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SEVERE WEATHER STATISTICS FOR THE WARNING AREA OF THE MODERNIZED WEATHER FORECAST OFFICE AT LITTLE ROCK, ARKANSAS

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1. Introduction

The National Weather Service is undergoing major restructuring. Part of this process has resulted in a different area of warning responsibility for the Little Rock office. The purpose of this paper is to examine the occurrence of severe weather in the new County Warning Area (CWA). Those counties are shown on Fig. 1. There are 75 counties in Arkansas, and the Weather Service Forecast Office (WSFO) at Little Rock warns 46 of them. Adjacent offices of the National Weather Service provide warnings for the remaining counties.

Statistics will be used to quantify and describe severe weather occurrences within the area of interest. In particular, figures will refer to tornado segments, hail, and damaging winds. The database used was provided by the Verification Section of the Storm Prediction Center (SPC) in Norman, Oklahoma, formerly known as the National Severe Storms Forecast Center (NSSFC) in Kansas City. The CLIMO program (Vescio 1995) produced data for the period from 1950 to 1993 for tornado segments, and from 1955 to 1993, except 1972, for hail and damaging winds.

Tornado segments are used instead of actual tornadoes because the SPC verifies weather warnings on a county by county basis. For example, if a tornado travels across three counties, the data base will show three tornado segments, although they were produced by a single tornado. Keep in mind as you look through the data that the term tornado will refer to segments rather than the full path of the tornadoes.

Large hail is defined as hailstones with a diameter greater than or equal to 0.75 in. Hail reports are subdivided into three categories—hail with diameter from 0.75 in to less than 1.75 in, from 1.75 in to less than 2.75 in, and with diameter equal to 2.75 in or larger. The base values of each of the three sizes are described as penny or dime, golf ball, and baseball.

Damaging wind reports refer to instances when wind damage occurred (whether speeds were known or not) or where wind speeds were greater than or equal to 50 kt (58 mph).

Data contained in this paper could serve several interests. At the WSFO data can be used to acquaint new forecasters with what they might expect throughout the year. Insurance companies can use the numbers to assess risk from severe weather. Emergency managers can evaluate the data to prepare for weather contingencies. Newcomers to the area can become familiar with meteorological disaster threats to which they may be exposed, and the curious may have their interest satisfied. Many more uses are possible.

2. Tornadoes in the NWSFO Little Rock CWA

2.1. Tornado Classification

Tornadoes have been classified (Table 1) by the strength of their winds using the Fujita Scale (Fujita 1987), ranging from F0 to F5. The CLIMO software tracked the total number of tornadoes, the number of strong tornadoes (F2 or greater), and the number of killer tornadoes (any intensity tornado as long as it caused at least one fatality).

Table 1. Fujita Scale of Tornado Intensity

Fujita Scale	Wind speed range in mph	Damage description
F0	Under 72	Light
F1	73-112	Moderate
F2	113-157	Considerable
F3	158-206	Severe
F4	207-260	Devastating
F5	261-318	Incredible

Grazulis (1993) augmented the F-scale to include median and average path lengths and widths, as shown in Table 2 below.

Table 2. Average and Median Path Length and Width per F-scale

F-scale	Average length (mi)	Median length (mi)	Average width (yds)	Median width (yds)
F0	1.11	0.30	46	17
F1	2.59	0.98	93	47
F2	5.66	2.19	167	99
F3	12.08	6.76	290	180
F4	22.42	13.80	432	297
F5	34.17	23.44	616	496
all	4.40	0.98	128	48

2.2. Tornado Frequencies

During the period in question (1950-1993), there were a total of 616 tornadoes, with 335 of them being classified as strong (F2 or greater intensity), and 45 of them were killer tornadoes causing 174 deaths (Fig. 2). Weak tornadoes (F0 and F1) numbered 271, leaving 10 tornadoes without an F-scale value assigned to them. It is interesting to note that 1987 was the only year which registered no tornadoes at all in the CWA, while 1982 had the highest number at 71.

Tornadoes occur primarily in the spring months, with a marked decline in the summer, and a secondary peak during the late fall (Table 3). March, April, and May receive 56 percent of all tornadoes, 58 percent of strong tornadoes, 69 percent of killer tornadoes, and 89 percent of all fatalities. Table 3 shows the monthly percentage of tornadoes, strong tornadoes, and killer tornadoes. Table 4 shows the monthly distribution of tornadoes. Figure 3 shows that even with most of the tornadoes occurring during two peaks, all months are are susceptible to tornado occurrences..

Table 3. Monthly Percentage of Tornadoes

	J	F	M	A	M	J	J	A	S	O	N	D
All	4	7	16	23	17	6	3	1	2	2	9	10
Strong	3	8	19	21	18	3	0	1	1	2	12	12
Killer	2	5	31	16	22	0	0	0	0	2	13	9

Table 4. Monthly Tornado Distribution

	J	F	M	A	M	J	J	A	S	O	N	D
All	26	41	98	139	107	34	21	8	12	10	58	62
Strong	11	26	65	70	59	10	0	4	3	7	40	40
Killer	1	2	14	7	10	0	0	0	0	1	6	4

As Fig. 4 shows, tornadoes occur mostly during the late afternoon and early evening. Table 5 shows the percentage distribution by hours of all tornadoes, strong tornadoes, and killer tornadoes. The hours between 4 p.m. and 9 p.m. encompass 58 percent of all tornadoes, 58 percent of strong tornadoes, and 65 percent of all killer tornadoes. Although there is a frequency minimum around 6 a.m., tornadoes can occur at all hours of the day.

Table 5. Hourly Percentage Distribution of Tornadoes

	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	NN
All	1	2	1	1	1	1	1	1	1	2	2	2
Strong	2	2	2	1	1	1	0	1	0	2	0	2
Killer	0	7	0	0	2	2	0	0	0	0	2	0

	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	MN
All	4	3	4	9	10	10	11	9	9	7	4	4
Strong	4	2	4	9	8	10	12	8	11	10	4	4
Killer	5	0	2	11	7	16	11	7	13	7	4	4

The intensity distribution of tornadoes is shown in Fig. 5. Of the 616 tornadoes, only 606 were given an F-scale classification. Table 6 shows the percentage distribution by F-scale for tornadoes within the CWA for WSFO Little Rock. Table 7 shows the distribution of observed tornadoes by the same categories.

