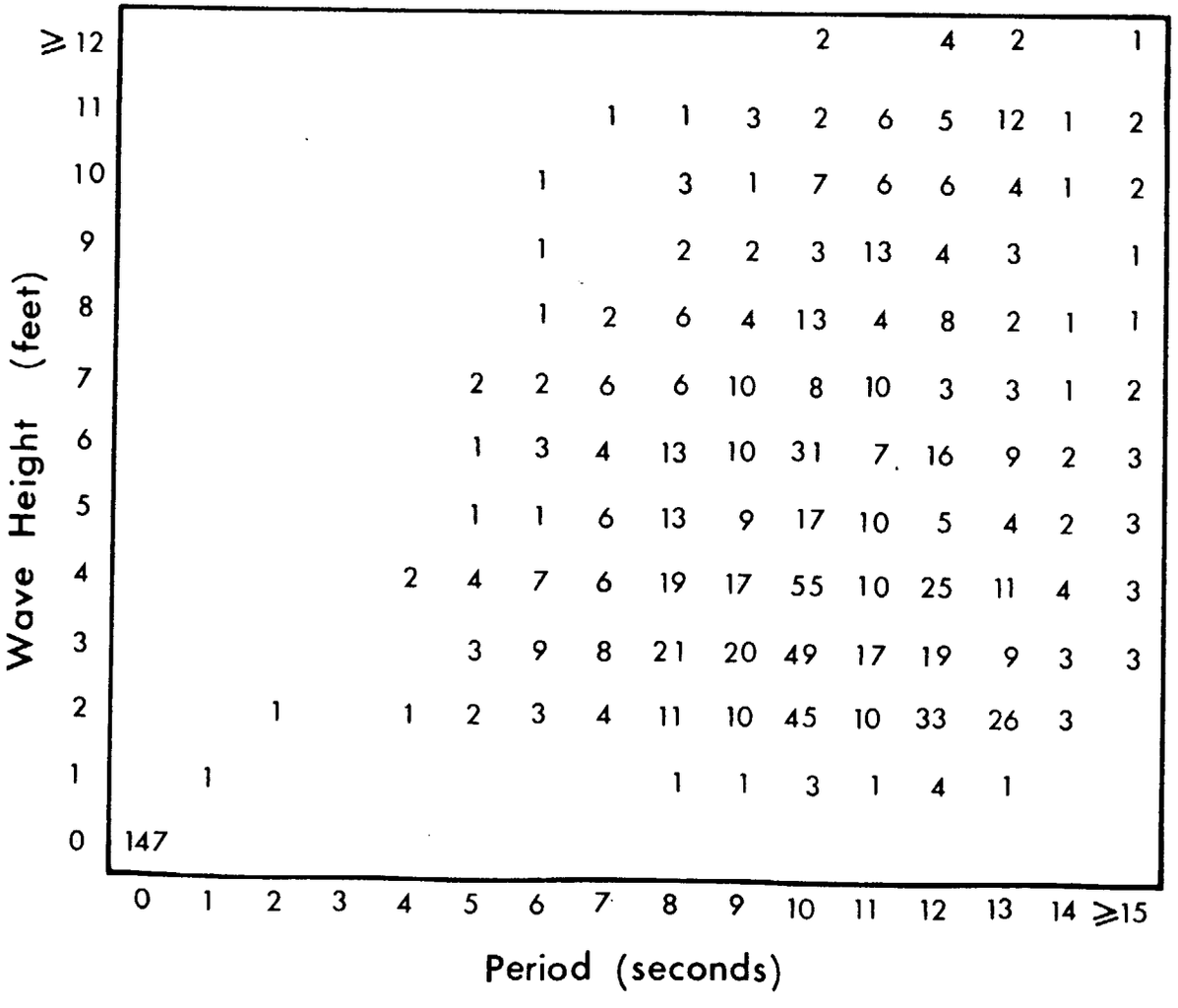


Tot Obs 3252

Fig. 43

Sc Stn. N6 1968-1985

SWELL



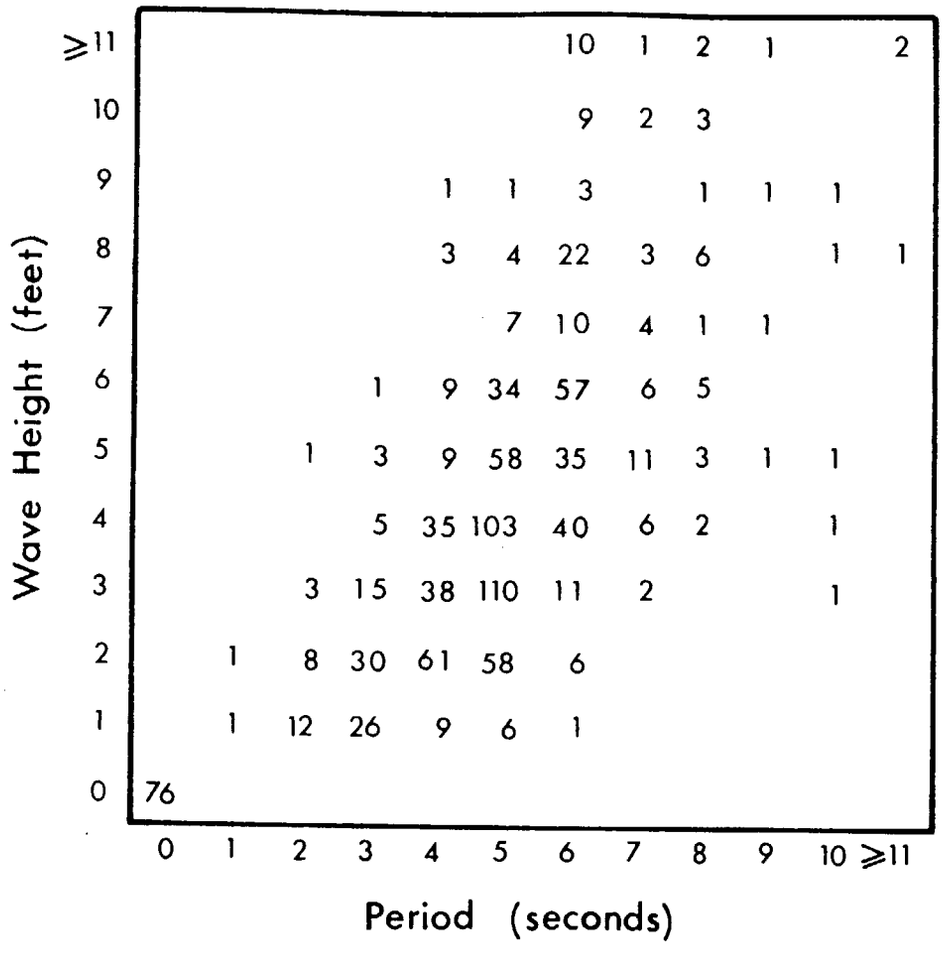
