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A SEVERE WEATHER CLIMATOLOGY FOR NWSFO PEACHTREE CITY'S COUNTY WARNING AREA

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1. Introduction

As a result of National Weather Service (NWS) modernization, warning responsibility for NWSFO Peachtree City (Atlanta Area) was expanded to include a large portion of north and central Georgia (Fig. 1). This area, known as the County Warning Area (CWA), is now more than twice its pre-modernization size. Included in the area being added to Peachtree City's original CWA are population centers such as Macon and Athens, as well as major recreational areas (e.g., Lake Lanier and the southern Appalachian mountains).

Providing severe thunderstorm and tornado warnings for the CWA will continue to be a fundamental task for the NWSFO forecasters. A "severe thunderstorm" is defined as one that produces wind damage or wind gusts of at least 50 kt, tornadoes, and/or hail with a diameter of at least ¾ in. Forecasters responsible for issuing these warnings may find it helpful to examine temporal and other characteristics of these storms. Toward this end, a climatology of severe weather over the new, expanded CWA has been developed.

2. Data

Much of the data was extracted from a database maintained by the National Centers for Environmental Prediction, Storm Prediction Center (SPC) using the CLIMO software described by Vescio (1995). This data set is the same one accessed by the SVRPLOT program (Hart 1993). Tornado data date back to 1950, while hail and wind events are archived as far back as 1955. Data relating to each type of event are maintained in the database on a county-by-county basis. This approach results in the breaking down of data relating to tornadoes that cross county boundaries into "segments." Therefore, combining data from the various counties that make up a CWA does not yield the total number of tornadoes, but rather the total number of "segments," or the total number of counties affected.

Damaging wind and hail data for the year 1972 were not archived at the SPC. To fill this void, data from the *Storm Data* publication (NOAA 1972) was used.

Data on population density were taken from the United States 1990 Census Data. Local Climatological Data (LCDs) provided information on the number of thunderstorm days. A "thunderstorm day" is defined as a day during which thunder is audible from an official observing site.

A number of authors have pointed out aspects of severe weather reporting that lead to problems in developing a severe storm climatology (e.g., Grazulis and Abbey 1983, Doswell 1985, Hales 1993). Such factors as population and roadway density, weather sensitivity of the media and public, increased awareness of the citizenry, and increased efforts to seek out reports in the wake of a severe weather episode have all been cited as sources for skewing data on which a climatology can be based. Biases are frequently seen in spatial distributions and in yearly frequency data. However, Ostby (1993) suggests the data can be made more reliable (biases reduced) by focusing on events on the stronger end of the intensity spectrum. This approach was used to examine spatial distributions of tornadoes (Fig. 2) and large hail (Fig. 3) in Peachtree City's CWA. A comparison of Figs. 2 and 3 with a population density map (Fig. 4) yields results that appear minimally biased toward over-representation in areas with the greatest population. Keeping that in mind, one can make certain inferences on the spatial characteristics of these storms. For example, it appears in Fig. 2 that tornadoes are not common in the rough terrain of extreme northeast Georgia. Also, the incidence of tornadoes is greater in northern and western sections of the region than in southern and eastern sections. In Fig. 3, a fairly uniform distribution of hail events is suggested after factoring in over-reporting along interstate highways.

Some of the storm data are less affected by bias. For example, developing distributions of monthly and hourly frequencies is possible, since biases are distributed more or less equally across the data.

3. General Thunderstorm Climatology

Before presenting data on storms classified as "severe," it is appropriate to briefly discuss general thunderstorm climatology. Thunderstorms in Georgia are common, especially during spring and summer. The number of thunderstorm days per year ranges from around 50 in the mountains of northeast Georgia to around 55 across the southern extremity of Peachtree City's CWA (based on Local Climatological Data).

Table 1 exhibits the monthly distribution of thunderstorm days at a few key locations. Note that the only significant difference in thunderstorm frequency among the chosen sites is during the months of July and August, when thunderstorms are more frequent at Macon (MCN), which represents the southern part of the CWA, than at Atlanta (ATL) or Athens (AHN) farther north. Note also that thunderstorms are more common in July than in any other month of the year. During December, thunderstorms are at a minimum.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ATL	1.1	1.9	3.6	4.2	6.0	8.6	10.3	8.0	3.1	1.0	1.0	0.7
AHN	1.1	1.3	3.2	4.0	6.1	8.8	11.7	8.4	3.4	1.0	1.1	0.6
MCN	1.1	1.9	3.3	4.0	6.3	8.8	13.3	9.6	3.4	0.8	1.1	0.9