Table 6. Percentage Distribution by F-scale

F0	F1	F2	F3	F4	F5
17	28	35	17	3	0

Table 7. Distribution by F-scale

F0	F1	F2	F3	F4	F5
101	170	216	102	17	0

2.3. Tornado Fatalities

The yearly distribution of tornado deaths is shown in Fig. 8, with the monthly and hourly distributions following in Figs. 9 and 10, respectively. The reader can see that tornado-related fatalities occur mostly during the spring months and during the late afternoon and early evening hours, as was the case with tornado occurrences. Table 8 shows the monthly death totals, while Table 9 shows the hourly totals.

Table 8. Monthly Distribution of Tornado Fatalities

	J	F	M	A	M	J	J	A	S	O	N	D
No.	1	2	115	18	22	0	0	0	0	1	11	4

Table 9. Hourly Distribution of Tornado Fatalities

	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	NN
No.	4	1	0	0	1	1	0	0	0	0	1	0

	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	MN
No.	2	0	2	8	63	38	19	9	11	7	3	4

2.4 Tornado Injuries

It is interesting to note in Table 10 that in the monthly distribution of tornado injuries only the month of July was free from injuries during the period under review (1950-1993). Similarly, there was only one injury-free hour during the same period, as shown in Table 11. The numbers of tornado injuries are shown in yearly, monthly, and hourly distribution, respectively, in Figs. 11-13.

Table 10. Monthly Distribution of Tornado Injuries

	J	F	M	A	M	J	J	A	S	O	N	D
No.	29	85	841	460	196	11	0	9	5	8	153	133

Table 11. Hourly Distribution of Tornado Injuries

	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	NN
No.	41	21	5	7	1	1	0	6	7	6	21	44

	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	MN
No.	21	22	61	100	429	278	355	165	158	113	32	37

3. Hail

Since hail is a product of severe thunderstorms, as are tornadoes, it is not surprising that hail occurs most frequently in the spring months and during the late afternoon and early evening hours (Figs. 14-16). Table 12 shows the monthly distribution of large hail occurrences (0.75 in or larger), and Table 13 shows the hourly distribution of large hail.

Table 12. Monthly Distribution of Large Hail

	J	F	M	A	M	J	J	A	S	O	N	D
No.	35	29	167	364	180	121	93	55	24	37	68	21

Table 13. Hourly Distribution of Large Hail

	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	NN
No.	23	21	10	14	3	9	15	16	13	10	16	15

	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	MN
No.	37	67	73	108	133	148	129	101	93	67	43	30

4. Damaging Wind

Wind damage has a tendency to occur during the warm months of the year, not just in the spring as with tornadoes and hail. The yearly, monthly, and hourly distribution of wind damage occurrences are depicted in Figs. 17-19. Table 14 shows the monthly distribution of damaging wind occurrences, while Table 15 shows the hourly distribution of damaging winds.

Table 14. Monthly Damaging Wind Occurrences

	J	F	M	A	M	J	J	A	S	O	N	D
No.	22	37	122	254	310	264	258	268	72	83	149	35

Table 15. Hourly Damaging Wind Occurrences

	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	NN
No.	69	55	37	41	30	31	16	20	25	11	26	32

	1P	2P	3P	4P	5P	6P	7P	8P	9P	10P	11P	MN
No.	62	100	168	160	184	164	121	124	133	122	81	65

5. Note Regarding Interpretation of Results

No attempt has been made to address population density, the increased efforts to solicit public reports of severe weather, nor the increased emphasis on severe weather warning verification, all of which may have changed over the period of time covered by this study. Another factor which seems to have increased the number of severe weather occurrences is the concerted effort by the NWS to train severe weather spotters and to deploy them during severe weather episodes. Some of these points are addressed by Grazulis, et al. (1993).

6. Conclusions and Recommendations

Severe weather occurs all year long within the CWA assigned to the Little Rock NWS Office. It does have a tendency to show its effects in the spring and during the fall, but no month should be considered completely safe. By the same token, one can see that no hour during the day is safe. It is true that most severe weather tends to happen during the late afternoon and early evening hours, but severe weather also occurs even at dawn, when heating is at a minimum and cooling at a maximum.

Forecasters should take a vigilant posture during their shifts to anticipate the possibility of severe weather, according to the current weather conditions, without discounting automatically the probability of severe weather simply because it is the wrong time of the year or the wrong hour of the day. Emergency managers should be prepared to respond to watches and warnings issued by the National Weather Service at any time, as well. The general public and severe weather spotters need to know and review severe weather safety rules, and they should be prepared to respond appropriately whenever a warning is issued or severe weather is observed.

Acknowledgments

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References

Fujita, T. F., 1987: *U. S. Tornadoes, Part 1, 70-Year Statistics*, Univ. Of Chicago Press, Chicago.

Grazulis, T. P., J. T. Schaefer, and R. F. Abbey, Jr., 1993: Advances in tornado climatology, hazards, and risk assessment since Tornado Symposium II. *Geophysical Monograph 79,* C. Church, et al, ed. Amer. Geophysical Union, Washington, DC, pp. 409-426.

Vescio, M. D., 1995: CLIMO—Software to generate severe weather statistics for NWS County Warning Areas. NWS/NCEP Storm Prediction Center, Norman, OK.

