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National Weather Service

Wave Climatology for the Great Lakes

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WAVE CLIMATOLOGY FOR THE GREAT LAKES

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WAVE CLIMATOLOGY FOR THE GREAT LAKES

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ABSTRACT. This climatological study is based upon 10 years of wave observations on the Great Lakes. The observations are summarized for each of the lakes according to month of the year. Also, an overall summary for all months together is given for each lake. The cumulative frequencies of wave height for each lake are shown on a logarithmic scale. A problem in the coding of very low period waves prior to 1968 is briefly discussed.

INTRODUCTION

The weather observation program of the ships on the Great Lakes is extremely valuable to the National Weather Service. The reports transmitted from the ships are analyzed and used extensively in forecasting for the Great Lakes area. Descriptions of the weather observation program have been published in several volumes of Mariners Weather Log by Burke (1965), Burke and Kennedy (1966), Kennedy (1967, 1968), Hight (1969), and Schwerdt and Hight (1970).

Such observations, when compiled over a period of time, form the basis for climatic studies used to determine shipping regulations. Harris (1968) analyzed the summary of wave reports made on merchant ships during the 1965 and 1966 seasons for the Society of Naval Architects and Marine Engineers as part of a study for the construction of larger ships for use on the Great Lakes.

DATA SUMMARIES

The present summary of wave observations is based upon the 10-year period, 1960-1969. Observations are from the 30 to 40 U. S. ships that participate each year in the observational program managed by the Port Meteorological Officer of the National Weather Service Forecast Office, Department of Commerce, Cleveland, Ohio. Regular observations are made at the hours of 0000, 0600, 1200, and 1800 Greenwich Mean Time. Special observations are made when certain meteorological conditions change significantly. From 1960 through

1967 the observations were recorded on WB Form 615-4, and during 1968 and 1969, ESSA Form 72-7 was used. The observations are stored on punched cards at the National Climatic Center in Asheville, N. C., where they become part of the International Marine Surface Data (Deck 128).

Tables 1 through 5 give summaries of wave heights by wave periods for the five Great Lakes. Each summary covers a single lake and includes all the data reported during the period 1960-1969. The Lake Superior summary (table 1) has the greatest number of observations with 17,376, followed by Lake Michigan with 15,539. The Lake Ontario summary is based on 3,564 observations, the smallest number of any lake.

The cumulative frequency of wave heights from tables 1 through 5 are shown for each lake on the logarithmic probability graph of figure 1. This type of display is similar to that used by Fan and Harris (1970) in showing the wave height distributions for several U. S. coastal locations. The Great Lakes data fall fairly close to straight lines in figure 1, in a manner similar to that found by Fan and Harris (1970) for coastal stations.

Tables 6 through 56 give summaries for the 10-year period for each lake by month. There is no summary presented for the months of January, February, and March for Lake Erie, Lake Huron, and Lake Superior as there were less than 10 observations available for these months.

The wave heights are tabulated to the nearest half-meter, the unit presently being used in recording the wave height. A wave height of 0 indicates height less than one-quarter meter. Wave periods are tabulated in seconds. The first row is for periods of 5 seconds or less. The following rows are for the period indicated and for a second higher. For example, the second row is labeled 6 seconds and includes waves with periods of 6 or 7 seconds. The last row indicated by three asterisks is for calm wave conditions or for waves with undetermined periods. The actual number of observations for each height-period category is shown in the tables along with the percent frequency of occurrence, which is expressed to the nearest whole percent. Frequencies of less than one-half percent are indicated by asterisks.

A POSSIBLE BIAS

It is very likely that this summary is biased toward high waves. An explanation of this bias is that the wave observations come from only about half of the weather observations. It is possible that many wave observations were not recorded when the waves were very low or calm. Also, before 1964 the observation vessels were requested to include wave data in their synoptic radio reports only if the waves exceeded 3 feet. This restriction on the wave reports to be included in the radio weather reports may have led to missing observations on the observation forms when waves were less than 3 feet.

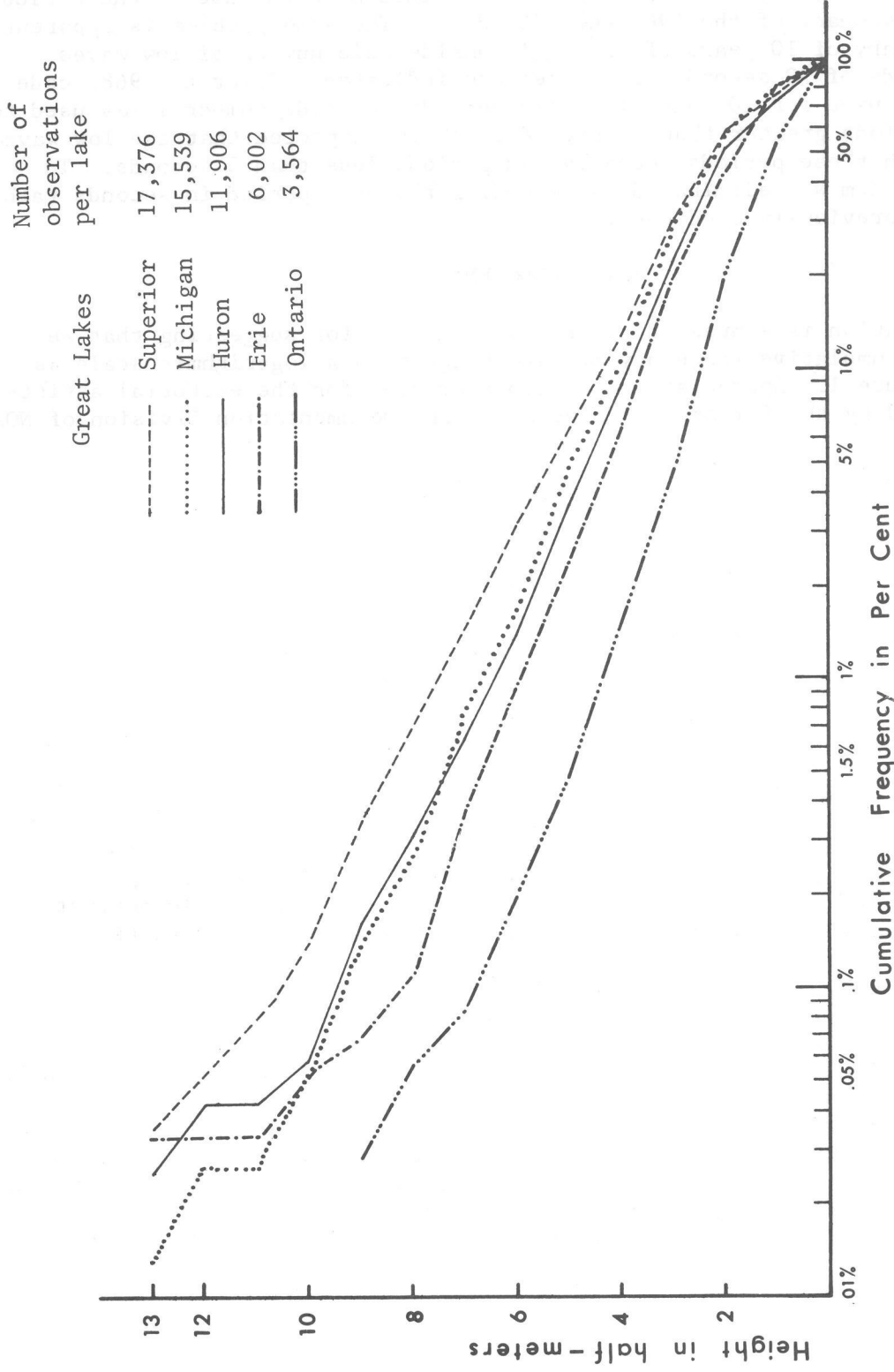


Figure 1.--Cumulative frequency on logarithmic scale of wave heights observed on the Great Lakes. Data included are for the period 1960 through 1969.

Harris (1968) reported some probable confusion in the use of the period code in the summary of the 1965 and 1966 data. The same problem is apparent in this summary of 10 years of data. A considerable number of low waves having periods of 20 seconds or greater are indicated. Prior to 1968, code number 0 was used for 20- and 21-second periods and code number 1 was used to indicate periods greater than 21 seconds. It is suspected that the low waves reported with these periods actually had periods less than 5 seconds. In 1968 the problem was eliminated by recording the wave period in seconds rather than in the previously used code.

ACKNOWLEDGMENTS

Appreciation is expressed to Dr. D. L. Harris for suggesting that we present the cumulative frequency of wave heights on a logarithmic scale as shown in figure 1. Appreciation is also expressed for the editorial assistance rendered by the Scientific Information and Documentation Division of NOAA.