Greatest height 20ft (2 occurrences) largest period 22sec

Tot Obs 3095

Fig. 44

Sc Stn. N10 1968 - 1985

SEA



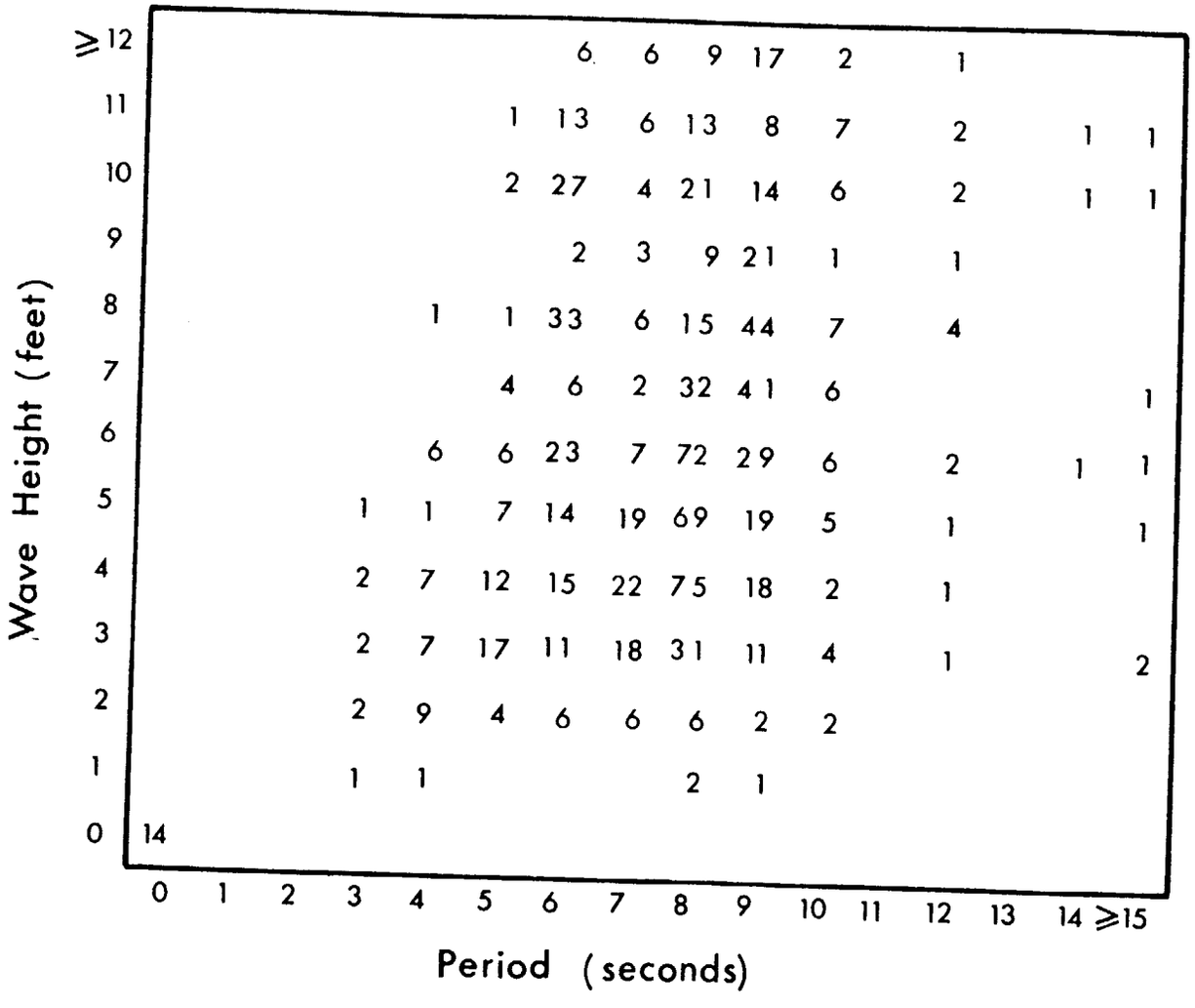
Greatest height 15 ft.