WSFO, Little Rock Arkansas County Warning Area

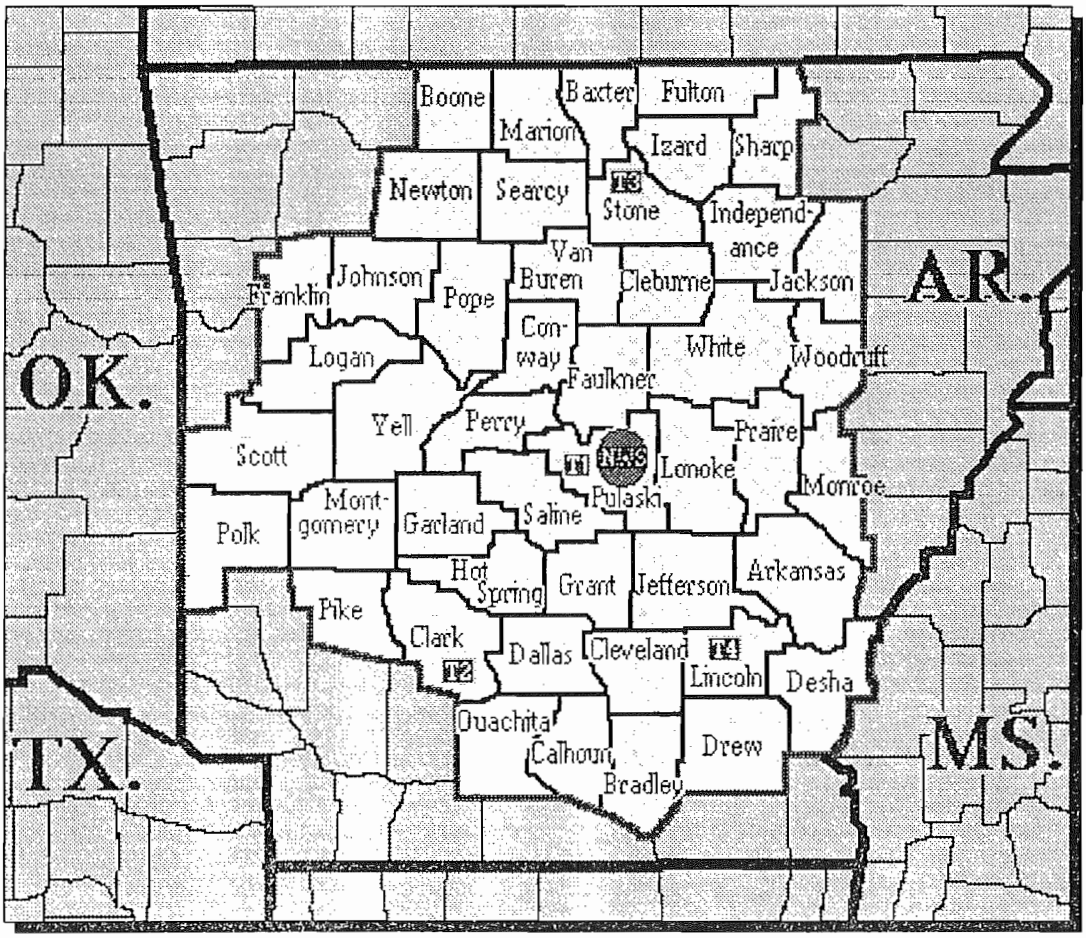


Fig. 1

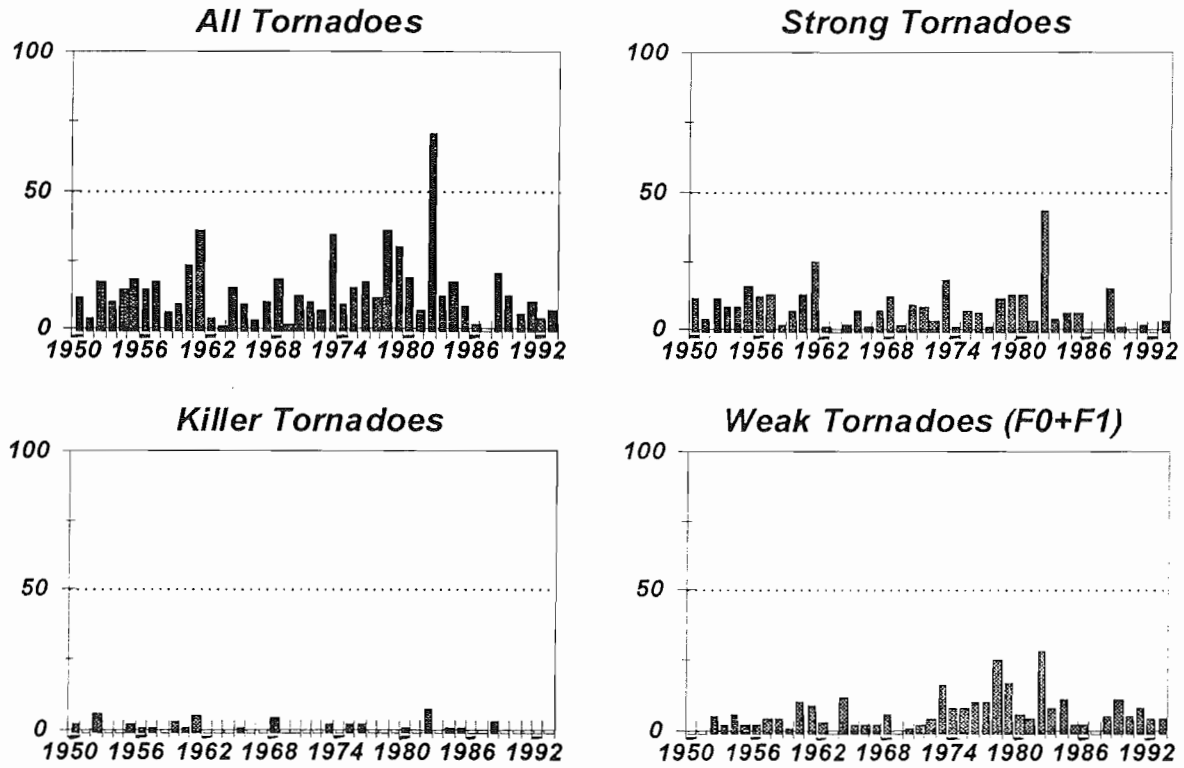

Annual Tornadoes
All Tornadoes
Strong Tornadoes
Killer Tornadoes
Weak Tornadoes (F0+F1)
100
50
0
1950 1956 1962 1968 1974 1980 1986 1992

