VISUAL WAVE OBSERVATIONS IN SCOTTISH WATERS 1968 - 1976

by

L. DRAPER AND J.P. HERBERT

REPORT No. 29

1976

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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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possible sources of wave data in Scottish waters (Draper, 1967, The Collection of Wave Data in Scottish Waters, unpublished).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 has been undertaken of reports received subsequently and the combined results, for all stations reporting a minimum of about 500 observations, are contained in this report. In addition, two eastern stations have been analysed, even though there are fewer observations, to give a comparative indication of conditions in that part of the North Sea.

THE DATA AND METHODS 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 are available are indicated by a circle around the location mark and by an asterisk in the table. 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.

*Vacation student, 1976

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	" "
NIL	-	" "
CALM		CALM
RIPPLED		"
NO SWELL		"
3/4	4/5	height 4 ft. period 5 sec
3/5	4/6	" " " " " "
10/14	10/15	height 12 ft. period 13 sec
3.4	4.5	height 4 ft. period 5 sec
3.5	4.6	" " " " " "
3-4	4-5	" " " " " "
3-5	4-6	" " " " " "
-"-	-"-	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 analysis are presented as a series of figures, 1-36. As an illustration, on Scottish Station W7 Sea, Fig. 3, the

most common occurrence appears to be of waves of 3 feet in height and of a period of 4 seconds. This occurs for 115 thousandths, or 11.5% of the time. Waves of 2 feet in height and of 3 seconds period are almost as common at 111 parts per thousand. Because of the small total number of observations this difference is not significant.

The results from only eighteen stations are presented here. Many of the others have been analyzed but are not published because a diagram prepared from a small number of observations can lead to misleading conclusions.

DISCUSSION

All the stations exhibit a known weakness of visual observations in reporting waves steeper than that which appears physically possible. 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 1. It has been shown (Ewing and Hogben 1966) that when visual observations are made from a vessel carrying a wave recorder, the wavelengths reported by experienced observers are usually spread over values of the wavelength calculated from the dominant instrumental period, down to a third of that wavelength. The shorter steeper waves dominate the observer's perception of wavelength, and also of period.

A further cause of error in the estimation of wave period from a moving vessel maybe 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 water and may have produced a small spread in estimates of height.

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. The continued collection of such data should enhance the reliability of the existing data and permit the completion of stations at present too sparsely sampled.

REFERENCE

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

ACKNOWLEDGEMENT

The authors wish to express their appreciation of the dedication shown by the officers responsible for the collection of these data over the last eight 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.

Scottish Wave Data Project

West Coast Recording and Observing Stations

W1*	South East of Pladda, Arran	55°24'N	5° 5'W
W2	10 miles North East of Mull of Kintyre	55°27'N	6° 0'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° 0'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° 0'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 this report

Table 1

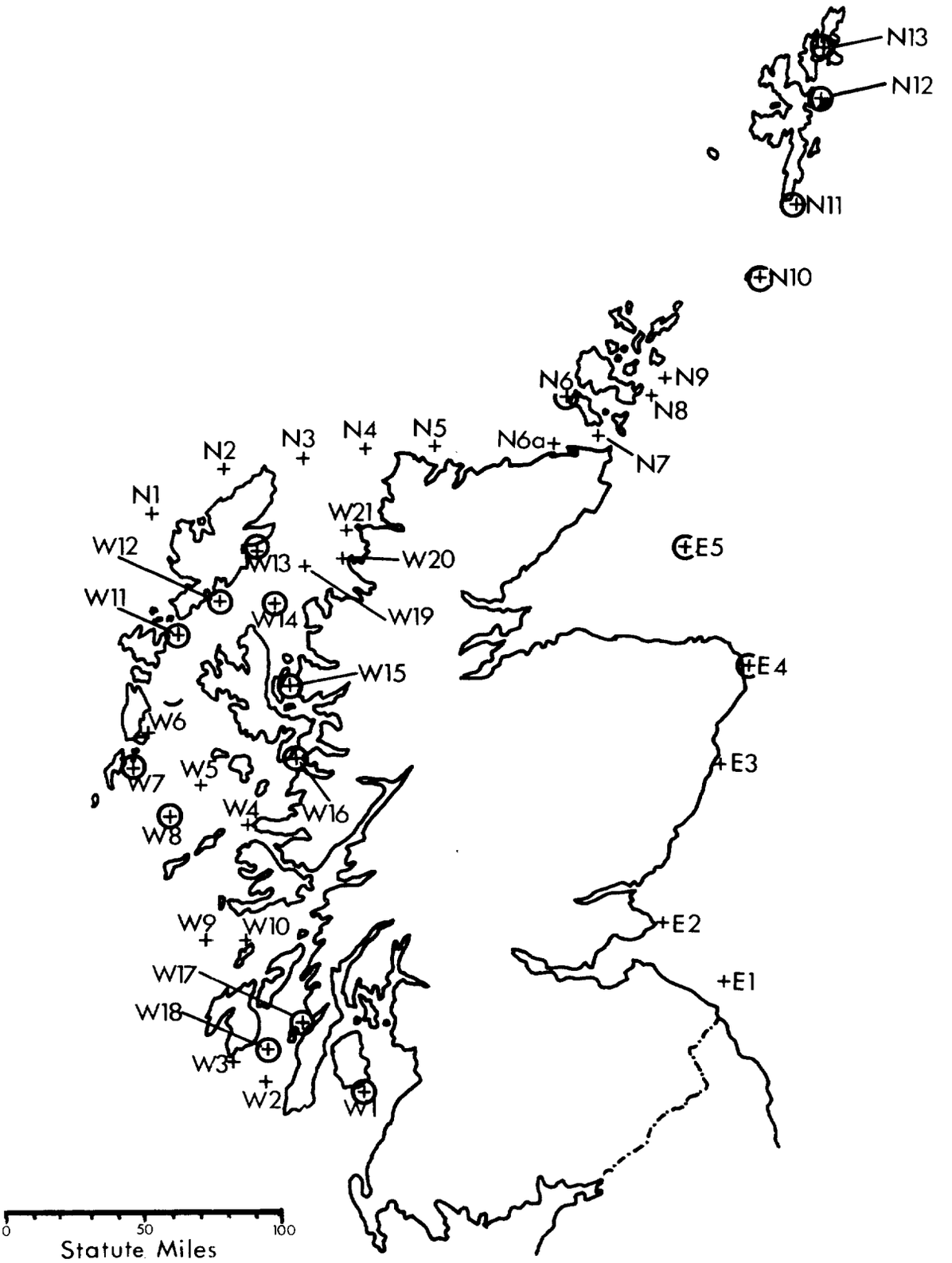
Scottish Wave Data Project

West/North Coasts Recording and Observing Stations

E1	Off St Abb's Head	56°00'N	2°00'W
E2	Off Fife Ness	56°17'N	2°32'W
E3	Off Stonehaven	56°58'N	2°08'W
E4*	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*	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*	Off Fair Isle	59°32'N	1°34'W
N11*	Off Sumburgh, Shetland	59°49'N	1°12'W
N12*	In Whalsay Sound, Shetland	60°20'N	1° 3'W
N13*	Between Fetlar and Gutcher, Shetland	60°38'N	0°27'W