Tot Obs 1607

Fig. 45

Sc Stn. N10 1968 - 1985

SWELL



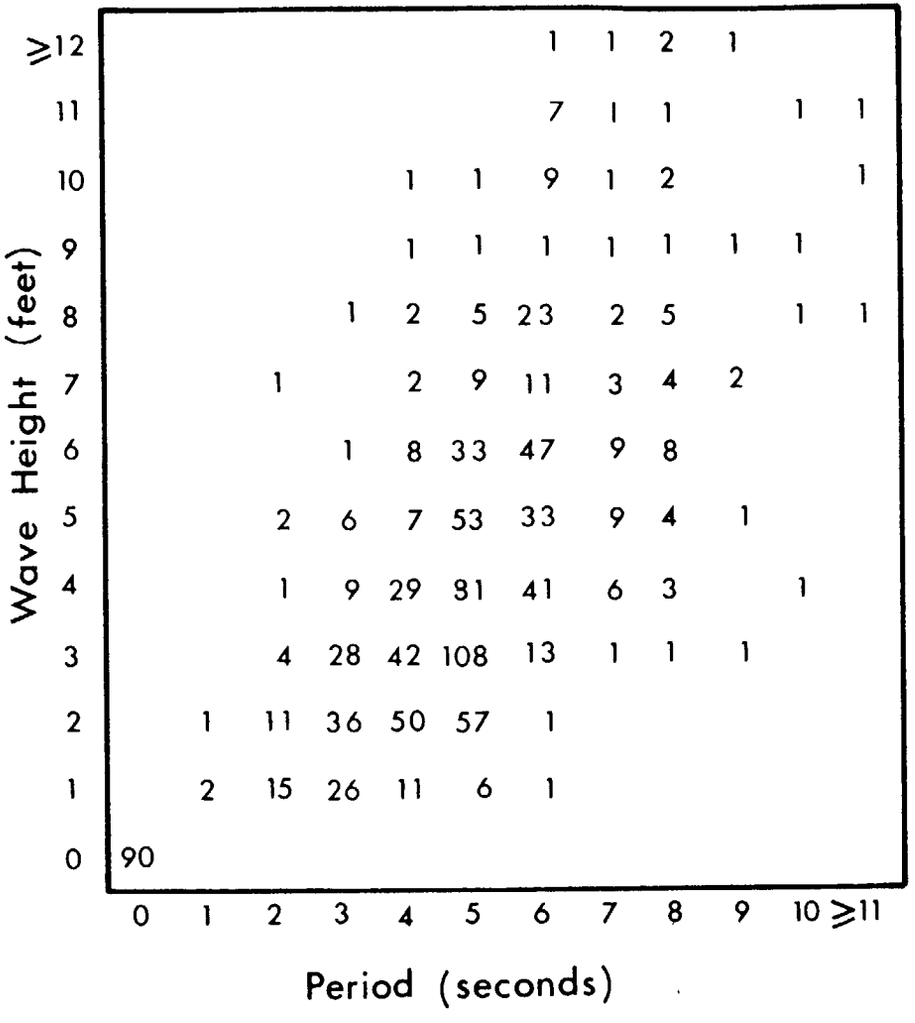
Greatest height 15 ft

Tot Obs 1617

Fig. 46

Sc Stn. N11 1968 - 1985