Fig. 2

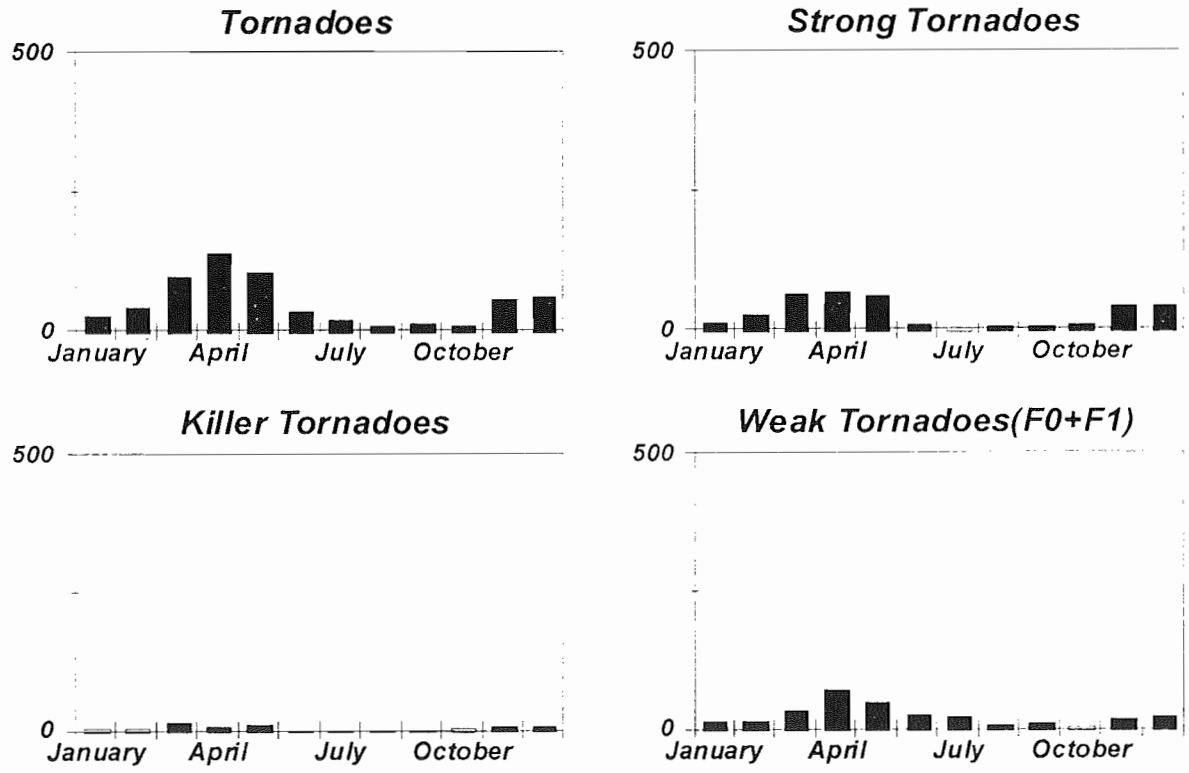

Tornadoes by Month (1950-1993)
Tornadoes
Strong Tornadoes
Killer Tornadoes
Weak Tornadoes(F0+F1)
500
0
January
April
July
October

Fig. 3

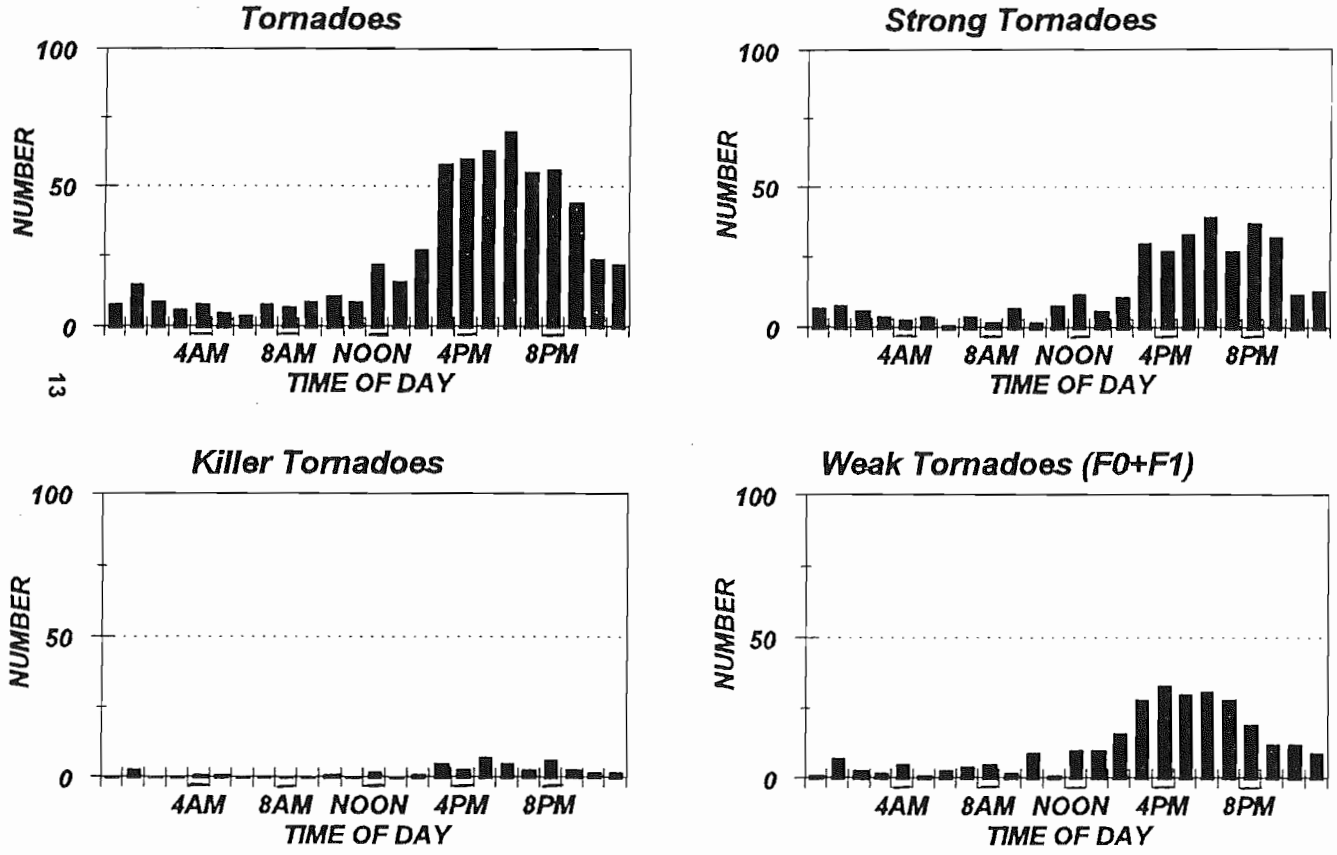

Tornadoes by Hour 1950-1993
Tornadoes
Strong Tornadoes
Killer Tornadoes
Weak Tornadoes (F0+F1)
NUMBER
100
50
0
4AM
8AM
NOON
4PM
8PM
TIME OF DAY
13