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Table 1 LAKE SUPERIOR ALL DATA 1960 - 1969 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	N 1288	3112	3147	1531	371	169	78	31	10	1	4				2	9744	
PCT F	7	18	18	9	2	1	*	*	*	*	*				*	56	56
6	N	187	726	868	330	159	94	45	13	7	3	1				2441	
PCT F	*	1	4	5	2	1	1	*	*	*	*	*				14	70
8	N	1	24	145	260	177	99	54	20	12	10	2		2	1	807	
PCT F	*	*	1	1	1	1	*	*	*	*	*	*		*	*	5	75
10	N	2	12	43	83	53	33	19	10	4	1	1	2			316	
PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*			2	77
12	N	3	5	11	21	34	11	11	2	1	1	1	1			124	
PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*			1	77
14	N	8	4	4	8	7	19	2	8	3	5			1		65	
PCT F	*	*	*	*	*	*	*	*	*	*	*			*		0	78
16	N	3	6	6	3	2	4	3	2	1						30	
PCT F	*	*	*	*	*	*	*	*	*	*	*					0	78
18	N				1	1	1	1								7	
PCT F				*	*	*	*	*								0	78
20	N	1	2	5				1		2						11	
PCT F	*	*	*	*				*		*						0	78
>21	N	11	6	9	3											29	
PCT F	*	*	*	*												0	78
***	N 2212	447	605	315	118	54	32	11	4	2	1	1				3802	
PCT F	13	3	3	2	1	*	*	*	*	*	*	*				22	100
TOTAL	N 3526	3806	4701	3093	1093	585	309	150	56	33	11	4	3	3	3	17376	
PCT F	20	22	27	18	6	3	2	1	0	0	0	0	0	0	0		
C	20	42	69	87	93	97	98	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 2

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN		ALL DATA 1960 - 1969																
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	N	1359	2872	2597	1091	271	104	38	20	4	3	1					8360	
	PCT F	9	18	17	7	2	1	*	*	*	*	*					54	54
6	N	11	235	972	975	288	147	32	18	2	5	2		1	1		2689	
	PCT F	*	2	6	6	2	1	*	*	*	*	*		*	*		17	71
8	N	3	31	140	270	129	83	31	8	7	1						703	
	PCT F	*	*	1	2	1	1	*	*	*	*						5	76
10	N	6	5	45	120	70	53	20	11	3	3	1		1	1		339	
	PCT F	*	*	*	1	*	*	*	*	*	*	*		*	*		2	78
12	N	2	5	13	22	25	22	2	4	3							98	
	PCT F	*	*	*	*	*	*	*	*	*							1	78
14	N		6	1	19	10	4	1	1	1							43	
	PCT F		*	*	*	*	*	*	*	*							0	79
16	N		1	2	2	7	5	1	3								21	
	PCT F		*	*	*	*	*	*	*								0	79
18	N		1	2	2	2	1										16	
	PCT F		*	*	*	*	*		*								0	79
20	N		12	1	1	1			1								99	
	PCT F		*	*	*	*			*								1	80
>21	N		25	54	17	2	1										3163	
	PCT F		*	*	*	*											20	100
***	N	1544	571	571	320	86	52	9	9		1							
	PCT F	10	4	4	2	1	*	*	*		*							
TOTAL	N	2962	3782	4361	2824	889	471	134	75	20	13	4	0	2	0	2	15539	
	PCT F	19	24	28	18	6	3	1	0	0	0	0	0	0	0	0		
	C	19	43	71	90	95	98	99	100	100	100	100	100	100	100	100		100

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Table 3 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON ALL DATA 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	1170	2388	2177	935	192	77	19	8	2	1	1			1		6971	
PCT F	10	20	18	8	2	1	*	*	*	*	*			*		59	59
6 N	11	134	553	517	172	74	26	10	5	2	1	1	1	1		1507	71
PCT F	*	1	5	4	1	1	*	*	*	*	*	*	*	*		13	
8 N	1	11	81	189	109	51	20	13	4	5						484	75
PCT F	*	*	1	2	1	*	*	*	*	*						4	
10 N	1	4	21	44	39	22	9	2		2						144	76
PCT F	*	*	*	*	*	*	*	*	*	*						1	
12 N		4	5	18	14	11	2	3	1			1	1			59	77
PCT F	*	*	*	*	*	*	*	*	*			*	*			0	
14 N		4		6	5	6	3	3	1	1						29	77
PCT F	*	*	*	*	*	*	*	*	*	*						0	
16 N		1	1	1	1	4	3			1				1		12	77
PCT F	*	*	*	*	*	*	*	*	*	*				*	*	0	
18 N							1									1	77
PCT F	*	*	*	*	*	*	*	*	*	*						0	
20 N	2	5	3		1											11	77
PCT F	*	*	*	*	*	*	*	*	*	*						0	
>21 N	7	13	7	2												29	78
PCT F	*	*	*	*	*	*	*	*	*	*						0	
*** N	1708	344	351	161	66	17	7	1	4							2659	100
PCT F	14	3	3	1	1	*	*	*	*	*						22	
TOTAL N	2900	2907	3199	1873	599	262	90	40	17	12	2	0	2	1	2	11906	
PCT F	24	24	27	16	5	2	1	0	0	0	0	0	0	0	0		
C	24	49	76	91	96	99	99	100	100	100	100	100	100	100	100		100

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PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 4

LAKF ERIE ALL DATA 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	757	1579	1060	467	79	18	4									3969	
PCT F	13	26	18	8	1	*	*									66	66
6 N	6	71	180	189	67	32	11	7								563	
PCT F	*	1	3	3	1	1	*	*								9	76
8 N	5	31	68	68	35	21	6	3	3							173	
PCT F	*	1	1	1	1	*	*	*	*					1	*	3	78
10 N	1	3	6	17	13	6	5									51	
PCT F	*	*	*	*	*	*	*									1	79
12 N	3	3	8	8	5	3	2	1								25	
PCT F	*	*	*	*	*	*	*	*								0	80
14 N	1	1	3	3	2	1	4									12	
PCT F	*	*	*	*	*	*	*			1	*					0	80
16 N			1			1										2	
PCT F			*			*										0	80
18 N																0	
PCT F																0	80
20 N	2															3	
PCT F	*															0	80
>21 N	11	2	3													16	
PCT F	*	*	*													0	80
*** N	912	93	109	50	21	1	1									1188	
PCT F	15	2	2	1	*	*	*									20	100
TOTAL N	1689	1757	1393	802	222	83	33	16	3	1	1	0	0	1	1	6002	
PCT F	28	29	23	13	4	1	1	0	0	0	0	0	0	0	0		
C	28	57	81	94	98	99	100	100	100	100	100	100	100	100	100		100

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Table 5 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE ONTARIO		ALL DATA 1960 - 1969													TOT	C		
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13		
<5	N	748	1195	468	80	20					1						2521	
	PCT F	21	34	13	2	1	*	*	*	*	*						71	71
6	N	2	17	49	10	3	2										83	
	PCT F	*	*	1	*	*	*										2	73
8	N		8	8	13	1				1							31	
	PCT F		*	*	*	*				*							1	74
10	N		2	1	1	5	1	2									12	
	PCT F		*	*	*	*	*	*									0	74
12	N		3	1	1	1	1										6	
	PCT F		*	*	*	*	*										0	74
14	N					1											1	
	PCT F					*											0	74
16	N																0	
	PCT F																0	74
18	N																0	
	PCT F																0	74
20	N		1	3													4	
	PCT F		*	*													0	75
>21	N		4	5													9	
	PCT F		*	*													0	75
***	N	856	19	14	5	3											897	
	PCT F	24	1	*	*	*											25	100
TOTAL	N	1611	1246	546	110	34	10	4	1	1	1	0	0	0	0	0	3564	
	PCT F	45	35	15	3	1	0	0	0	0	0	0	0	0	0	0		
	C	45	80	95	99	100	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

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PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR APRIL 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C			
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13	
<5	N	53	106	102	49	10	3	3	1								336	
	PCT F	6	13	12	6	1	*	*	*	*							41	41
6	N	2	4	37	40	17	15	2		1							122	
	PCT F	*	*	5	5	2	*	*	*	*							15	56
8	N		2	14	14	7	10	3	1	1	1						54	
	PCT F		*	2	2	1	*	*	*	*	*						7	62
10	N		3	3	10	4	5	1	1	1							28	
	PCT F		*	*	1	*	1	*	*	*							3	66
12	N	1		1	1	3		1									6	
	PCT F	*		*	*	*		*									1	66
14	N			1	3	1	2										7	
	PCT F			*	*	*	*										1	67
16	N			1	1		2	1									4	
	PCT F			*	*		*	*									0	68
18	N					1											1	
	PCT F					*											0	68
20	N																0	
	PCT F																0	68
>21	N	2	1														3	
	PCT F	*	*														0	68
***	N	68	40	68	47	21	7	5	3	1		1				261		
	PCT F	8	5	8	6	3	1	1	*	*		*				32	100	
TOTAL	N	126	156	226	164	64	49	17	11	3	3	1	0	0	1	822		
	PCT F	15	19	27	20	8	6	2	1	0	0	0	0	0	0			
	C	15	34	62	82	90	95	98	99	99	100	100	100	100	100			100