Table 1. Monthly Distribution of Thunderstorm Days (1961-1990)

4. Severe Thunderstorm Climatology

a. Tornadoes

As seen in Fig. 5, during the 44-year period from 1950 to 1993, the CWA averaged six tornado days per year—two of which involved tornadoes with an intensity of at least F2. Events involving "killer" tornadoes were infrequent, having occurred on average once every two years. In no year did killer tornadoes occur on more than two days. The records also show only one year where more than three counties reported tornado-related deaths (six in 1974). Nevertheless, despite the rarity of killer tornadoes, a total of 72 people perished, and almost 1700 were injured.

Figure 6 shows the monthly distribution of tornado occurrence in terms of the number of counties affected. Several things to note include:

- More counties report tornadoes and tornado-related deaths in April than in any other month of the year.
- The primary tornado season is March-April-May.
- Strong tornadoes (F2+) have occurred in every month of the year.

From the data used to generate Fig. 6, one finds that of all counties reporting tornado occurrences, 37% are affected by storms with an intensity of at least F2. This is somewhat higher than the 32% ratio reported nationwide (Grazulis 1993).

Figures 7, 8, and 9 show favored times of the day for tornado occurrence for each of three "seasons." Figure 7 shows data for the warmest months (June-September) when the westerlies aloft are weak, and transient weather systems are at a minimum. Note the strong correlation of events with the afternoon and early evening hours. This implies that diurnal heating is a major ingredient in the development of tornadic thunderstorms during these months.

Figure 8 shows data for the coldest months (October-February) when the westerlies are often strong and progressive weather systems are common. Note that tornadoes occur at any hour of the day, suggesting that large-scale forcing is an important ingredient in the formation of tornadoes during these months. However, the most favored time for occurrence is mid afternoon through early evening, again pointing to diurnal heating as a contributing element.

Figure 9 shows data for the main "tornado season" (March-May). This is a time of transition when the strength of the westerlies varies, and strong cold fronts occasionally displace warm and unstable air masses. Since tornado occurrence is well represented in all hours of the day (Fig. 9), there is a suggestion that fronts and transient features aloft are important ingredients in many springtime tornadic episodes. However, once again we see the best correlation with the hours of maximum heating, when surface-based instability is usually greatest.

b. Hail (¾ in diameter or larger)

Hailstorms involving hailstone diameters of at least ¾ in are more common than tornadoes across the CWA. Between 1955 and 1993, the average number of hail days per year was seven, compared to about six tornado days. A dramatic increase in the number of hail events in the 1980s and 1990s is seen in Fig. 10. This is likely related to increasing efforts to verify warnings and increased public awareness, as opposed to being associated with any meteorological phenomenon.

When looking at size distribution (Fig. 11) we find that most severe hailstorms (59%) in the CWA involved hailstone diameters of less than 1.75 in. Hailstones larger than 2.75 in are truly rare, making up only 2% of the total.

The occurrence of large hail is a seasonal phenomenon. Figure 12 shows that nearly all hailstorms strike between February and August. April is the most favored month. During the spring and summer months, the vast majority of hail events have occurred during the afternoon and evening hours (Figs. 13 and 14, respectively). This points to the importance of diurnal heating in the formation of the Georgia hailstorm. In the autumn and winter months (Fig. 15) we find not only a much lower frequency, but a broader distribution in the time of occurrence. Only in the morning hours, from predawn to around noon, do these storms rarely occur.

c. Damaging Wind

By far the most common severe weather event in the CWA is damaging wind. The average number of damaging wind days during the 1955-1993 period was 19 per year. Figure 16 shows a dramatic upsurge in the number of events in recent years; however, this is thought to be the result of increased reporting rather than a true increase in occurrence.

Unlike hail and tornadoes, damaging windstorms are just as common in summer as in the spring (Fig. 17). In fact, more windstorms occur in July than in any other month. One explanation for this relates to the nature of summer thunderstorms in Georgia. Nearly all are of the "pulse" type that develop with afternoon heating. They often collapse abruptly, sometimes resulting in brief damaging microbursts. Note in Fig. 18 how well these summertime events correlate with the hours of maximum heating.

The afternoon maximum seen in Fig. 19 suggests that afternoon heating is an important ingredient in springtime events as well. However, some spring windstorms occur at night and during the morning hours. This suggests that some events are driven by large-scale forcing from fronts and/or features aloft.