Fig. 4

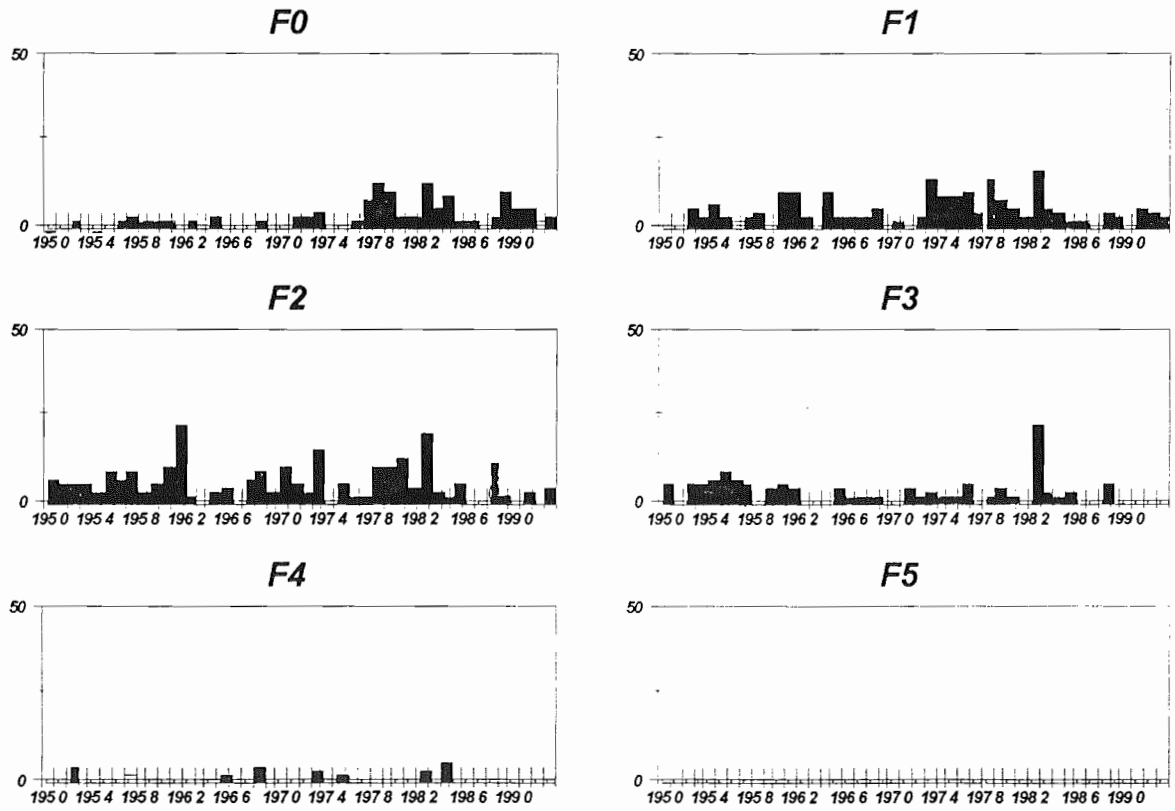
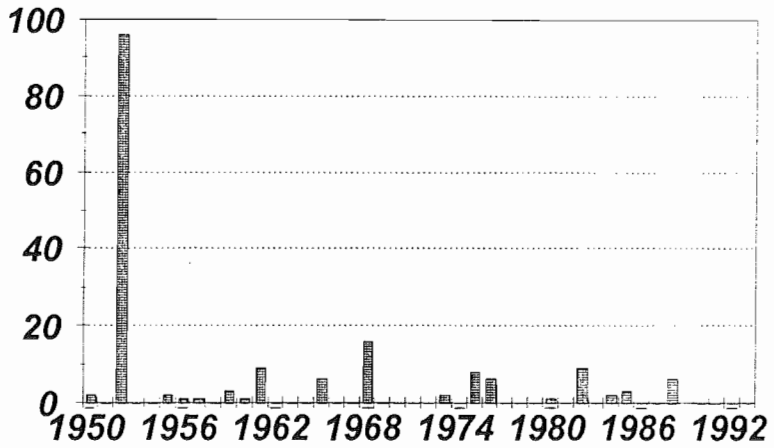

Tornado Intensities
F0
F1
F2
F3
F4
F5
50
0
1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990