*Data presented in this report

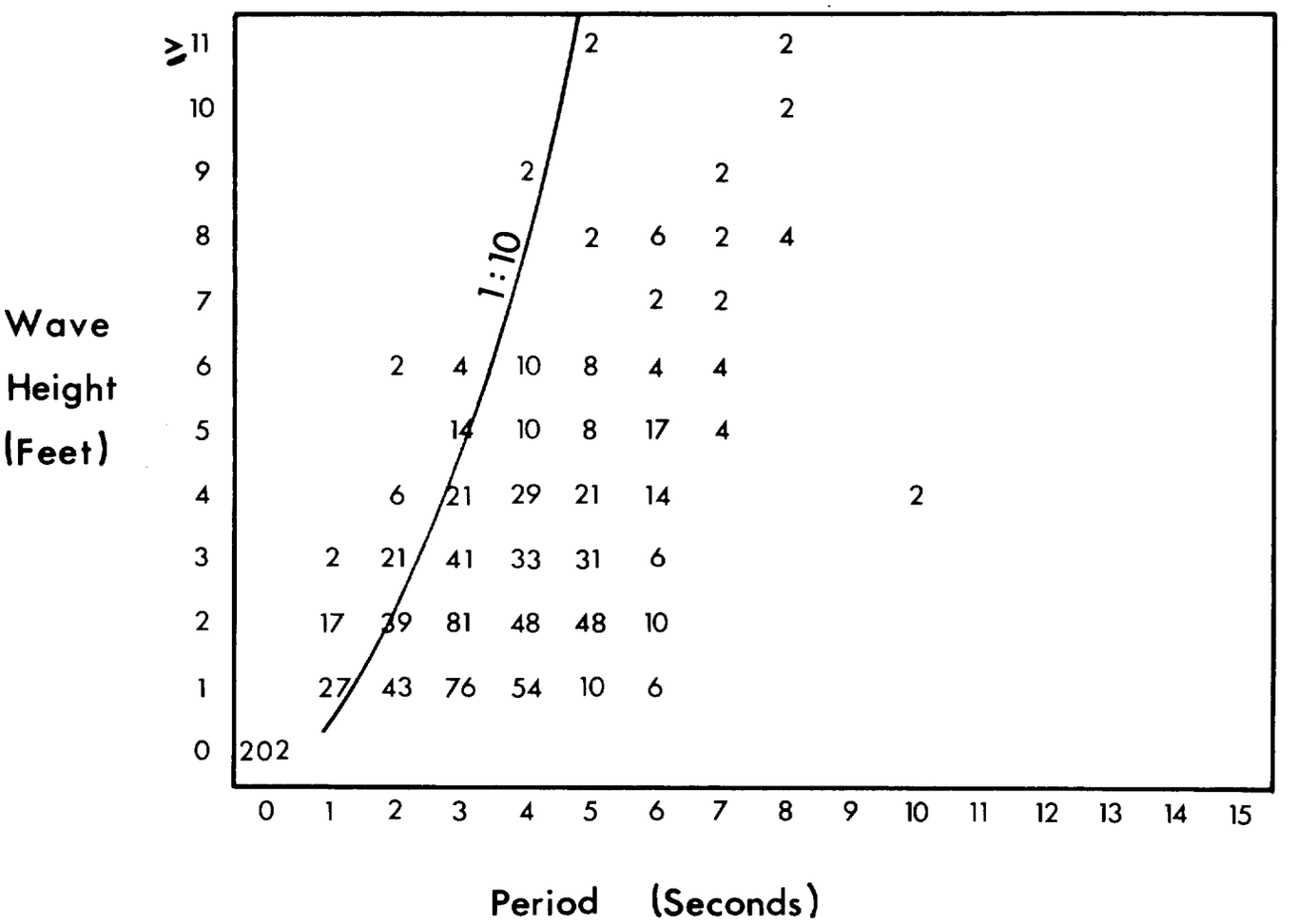
Table 2



LOCATION MAP OF THE STATIONS

Sc Stn W1

SEA

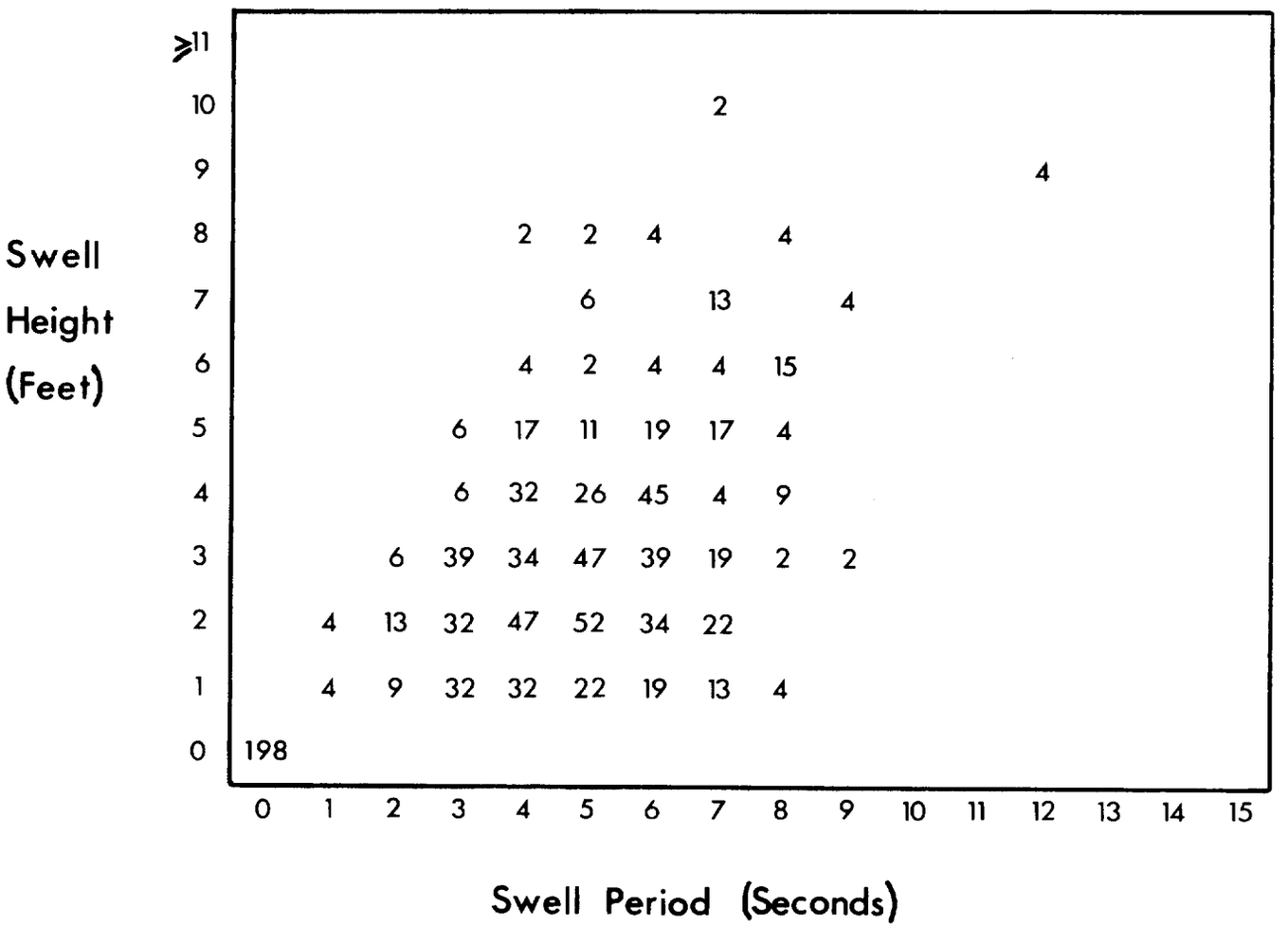


Tot Obs 484

Fig. 1

Sc Stn W1

SWELL

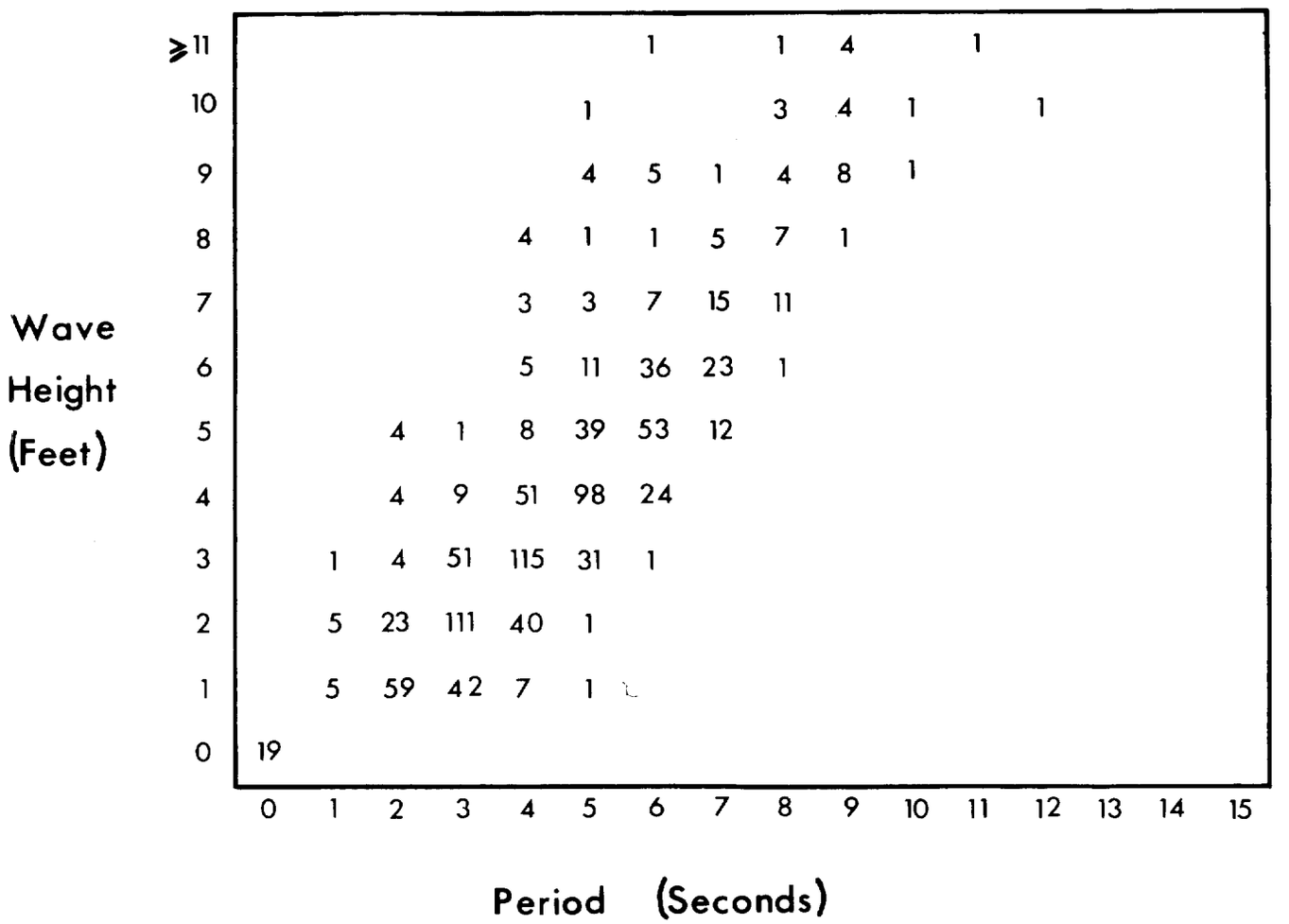


Tot Obs 465

Fig. 2

Sc Stn W7

SEA



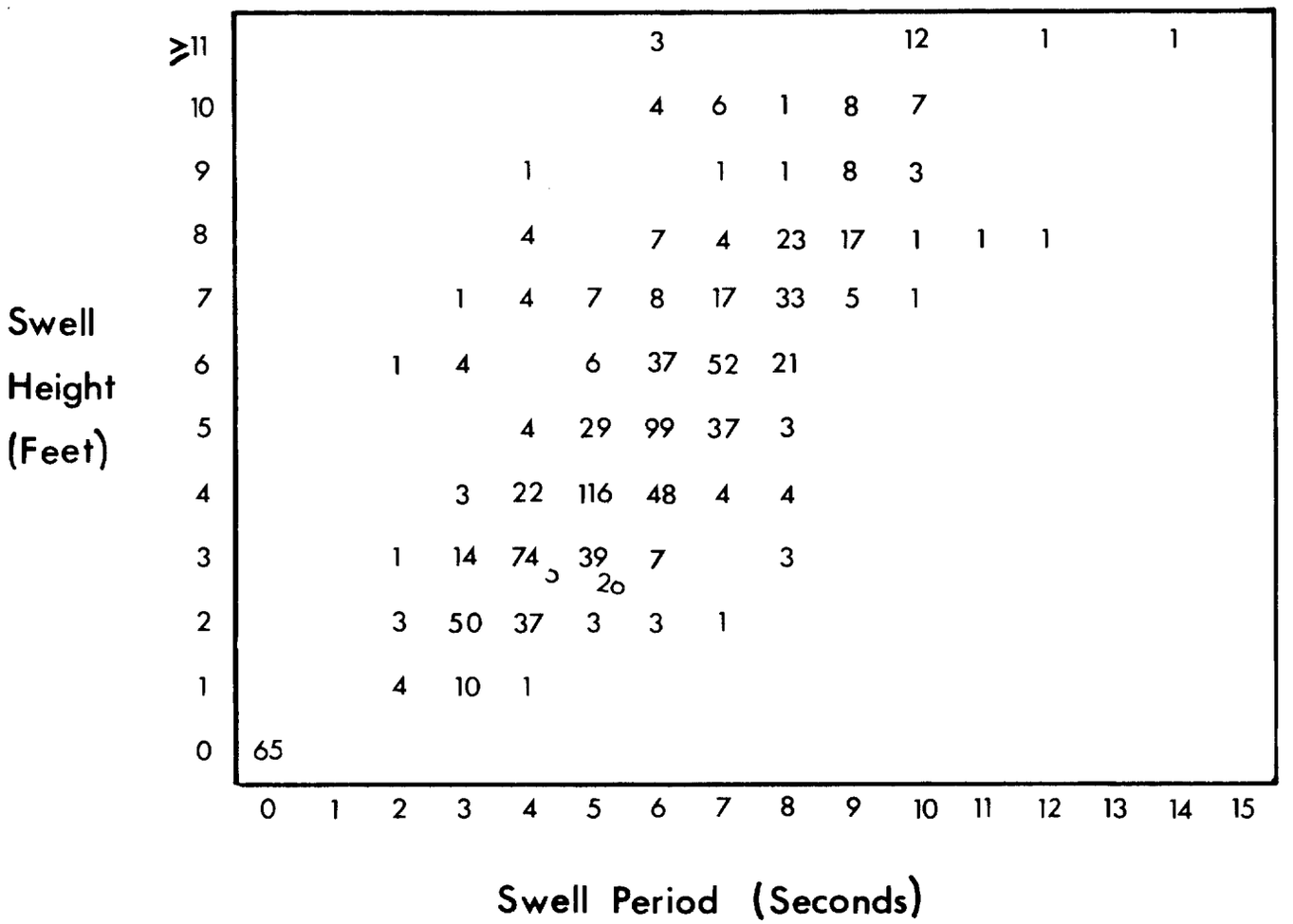
Wave Height (Feet)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
≥11							1		1	4		1				
10						1			3	4	1		1			
9						4	5	1	4	8	1					
8					4	1	1	5	7	1						
7					3	3	7	15	11							
6					5	11	36	23	1							
5			4	1	8	39	53	12								
4			4	9	51	98	24									
3		1	4	51	115	31	1									
2		5	23	111	40	1										
1		5	59	42	7	1										
0	19															

Tot Obs 742

Fig. 3

Sc Stn W7

SWELL

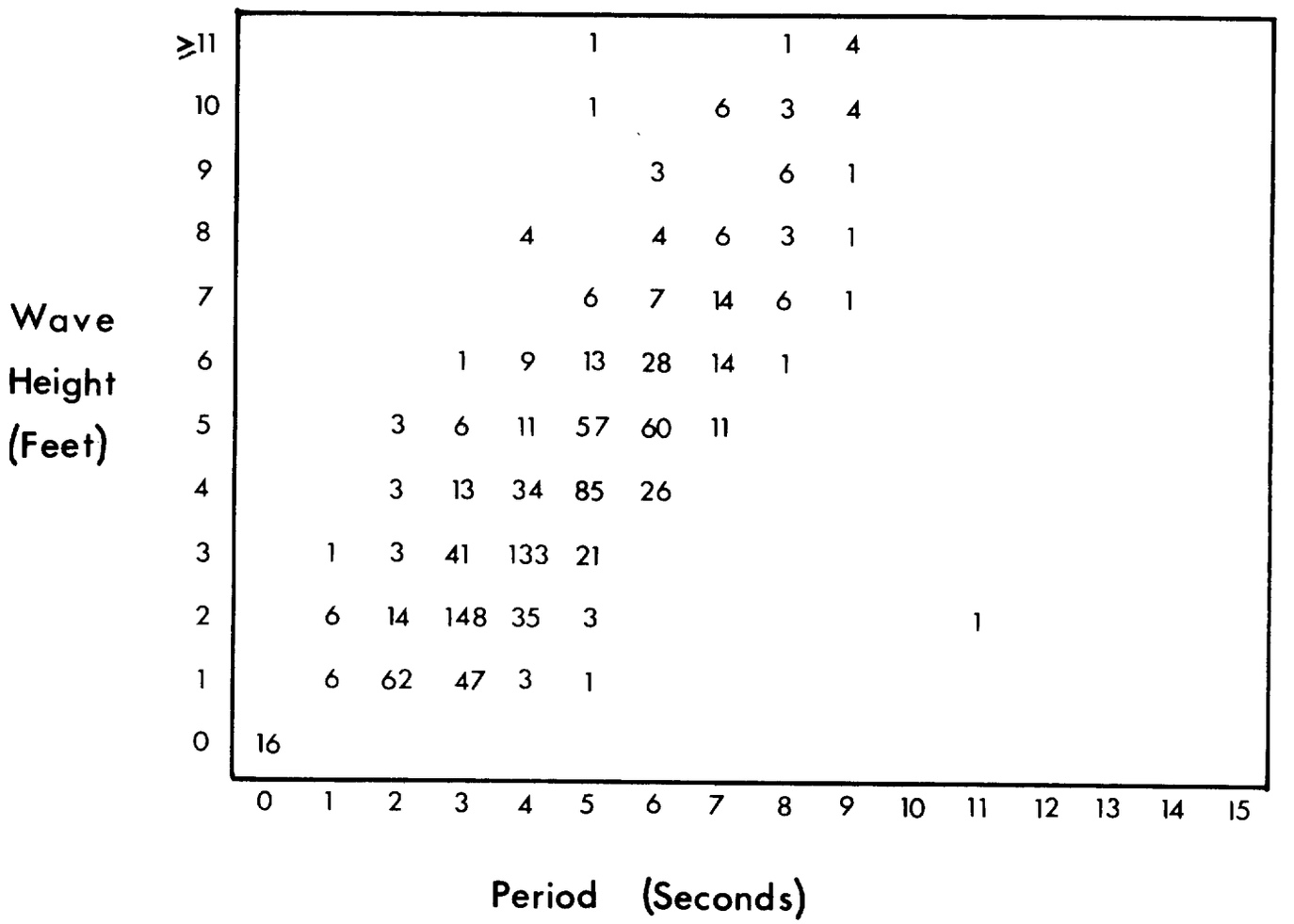


Tot Obs 726

Fig. 4

Sc Stn W8

SEA

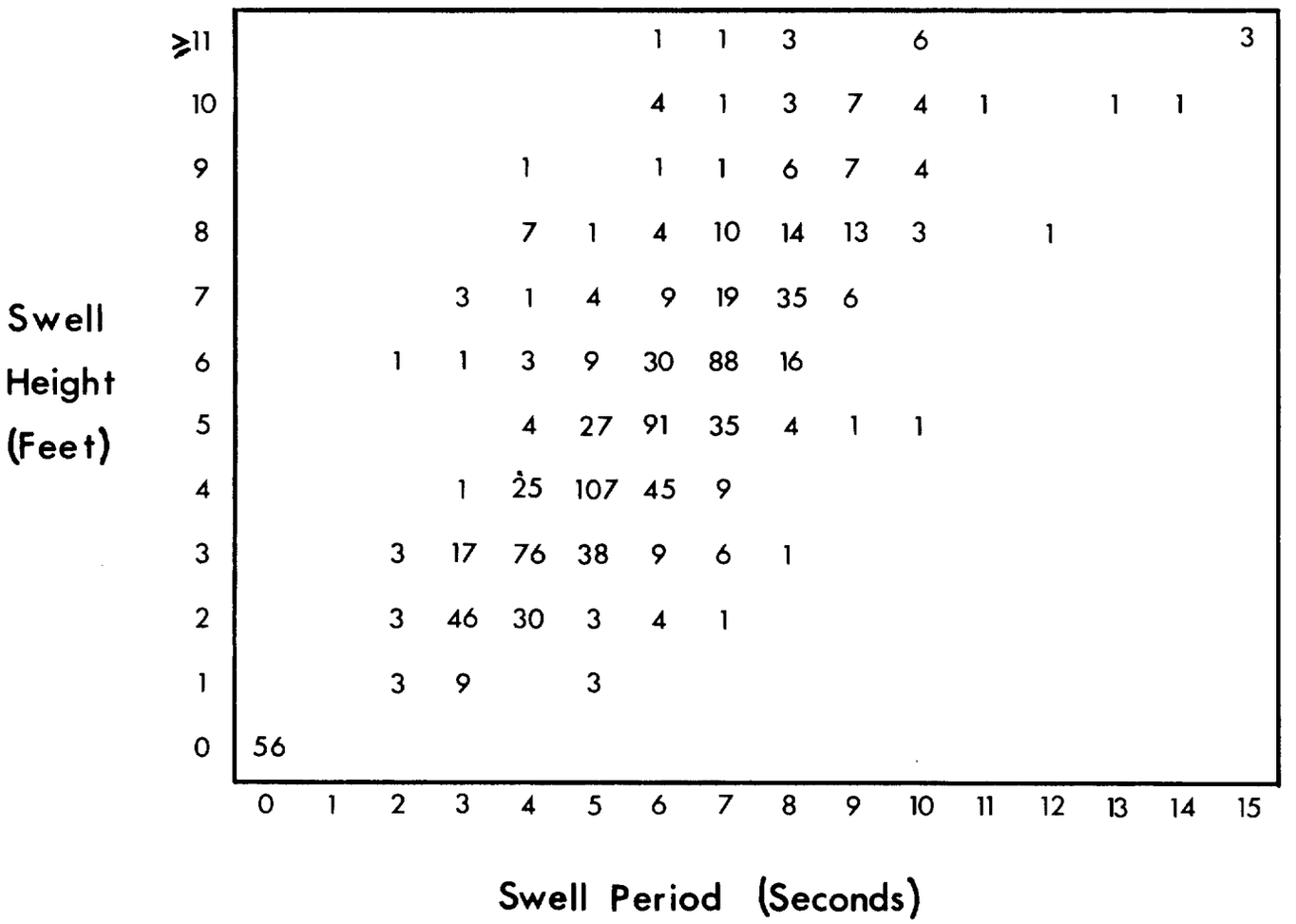


Tot Obs 705

Fig. 5

Sc Stn W8

SWELL



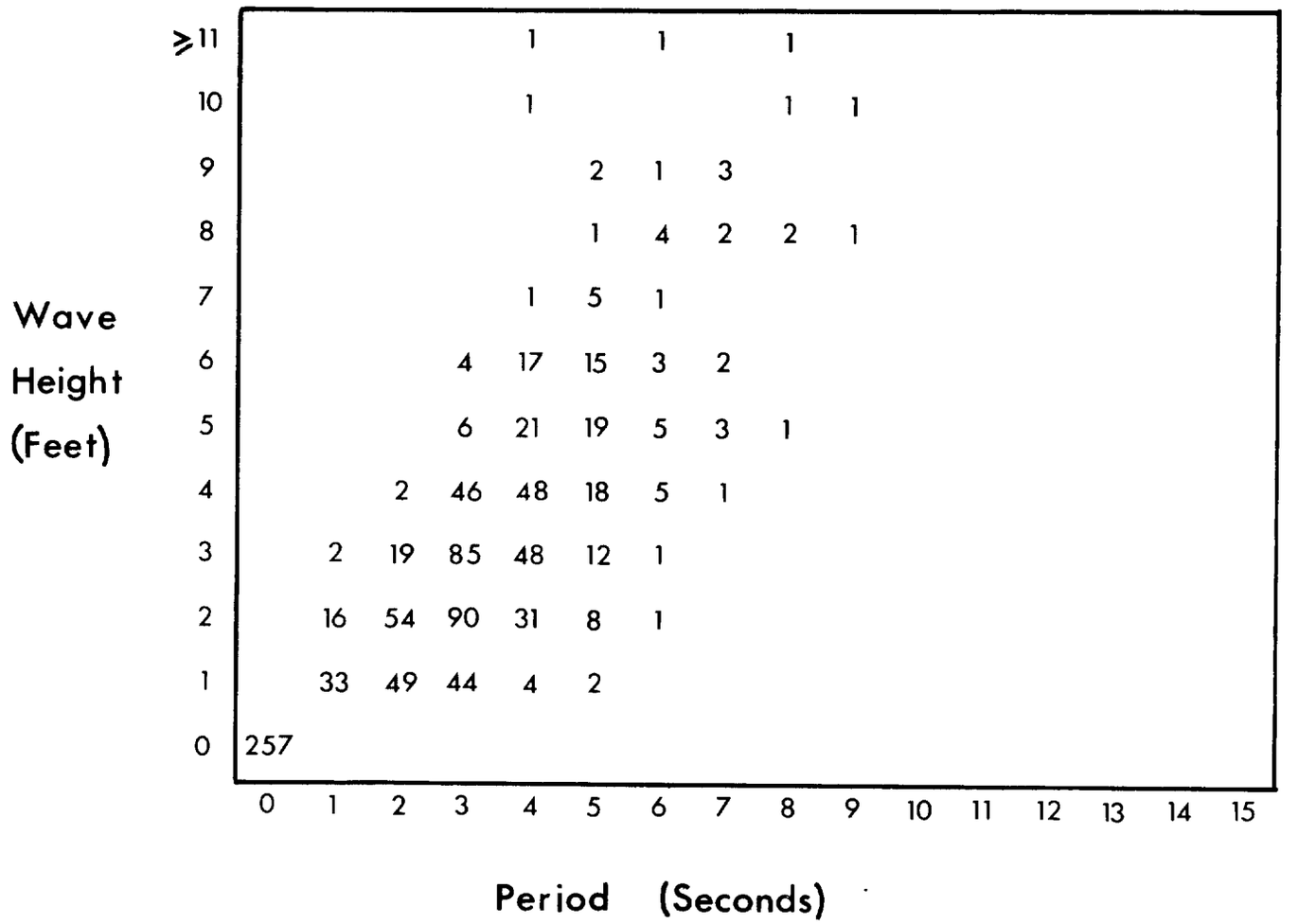
Swell Height (Feet)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
≥11							1	1	3		6					3
10							4	1	3	7	4	1		1	1	
9					1		1	1	6	7	4					
8					7	1	4	10	14	13	3		1			
7				3	1	4	9	19	35	6						
6			1	1	3	9	30	88	16							
5					4	27	91	35	4	1	1					
4				1	25	107	45	9								
3			3	17	76	38	9	6	1							
2			3	46	30	3	4	1								
1			3	9		3										
0	56															