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Table 7 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR MAY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)										TOT	C					
	0	1	2	3	4	5	6	7	8	9			10	11	12	13	>13
55 N	163	387	321	149	24	8	6	2	1							1061	
PCT F	8	19	16	7	1	*	*	*	*							52	52
6 N	3	47	79	88	24	9	6	7	1							264	
PCT F	*	2	4	4	1	*	*	*	*							13	65
8 N		2	15	29	10	4	5	1	2	1						69	
PCT F		*	1	1	*	*	*	*	*	*						3	68
10 N			3	17	9	5	4	1	2				1			42	
PCT F			*	1	*	*	*	*	*				*			2	70
12 N		2	1	2	3	2	4			1			1			16	
PCT F		*	*	*	*	*	*			*			*			1	71
14 N		2			2	3			1	1						9	
PCT F		*			*	*			*	*						0	71
16 N			2			1										3	
PCT F			*			*										0	72
18 N																0	
PCT F																0	72
20 N		1	1													2	
PCT F		*	*													0	72
>21 N	3		5	2												10	
PCT F	*		*	*												0	72
*** N	252	92	137	54	19	9	4	2		1						570	
PCT F	12	4	7	3	1	*	*	*		*						28	100
TOTAL N	421	533	564	341	91	41	25	17	7	4	0	0	2	0	0	2046	
PCT F	21	26	28	17	4	2	1	1	0	0	0	0	0	0	0		
C	21	47	74	91	95	97	99	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR JUNE 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
≤5	N	210	393	321	97	13	9	1	1	1	1	1	1	1	1	1044	56
	PCT F	11	21	17	5	1	*	*	*	*	*	*	*	*	*	56	56
6	N		35	69	32	9	1	2								148	64
	PCT F		2	4	2	*	*	*								8	64
8	N		2	16	14	4			1							37	66
	PCT F		*	1	1	*			*							2	66
10	N				1	1										2	66
	PCT F				*	*										0	66
12	N	1	2	1	1	1	1									6	66
	PCT F	*	*	*	*	*	*									0	66
14	N		2													2	66
	PCT F		*													0	66
16	N		1													1	66
	PCT F		*													0	66
18	N															0	66
	PCT F															0	66
20	N				3											3	67
	PCT F				*											0	67
>21	N		1	2	1											4	67
	PCT F		*	*	*											0	67
***	N	405	76	96	26	13	1	2								619	100
	PCT F	22	4	5	1	1	*	*								33	100
TOTAL	N	616	512	508	171	41	12	2	0	1	1	0	0	0	0	1866	
	PCT F	33	27	27	9	2	1	0	0	0	0	0	0	0	0		
	C	33	60	88	97	99	100	100	100	100	100	100	100	100	100		

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 9 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR		JULY 1960 - 1969																
PER (SEC)	N	WAVE HEIGHT (HALF METERS)													TOT	C		
		0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55	285	538	264	71	14	2	1										1175	
	PCT F	13	12	3	1	*	*										54	54
6	1	28	68	29	10	1	1										138	
	PCT F	*	1	3	1	*	*										6	61
8	N	2	14	9	1												27	
	PCT F	*	1	*	*												1	62
10	N	1	2	4	1												8	
	PCT F	*	*	*	*												0	62
12	N	1	1	1	3												6	
	PCT F	*	*	*	*												0	63
14	N	4				1											5	
	PCT F	*	*	*	*	*											0	63
16	N	1															1	
	PCT F	*	*	*	*	*											0	63
18	N																0	
	PCT F																0	63
20	N																0	
	PCT F																0	63
>21	N	5	3	2													10	
	PCT F	*	*	*													0	63
***	N	588	70	81	39	13	1	2									795	
	PCT F	27	3	4	2	1	*	*									37	100
TOTAL	N	881	649	434	152	39	4	4	1	0	0	0	0	0	0	0	2165	
	PCT F	41	30	20	7	2	0	0	0	0	0	0	0	0	0	0		
	C	41	71	91	98	100	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

CUMULATIVE PERCENT

Table 10

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR AUGUST 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	256	553	412	146	24	9	5	2								1407	
PCT F	10	22	17	6	1	*	*	*								57	57
6 N	1	21	94	124	31	17	2	1	1	1						292	
PCT F	*	1	4	5	1	1	*	*	*	*						12	69
8 N	1	2	16	24	26	1	1	1								71	
PCT F	*	*	1	1	1	*	*	*								3	72
10 N	1	1	6	9	2	1	1		1							21	
PCT F	*	*	*	*	*	*	*	*	*							1	73
12 N			2	2	2	3										9	
PCT F			*	*	*	*										0	73
14 N				1	1	2								1		4	
PCT F				*	*	*								*		0	73
16 N		1		1												2	
PCT F		*		*												0	73
18 N				1		1										2	
PCT F				*		*										0	73
20 N	1															1	
PCT F	*															0	73
>21 N	1															1	
PCT F	*															0	73
*** N	451	78	83	29	5	5	3	1								655	
PCT F	18	3	3	1	*	*	*	*								27	100
TOTAL N	712	656	613	337	90	39	10	5	1	1	0	0	0	1	0	2465	
PCT F	29	27	25	14	4	2	0	0	0	0	0	0	0	0	0		
C	29	55	80	94	98	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 11 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR		SEPTEMBER 1960 - 1969										TOT	C			
PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	
≤5	N 174	454	512	222	65	24	8	4	1							1464
	PCT F 7	19	22	9	3	1	*	*	*							63
6	N	18	103	142	71	23	11	5	1							374
	PCT F 1	4	6	3	1	1	*	*	*							16
8	N	5	17	39	18	10	5	2								96
	PCT F *		1	2	1	*	*	*								4
10	N		4	9	12	7		4								36
	PCT F *		*	*	1	*		*								2
12	N		2	6	3	4	1	1								17
	PCT F *		*	*	*	*	*	*								1
14	N		2	2												4
	PCT F *		*	*												0
16	N		1		2			1								4
	PCT F *		*		*			*								0
18	N															4
	PCT F															0
20	N		1													1
	PCT F *		*													0
>21	N															0
	PCT F															0
***	N 202	38	53	33	9	4	4		1							344
	PCT F 9	2	2	1	*	*	*		*							15
TOTAL	N 376	515	695	453	180	72	29	17	3	0	0	0	0	0	0	2340
	PCT F 16	22	30	19	8	3	1	1	0	0	0	0	0	0	0	
	C 16	38	68	87	95	98	99	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 12

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR		OCTOBER 1960 - 1969															
PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55	N	95	342	536	349	105	18	8	4		1				1	1514	
	PCT F	4	13	20	13	4	1	*	*		*				*	57	57
6	N	1	20	139	197	80	27	19	7	4	1					543	
	PCT F	*	1	5	7	3	1	1	*	*	*					21	78
8	N	5	30	61	45	30	15	9	4	2				1		202	
	PCT F	*	1	2	2	1	1	*	*	*				*		8	85
10	N	3	18	17	6	19	9	10	1				1			84	
	PCT F	*	1	1	*	1	*	*	*				*			3	88
12	N	3	5	11	9	9	9	3								40	
	PCT F	*	*	*	*	*	*	*								2	90
14	N	1	1	2	4	4	2	5								15	
	PCT F	*	*	*	*	*	*	*								1	91
16	N	2	2	2	1	1	2	1								6	
	PCT F	*	*	*	*	*	*	*								0	91
18	N	2	1	1	2	2	1	1								4	
	PCT F	*	*	*	*	*	*	*								0	91
20	N	0	0	0	0	0	0	0								0	
	PCT F															0	91
>21	N	1	1	1	1	1	1	1								1	
	PCT F	*	*	*	*	*	*	*								0	91
***	N	103	20	40	38	19	4	1								239	
	PCT F	4	1	2	1	1	*	*								9	100
TOTAL	N	199	391	767	670	268	87	57	16	6	2	0	1	1	1	2648	
	PCT F	8	15	29	25	10	3	2	1	0	0	0	0	0	0		
	C	8	22	51	77	87	97	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LFSS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 13 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR		NOVEMBER 1960 - 1969													TOT	C		
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55	N	48	237	457	304	81	37	28	8	3							1203	
	PCT F	2	11	21	14	4	2	1	*	*							55	55
6	N	11	114	166	166	67	33	27	10	2	1	2	1				434	
	PCT F	1	5	8	8	3	2	1	*	*	*	*	*				20	75
8	N	3	19	46	44	44	36	19	5	3	3						180	
	PCT F	*	1	2	2	2	2	1	*	*	*	*	*				8	83
10	N	3	4	16	12	12	8	17	3	4	2	1	1				70	
	PCT F	*	*	*	1	1	*	1	*	*	*	*	*				3	87
12	N	1	1	1	10	10	4	1	1	1							19	
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*				1	88
14	N	1	1	1	1	1	7	3	3	2	4						18	
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*				1	88
16	N	2	2	2	2	2	1	1	1	1							6	
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*				0	89
18	N	0	0	0	0	0	0	0	0	0							0	
	PCT F																0	89
20	N	3	3	3	3	3	1	2	1	2							3	
	PCT F	0	0	0	0	0	0	0	0	0	*	*	*				0	89
>21	N	0	0	0	0	0	0	0	0	0							0	
	PCT F																0	89
***	N	106	27	31	40	16	11	9	2	2		1	1				245	
	PCT F	5	1	1	2	1	1	*	*	*	*	*	*				11	100
TOTAL	N	154	281	628	574	231	137	102	34	20	12	3	2	0	0	0	2178	
	PCT F	7	13	29	26	11	6	5	2	1	1	0	0	0	0	0		
	C	7	20	49	75	86	92	97	98	99	100	100	100	100	100	100		