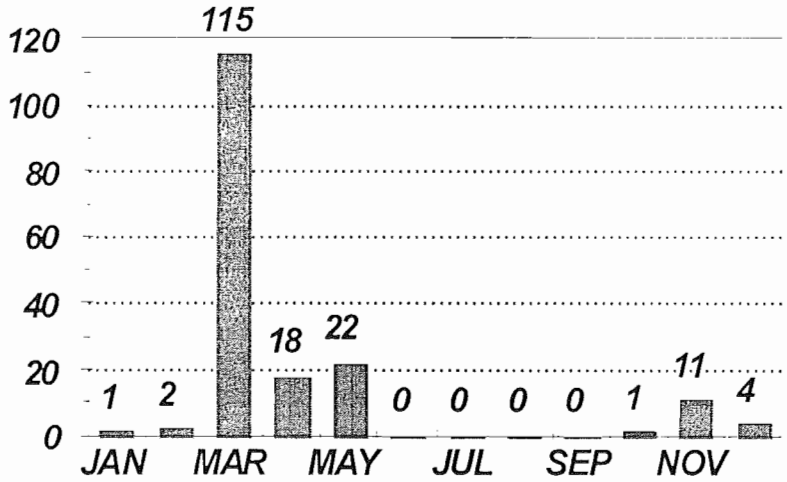
Fig. 5

Tornado Deaths



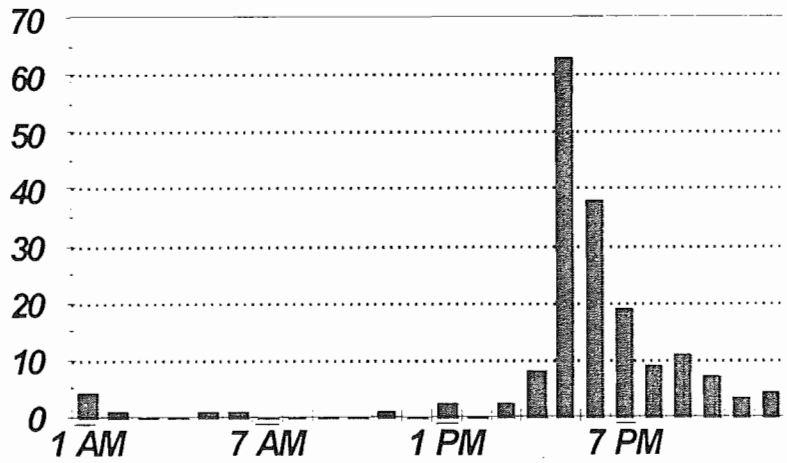
1950-1993

Fig. 6



by Month

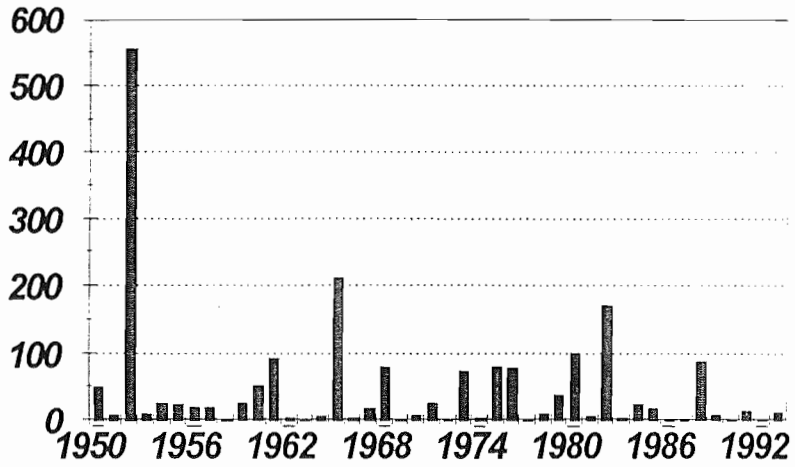
Fig. 7



by Hour

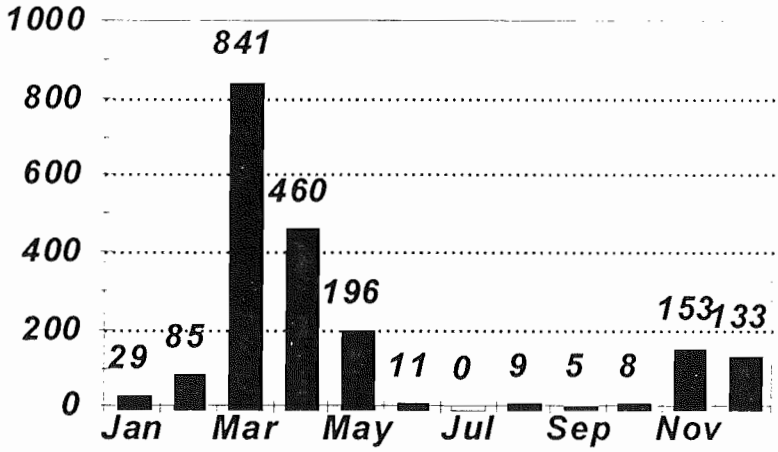
Fig. 8

Tornado Injuries



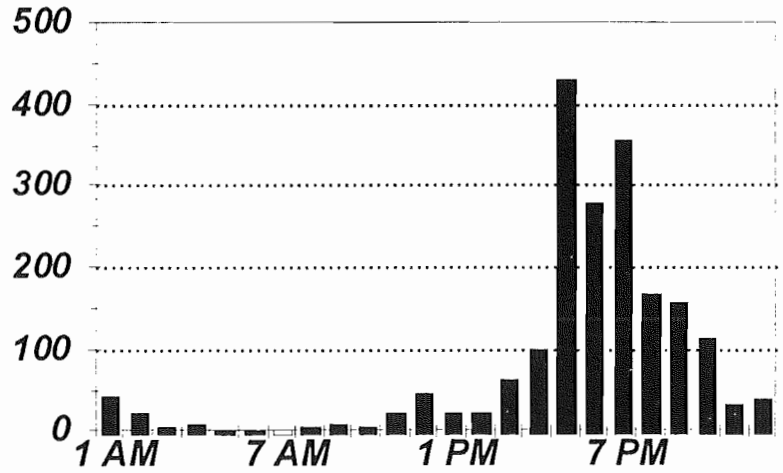
1950-1993

Fig. 9



by Month

Fig. 10



by Hour

Fig. 11

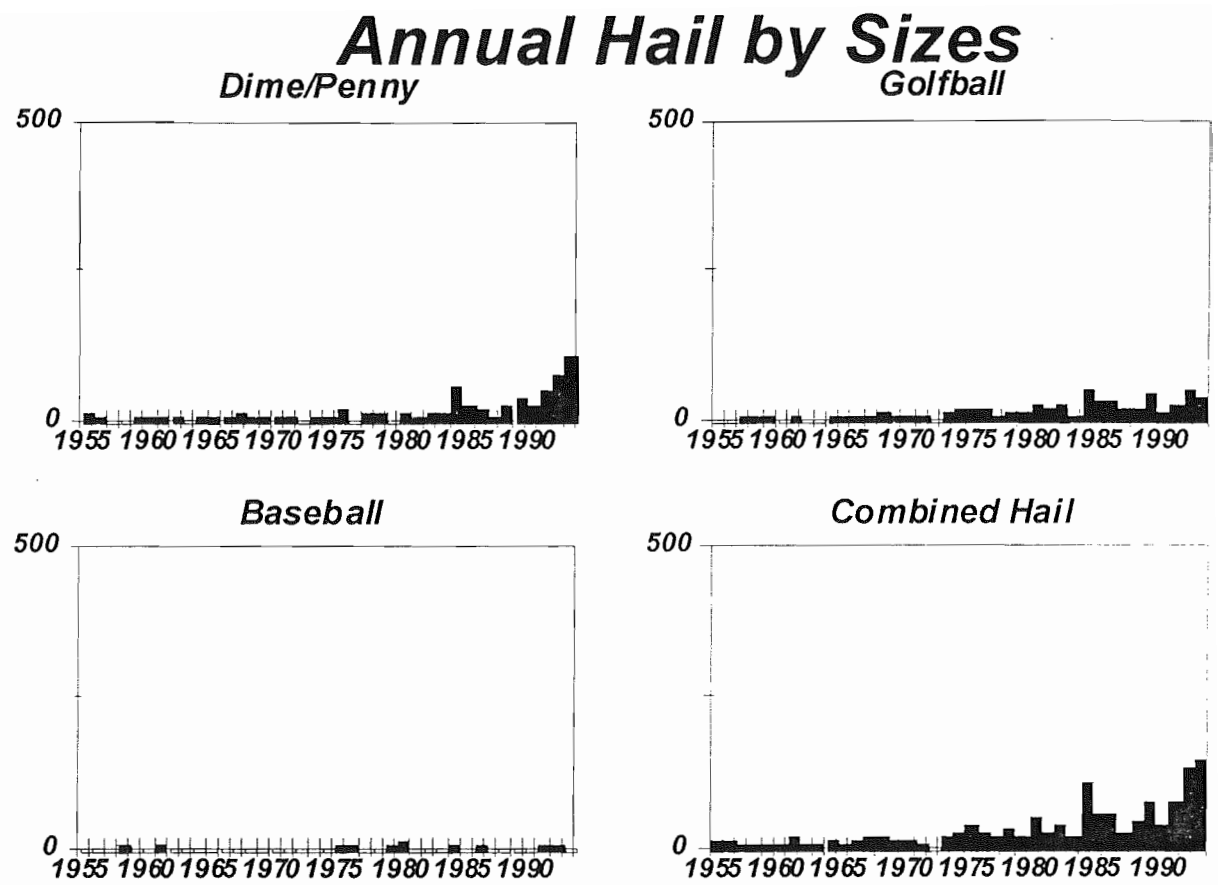

Annual Hail by Sizes
Dime/Penny
Golfball
Baseball
Combined Hail
500
0
1955 1960 1965 1970 1975 1980 1985 1990