Tot Obs 693

Fig. 6

Sc Stn W11

SEA

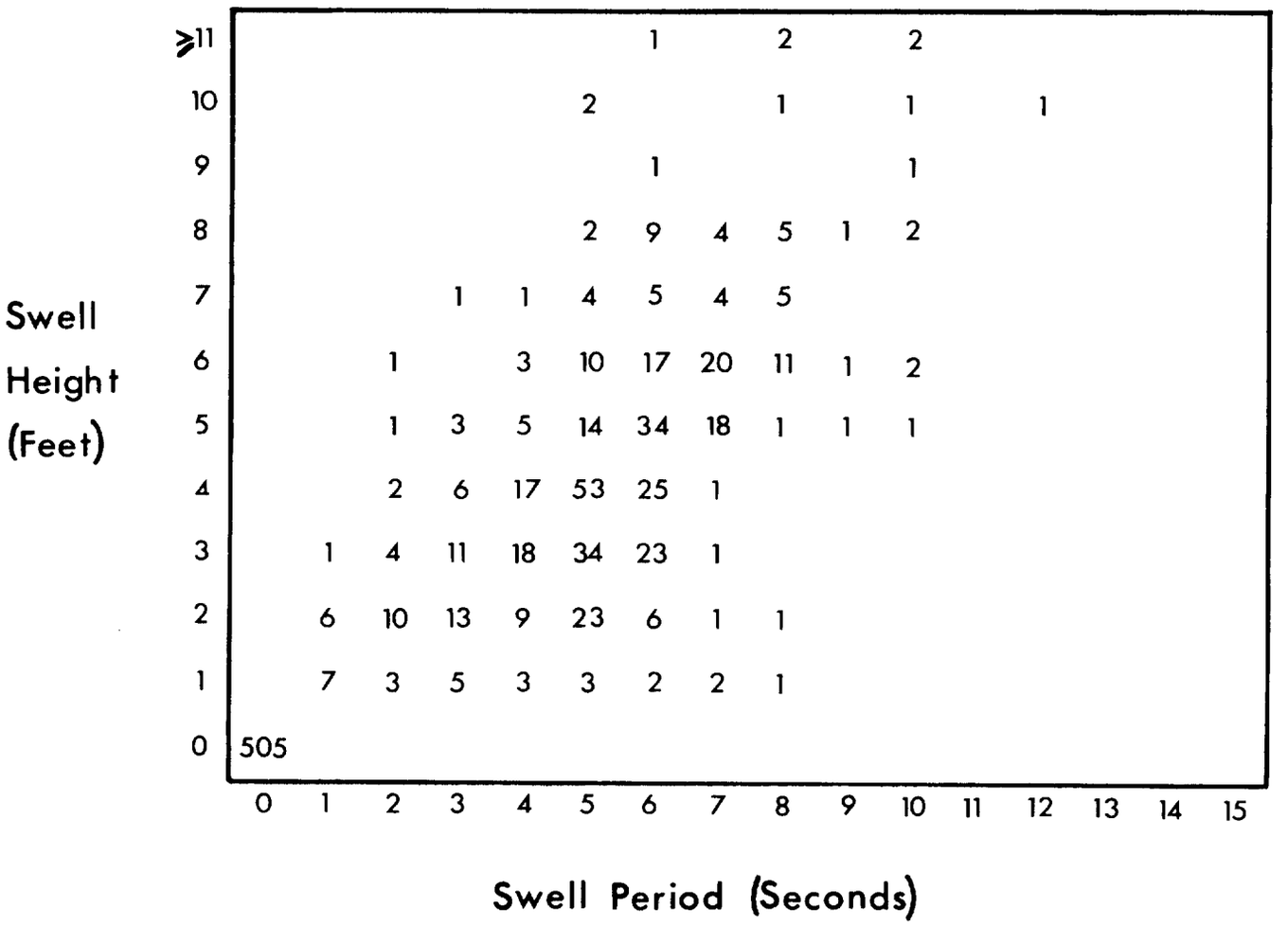


Tot Obs 1039

Fig. 7

Sc Stn W 11

SWELL

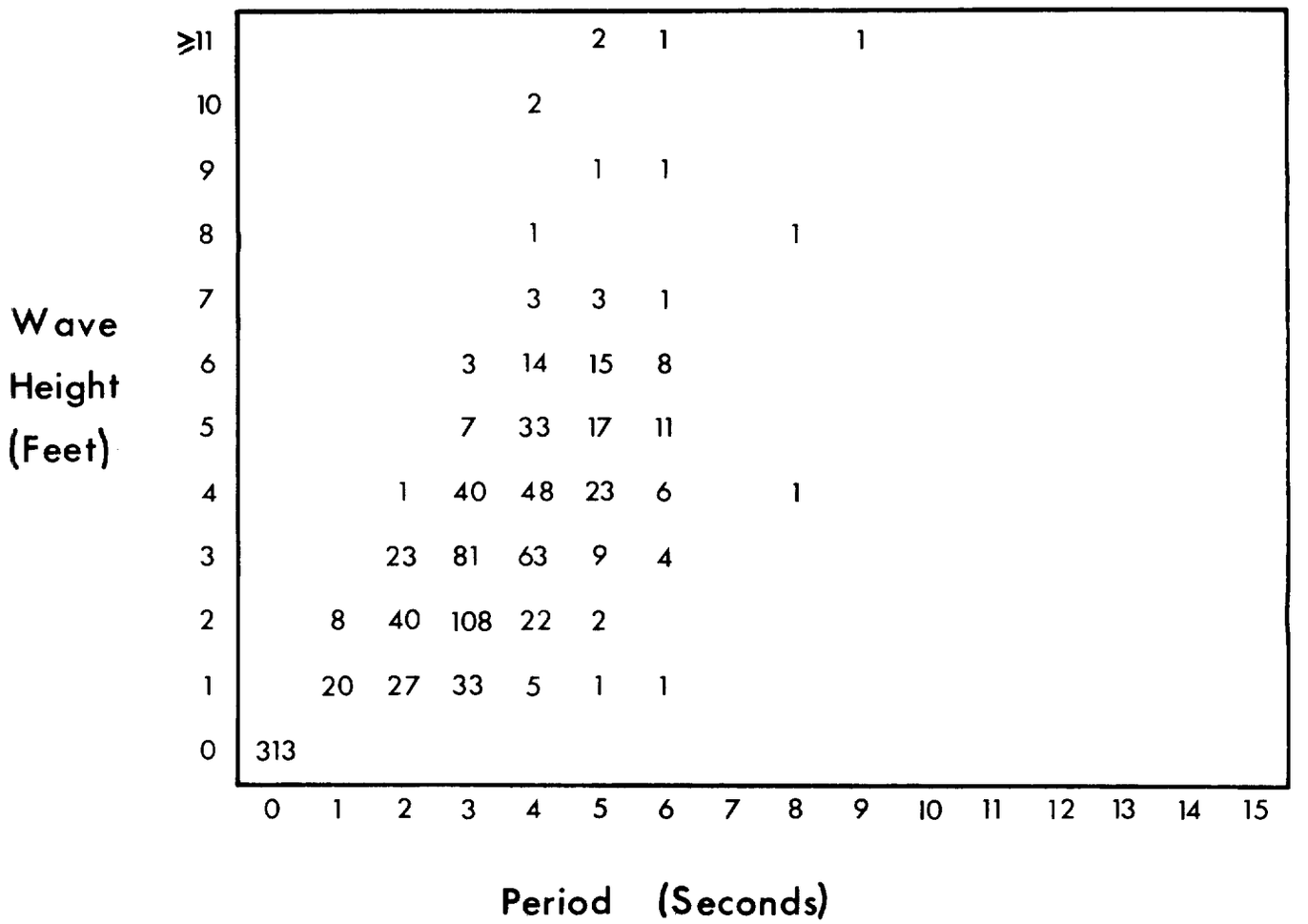


Tot Obs 981

Fig. 8

Sc Stn W12

SEA

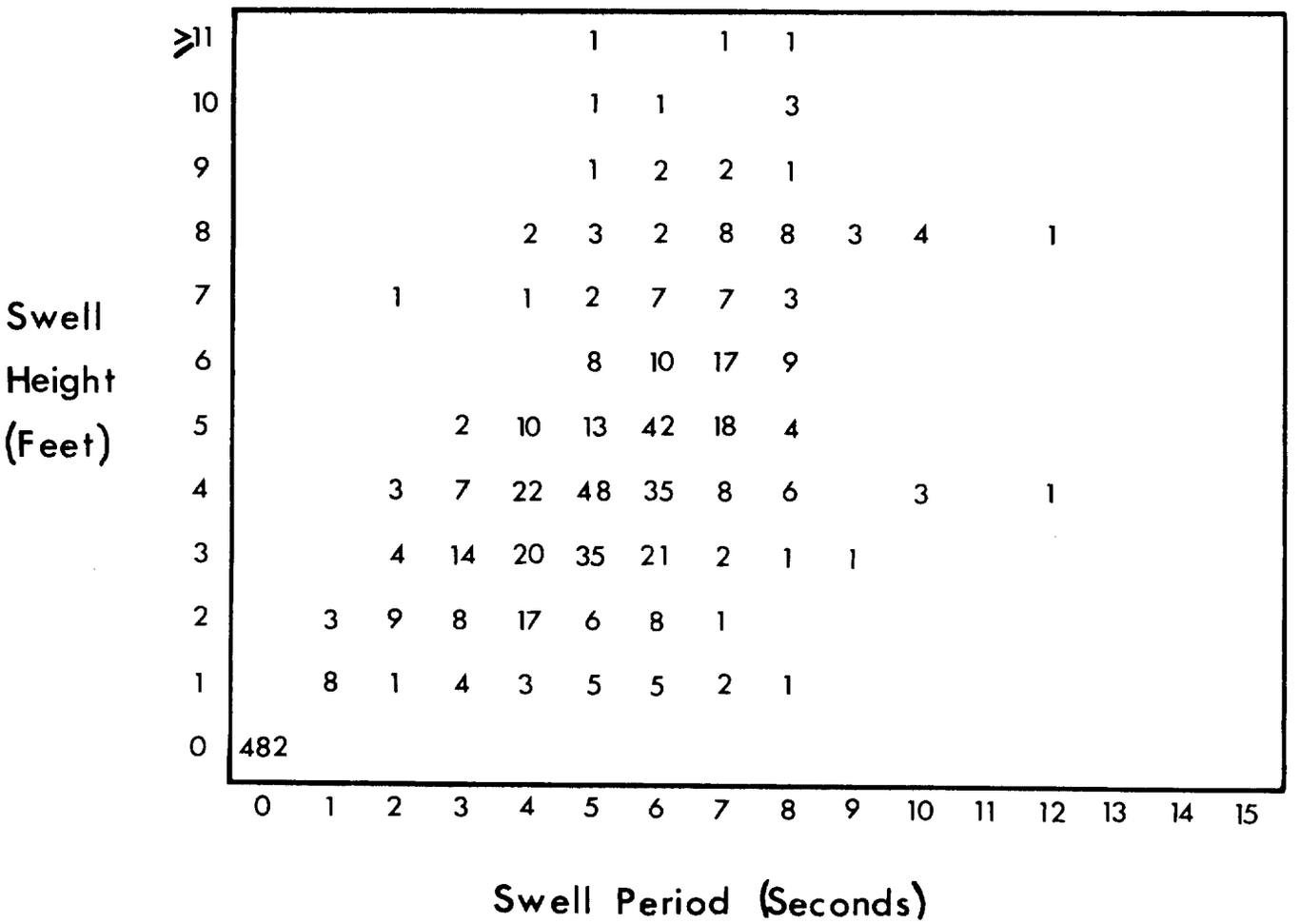


Tot Obs 1052

Fig. 9

Sc Stn W12

SWELL

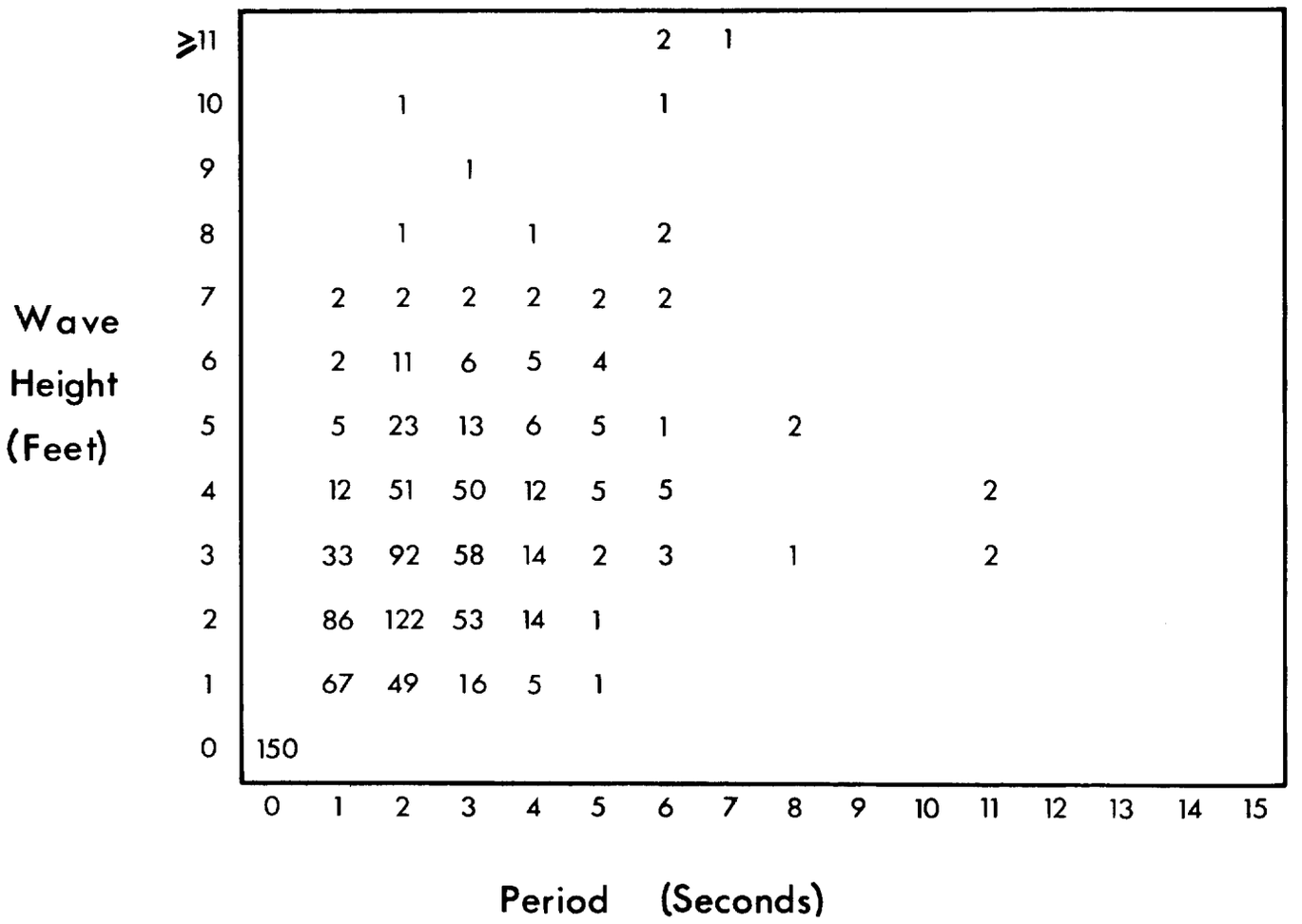


Tot Obs 979

Fig. 10

Sc Stn W13

SEA

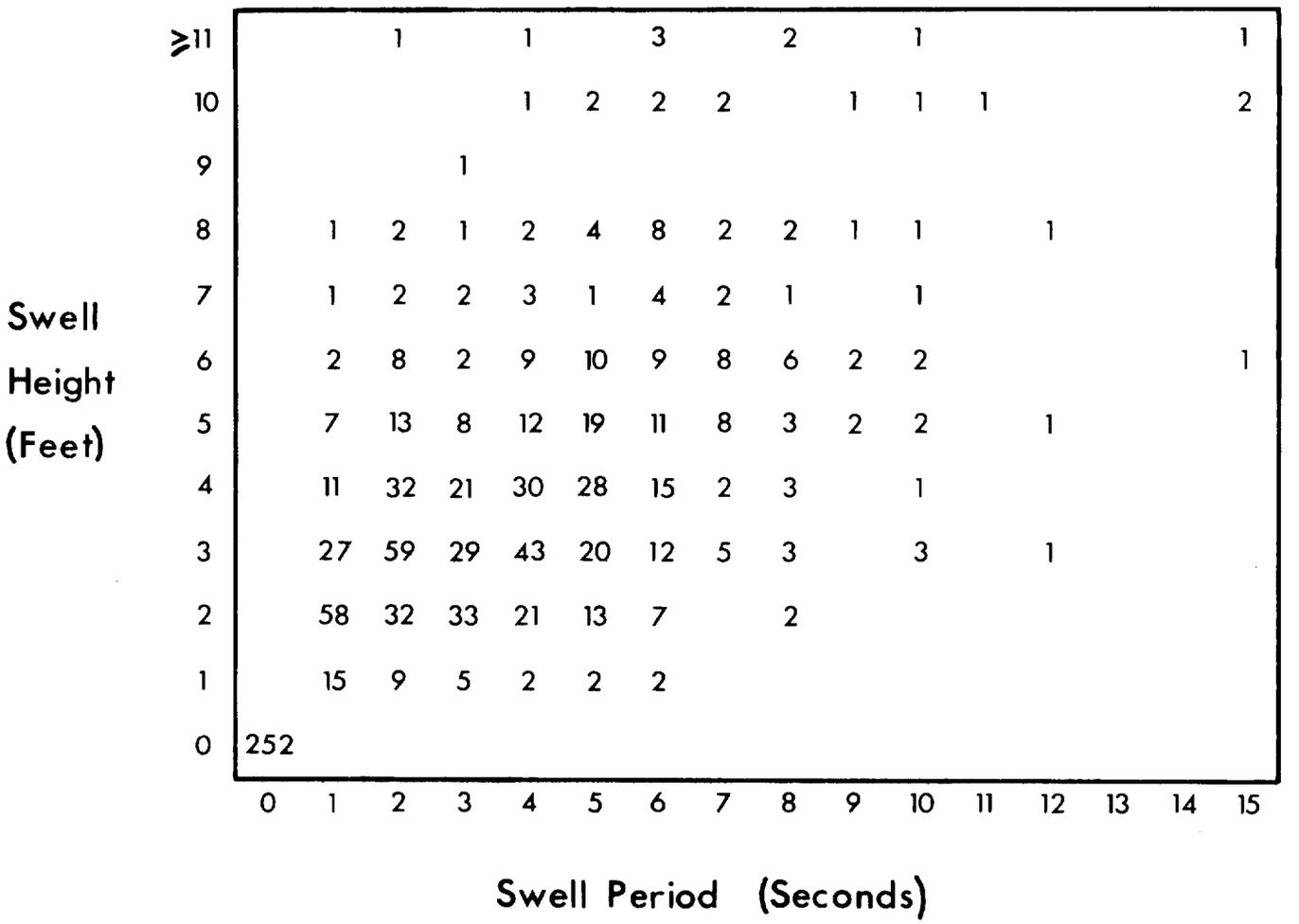


Tot Obs 1333

Fig. 11

Sc Stn W13