During autumn and winter, the times of events are more evenly distributed (Fig. 20). The two maxima, one just prior to sunrise and the other just after sunset, are **not** representative of the entire cool season. The morning maximum is unique to the month of February, whereas the evening maximum is largely made up of events from the month of November. Causes for either of these maxima are not obvious. Despite these aberrations, it is apparent that diurnal heating does **not** play the primary role in the occurrence of damaging wind events during the cool season.

5. Summary

Severe weather is common in Peachtree City's CWA. Damaging thunderstorm winds, large hail, and tornadoes strike the area each year.

Damaging winds occur, on average, on 19 days per year. These events have taken place in every month, but tend to be most frequent during the spring and summer months. The **peak** month is July during which more than 500 events were reported over the past 40 years. During the favored months, the most likely time of day for wind damage is mid afternoon through early evening.

Large hail pelts the CWA on average seven days per year. April is the month of peak occurrence, but many episodes have also been reported in the other spring and summer months. During this active period, the most likely time of occurrence is from mid afternoon through early evening.

The average number of tornado days is six per year. While tornadoes have been reported in **all** months of the year, **most** occur in the March-April-May time frame. During this "tornado season" the most likely time of occurrence is from mid afternoon through early evening.

Tornado intensities of F2 or greater are involved in 37% of the events when the data are broken down into a county-by-county basis. These strong tornadoes are more likely to occur during the month of April than in any other month. During the period 1950-1993, 72 people lost their lives in tornadoes. Almost 1700 were injured.

Forecasters may be able to utilize the temporal tendencies displayed in this climatology. The data show that during the most active severe weather months, the most likely time of occurrence is from mid afternoon through early evening. An exceptional tendency is seen in the February wind damage data—a morning maximum just prior to sunrise. October and March show a similar pattern, but the tendency is not nearly as prominent. Armed with this knowledge and other such tendencies, forecasters can make plans that will put the forecast operations in the proper warning posture. Of course, not all severe weather episodes follow the climatological norm. Thus, there remains the need for vigilance and utilization of **all** available diagnostic and detection tools whenever thunderstorms are a possibility.

Acknowledgements

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References

Doswell, Charles A. III, 1985: The operational meteorology of convective weather volume II: storm scale analysis. *NOAA Tech. Memo. ERL ESG-15,* 240 pp.

Grazulis, Thomas P., 1993: *Significant tornadoes 1680 - 1991*, Environmental Films, 1326 pp.

_________, and Robert F. Abbey, Jr., 1983: 103 years of violent tornadoes...patterns of serendipity, population, and mesoscale topography. *Preprints*, 13th Conf. Severe Local Storms, Tulsa, OK., Amer. Meteor. Soc., 124-127.

Hales, John E., 1993: Biases in the severe thunderstorm data base: ramifications and solutions. *Preprints*, 13th Conf. Wea. Forecasting and Analysis, Vienna, VA, Amer. Meteor. Soc., 504-507.

Hart, John A. 1993: SVRPLOT: A new method of accessing and manipulating the NSSFC severe weather database. *Preprints*, 17th Conf. Severe Local Storms, St. Louis, MO, Amer. Meteor. Soc., 40-41.

National Oceanic and Atmospheric Administration, 1972: *Storm Data*. **14**, Nos. 1-12, National Climatic Data Center, Asheville, NC.

Ostby, Frederick P., 1993: The changing nature of tornado climatology. *Preprints*, 17th Conf. Severe Local Storms, St. Louis, MO, Amer. Meteor. Soc., 1-5.