Fig. 12

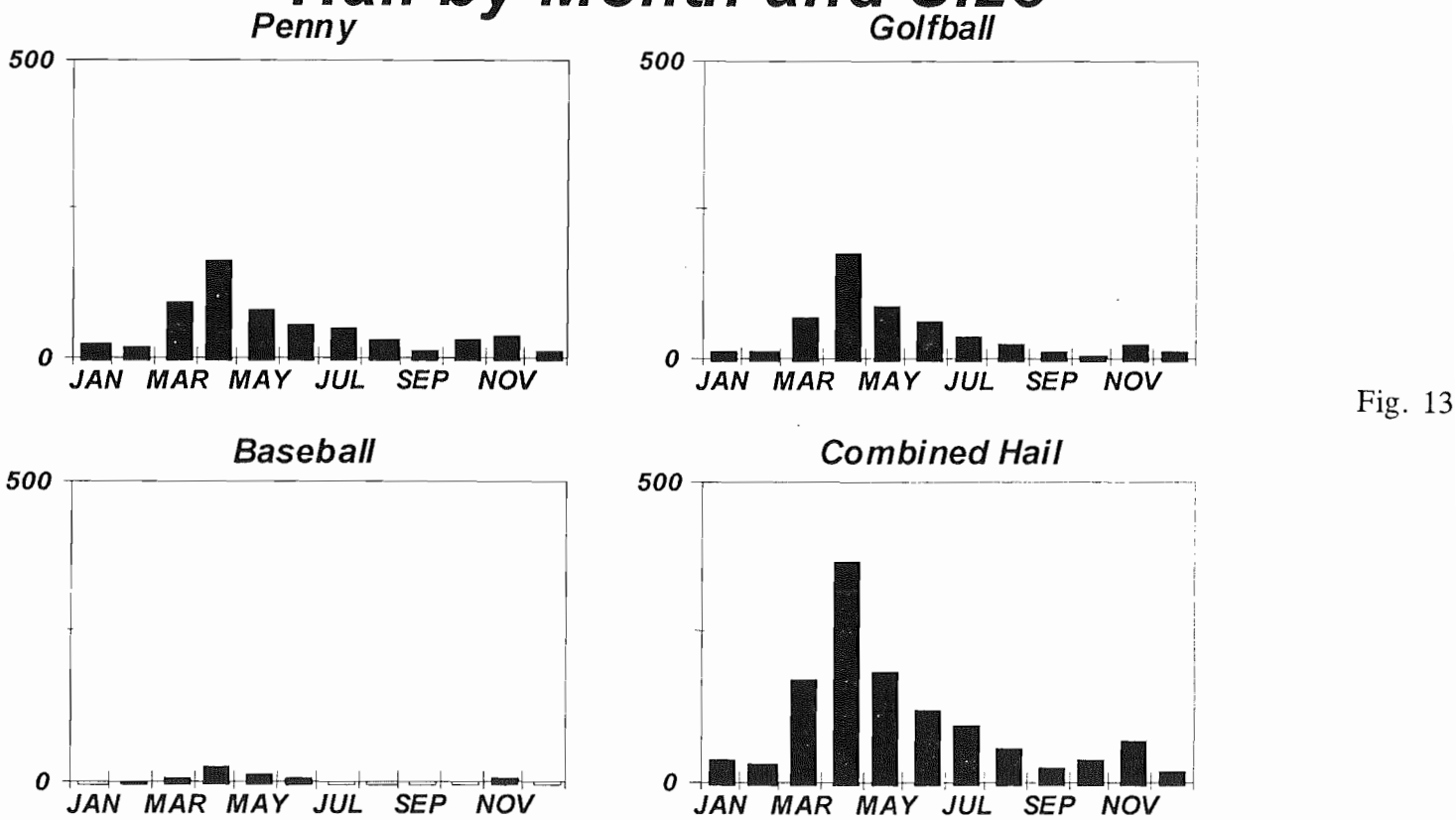

Hail by Month and Size
Penny
Golfball
Baseball
Combined Hail
500
0
JAN MAR MAY JUL SEP NOV