SWELL

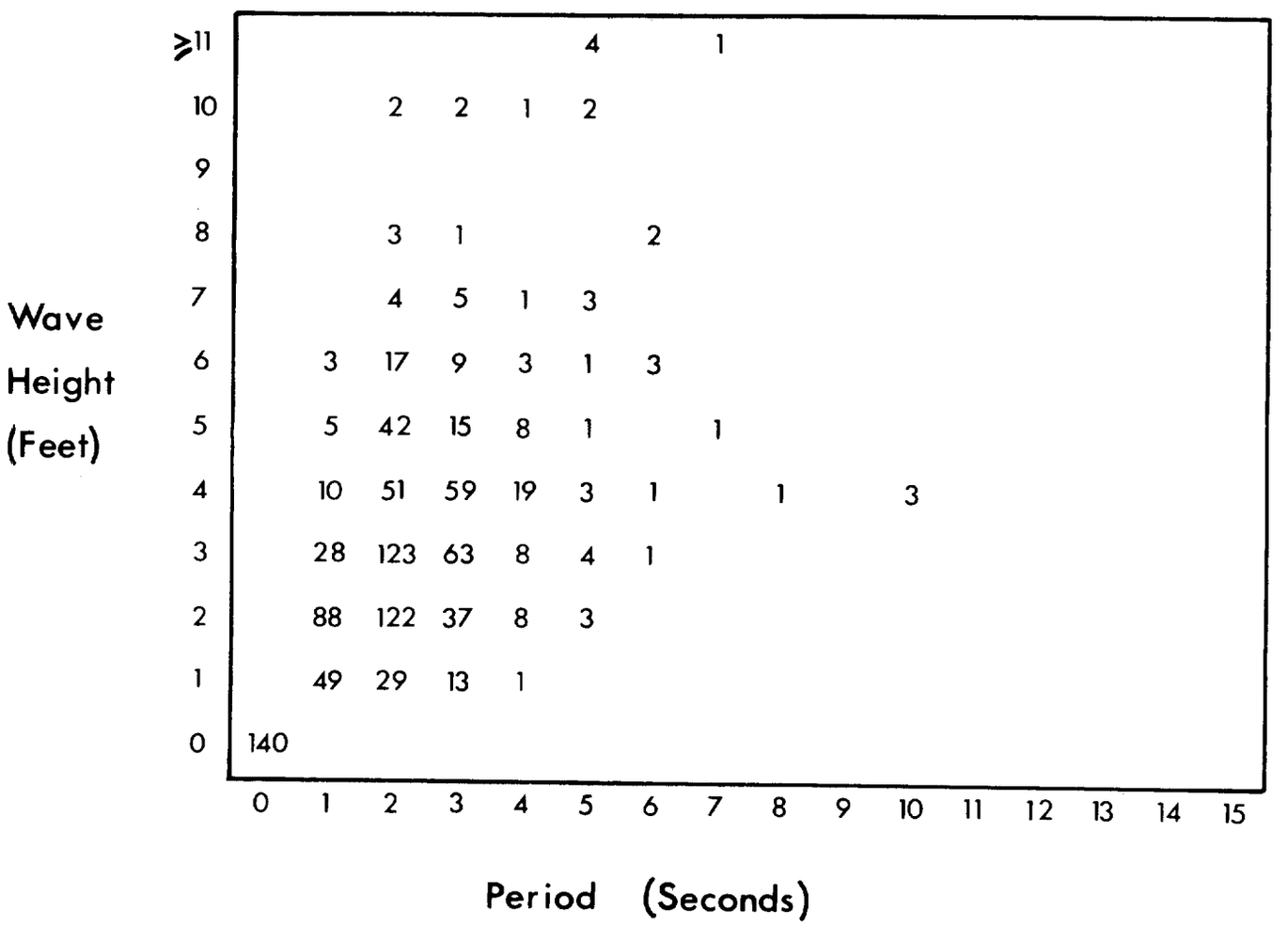


Tot Obs 1265

Fig. 12

Sc Stn W14

SEA

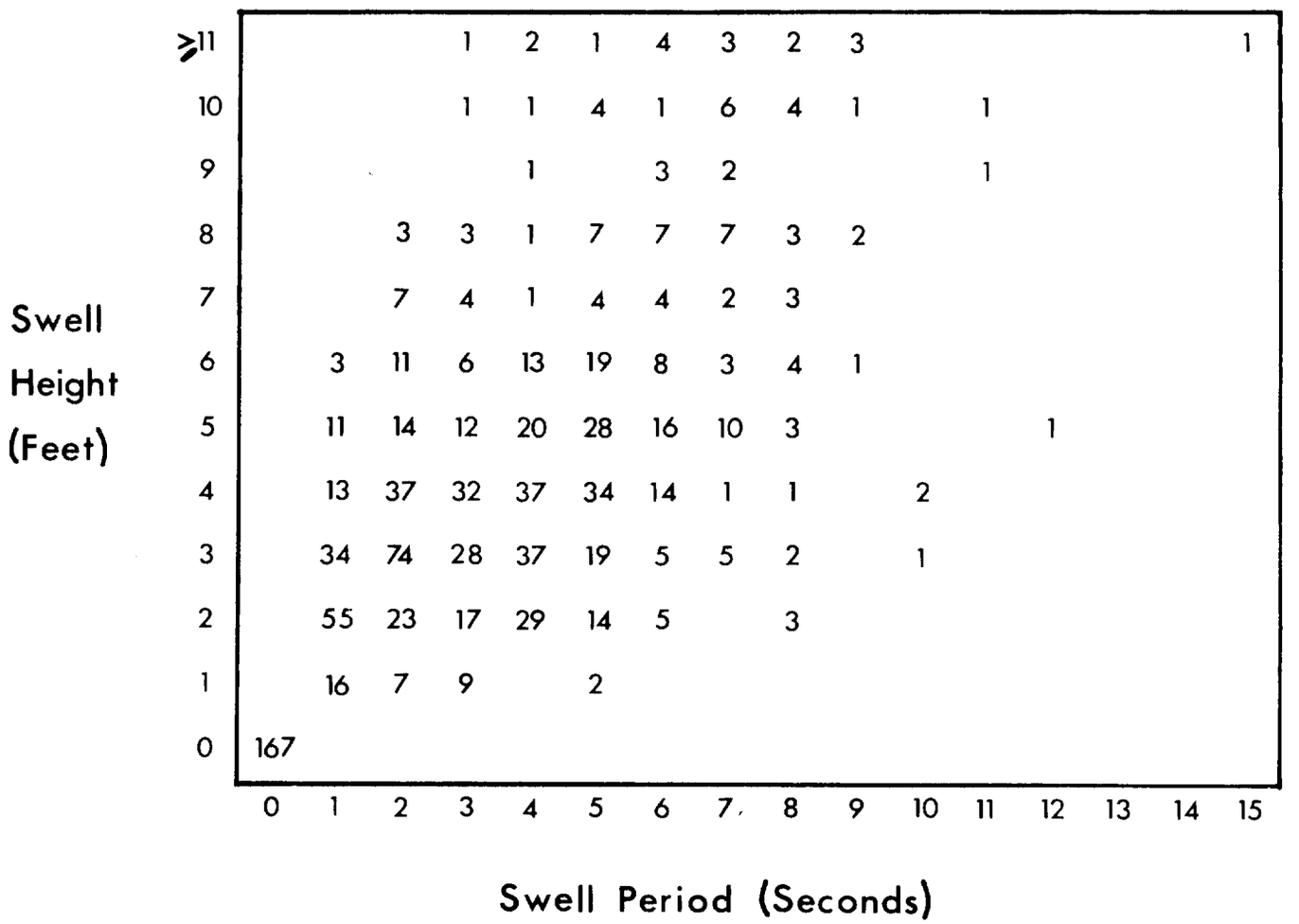


Tot Obs 1064

Fig. 13

Sc Stn W14

SWELL

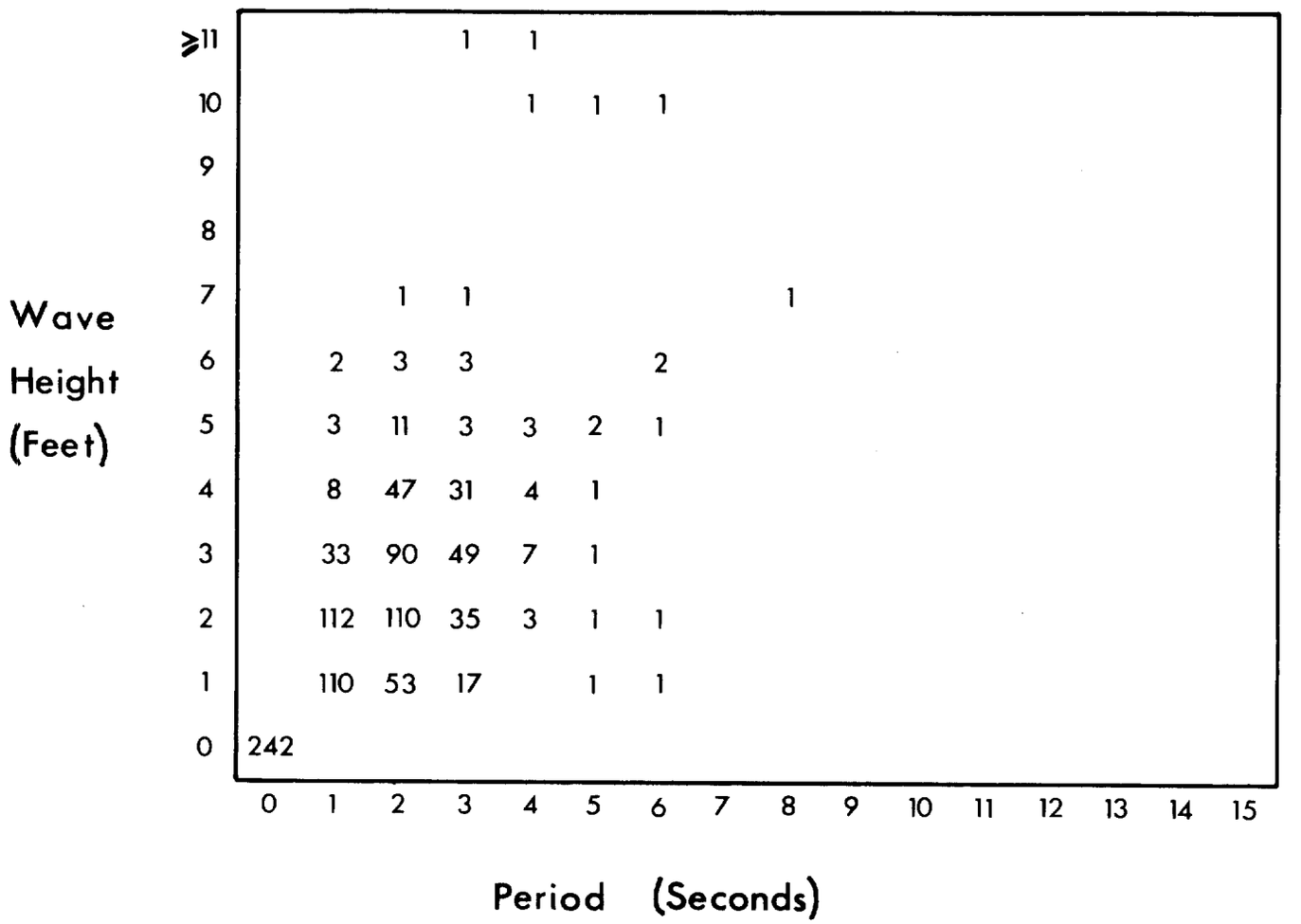


Tot Obs 1039

Fig. 14

Sc Stn W15

SEA

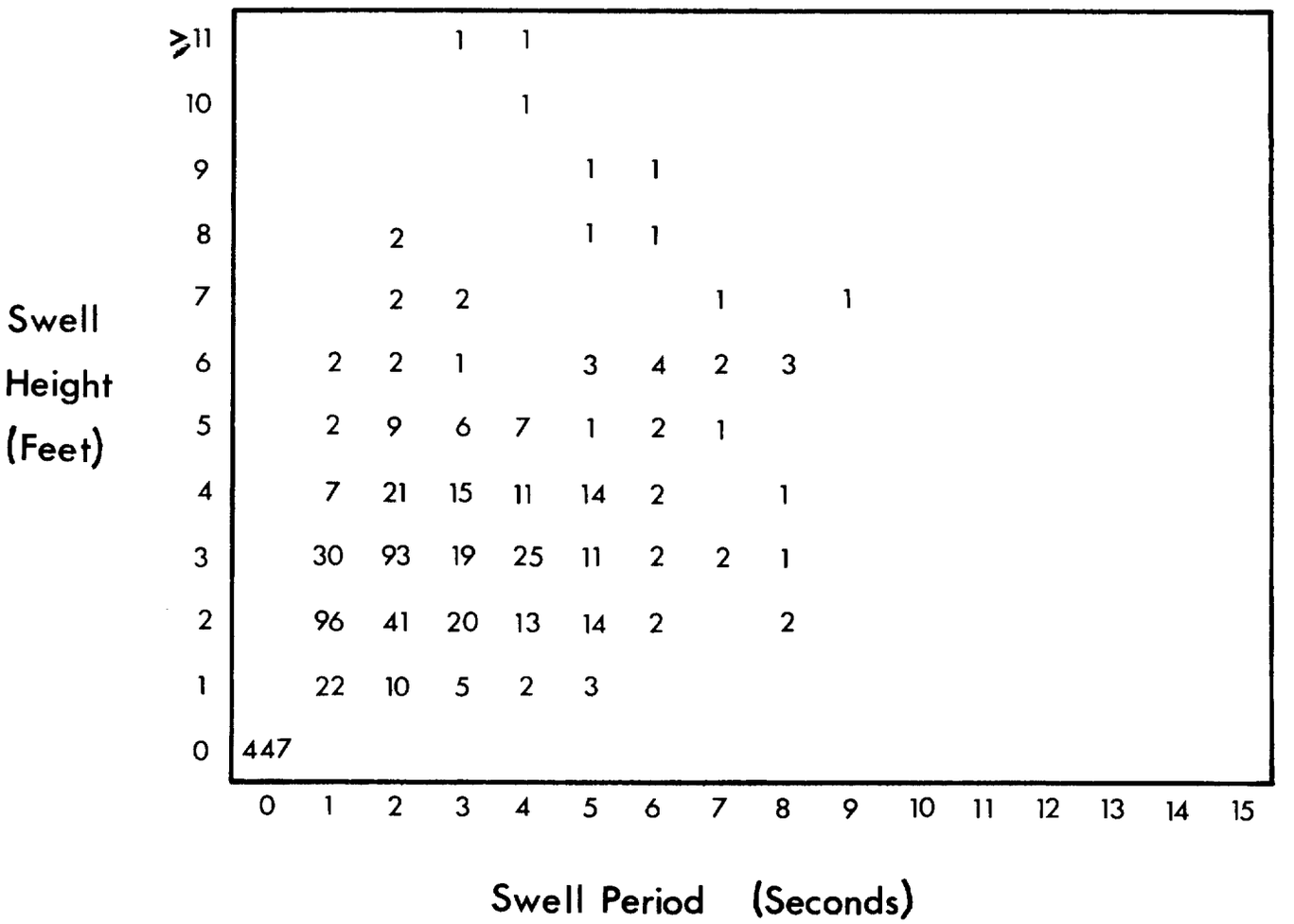


Tot Obs 992

Fig. 15

Sc Stn W15

SWELL



Tot Obs 959

Fig. 16

Sc Stn W16

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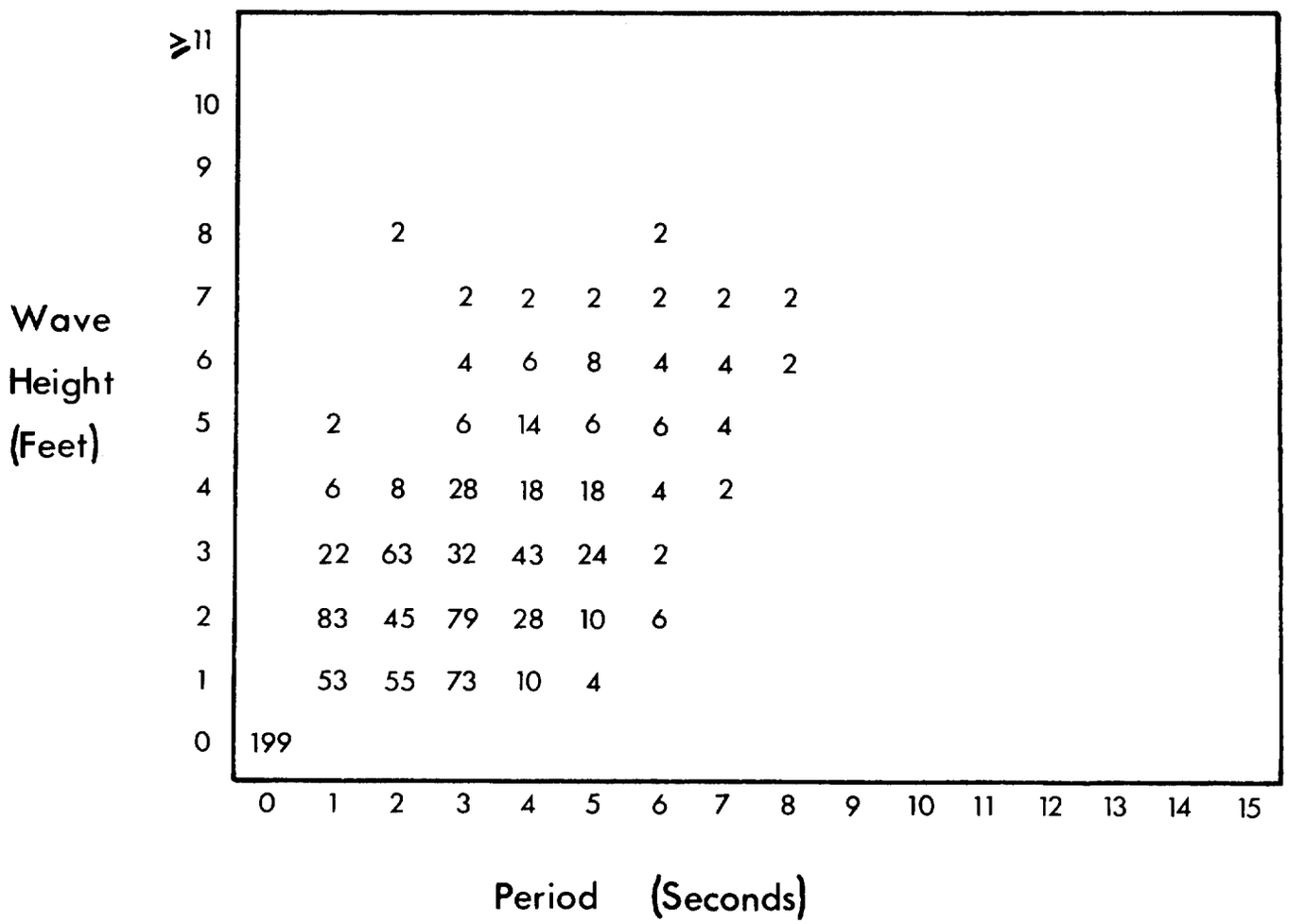