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

Fig. 1. NWSFO Peachtree City County Warning Area

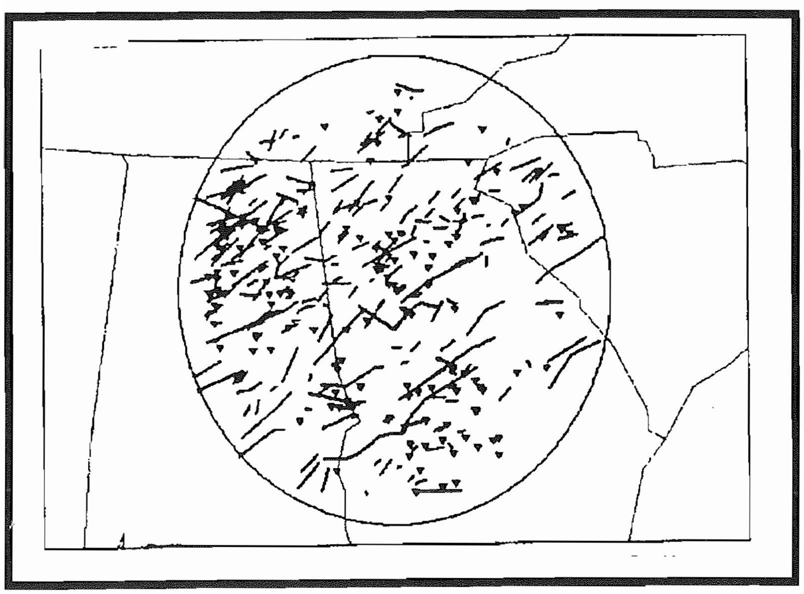

Fig. 2. Tornado Events — F2 or Greater (1950-1993)

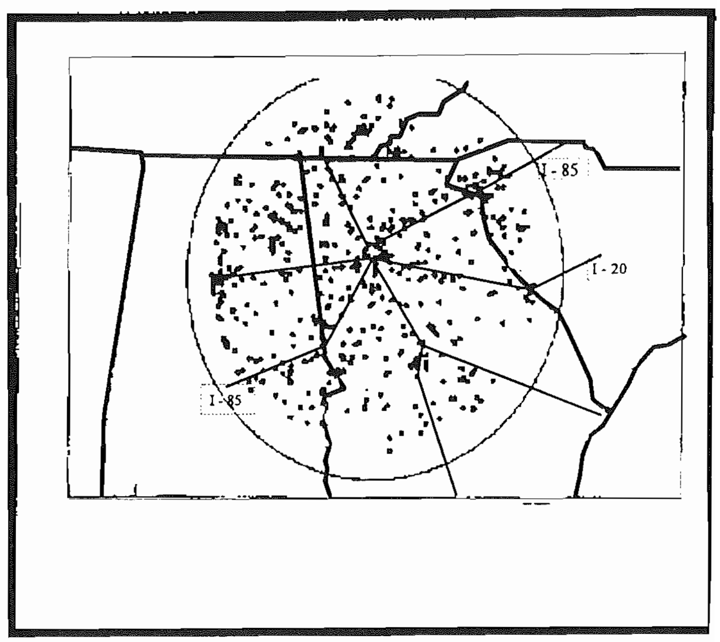

Fig. 3. Reports of Hail 1.75 in Diameter or Larger (1955-1993)