Fig. 13

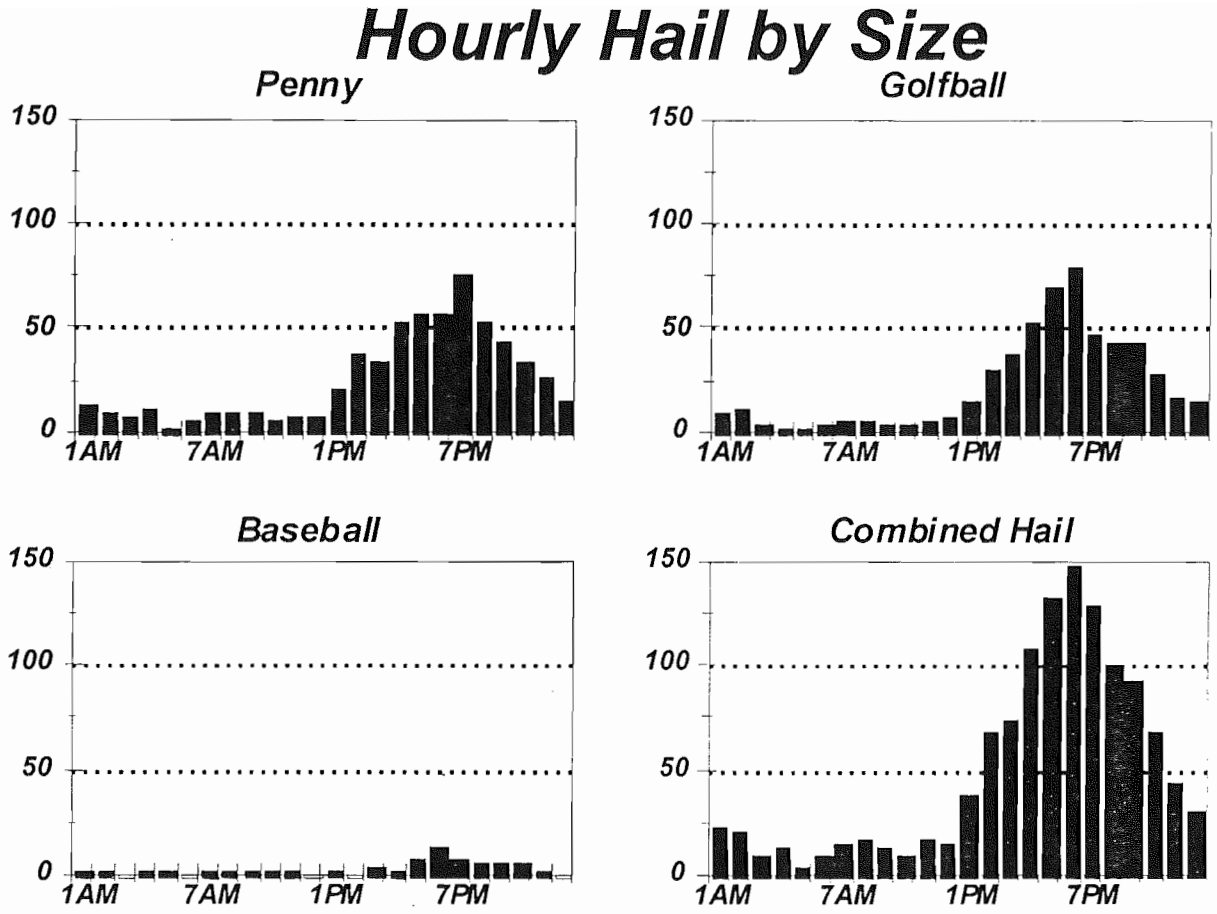
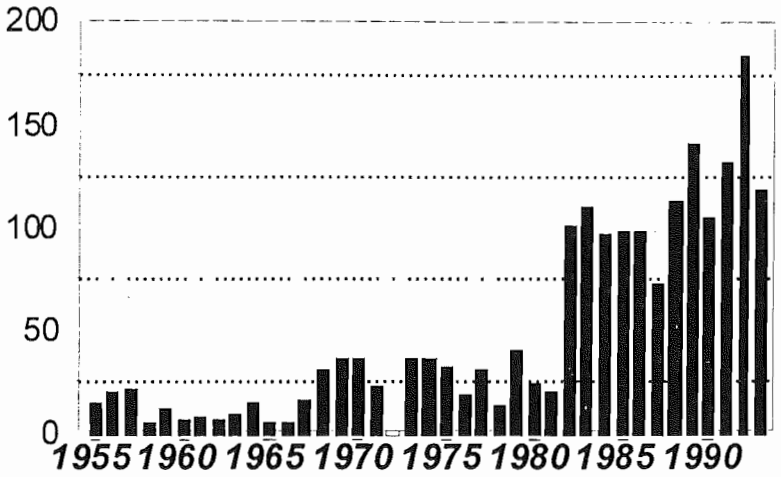

Hourly Hail by Size
Penny
Golfball
Baseball
Combined Hail
150
100
50
0
1AM
7AM
1PM
7PM

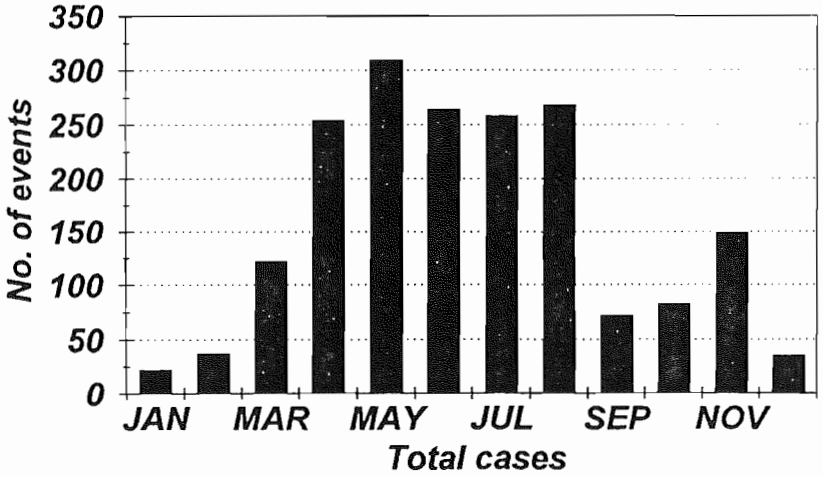
Fig. 14

Damaging Winds



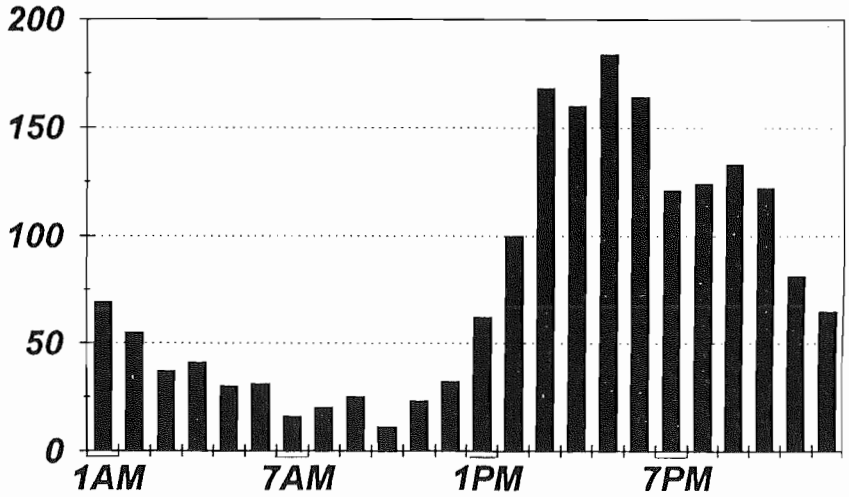
by Year

Fig. 15



by Month

Fig. 16



by Hour

Fig. 17