SEA



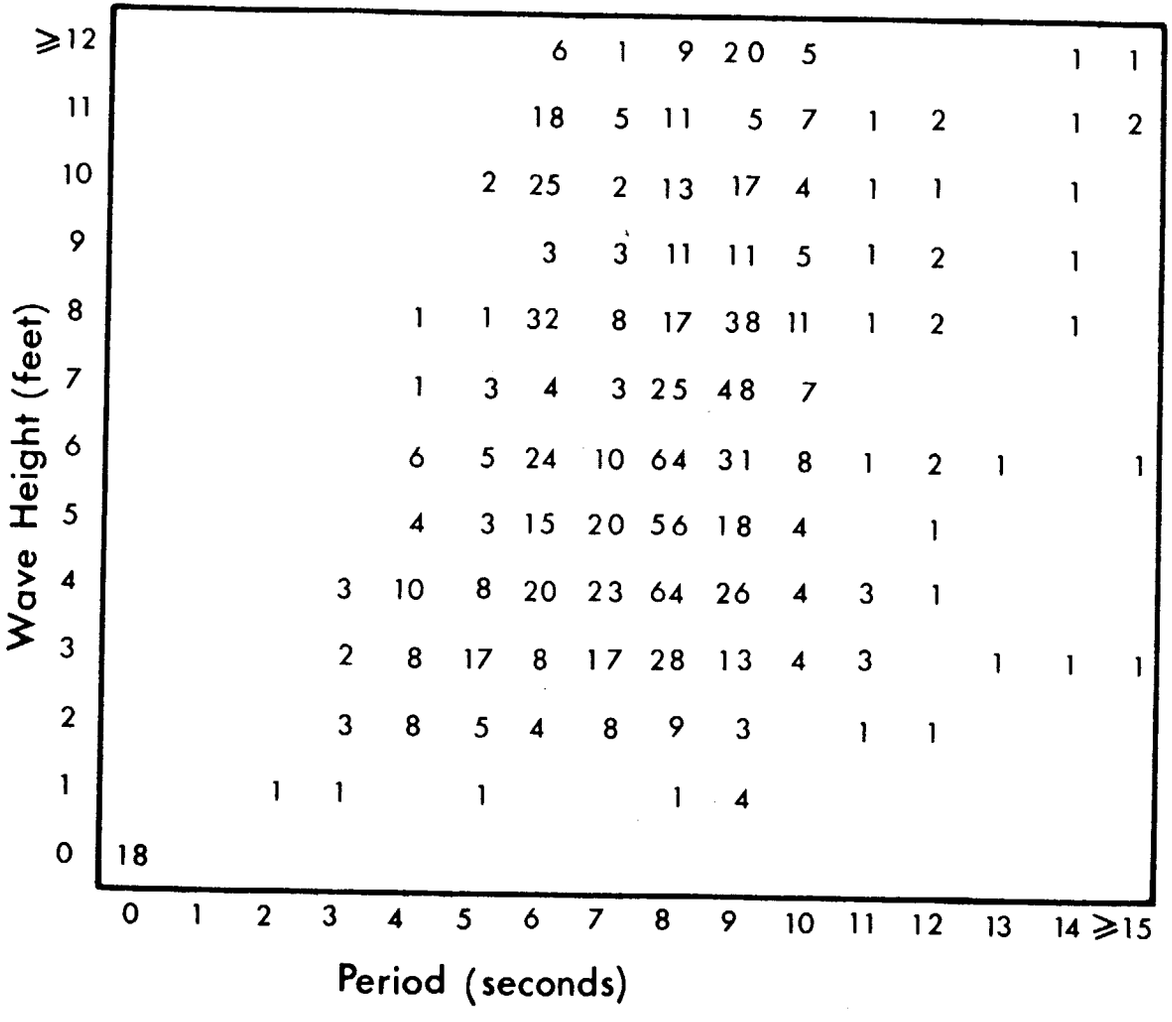
Greatest height 12ft

Tot Obs 1709

Fig. 47

Sc Stn. N11 1968 - 1985

SWELL



Greatest height 16ft

Tot Obs 1715

Fig. 48