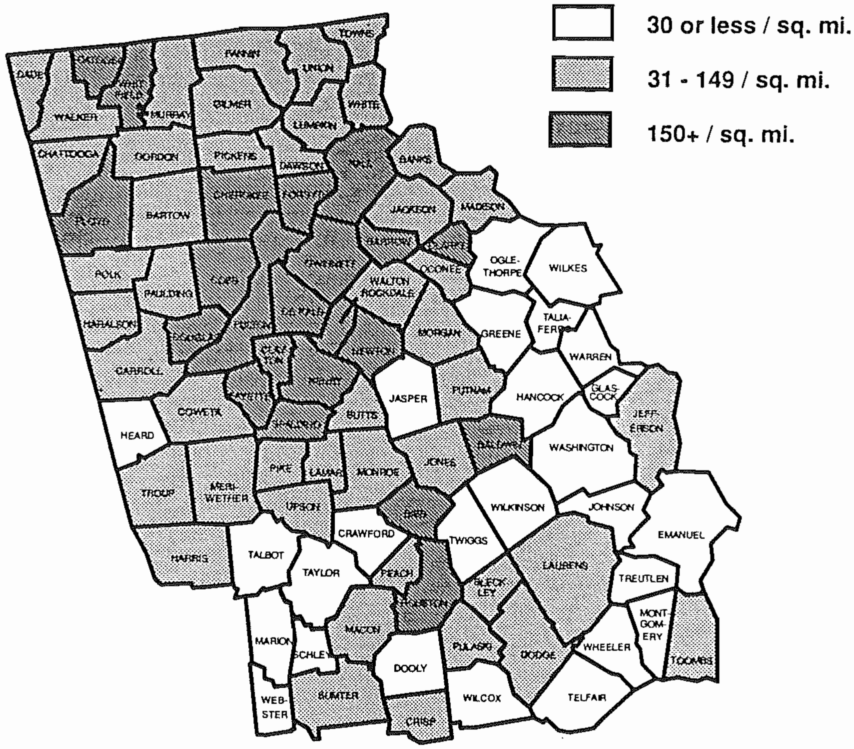

Fig. 4. Population Density

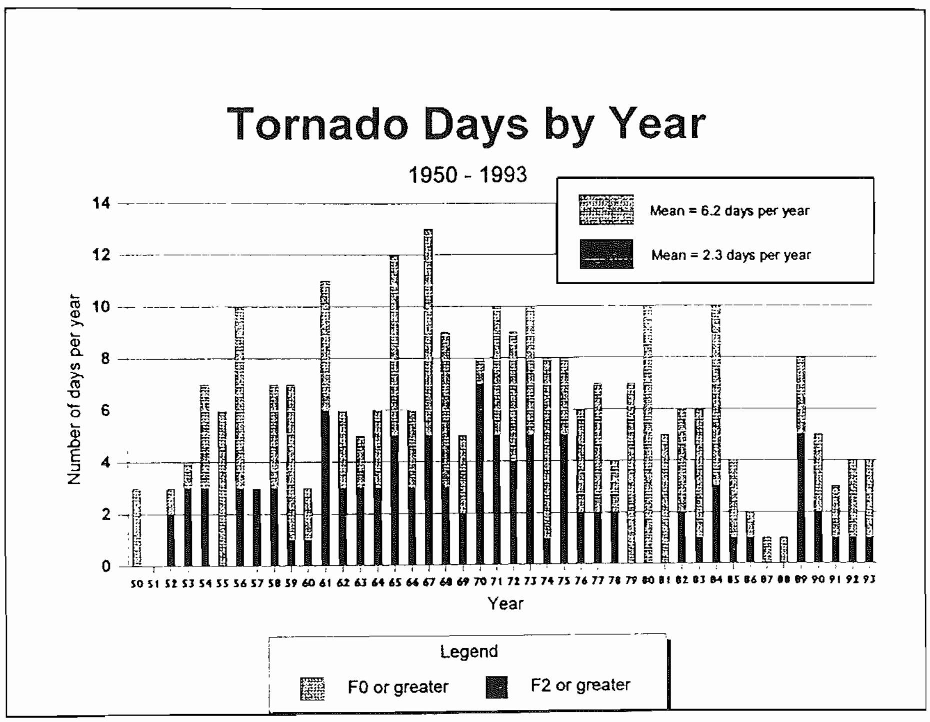

Figure 5