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 14 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE SUPERIOR, DECEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	4	102	222	142	35	16	9	4			2					536	
PCT F	*	12	26	17	4	2	1	*			*					64	64
6	N	3	23	50	20	12	13	1	2	*						124	
PCT F		*	3	6	2	1	2	*								15	79
8	N	1	4	24	22	8	6	1	1	*	2	1		1		70	
PCT F		*	*	3	3	1	1	*		*	*	*		*		8	87
10	N	1	3	3	7	8	2		1	2	1					25	
PCT F		*	*	*	1	1	*		*	*	*					3	90
12	N			1	1			1	1			1				5	
PCT F				*	*			*	*			*				1	91
14	N					1										1	
PCT F						*										0	91
16	N					1			1							3	
PCT F						*			*							0	91
18	N															0	
PCT F																0	91
20	N															1	
PCT F																0	91
>21	N															0	
PCT F																0	91
***	N	37	6	16	9	3	2	1								74	
PCT F		4	1	2	1	*	*	*								9	100
TOTAL	N	41	113	266	229	88	48	31	7	5	4	1	0	0	1	839	
PCT F		5	13	32	27	10	6	4	1	1	0	0	0	0	0		
C		5	18	50	77	88	94	97	98	99	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 15 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN JANUARY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)											TOT	C					
	0	1	2	3	4	5	6	7	8	9	10			11	12	13	>13	
≤5	N	30	113	102	53	6	7	1									312	
	PCT F	5	20	18	9	1	1	*									55	55
6	N	11	54	65	11	24	13	2									169	
	PCT F	2	9	11	4	4	2	*									30	84
8	N	2	6	11	7	7	3	1									37	
	PCT F	*	1	2	1	1	1	*									6	91
10	N	1	1			8	4										14	
	PCT F	*	*	*		1	1										2	93
12	N	2			2		3	1									6	
	PCT F	*	*	*	*	*	1	*									1	94
14	N	1	1		1	1	1	1									4	
	PCT F	*	*	*	*	*	*	*									1	95
16	N	3	3			3	1										4	
	PCT F	1	1			1	*										1	96
18	N																0	
	PCT F																0	96
20	N																0	
	PCT F																0	96
>21	N	8	2														10	
	PCT F	1	*														2	98
***	N	10	1	2													14	
	PCT F	2	*	*													2	100
TOTAL	N	41	135	165	134	49	36	5	3	1	1	0	0	0	0	0	570	
	PCT F	7	24	29	24	9	6	1	1	0	0	0	0	0	0	0		
	C	7	31	60	83	92	98	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 16 PERCENTAGE SUMMARY OF W. HEIGHTS BY PERIODS

LAKE MICHIGAN, FEBRUARY 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	32	99	67	29	3	2		1	1							234	
PCT F	6	20	13	6	1	*		*	*							47	47
6 N	20	54	72	72	24	4		1								175	
PCT F	4	11	14	5	1	1		*								35	82
8 N	3	8	22	6	2	2	1									42	
PCT F	1	2	4	1	*	*	*									8	90
10 N	3	5	6	1	6	1	4									19	
PCT F	1	1	1	1	1	*	1									4	94
12 N	5	5	2	1	2	1		1								9	
PCT F	1	1	*	*	*	*		*								2	96
14 N	1	1														1	
PCT F	*	*														0	96
16 N	3	3	1	1	3	3										6	
PCT F	1	1			1	1										1	97
18 N	1	1			1	1										1	
PCT F	*	*			*	*										0	97
20 N	1	1														1	
PCT F	*	*														0	97
>21 N	1	2		1												4	
PCT F	*	*		*												1	98
*** N	9															9	
PCT F	2															2	100
TOTAL N	43	124	132	135	44	14	5	3	1	0	0	0	0	0	0	501	
PCT F	9	25	26	27	9	3	1	1	0	0	0	0	0	0	0		
C	9	33	60	87	95	98	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 17 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN		MARCH 1960 - 1969											TOT	C		
PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	
≤5 N	36	113	75	28	6	2	1									261
PCT F	6	20	14	5	1	*	*									47
6 N	17	63	46	10	7	2	1	1	2	*						146
PCT F	3	11	8	2	1	*	*	*	*	*						26
8 N	10	27	14	3	1	2	1	1	1	*						63
PCT F	2	5	3	1	*	*	*	*	*	*						11
10 N	3	9	12	6	1	1			1	*						31
PCT F	1	2	2	1	*	*			*	*						6
12 N	1	2	5	1	1	1										9
PCT F	*	*	1	*	1	*										2
14 N	1	1	1	1	1	1	1									3
PCT F	*	*	*	*	*	*	*									1
16 N	1	1	1	1	1	1	1	1								3
PCT F	*	*	*	*	*	*	*	*								1
18 N																0
PCT F																0
20 N																0
PCT F																0
>21 N		5														5
PCT F		1														1
*** N	33					1										34
PCT F	6					*										6
TOTAL N	69	135	152	113	48	26	4	4	1	3	0	0	0	0	0	555
PCT F	12	24	27	20	9	5	1	1	0	1	0	0	0	0	0	
C	12	37	64	85	93	98	99	99	99	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 18

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN APRIL 1960 - 1969

PER (SEC)	0	1	2	3	4	WAVE HEIGHT (HALF METERS)										TOT	C			
						5	6	7	8	9	10	11	12	13	>13					
55	N	124	226	148	52	8	2											566	52	52
	PCT F	11	21	14	5	1	1	*										153	14	66
6	N	23	64	44	44	14	1	1	1	1	*							45	4	70
	PCT F	2	6	4	4	1	*	*	*	*	*	*	*	*	*	*	*	40	4	74
8	N	1	14	23	2	5	2	2	2	2	*	*	*	*	*	*		9	1	75
	PCT F	*	*	2	*	*	*	*	*	*	*	*	*	*	*	*	*	4	0	75
10	N	3	27	2	2	5	1	1	1	1	*	*	*	*	*	*		1	0	75
	PCT F	*	*	2	*	*	*	*	*	*	*	*	*	*	*	*	*	4	0	75
12	N	1	2	1	1	3	2	2	2	2	*	*	*	*	*	*		1	0	75
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	0	75
14	N	2	2	2	2	2	2	2	2	2	*	*	*	*	*	*		2	0	76
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	0	76
16	N	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*		1	0	76
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	0	76
18	N	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*		1	0	76
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	0	76
20	N	2	1	1	1	1	1	1	1	1	*	*	*	*	*	*		3	0	76
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	0	76
>21	N	2	2	2	2	2	2	2	2	2	*	*	*	*	*	*		6	1	76
	PCT F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	6	1	76
***	N	119	45	58	26	6	2	1	1	1	*	*	*	*	*	*		257	24	100
	PCT F	11	4	5	2	1	2	1	1	1	*	*	*	*	*	*	*	257	24	100
TOTAL	N	248	298	293	176	43	20	3	1	1	0	0	0	0	0	0		1086		
	PCT F	23	27	27	16	4	2	0	0	0	0	0	0	0	0	0		1086		
	C	23	50	77	93	97	99	100	100	100	100	100	100	100	100	100		100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 19 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

PER (SEC)	MAY 1960 - 1969		WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13				
≤5	N 171	339	212	69	8	5		2	1									807	
	PCT F 11	22	14	5	1	*	*	*	*									54	54
6	N 1	24	60	49	15	2	1	1	*			1						159	
	PCT F *	2	4	3	1	*	*	*	*		*	*						11	64
8	N		8	15	2	1	3	2										31	
	PCT F		1	1	*	*	*	*										2	66
10	N	3	1	9	5	2	3											23	
	PCT F *	*	*	1	*	*	*											2	68
12	N		2															2	
	PCT F		*															0	68
14	N		2				1											3	
	PCT F		*				*											0	68
16	N																	0	
	PCT F																	0	68
18	N																	0	
	PCT F																	0	68
20	N	1																1	
	PCT F *	*																0	68
>21	N	3	3	6														12	
	PCT F *	*	*	*														1	69
***	N	283	103	61	13	7	3											470	
	PCT F	19	7	4	1	*	*											31	100
TOTAL	N	462	471	350	156	37	17	8	5	1	0	1	0	0	0	0	0	1508	
	PCT F	31	31	23	10	2	1	1	0	0	0	0	0	0	0	0	0		
	C	31	62	85	95	98	99	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 20

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN JUNE 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	211	320	193	63	4	2										793	
PCT F	15	22	14	4	*	*										56	56
6 N	2	28	59	25	8	3									1	126	64
PCT F	*	2	4	2	1	*									*	9	
8 N		4	7	11		1										23	66
PCT F		*	*	1		*										2	
10 N		1	5	8												14	67
PCT F		*	*	1												1	
12 N		1	1													3	67
PCT F		*	*													0	
14 N		3														3	67
PCT F		*														0	
16 N																0	67
PCT F																0	
18 N																0	67
PCT F																0	
20 N		1														2	68
PCT F		*														0	
>21 N		2														4	68
PCT F		*														0	
*** N	293	80	55	26	4	2										460	100
PCT F	21	6	4	2	*	*										32	
TOTAL N	510	439	320	134	16	8										1428	
PCT F	36	31	22	9	1	1										0	1
C	36	66	89	98	99	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 21 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN JULY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	210	327	195	50	12	2		1								797	
PCT F	14	22	13	3	1	*	*	*								53	53
6 N		28	73	27	8	5	1									142	
PCT F		2	5	2	1	*	*									9	62
8 N		1	5	6	2											14	
PCT F		*	*	*	*	*	*									1	63
10 N	1		3	5	3	1										13	
PCT F	*		*	*	*	*	*									1	64
12 N		1	2													3	
PCT F		*	*													0	64
14 N																0	
PCT F																0	64
16 N																0	
PCT F																0	64
18 N			1													1	
PCT F			*													0	64
20 N																0	
PCT F																0	64
>21 N			1													1	
PCT F			*													0	65
*** N	297	111	88	26	9	2										533	
PCT F	20	7	6	2	1	*										35	100
TOTAL N	508	469	367	114	34	18	1	0	0	0	0	0	0	0	0	1504	
PCT F	34	31	24	8	2	1	0	0	0	0	0	0	0	0	0		
C	34	65	89	97	99	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN AUGUST 1960 - 1969