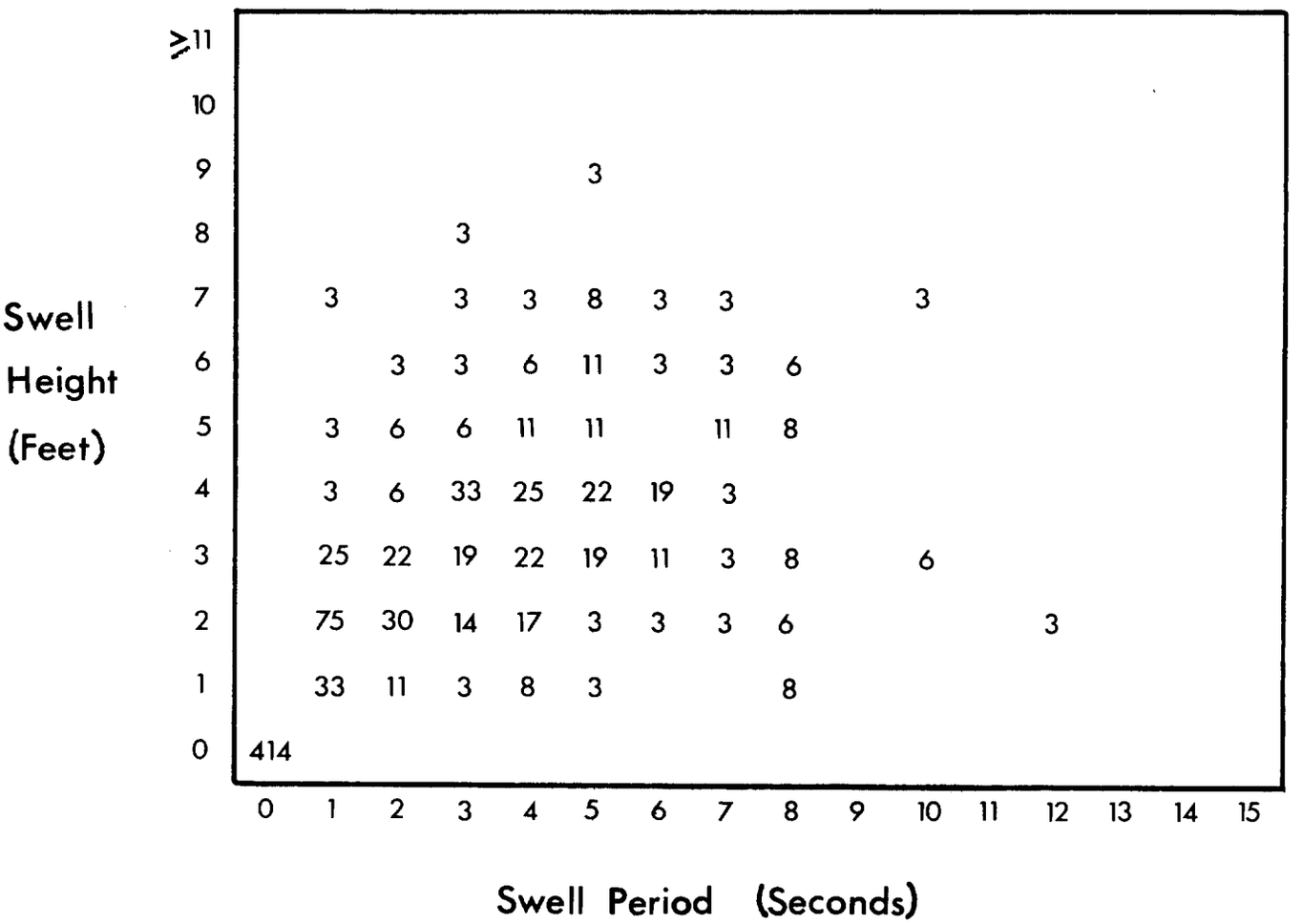


Tot Obs 493

Fig. 17

Sc Stn W16

SWELL

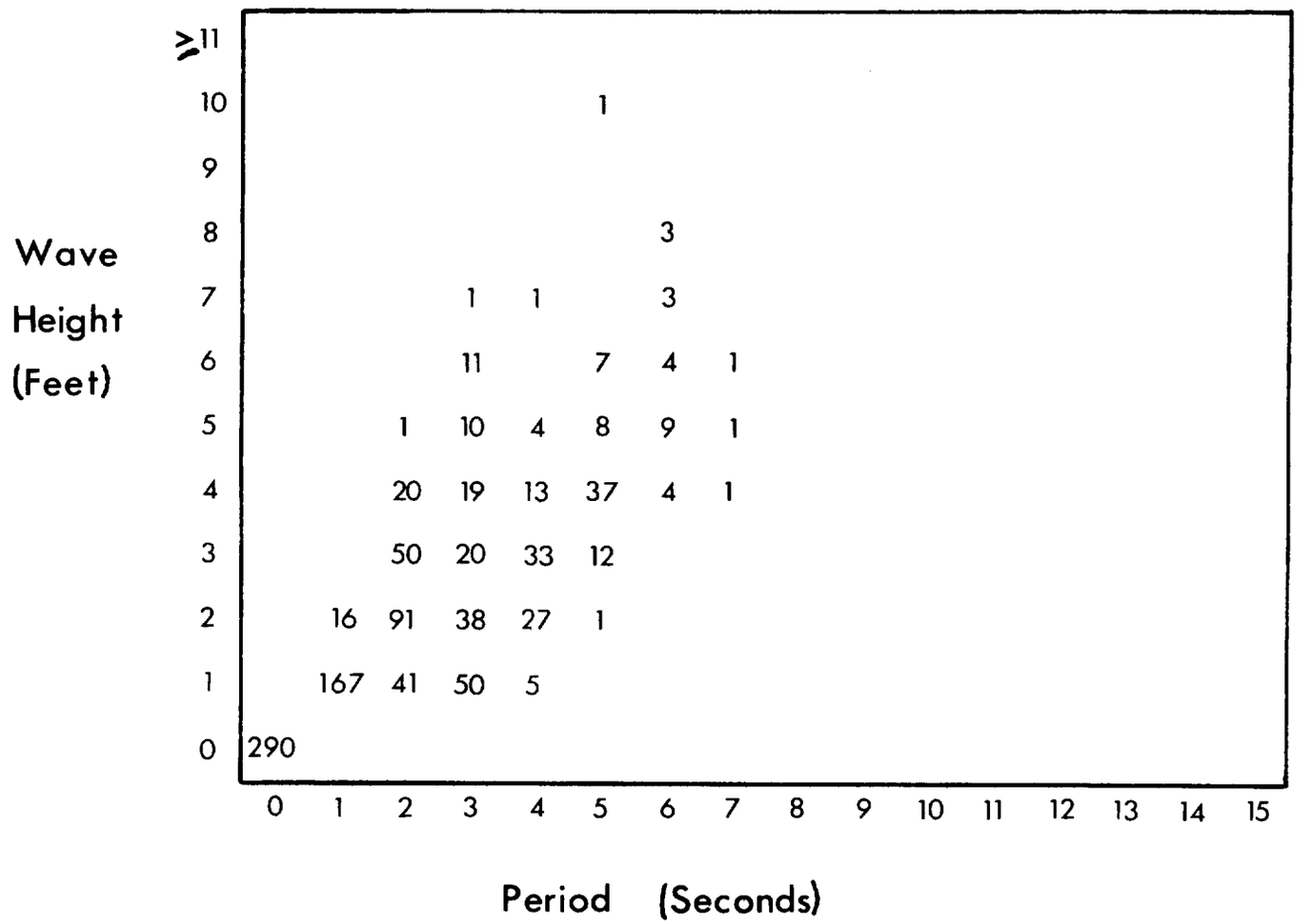


Tot Obs 362

Fig 18

Sc Stn W17

SEA

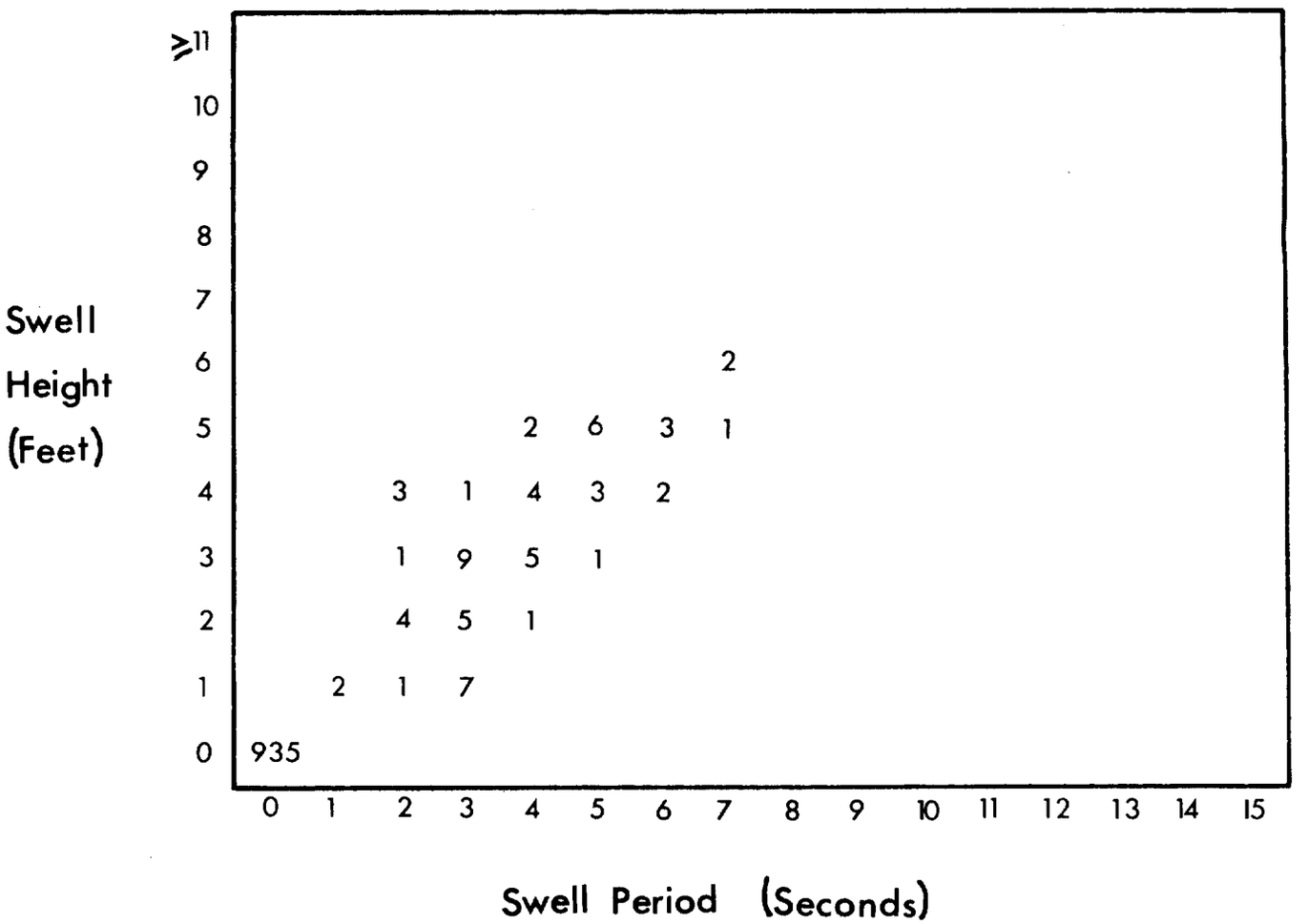


Tot Obs 1421

Fig. 19

Sc Stn W17

SWELL



Tot Obs 967

Fig. 20

Sc Stn W18

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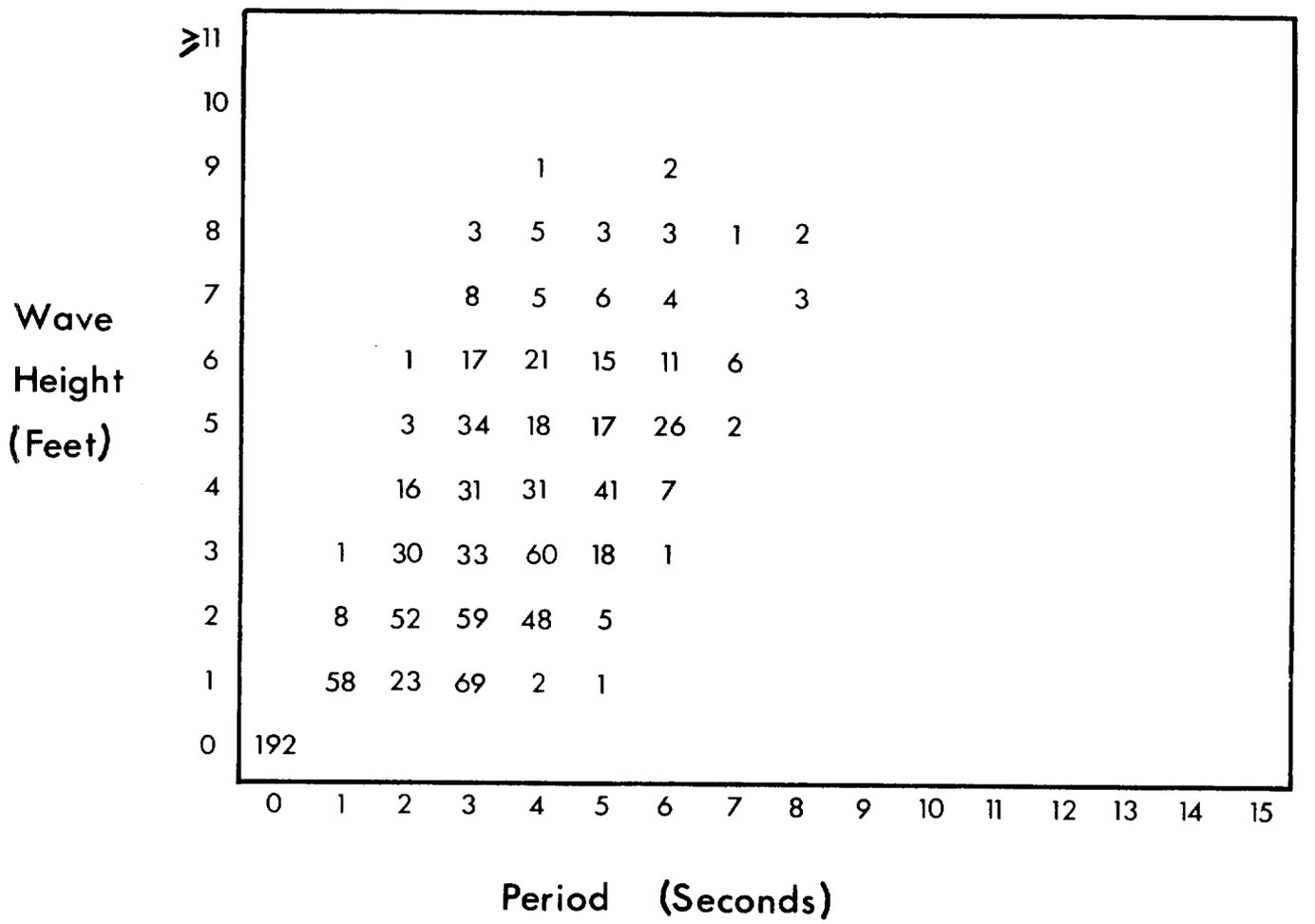
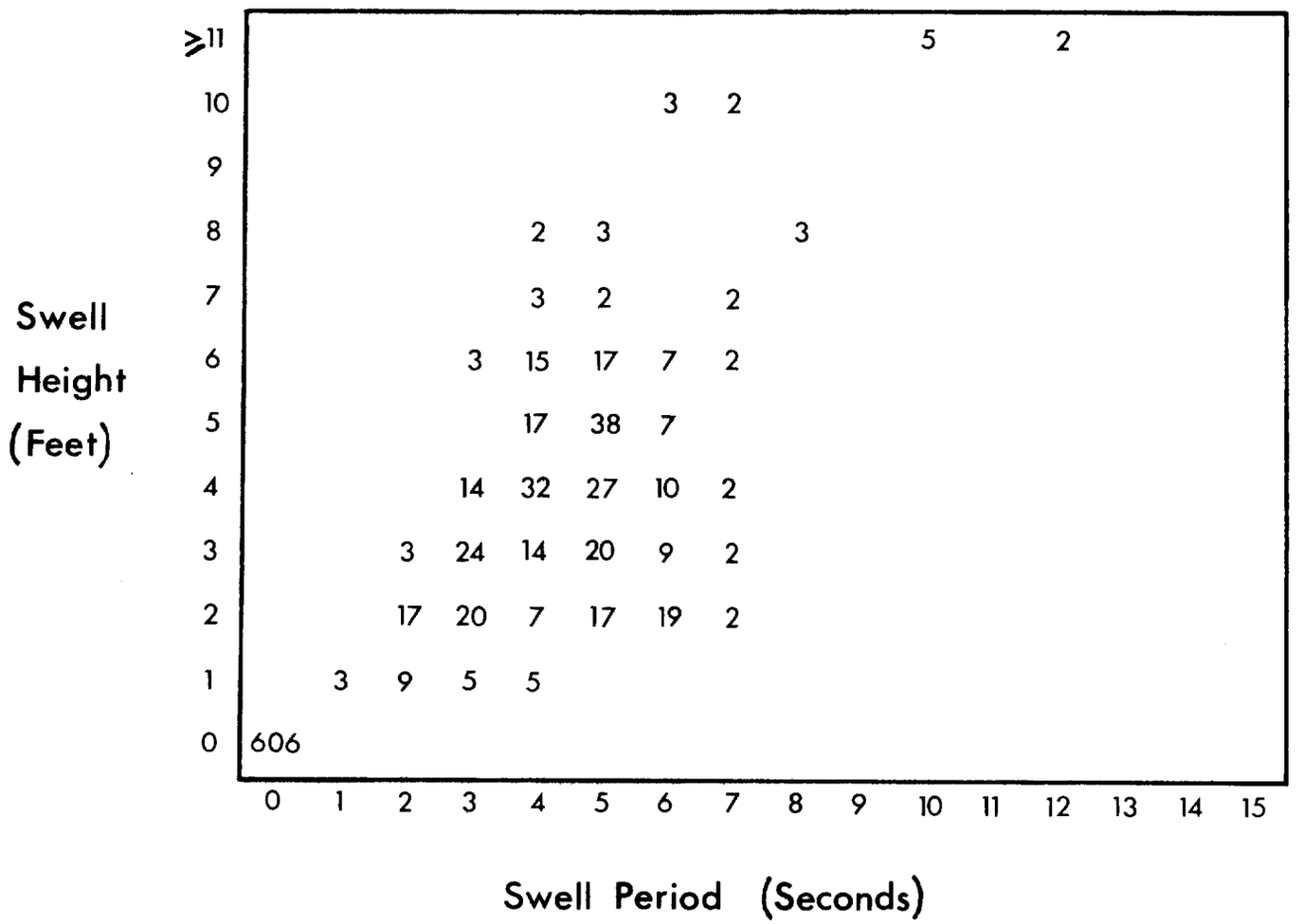