PER EC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	169	345	276	87	26	3	1	1								908	
PCT F	10	21	17	5	2	*	*	*								56	56
6 N	1	22	90	86	13	12										224	
PCT F	*	1	6	5	1	1										14	70
8 N	1	9	22	28	14	6										80	
PCT F	*	1	1	2	1	*										5	75
10 N	1	2	6	8	2	2	3	1								26	
PCT F	*	*	*	*	*	*	*	*								2	77
12 N			3	3	3	3	1									13	
PCT F			*	*	*	*	*									1	78
14 N				2												2	
PCT F				*												0	78
16 N		1														1	
PCT F		*														0	78
18 N																0	
PCT F																0	78
20 N	6	1														7	
PCT F	*	*														0	78
>21 N	12	13	1													26	
PCT F	1	1	*													2	80
*** N	180	68	52	19	6	1	1									327	
PCT F	11	4	3	1	*	*	*									20	100
TOTAL N	370	461	450	233	64	27	5	1	2	1	0	0	0	0	0	1614	
PCT F	23	29	28	14	4	2	0	0	0	0	0	0	0	0	0		
C	23	51	79	94	98	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 23 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN		SEPTEMBER 1960 - 1969																
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55	N	145	301	303	128	31	12	6									926	
	PCT F	8	17	17	7	2	1	*									53	53
6	N	2	21	143	134	32	11										343	
	PCT F	*	1	8	8	2	1										20	73
8	N		3	10	32	19	7			1							72	
	PCT F		*	1	2	1	*			*							4	77
10	N		2	7	17	3	6							1			36	
	PCT F		*	*	1	*	*							*			2	79
12	N		1		1	4	4		1								11	
	PCT F		*		*	*	*		*								1	80
14	N			1	1	2											4	
	PCT F			*	*	*											0	80
16	N				1					2							3	
	PCT F				*					*							0	80
18	N			1		2											3	
	PCT F			*		*											0	80
20	N																0	
	PCT F																0	80
>21	N	4	2	1													7	
	PCT F	*	*	*													0	81
***	N	163	58	57	37	6	14	1									336	
	PCT F	9	3	3	2	*	1	*									19	100
TOTAL	N	314	388	523	351	99	54	7	3	1	0	0	0	1	0	0	1741	
	PCT F	18	22	30	20	6	3	0	0	0	0	0	0	0	0	0		
	C	18	40	70	91	96	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

= CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 24

LAKE MICHIGAN OCTOBER 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C			
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13	
55 N	124	276	400	235	77	20	12	2		2							1148	
PCT F	6	13	19	11	4	1	1	*		*							55	55
6 N	2	15	124	157	58	32	14	8		1							412	
PCT F	*	1	6	8	3	2	1	*		*			1	*			20	75
8 N	1	3	26	29	28	20	7		4								118	
PCT F	*	*	1	1	1	1	*		*								6	80
10 N			6	14	16	18	5	7		2							70	
PCT F			*	1	1	1	*	*		*	1	*					3	84
12 N		2	1		2	5											10	
PCT F		*	*		*	*											0	84
14 N																	8	
PCT F																	0	85
16 N																	2	
PCT F																	0	85
18 N																	0	
PCT F																	0	85
20 N																	0	
PCT F																	0	85
>21 N		3	1														4	
PCT F		*	*														0	85
*** N	62	38	81	89	26	14	1	5									316	
PCT F	3	2	4	4	1	1	*	*									15	100
TOTAL N	189	337	640	532	207	109	39	22	5	5	1	0	1	0	1	2088		
PCT F	9	16	31	25	10	5	2	1	0	0	0	0	0	0	0			
C	9	25	56	81	91	96	98	99	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 25 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN		NOVEMBER 1960 - 1969															
PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	N	75	249	351	156	41	15	2	1	1	1					897	
	PCT F	4	15	21	9	2	1	*	*	*	*					52	52
6	N	3	18	118	150	28	19	4	4	1	1					349	
	PCT F	*	1	7	9	2	1	*	*	*	*					20	73
8	N	1	4	16	47	14	15	3	3	*						106	
	PCT F	*	*	1	3	1	1	*	*	*						6	79
10	N		4	11	11	5	7	2	1	*						33	
	PCT F		*	1	1	*	*	*	*	*						2	81
12	N		1	7	7	5	2	1	1	*						18	
	PCT F		*	*	*	*	*	*	*	*						1	82
14	N		1		3	2	1									7	
	PCT F		*		*	*	*	*	*	*						0	82
16	N					1										1	
	PCT F					*	*	*	*	*						0	82
18	N				1											1	
	PCT F				*											0	82
20	N															0	
	PCT F															0	82
>21	N	1	6	4		1										12	
	PCT F	*	*	*		*										1	83
***	N	68	40	91	59	17	10	2	1							288	
	PCT F	4	2	5	3	1	1	*	*							17	100
TOTAL	N	148	318	585	434	114	69	25	13	2	2	0	0	0	0	1712	
	PCT F	9	19	34	25	7	4	1	1	0	0	0	0	0	0		
	C	9	27	61	87	93	97	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 26

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE MICHIGAN		DECEMBER 1960 - 1969										TOT	C					
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13		
≤5	N	32	164	275	141	49	28	13	8	1							711	
	PCT F	3	13	22	11	4	2	1	1	*							58	58
6	N		8	70	120	54	30	5	3	1							291	
	PCT F		1	6	10	4	2	*	*	*							24	81
8	N		1	8	19	18	14	9	1	2							72	
	PCT F		*	1	2	1	1	1	*	*							6	87
10	N			3	7	5	3	1	1								20	
	PCT F			*	1	*	*	*	*	*							2	89
12	N				1	1	1	1		1							5	
	PCT F				*	*	*	*	*	*							0	89
14	N					2	2										4	
	PCT F					*	*	*	*	*							0	90
16	N																0	
	PCT F																0	90
18	N																0	
	PCT F																0	90
20	N																2	
	PCT F																0	90
>21	N		7		1												8	
	PCT F		1		*												1	90
***	N	27	27	28	23	5	3	3	3								119	
	PCT F	2	2	2	2	*	*	*	*								10	100
TOTAL	N	60	207	384	312	134	81	32	17	5	0	0	0	0	0	0	1232	
	PCT F	5	17	31	25	11	7	3	1	0	0	0	0	0	0	0		
	C	5	22	53	78	89	96	98	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 27

PERCENTAGE SUMMARY OF WAVE HEIGHTS PER PERIODS

LAKE HURON

APRIL 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	87	104	80	23	6	1	1									302	
PCT F	16	19	14	4	1	*										55	55
6 N	11	18	5	5	5	3	1									43	
PCT F	2	3	1	1	1	*										8	62
8 N	1	4	5	5	3	1	1	1	1	1						17	
PCT F	*	*	1	1	1	*	*	*	*	*						3	65
10 N	1	3	4	4	1	1	1									10	
PCT F	*	*	1	1	*	*	*									2	67
12 N	1	1	1	1	1											2	
PCT F	*	*	*	*	*											0	68
14 N																0	
PCT F																0	68
16 N																0	
PCT F																0	68
18 N																0	
PCT F																0	68
20 N	1	1														2	
PCT F	*	*														0	68
>21 N	2	1														2	
PCT F	*	*														0	68
*** N	75	34	30	25	10											175	
PCT F	14	6	5	5	2											32	100
TOTAL N	165	153	135	63	25	6	4	1	1	1	0	0	0	0	0	554	
PCT F	30	28	24	11	5	1	1	0	0	0	0	0	0	0	0		
C	30	57	82	93	98	99	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 28

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON MAY 1960 - 1969

PER (SEC)	0		1		2		3		4		5		6		7		8		9		10		11		12		13		>13		TOT	C
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F		
≤5	164	12	289	21	168	12	68	5	9	1	1	*	1	*	1	*														700	52	
PCT F																														52		
6	1	*	8	1	66	5	31	2	8	1	2	*	2	*															117	9	60	
PCT F																														9	60	
8	1	*	2	*	10	1	9	1	5	*	1	*	1	*															28	2	63	
PCT F																														2	63	
10			5	*	5	*	3	*	3	*	2	*	2	*															13	1	64	
PCT F																														1	64	
12							2	*	2	*																			4	0	64	
PCT F																														0	64	
14							1	*	1	*																			3	0	64	
PCT F																														0	64	
16																													0	0	64	
PCT F																														0	64	
18																													0	0	64	
PCT F																														0	64	
20			1	*	1	*			1	*																			4	0	64	
PCT F																														0	64	
>21			2	*	1	*																							3	0	65	
PCT F																														0	65	
***			277	21	72	5	19	1	17	1	3	*	2	*															479	35	100	
PCT F																														35	100	
TOTAL	446	33	372	28	340	25	133	10	45	10	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1351	0	100	
PCT F																														0	100	
C	33	33	61	86	96	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 29 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON JUNE 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	221	302	209	75	6	2										815	
PCT F	16	21	15	5	*	*										57	57
6 N	25	48	16	1	5	1										95	
PCT F	2	3	1	*	*	*										7	64
8 N		8	16	1	2	1										27	
PCT F		1	1	*	*	*										2	66
10 N	1	1	1	4	2	2										11	
PCT F	*	*	*	*	*	*										1	67
12 N																0	
PCT F																0	67
14 N																0	
PCT F																0	67
16 N																0	
PCT F																0	67
18 N																0	
PCT F																0	67
20 N			2													2	
PCT F			*													0	67
>21 N	1	4	2	1												8	
PCT F	*	*	*	*												1	67
*** N	327	63	43	19	7	2										462	
PCT F	23	4	3	1	*	*										33	100
TOTAL N	550	397	311	131	22	8										1420	
PCT F	39	28	22	9	2	1										0	0
C	39	67	89	98	99	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 30

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON JULY 1960 - 1969

PER (SEC)	0		1		2		3		4		5		6		7		8		9		10		11		12		13		>13		TOT	C
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F		
≤5	356	17	515	25	288	14	67	3	12	4	4	4	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1243	60	
PCT F																*	*	*	*	*	*	*	*	*	*	*	*	*		60		
6	N	4	34	2	74	4	23	1	9	1	1	1	1	1	2	*	*	*	*	*	*	*	*	*	*	*	*	*	147	7	67	
PCT F		*														*	*	*	*	*	*	*	*	*	*	*	*	*		67		
8	N	2	14	2	14	11	11	1	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	39	2	69	
PCT F		*														*	*	*	*	*	*	*	*	*	*	*	*	*		69		
10	N	4	4	2	4	4	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6	0	69		
PCT F										*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
12	N	1	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	0	69		
PCT F		*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
14	N	4	2	4	2	4	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	0	69		
PCT F										*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
16	N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	69		
PCT F		*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
18	N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	69		
PCT F		*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
20	N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	69		
PCT F		*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		69		
>21	N	1	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	0	70		
PCT F		*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		70		
***	N	515	44	46	19	46	19	46	19	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	630	30	100		
PCT F		25	2	2	1	2	1	2	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		100			
TOTAL	N	876	598	425	128	425	128	425	128	38	38	38	38	38	38	3	3	3	3	3	3	3	3	3	3	3	3	2077	0	0		
PCT F		42	29	20	6	20	6	20	6	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
C		42	71	91	98	91	98	91	98	99	99	99	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 31 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON		AUGUST 1960 - 1969																
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55	N	110	346	264	116	25	3	2	1								867	
	PCT F	8	24	18	8	2	*	*	*								59	59
6	N		18	66	72	16	7	1		1	1						182	
	PCT F		1	5	5	1	*	*		*	*						12	72
8	N		1	8	19	11	11										50	
	PCT F		*	1	1	1	1										3	75
10	N		1	2	6	2											11	
	PCT F		*	*	*	*											1	76
12	N		1	1	3	4	2										11	
	PCT F		*	*	*	*	*										1	77
14	N				1	1											2	
	PCT F				*	*											0	77
16	N																0	
	PCT F																0	77
18	N																0	
	PCT F																0	77
20	N			1													1	
	PCT F			*													0	77
>21	N																0	
	PCT F																0	77
***	N	186	54	63	24	4	3			2							336	
	PCT F	13	4	4	2	*	*			*							23	100
TOTAL	N	296	421	405	241	63	26	3	1	3	1	0	0	0	0	0	1460	
	PCT F	20	29	28	17	4	2	0	0	0	0	0	0	0	0	0		
	C	20	49	77	93	98	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 32 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON SEPTEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	105	291	341	147	45	16	2	2								949	
PCT F	7	18	22	9	3	1	*	*								60	60
6 N	2	10	70	117	42	17	3	2			1					264	
PCT F	*	1	4	7	3	1	*	*			*					17	77
8 N		1	7	24	26	9	5	2	1	1						76	
PCT F		*	*	2	2	1	*	*	*	*						5	82
10 N		1	1	4	7	3				1						17	
PCT F		*	*	*	*	*				*						1	83
12 N		2		4	1	5										12	
PCT F		*	*	*	*	*				*						1	84
14 N		2					1									3	
PCT F		*					*									0	84
16 N				1			1									2	
PCT F				*			*									0	84
18 N																0	
PCT F																0	84
20 N																0	
PCT F																0	84
>21 N		4														6	
PCT F		*	*													0	84
*** N	164	25	26	20	6	3	1									245	
PCT F	10	2	2	1	*	*	*									16	100
TOTAL N	271	336	447	317	127	53	13	6	1	2	1	0	0	0	0	1574	
PCT F	17	21	28	20	8	3	1	0	0	0	0	0	0	0	0		
C	17	39	67	87	95	99	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 33 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON OCTOBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	76	243	349	186	34	18	6	2	2	1	1					918	59
PCT F	5	16	22	12	2	1	*	*	*	*	*					59	59
6	4	16	111	112	32	20	8	4		1			1			309	79
PCT F	*	1	7	7	2	1	1	*		*			*			20	79
8	3	18	58	58	20	14	5	6	1	1						126	87
PCT F	*	*	1	4	1	1	*	*	*	*						8	87
10			5	6	9	3	1									24	98
PCT F			*	*	1	*	*									2	98
12			3	4	4	3		1								15	89
PCT F			*	*	*	*		*								1	89
14					2	1	1									4	90
PCT F					*	*	*									0	90
16			1			3	1									5	90
PCT F			*			*	*									0	90
18																0	90
PCT F																0	90
20																0	90
PCT F																0	90
>21		1														3	90
PCT F		*														0	90
***	70	21	31	22	6	3	2									155	100
PCT F	4	1	2	1	*	*	*									10	100
TOTAL	N	151	284	518	389	107	24	13	3	3	1	0	1	0	0	1559	
PCT F	C	10	18	33	25	7	2	1	0	0	0	0	0	0	0		
C		10	28	61	86	93	99	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 34 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON NOVEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	41	226	344	170	41	17	3	1								844	59
PCT F	3	16	24	12	3	1	*	*						1	*	59	
6 N	6	77	112	46	18	10	1	4	2							275	79
PCT F	*	*	5	8	3	1	1	*	*							19	
8 N	11	31	20	12	9	2	1	2	1	2						88	85
PCT F	1	2	1	1	1	1	1	*	*	*						6	
10 N	4	11	12	7	4	2	4	2		1						41	88
PCT F	*	*	1	1	1	*	*	*		*						3	
12 N	1	1	2	1	2	2	2	2	1			1				11	89
PCT F	*	*	*	*	*	*	*	*	*			*	*			1	
14 N	2	2	2	4	1	1	1	2		1						14	90
PCT F	*	*	*	*	*	*	*	*		*						1	
16 N					1	1	1	1	1	1						5	90
PCT F					*	*	*	*	*	*						0	
18 N					1											1	90
PCT F					*											0	
20 N																0	90
PCT F																0	
>21 N																1	90
PCT F																0	
*** N	68	25	20	11	10	3	2									139	100
PCT F	5	2	1	1	1	*	*									10	
TOTAL N	109	260	457	338	134	63	33	13	4	5	0	0	1	1	1	1419	
PCT F	8	18	32	24	9	4	2	1	0	0	0	0	0	0	0		
C	8	26	58	82	91	96	98	99	99	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED
 * LESS THAN 0.5 PERCENT
 N = NUMBER
 PCT F = PERCENT FREQUENCY
 C = CUMULATIVE PERCENT

Table 35 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE HURON		DECEMBER 1960 - 1969															
PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	10	71	133	80	14	15	5									328	
PCT F	2	15	27	17	3	3	1									68	68
6 N	5	5	23	28	8	5	1	2								72	
PCT F	1	1	5	6	2	1	*	*								15	83
8 N	1	1	1	16	11	1		2	1							33	
PCT F	*	*	*	3	2	*		*	*							7	89
10 N				2	3	3	3									11	
PCT F				*	1	1	1									2	92
12 N				1												1	
PCT F				*												0	92
14 N																0	
PCT F																0	92
16 N																0	
PCT F																0	92
18 N																0	
PCT F																0	92
20 N																0	
PCT F																0	92
>21 N																1	
PCT F																0	92
*** N	26	6	3	2	1											38	
PCT F	5	1	1	*	*											8	100
TOTAL N	36	84	160	129	37	24	9	2	3	0	0	0	0	0	0	484	
PCT F	7	17	33	27	8	5	2	0	1	0	0	0	0	0	0		
C	7	25	58	85	92	97	99	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

LAKE ERIE APRIL 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)											TOT	C				
	0	1	2	3	4	5	6	7	8	9	10			11	12	13	>13
55	N	77	124	25	7	2	1	*								236	
	PCT F	22	35	7	2	1	*									67	67
6	N	5	8	4	4	1	*									18	
	PCT F	1	2	1	1	*										5	72
8	N		4	1	1	*		4	1						10		
	PCT F		1	1	*			1	*						3		75
10	N		1	1					1	*					2		
	PCT F		*	*					*						1		75
12	N								1	*					1		
	PCT F								*						0		75
14	N										1	*			1		
	PCT F										*				0		76
16	N			1											1		
	PCT F			*											0		76
18	N														0		
	PCT F														0		76
20	N														0		
	PCT F														0		76
>21	N	2													2		
	PCT F	1													1		77
***	N	63	9	5	3	3									83		
	PCT F	18	3	1	1	1									23		100
TOTAL	N	142	138	44	15	8	5	2	0	0	0	0	0	0	354		
	PCT F	40	39	12	4	2	1	1	0	0	0	0	0	0			
	C	40	79	92	96	98	99	100	100	100	100	100	100	100			100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

LAKE ERIE WAVE HEIGHTS BY PERIODS

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 37

LAKE ERIE MAY 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	N	116	101	20	7	1										437	
PCT F	16	27	14	3	1	*										61	61
6	N	2	6	9	4	1	1	1	1							41	66
PCT F	*	1	2	1	1	*	*	*	*							6	
8	N		1	5	2	1										9	68
PCT F			*	1	*	*										1	
10	N		1	3	3	1										8	69
PCT F		*	*	*	*	*										1	
12	N			2	1											3	69
PCT F				*	*											0	
14	N		1													1	69
PCT F		*	*													0	
16	N															0	69
PCT F																0	
18	N															0	69
PCT F																0	
20	N															0	69
PCT F																0	
>21	N	2	1													3	70
PCT F	*	*	*													0	
***	N	157	24	8	2											219	100
PCT F	22	3	4	1	*											30	
TOTAL	N	277	224	152	47	16	4	1	0	0	0	0	0	0	0	721	
PCT F	C	38	31	21	7	2	1	0	0	0	0	0	0	0	0		
		38	69	91	97	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 38