Tot Obs 1088

Fig. 21

Sc Stn W18

SWELL

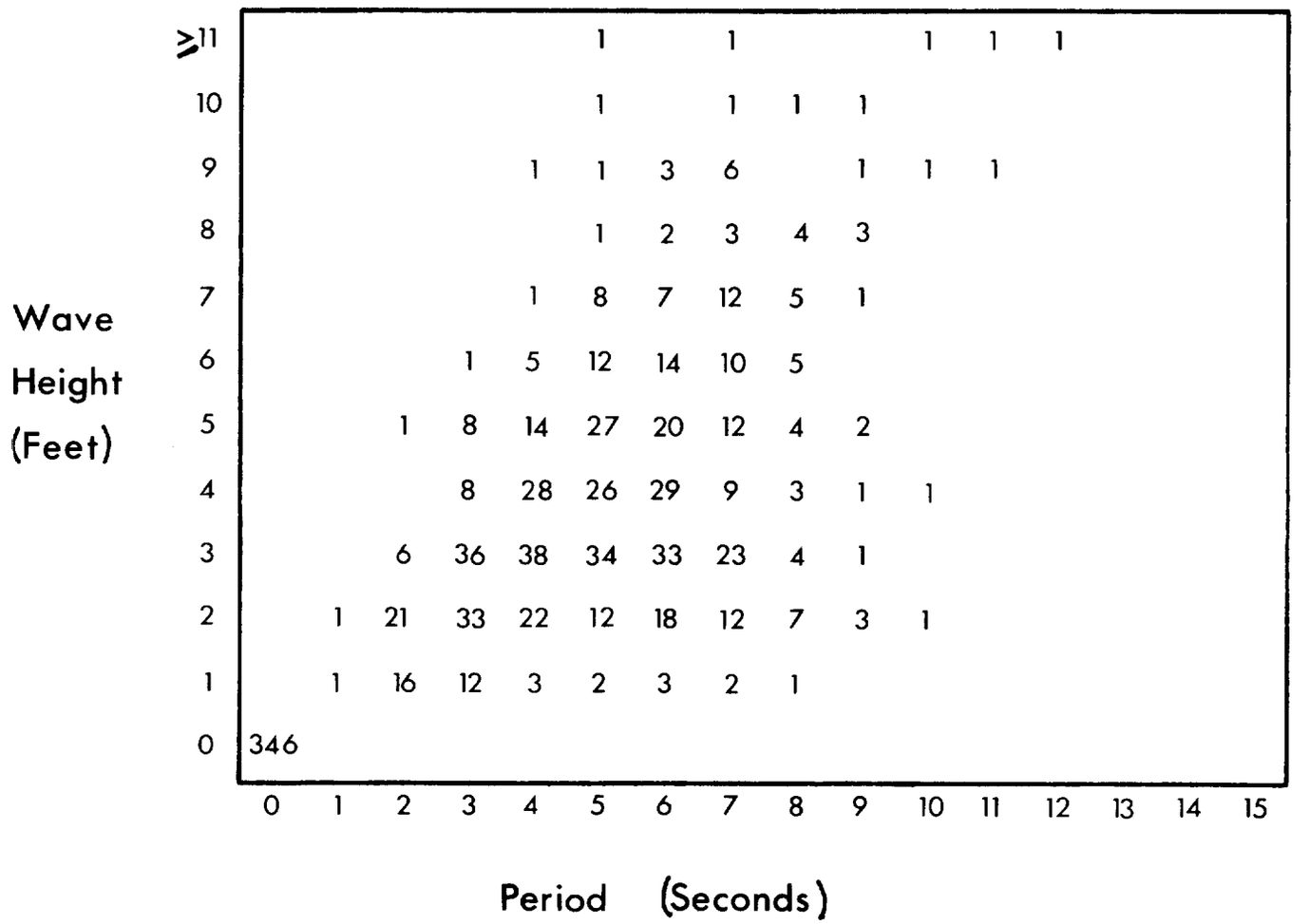


Tot Obs 586

Fig. 22

Sc Stn N6

SEA

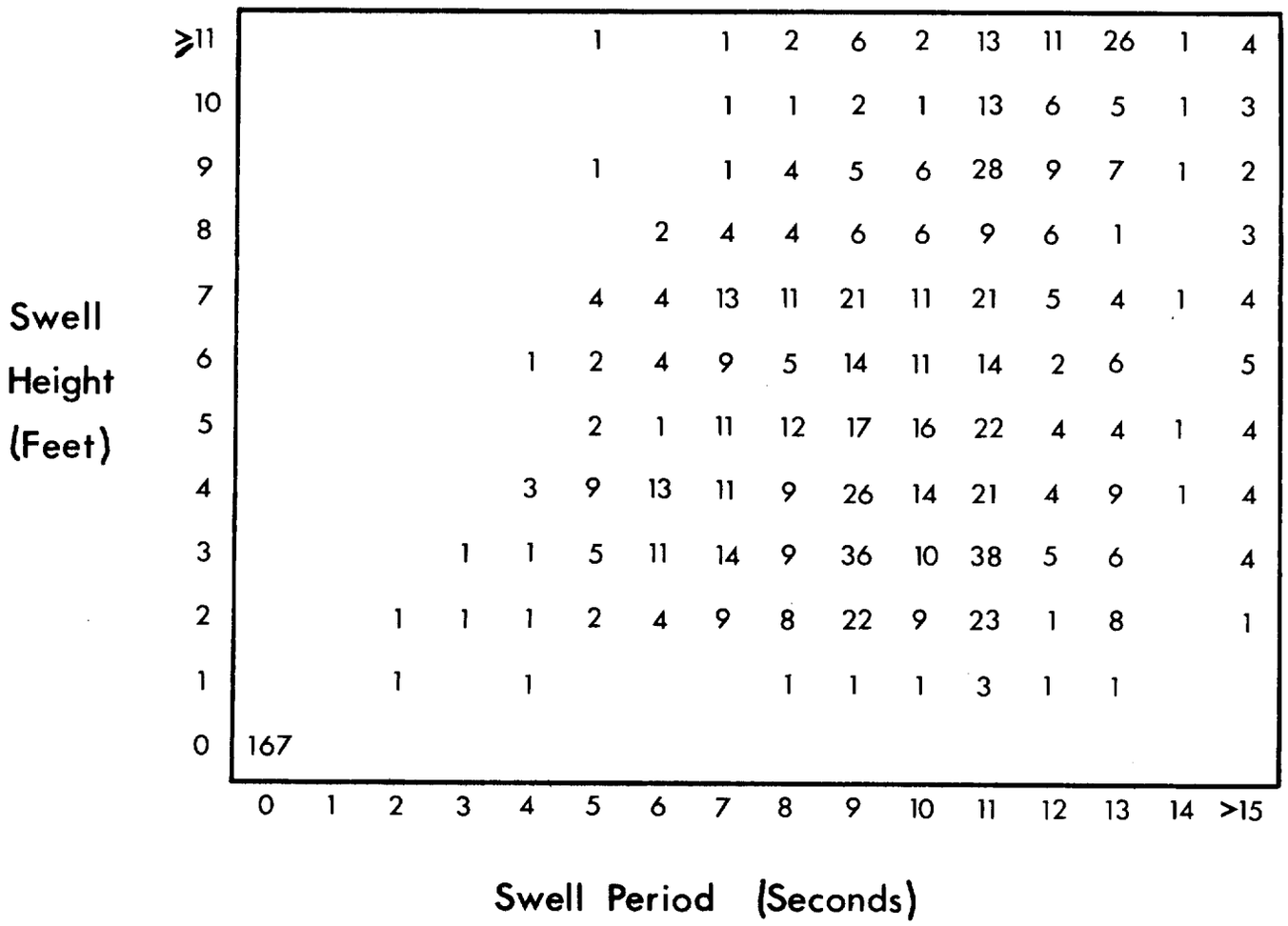


Tot Obs 1464

Fig. 23

Sc Stn N6

SWELL

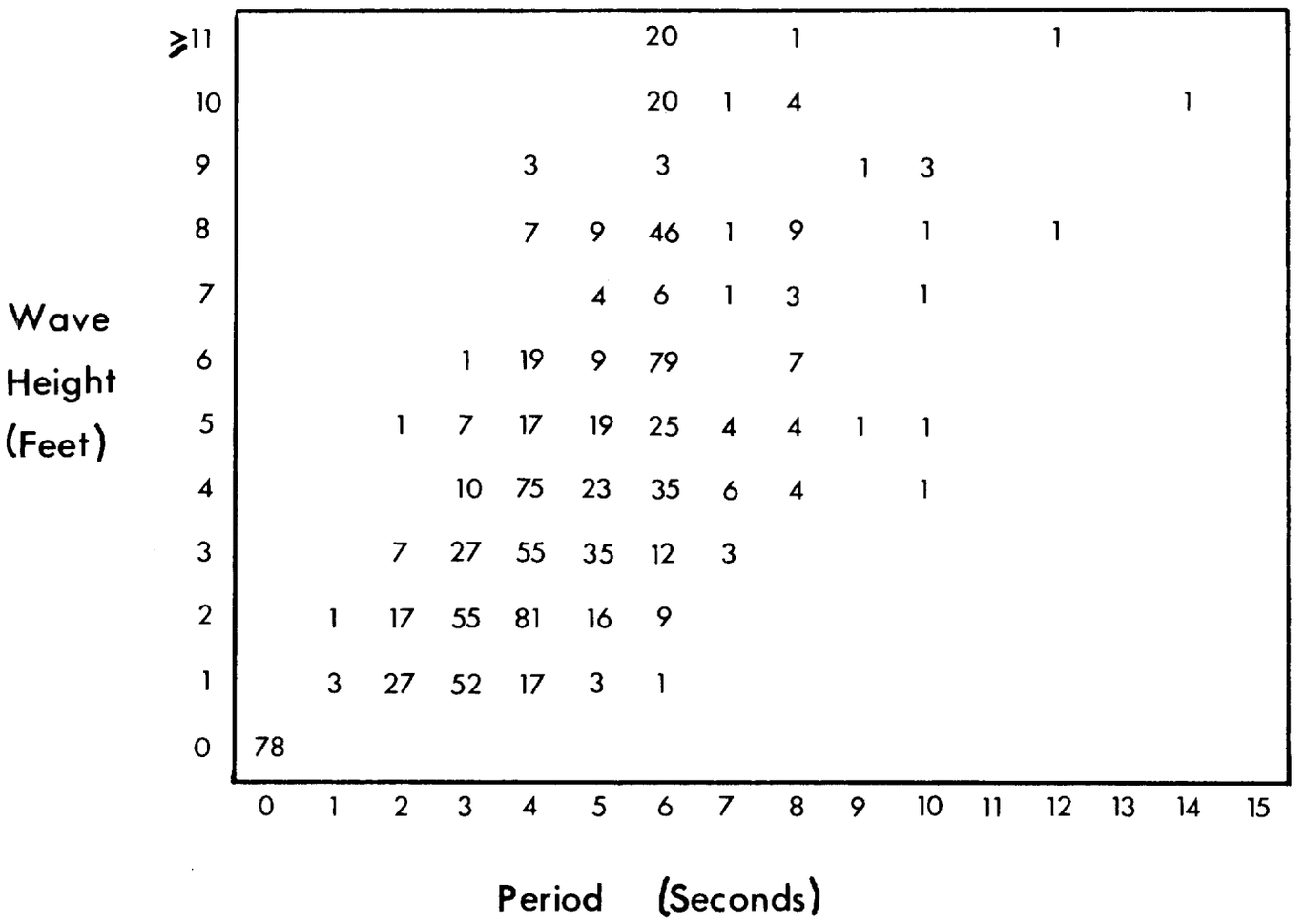


Tot Obs 1405

Fig. 24

Sc Stn N10

SEA

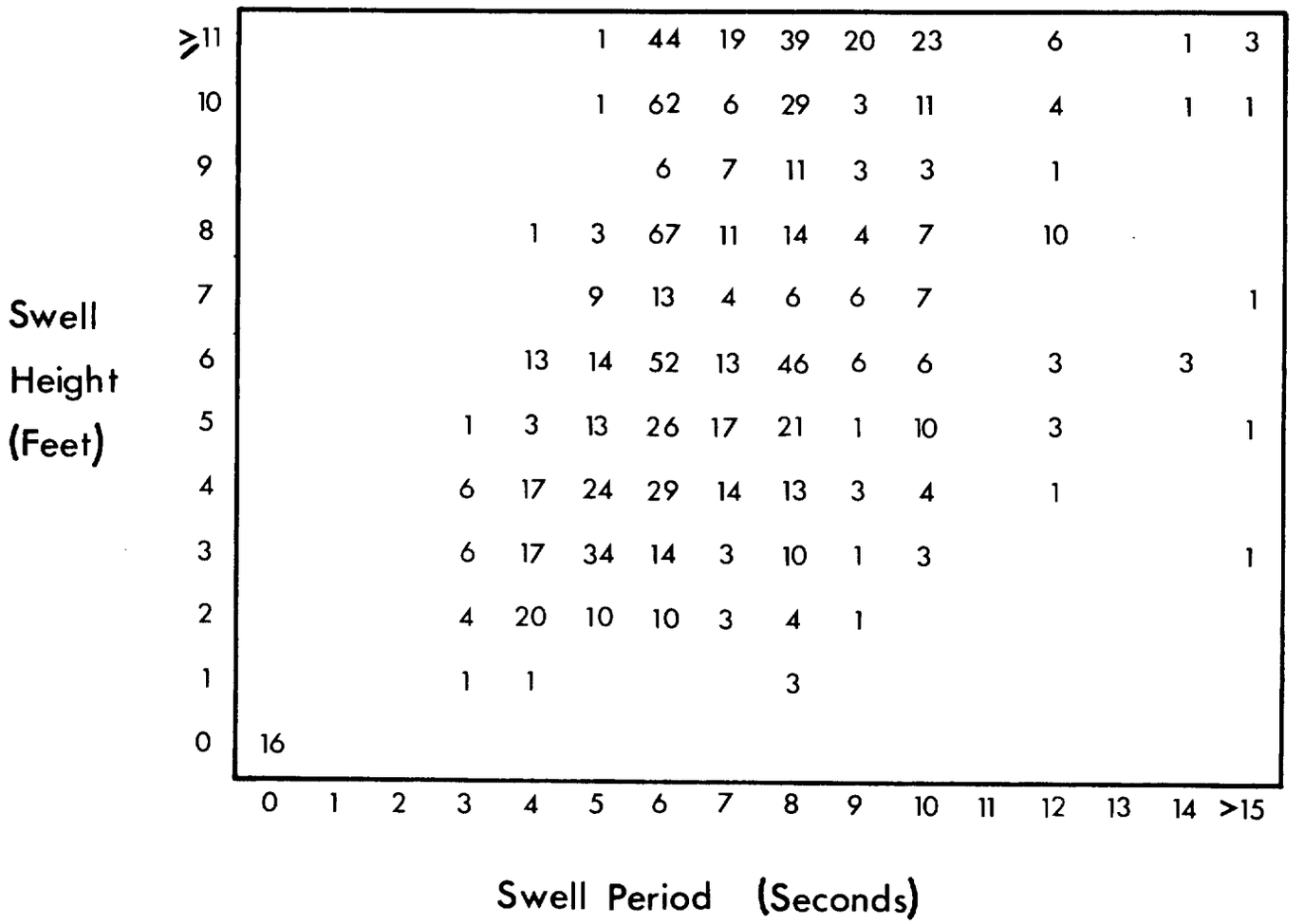


Tot Obs 694

Fig 25

Sc Stn N10

SWELL

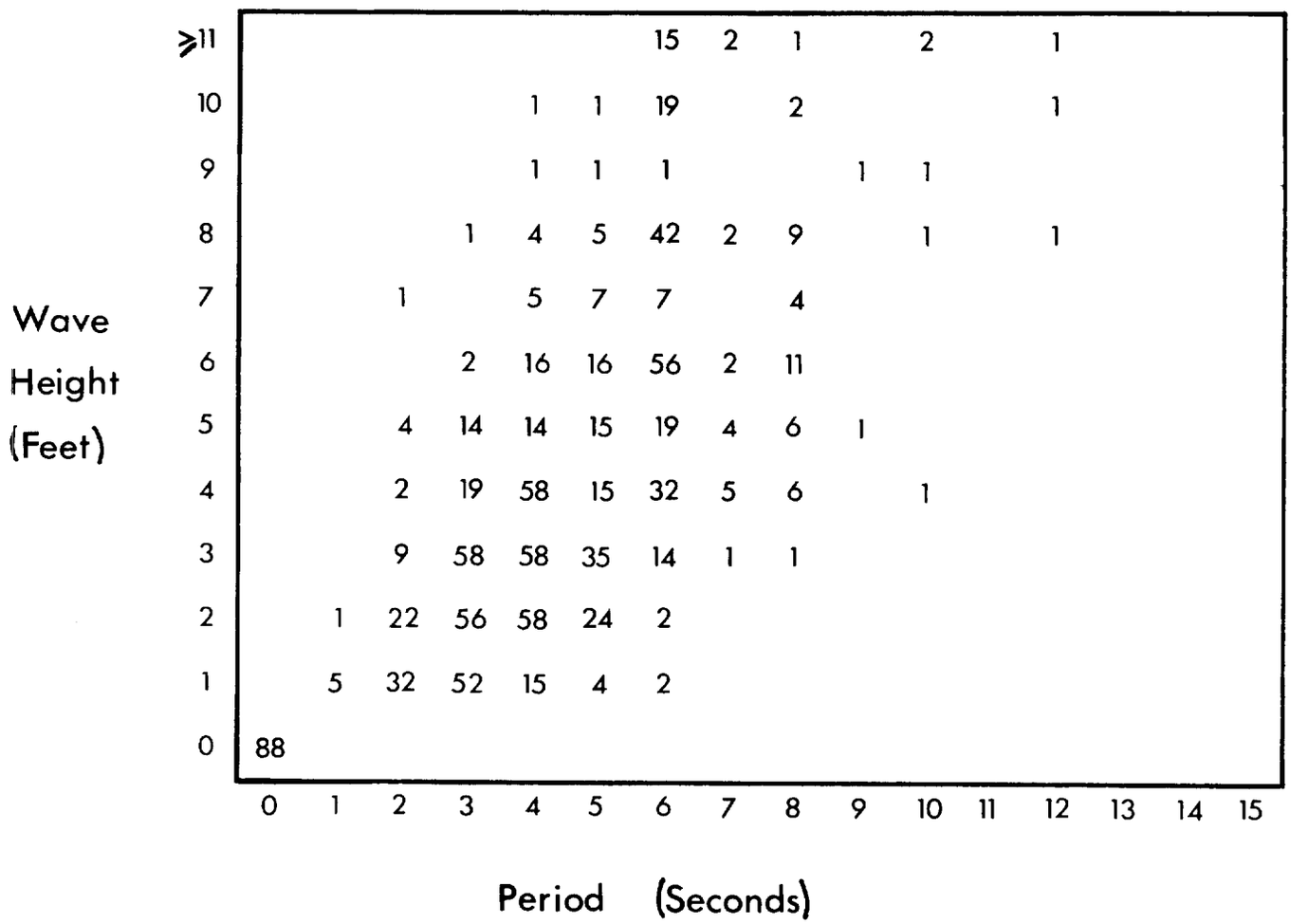