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE ERIE JUNE 1960 - 1969

PER (SEC)	0		1		2		3		4		5		6		7		8		9		10		11		12		13		>13		TOT	C
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F		
55	104	14	251	34	127	17	33	4	4	4																				519	71	71
6	N	F	13	2	17	2	5	3	1	3	2	2	1	1	*														41	6	76	
8	N	F	2	*	5	1					1	*					1	*											9	1	78	
10	N	F					2	1	*	1	1	*																	4	1	78	
12	N	F																											0	0	78	
14	N	F																											0	0	78	
16	N	F																											0	0	78	
18	N	F																											0	0	78	
20	N	F	2	*																									2	0	78	
>21	N	F	1	*	2	*	1																						4	1	79	
***	N	F	116	16	4	21	10	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	155	21	100	
TOTAL	N	F	223	30	272	37	171	50	12	12	4	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	734			
PCT F	C		30	30	67	91	98	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 39

LAKE ERIE JULY 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	120	277	172	54	7	2										632	
PCT F	13	29	18	6	1	*										67	67
6 N		15	14	14	6	1	2									52	
PCT F		2	1	1	1	*	*									5	72
8 N			7	5	3	1										16	
PCT F			1	1	*	*										2	74
10 N																3	
PCT F						*										0	74
12 N																1	
PCT F																0	74
14 N																0	
PCT F																0	74
16 N																0	
PCT F																0	74
18 N																0	
PCT F																0	74
20 N																0	
PCT F																0	74
>21 N		4														4	
PCT F		*														0	75
*** N	208	13	13	5												239	
PCT F	22	1	1	1												25	100
TOTAL N	332	308	206	79	16	4	2	0	0	0	0	0	0	0	0	947	
PCT F	35	33	22	8	2	0	0	0	0	0	0	0	0	0	0		
C	35	68	89	98	99	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 40.

LAKE ÉRIÉ AUGUST 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)										TOT	C					
	0	1	2	3	4	5	6	7	8	9			10	11	12	13	>13
≤5	N	197	330	225	80	13	2									847	
	PCT F	16	27	18	7	1	*									69	69
6	N	1	12	33	28	7	1									82	
	PCT F	*	1	3	2	1	*									7	76
8	N				10	3	2	1								16	
	PCT F				1	*	*	*								1	77
10	N				2	2										4	
	PCT F				*	*	*									0	77
12	N			2												2	
	PCT F			*												0	77
14	N															0	
	PCT F															0	77
16	N															0	
	PCT F															0	77
18	N															0	
	PCT F															0	77
20	N													1		1	
	PCT F													*		0	77
>21	N		2													2	
	PCT F	*	*													0	78
***	N	222	21	19	11	3										276	
	PCT F	18	2	2	1	*										22	100
TOTAL	N	422	363	279	131	28	5	1	0	0	0	0	0	0	1	1230	
	PCT F	34	30	23	11	2	0	0	0	0	0	0	0	0	0		
	C	34	64	87	97	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 41 PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE ERIE		SEPTEMBER 1960 - 1969																
PER (SEC)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5	N	69	144	133	75	8	1	2									432	
	PCT F	10	22	20	11	1	*	*									65	65
6	N	2	5	25	34	10	1	2	1								80	
	PCT F	*	1	4	5	1	*	*	*								12	77
8	N	1	1	3	14	4	1	1	1								24	
	PCT F	*	*	*	2	1	*	*	*								4	80
10	N			1	1	2	1										5	
	PCT F			*	*	*	*										1	81
12	N	1	1	1	5												7	
	PCT F	*	*	*	1												1	82
14	N																0	
	PCT F																0	82
16	N																0	
	PCT F																0	82
18	N																0	
	PCT F																0	82
20	N																0	
	PCT F																0	82
>21	N																0	
	PCT F																0	82
***	N	85	10	12	9	3	1										120	
	PCT F	13	1	2	1	*	*										18	100
TOTAL	N	156	161	175	138	27	5	4	2	0	0	0	0	0	0	0	668	
	PCT F	23	24	26	21	4	1	1	0	0	0	0	0	0	0	0		
	C	23	47	74	94	98	99	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 42

LAKE ERIE OCTOBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	44	97	125	79	20	3	2	1								371	
PCT F	7	16	21	13	3	1	*	*								62	62
6 N	1	10	38	50	15	10	1									125	
PCT F	*	2	6	8	3	2	*									21	83
8' N		1	5	15	8	4	3	1								37	
PCT F		*	1	3	1	1	1	*								6	89
10 N	1		4	4	5	1	1									12	
PCT F	*		1	1	1	*	*									2	91
12 N					3	2										5	
PCT F					1	*										1	92
14 N							2									4	
PCT F							*									1	93
16 N																0	
PCT F																0	93
18 N																0	
PCT F																0	93
20 N																0	
PCT F																0	93
>21 N																0	
PCT F																0	93
*** N	27	6	2	2	4											42	
PCT F	5	1	*	*	1											7	100
TOTAL N	73	114	170	152	55	20	9	2	0	0	1	0	0	0	0	596	
PCT F	12	19	29	26	9	3	2	0	0	0	0	0	0	0	0		
C	12	31	60	85	95	98	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 43

LAKE ERIE NOVEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5 N	25	140	120	85	9	5										384	
PCT F	4	24	20	14	2	1										65	65
6 N	4	4	20	38	19	14	6	3								104	
PCT F	1	1	3	6	3	2	1	1								18	82
8 N	1	1	5	15	9	4	2	1	1							38	
PCT F	*	*	1	3	2	1	*	*	*							6	89
10 N	1	1	1	3	3	2	3									12	
PCT F			*	1	1	*	1									2	91
12 N	1	1	1	1	1	1	1	1								6	
PCT F	*	*		*	*	*	*	*								1	92
14 N				1	1											2	
PCT F				*	*											0	92
16 N						1										1	
PCT F						*										0	92
18 N																0	
PCT F																0	92
20 N																0	
PCT F																0	92
>21 N																1	
PCT F																0	93
*** N	28	3	8	2	2											44	
PCT F	5	1	1	*	*											7	100
TOTAL N	53	149	155	145	44	27	12	6	1	0	0	0	0	0	0	592	
PCT F	9	25	26	24	7	5	2	1	0	0	0	0	0	0	0		
C	9	34	60	85	92	97	99	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 44

LAKE ERIE DECEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	5	24	32	34	9	3	1	3								111	
PCT F	3	15	20	21	6	2	1	2								69	69
6 N	1	1	7	7	2	2		1								20	
PCT F	1	1	4	4	1	1		1								12	82
8 N			1	3	5	3		1						1		14	
PCT F			1	2	3	2		1						1		9	91
10 N				1												1	
PCT F				1												1	91
12 N																0	
PCT F																0	91
14 N						1	2				1					4	
PCT F						1	1				1					2	94
16 N																0	
PCT F																0	94
18 N																0	
PCT F																0	94
20 N																0	
PCT F																0	94
>21 N																0	
PCT F																0	94
*** N	6	3	1													10	
PCT F	4	2	1													6	100
TOTAL N	11	28	41	45	16	9	3	4	1	1	1	0	0	1	0	160	
PCT F	7	17	26	28	10	6	2	2	1	1	1	0	0	1	0		
TOTAL C	7	24	50	78	88	94	96	98	99	99	99	99	99	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 45

LAKE ONTARIO JANUARY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C			
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13	
≤5	9	46	29	9	5	2	1										101	
PCT F	8	42	27	8	5	2	1										93	93
6	N																0	
PCT F																	0	93
8	N																0	
PCT F																	0	93
10	N																0	
PCT F																	0	93
12	N																0	
PCT F																	0	93
14	N																0	
PCT F																	0	93
16	N																0	
PCT F																	0	93
18	N																0	
PCT F																	0	93
20	N																0	
PCT F																	0	93
>21	N																0	
PCT F																	0	93
***	N																8	
PCT F																	7	100
TOTAL	N	17	46	29	9	5	2	1	0	0	0	0	0	0	0	0	109	
PCT F	C	16	42	27	8	5	2	1	0	0	0	0	0	0	0	0	109	
		16	58	84	93	97	99	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED
 * LESS THAN 0.5 PERCENT
 N = NUMBER
 PCT F = PERCENT FREQUENCY
 C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 46

LAKE ONTARIO FEBRUARY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
<5	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
N	1	2	8	6	3	4	5	6	7	8	9	10	11	12	13	20	83
PCT F	4	8	33	25	13	13	13	13	13	13	13	13	13	13	13	83	83
6	N															0	83
PCT F																0	83
8	N															0	83
PCT F																0	83
10	N															0	83
PCT F																0	83
12	N															0	83
PCT F																0	83
14	N															0	83
PCT F																0	83
16	N															0	83
PCT F																0	83
18	N															0	83
PCT F																0	83
20	N	1														1	87
PCT F	4															4	87
>21	N		2													2	96
PCT F			8													8	96
***	N															1	100
PCT F																4	100
TOTAL	N	2	4	9	6	3	0	0	0	0	0	0	0	0	0	24	
PCT F	8	17	37	25	13	13	13	13	13	13	13	13	13	13	13	83	100
C	8	25	62	87	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 47

LAKE ONTARIO MARCH 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55 N	28	19	19	2	3	1										72	
PCT F	38	26	26	3	4	1										99	99
6 N																0	
PCT F																0	99
8 N																0	
PCT F																0	99
10 N																0	
PCT F																0	99
12 N																0	
PCT F																0	99
14 N																0	
PCT F																0	99
16 N																0	
PCT F																0	99
18 N																0	
PCT F																0	99
20 N																0	
PCT F																0	99
>21 N																0	
PCT F																0	99
*** N	1															1	
PCT F	1															1	100

		WAVE HEIGHT (HALF METERS)																
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
TOTAL N		29	19	19	2	3	1	0	0	0	0	0	0	0	0	0	73	
PCT F		40	26	26	3	4	1	0	0	0	0	0	0	0	0	0		
C		40	66	92	95	99	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 48

LAKE ONTARIO APRIL 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	19	66	46	10	1	1		1								144	
PCT F	11	38	26	6	1	1		1								82	82
6 N			3	1												4	
PCT F			2	1												2	84
8 N			1						1							2	
PCT F			1						1							1	85
10 N			1			1	1									3	
PCT F			1			1	1									2	87
12 N																0	
PCT F																0	87
14 N																0	
PCT F																0	87
16 N																0	
PCT F																0	87
18 N																0	
PCT F																0	87
20 N																0	
PCT F																0	87
>21 N																0	
PCT F																0	87
*** N	18	1	2	2												23	
PCT F	10	1	1	1												13	100
TOTAL N	37	67	53	13	1	2	1	1	1	0	0	0	0	0	0	176	
PCT F	21	38	30	7	1	1	1	1	1	0	0	0	0	0	0		
C	21	59	89	97	97	98	99	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

Table 49

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

LAKE ONTARIO MAY 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)											TOT	C		
	0	1	2	3	4	5	6	7	8	9	>9				
≤5	N	93	75	38	10				1					217	
	PCT F	30	25	12	3				*					71	71
6	N			1		2								3	
	PCT F			*		1								1	72
8	N													0	
	PCT F													0	72
10	N													0	
	PCT F													0	72
12	N			1				1						2	
	PCT F			*				*						1	73
14	N													0	
	PCT F													0	73
16	N													0	
	PCT F													0	73
18	N													0	
	PCT F													0	73
20	N													0	
	PCT F													0	73
>21	N													0	
	PCT F													0	73
***	N	80	2	2										84	
	PCT F	26	1	1										27	100
TOTAL	N	173	77	42	10	2	1	0	1	0	0	0	0	306	
	PCT F	57	25	14	3	1	0	0	0	0	0	0	0		
	C	57	82	95	99	99	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 50

LAKE ONTARIO JUNE 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)													TOT	C		
	0	1	2	3	4	5	6	7	8	9	10	11	12			13	>13
55	N 312	269	71	5												657	60
	PCT F 28	24	6	*												60	60
6	N 2	11	4													17	2
	PCT F *	1	*													2	61
8	N 4			2												6	1
	PCT F *			*												1	62
10	N 2															2	0
	PCT F *															0	62
12	N 2															2	0
	PCT F *															0	62
14	N 0															0	0
	PCT F															0	62
16	N 0															0	0
	PCT F															0	62
18	N 0															0	0
	PCT F															0	62
20	N 3															3	0
	PCT F *															0	62
>21	N 0															0	0
	PCT F															0	62
***	N 412	4														416	38
	PCT F 37	*														38	100

TOTAL	N 726	290	80	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1103
	PCT F 66	26	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	100
	C 66	92	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 51
LAKE ONTARIO JULY 1960 - 1969

PER (SEC)	0		1		2		3		4		5		6		7		8		9		10		11		12		13		>13		TOT	C						
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F								
≤5	177	28	231	37	48	8	1	*	4	1	18	3	*	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	457	73	73				
PCT F																																						
6			4	1	18	3	*																										23	4	77			
PCT F																																						
8			4	1	4	1																													8	1	78	
PCT F																																						
10									4	1																									4	1	79	
PCT F																																						
12																																				0	0	79
PCT F																																						
14																																				0	0	79
PCT F																																						
16																																				0	0	79
PCT F																																						
18																																				0	0	79
PCT F																																						
20																																				0	0	79
PCT F																																						
>21			2	*																															2	0	79	
PCT F																																						
***			124	8																															132	21	100	
PCT F																																						
TOTAL	303	48	247	39	70	11	2	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	626				
PCT F																																						
CUMULATIVE	48	48	88	88	99	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 52

LAKE ONTARIO AUGUST 1960 - 1969

PER (SEC)	0		1		2		3		4		5		6		7		8		9		10		11		12		13		>13		TOT	C
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F		
55	57	143	54	19																										273		
PCT F	14	35	13	5																									67	67		
6	N	1	5	2																									8		69	
PCT F		*	1	*																									2		2	69
8	N			2																									2		0	69
PCT F				*																									0		0	69
10	N																												0		0	69
PCT F																													0		0	69
12	N																												0		0	69
PCT F																													0		0	69
14	N																												0		0	69
PCT F																													0		0	69
16	N																												0		0	69
PCT F																													0		0	69
18	N																												0		0	69
PCT F																													0		0	69
20	N																												0		0	69
PCT F																													0		0	69
>21	N																												0		0	69
PCT F																													0		0	69
***	N	120	1	5																									126		100	
PCT F		29	*	1																									31		100	
TOTAL	N	177	145	64	23																								409		100	
PCT F		43	35	16	6																								0		0	100
C		43	79	94	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED
 * LESS THAN 0.5 PERCENT
 N = NUMBER
 PCT F = PERCENT FREQUENCY
 C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 53

LAKE ONTARIO SEPTEMBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
55 N	25	226	74	6	1	1	1									334	80
PCT F	6	54	18	1	*	*	*									80	80
6 N			6		1											7	82
PCT F			1		*											2	82
8 N			1	2												3	83
PCT F			*	*												1	83
10 N																0	83
PCT F																0	83
12 N																0	83
PCT F																0	83
14 N																0	83
PCT F																0	83
16 N																0	83
PCT F																0	83
18 N																0	83
PCT F																0	83
20 N																0	83
PCT F																0	83
>21 N																0	83
PCT F																0	83
*** N	66	1	1	3												71	100
PCT F	16	*	*	1												17	100

TOTAL N	91	227	82	11	2	1	1	0	0	0	0	0	0	0	0	415	
PCT F	22	55	20	3	0	0	0	0	0	0	0	0	0	0	0		
C	22	77	96	99	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 54

LAKE ONTARIO OCTOBER 1960 - 1969

PER (SEC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	>13	TOT	C
≤5																	
N	12	54	20	2	3											91	
PCT F	10	44	16	2	2											75	75
6																	
N			8	3												11	
PCT F			7	2												9	84
8																	
N			2	4												6	
PCT F			2	3												5	89
10																	
N					1											1	
PCT F					1											1	89
12																	
N					1											1	
PCT F					1											1	90
14																	
N																0	
PCT F																0	90
16																	
N																0	
PCT F																0	90
18																	
N																0	
PCT F																0	90
20																	
N																0	
PCT F																0	90
>21																	
N	2	1														3	
PCT F	2	1														2	93

N	5	3			1											9	
PCT F	4	2			1											7	100
TOTAL	19	55	33	9	6	0	0	0	0	0	0	0	0	0	0	122	
PCT F	16	45	27	7	5	0	0	0	0	0	0	0	0	0	0		
C	16	61	88	95	100	100	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 55

LAKE ONTARIO NOVEMBER 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)											TOT	C				
	0	1	2	3	4	5	6	7	8	9	10			11	12	13	>13
55 N	14	47	45	9	1	1										117	
PCT F	9	30	29	6	1	1										75	75
6 N		1	4	3		2										10	
PCT F		1	3	2		1										6	82
8 N				2	1											3	
PCT F				1	1											2	84
10 N				1												1	
PCT F				1												1	85
12 N				1												1	
PCT F				1												1	85
14 N					1											1	
PCT F					1											1	86
16 N																0	
PCT F																0	86
18 N																0	
PCT F																0	86
20 N																0	
PCT F																0	86
>21 N		2														2	
PCT F		1														1	87
*** N	16	2			2											20	
PCT F	10	1			1											13	100
TOTAL N	30	52	49	16	5	3	0	0	0	0	0	0	0	0	0	155	
PCT F	19	34	32	10	3	2	0	0	0	0	0	0	0	0	0		
C	19	53	85	95	98	100	100	100	100	100	100	100	100	100	100		100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

PERCENTAGE SUMMARY OF WAVE HEIGHTS BY PERIODS

Table 56

LAKE ONTARIO DECEMBER 1960 - 1969

PER (SEC)	WAVE HEIGHT (HALF METERS)										TOT	C						
	0	1	2	3	4	5	6	7	8	9			10	11	12	13	>13	
≤5	N	17	16	1	3												38	
	PCT	37	35	2	7												83	83
6	N																0	
	PCT																0	83
8	N				1												1	
	PCT				2												2	85
10	N						1										1	
	PCT						2										2	87
12	N																0	
	PCT																0	87
14	N																0	
	PCT																0	87
16	N																0	
	PCT																0	87
18	N																0	
	PCT																0	87
20	N																0	
	PCT																0	87
>21	N																0	
	PCT																0	87
***	N																6	
	PCT																13	100
TOTAL	N	7	17	16	2	3	0	1	0	0	0	0	0	0	0	0	0	46
	PCT	15	37	35	4	7	0	2	0	0	0	0	0	0	0	0	0	0
	C	15	52	87	91	98	98	100	100	100	100	100	100	100	100	100	100	100

*** CALM OR PERIOD NOT DETERMINED

* LESS THAN 0.5 PERCENT

N = NUMBER

PCT F = PERCENT FREQUENCY

C = CUMULATIVE PERCENT

(Continued from inside front cover)

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