Tot Obs 698

Fig. 26

Sc Stn N11

SEA

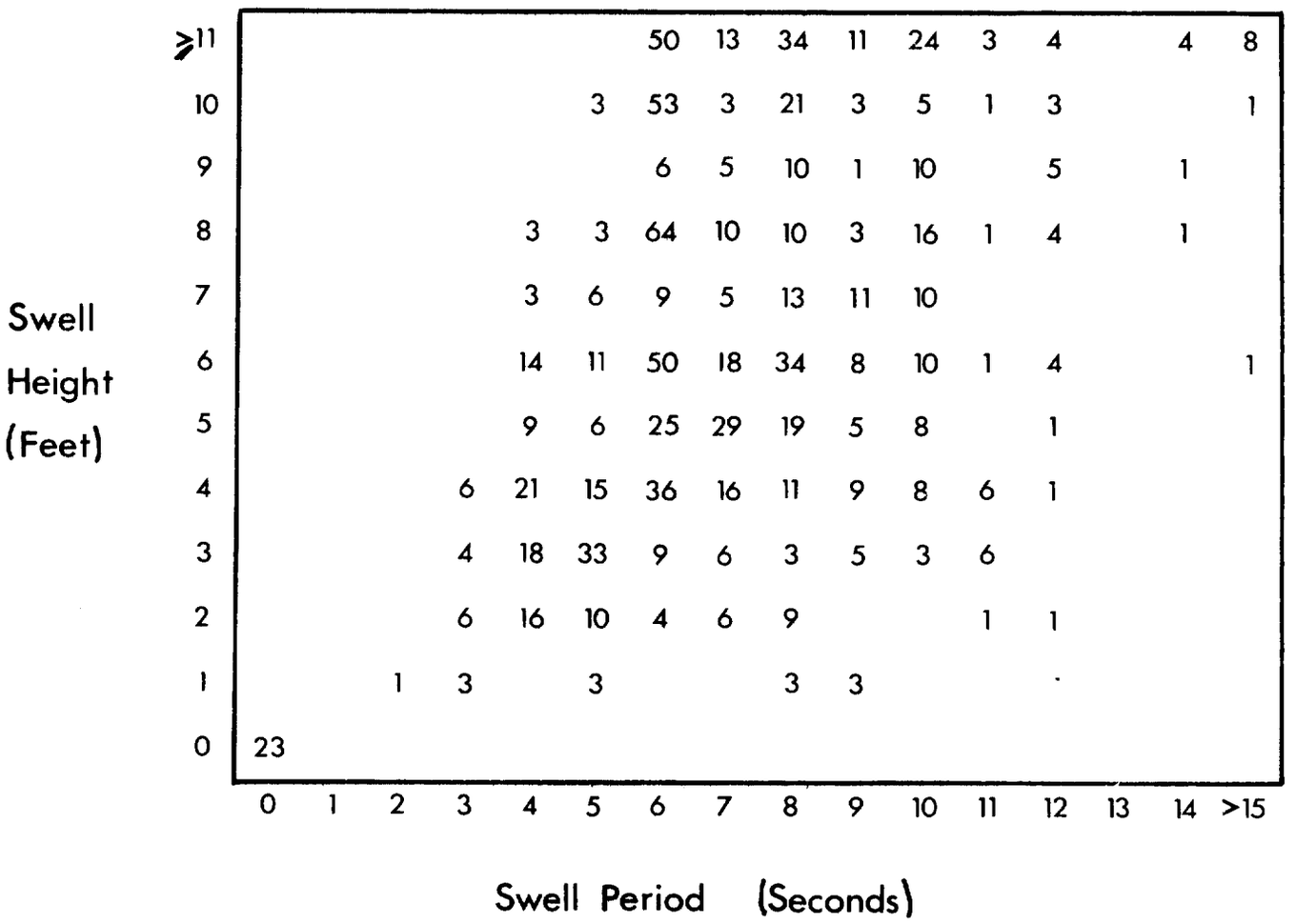


Tot Obs 807

Fig. 27

Sc Stn N11

SWELL

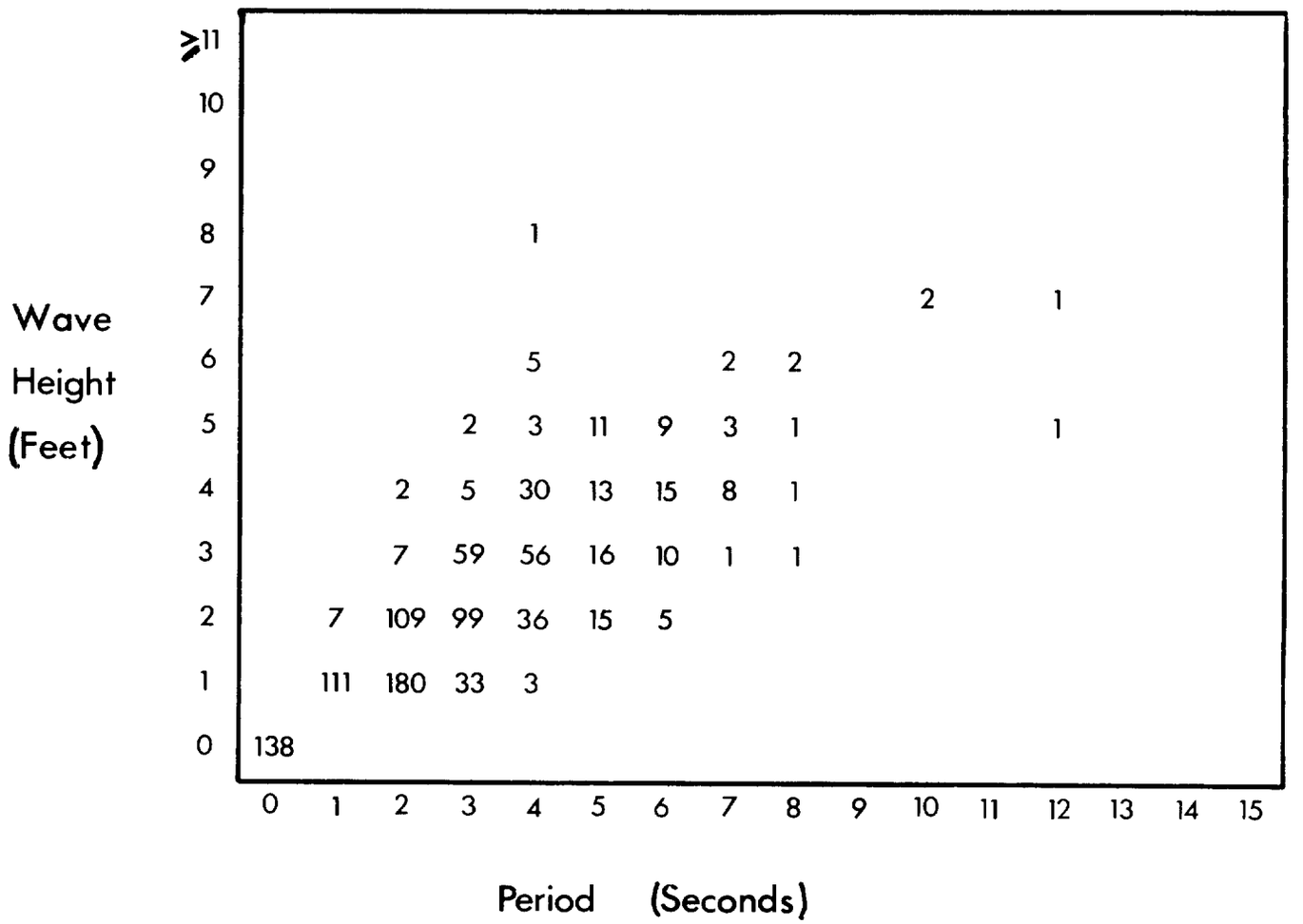


Tot Obs 799

Fig. 28

Sc Stn N12

SEA

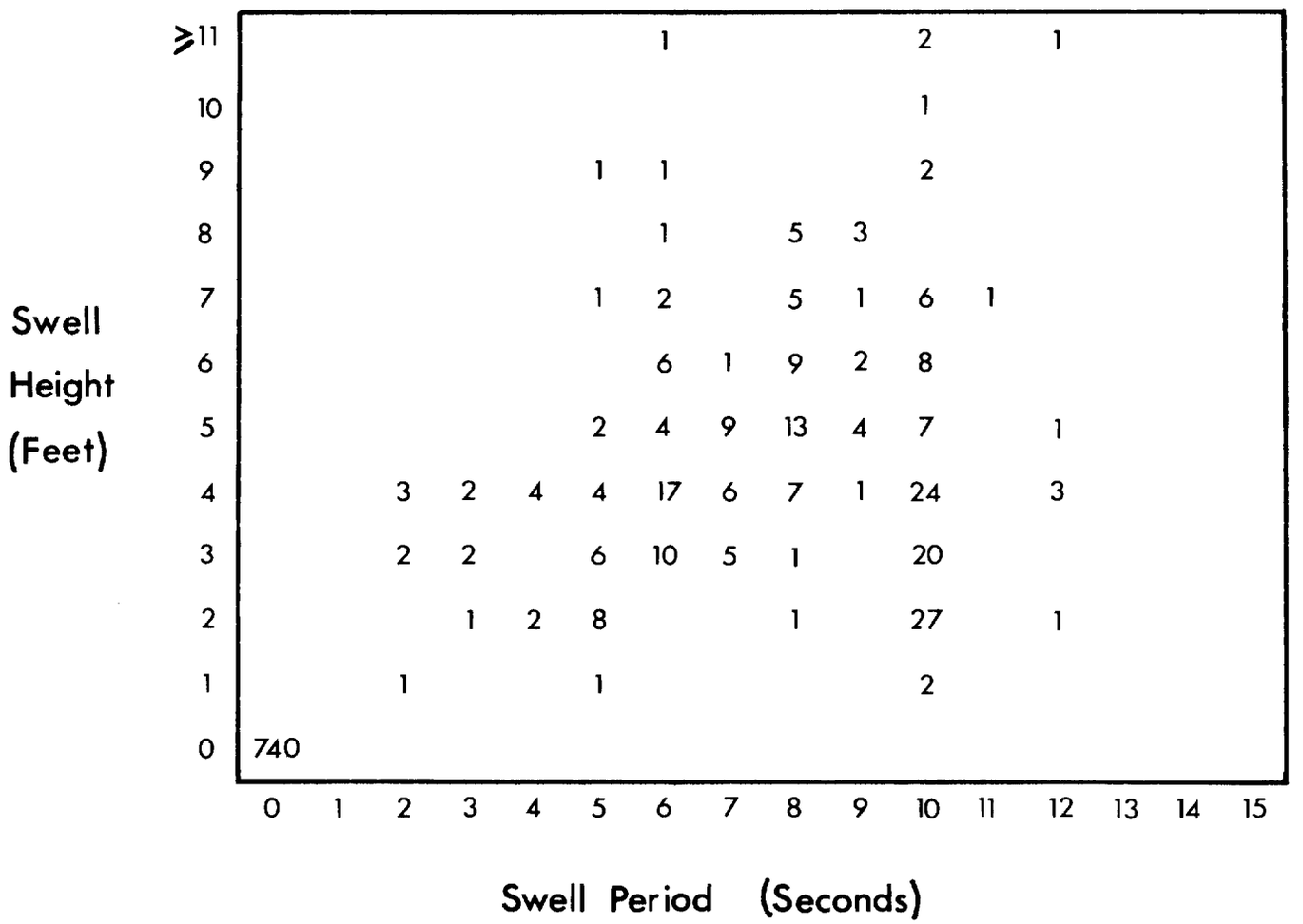


Tot Obs 1038

Fig. 29

Sc Stn N12

SWELL

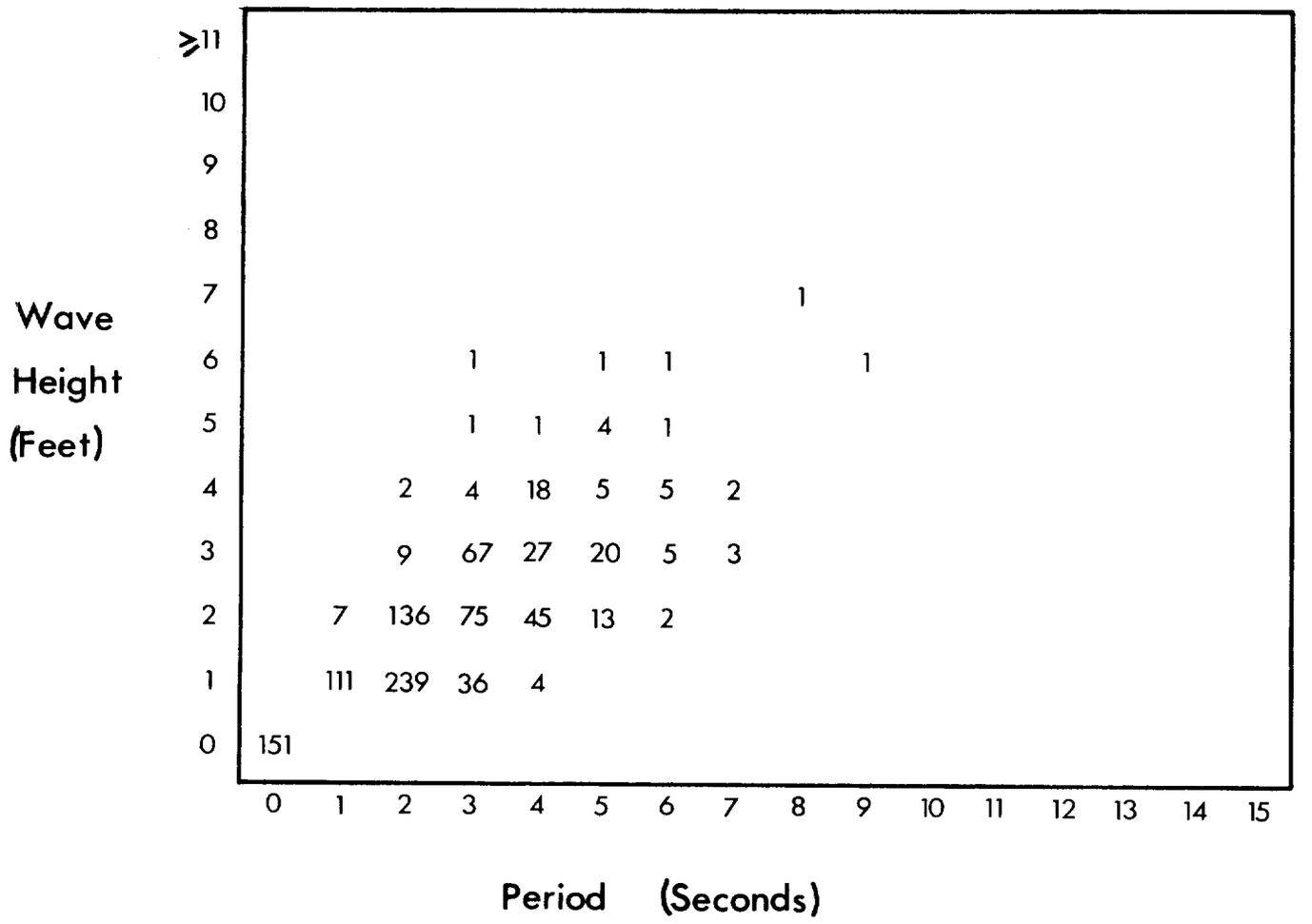


Tot Obs 1005

Fig. 30

Sc Stn N13

SEA

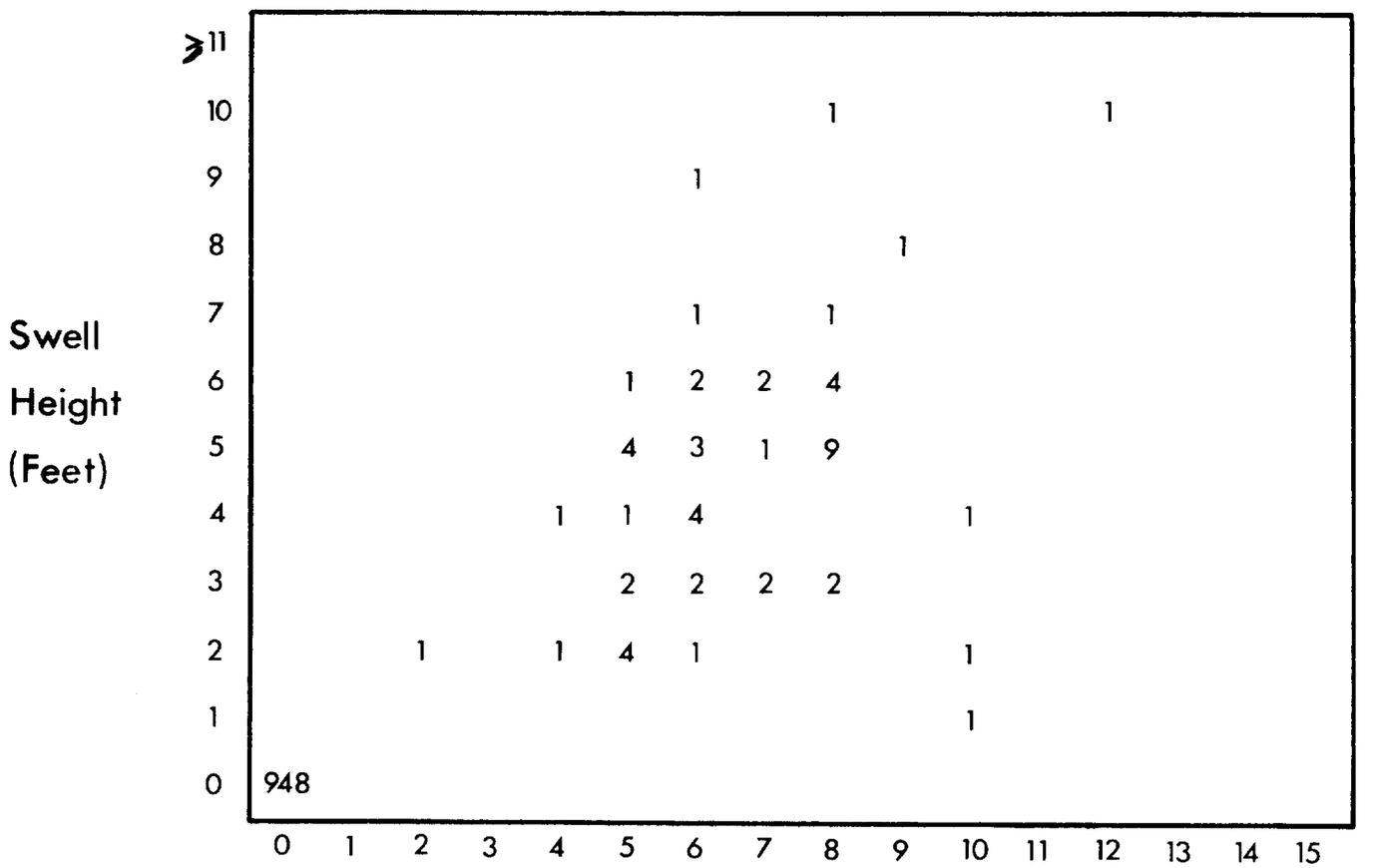


Tot Obs 997

Fig. 31

Sc Stn N13

SWELL

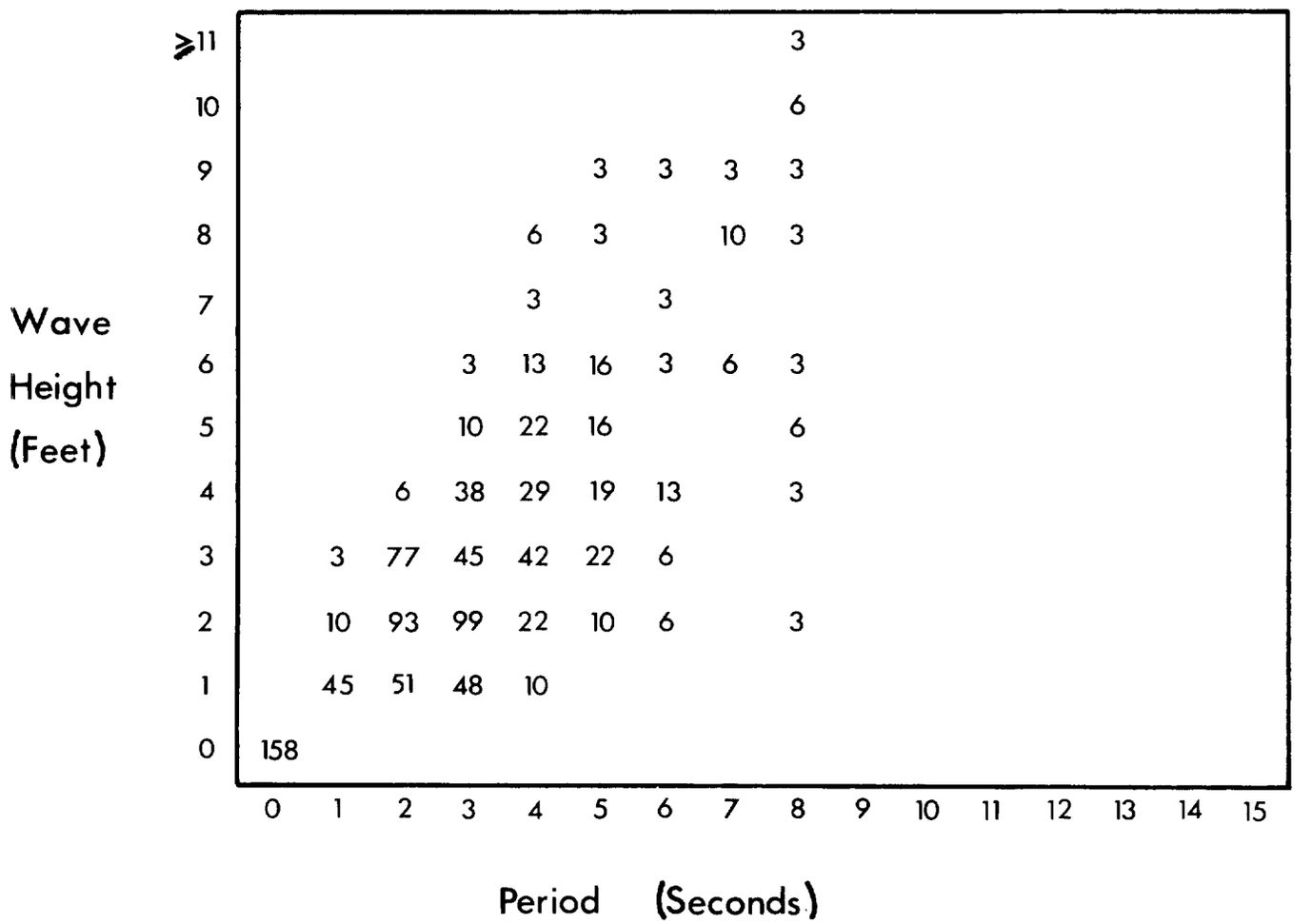


Tot Obs 902

Fig. 32

Sc Stn E4

SEA

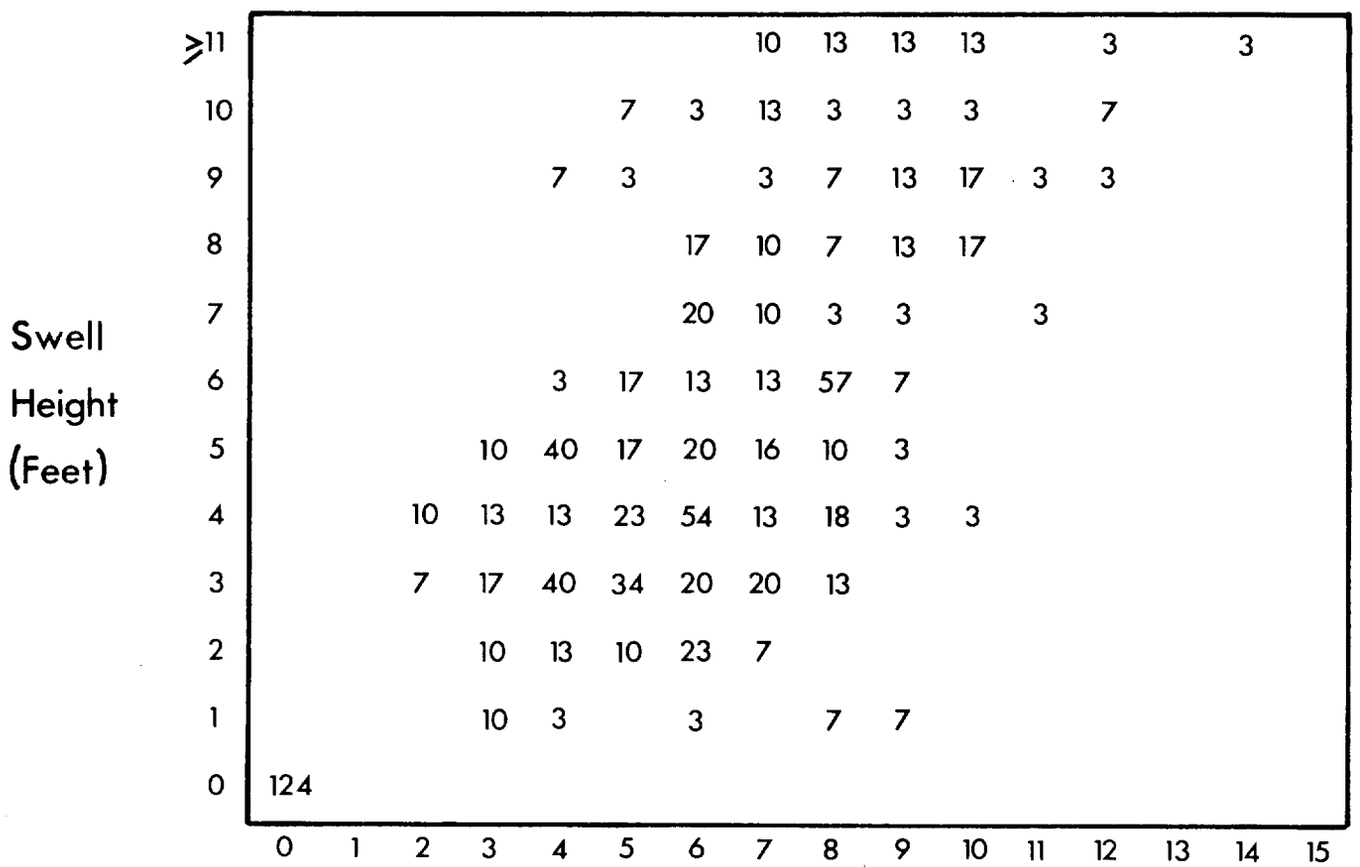


Tot Obs 312

Fig. 33

Sc Stn E4

SWELL

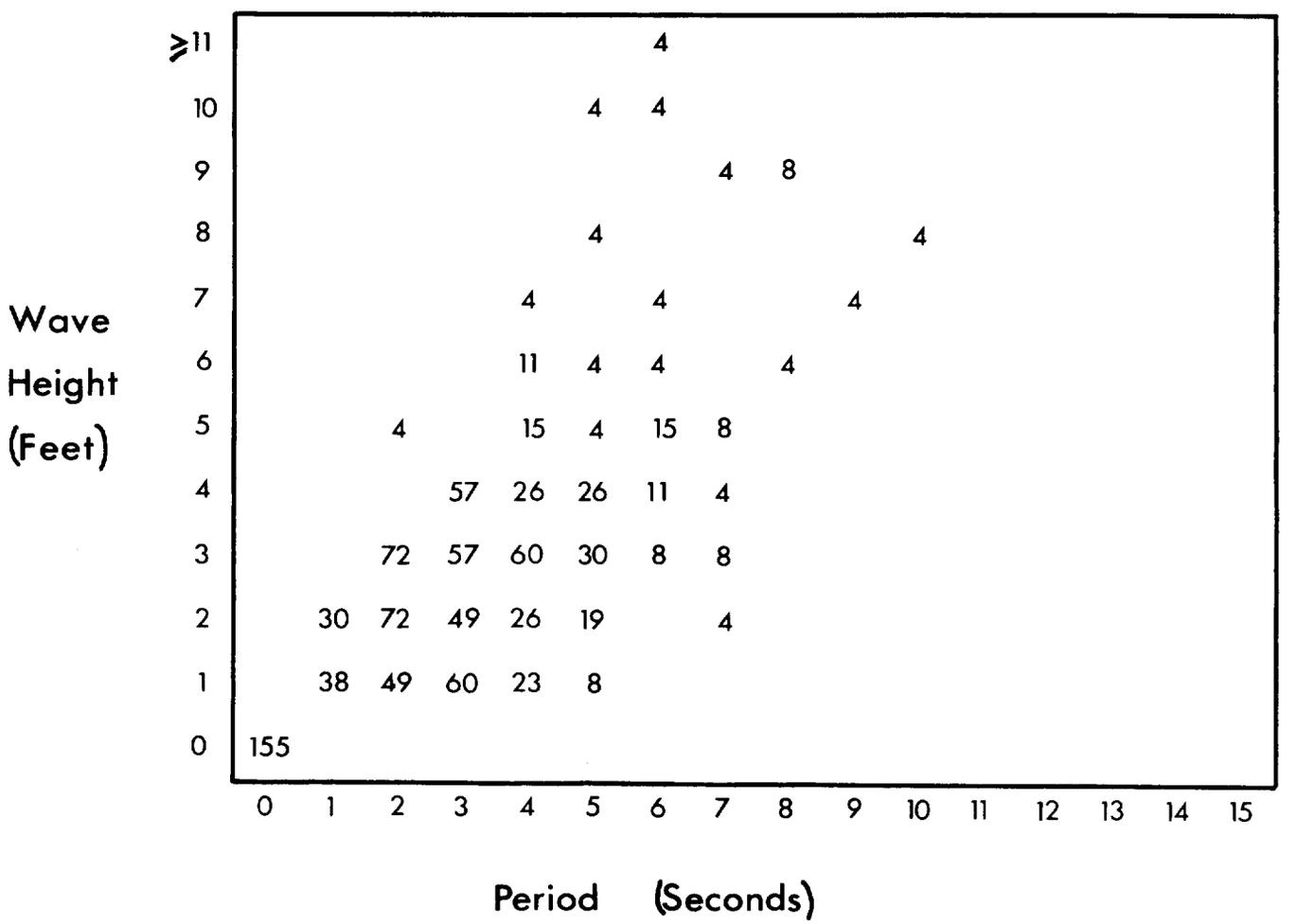


Tot Obs 298

Fig. 34

Sc Stn E5

SEA

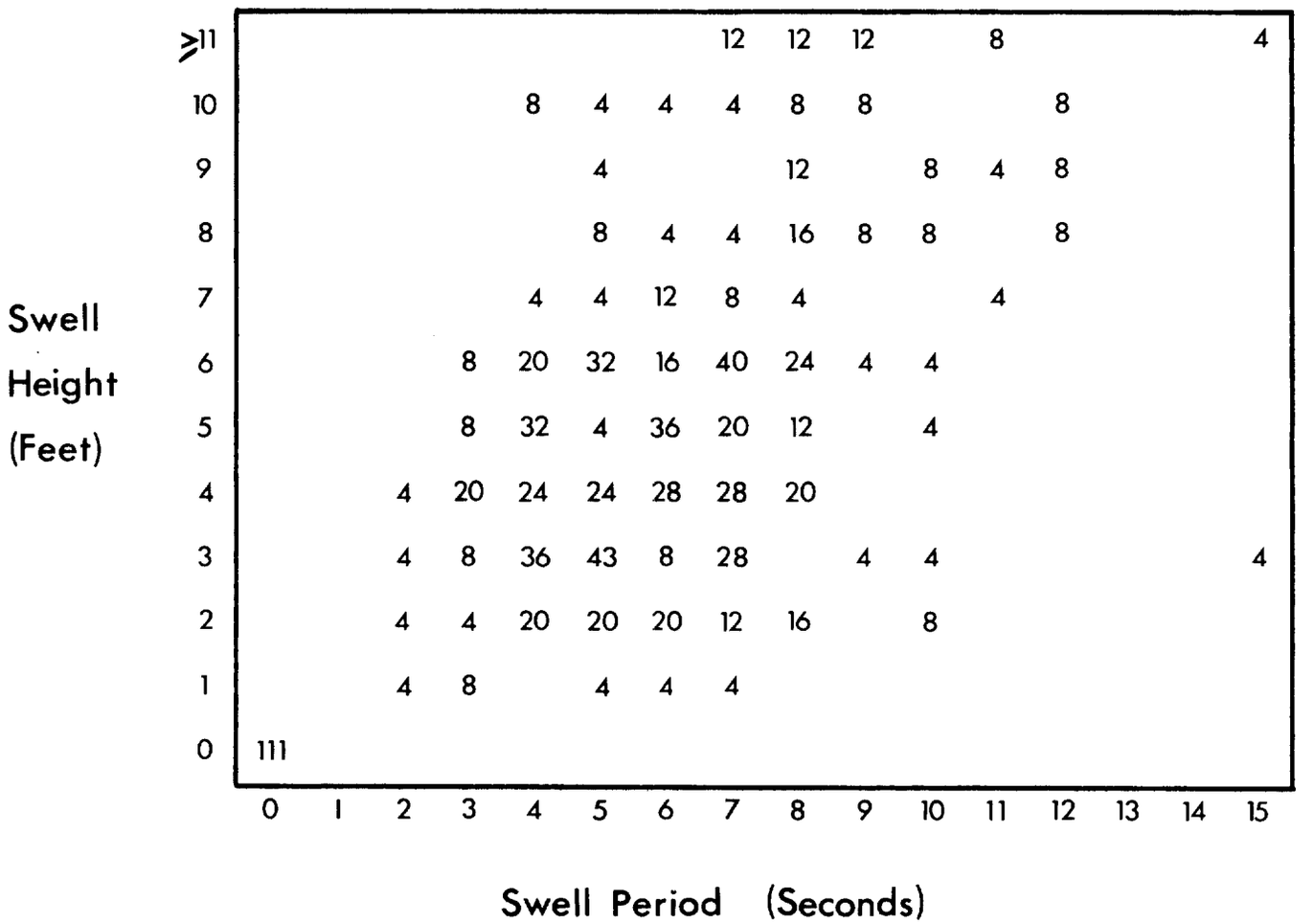


Tot Obs 265

Fig. 35

Sc Stn E5

SWELL



Tot Obs 253

Fig. 36