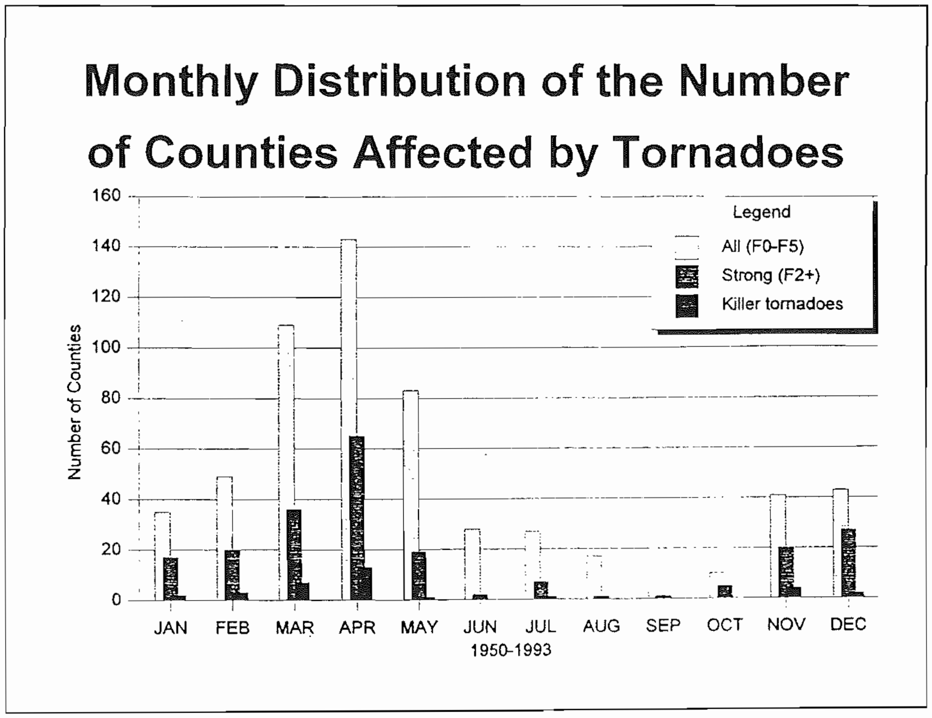

Figure 6

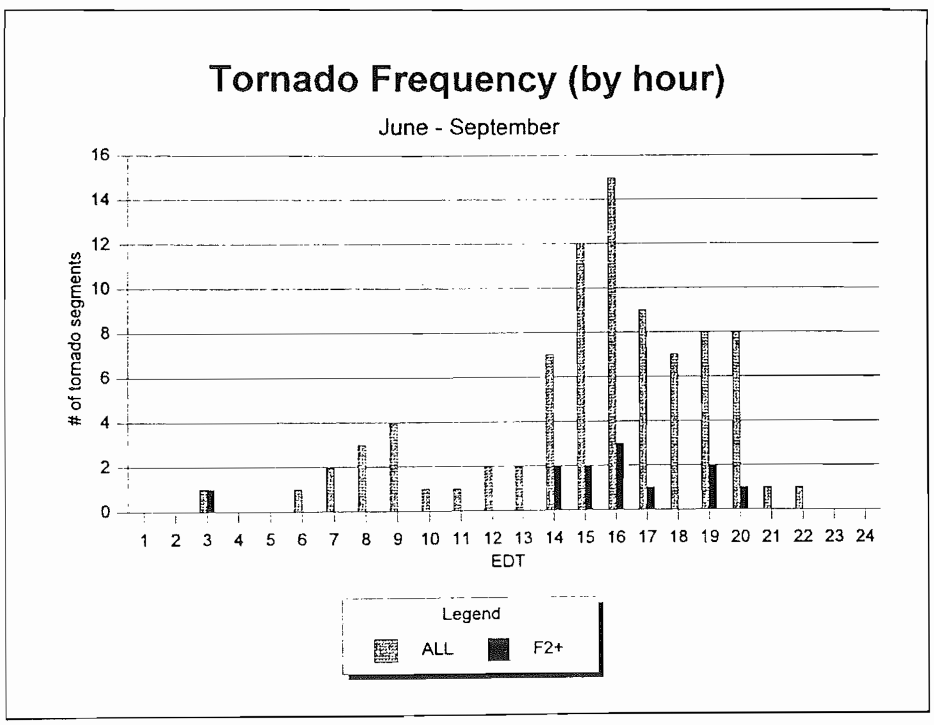

Figure 7

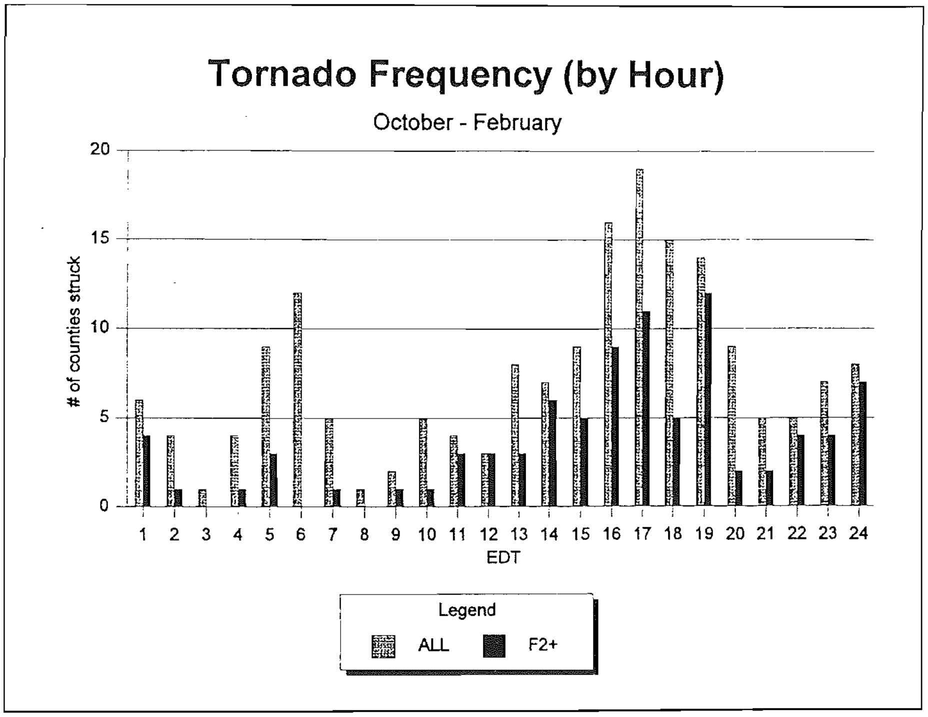

Figure 8

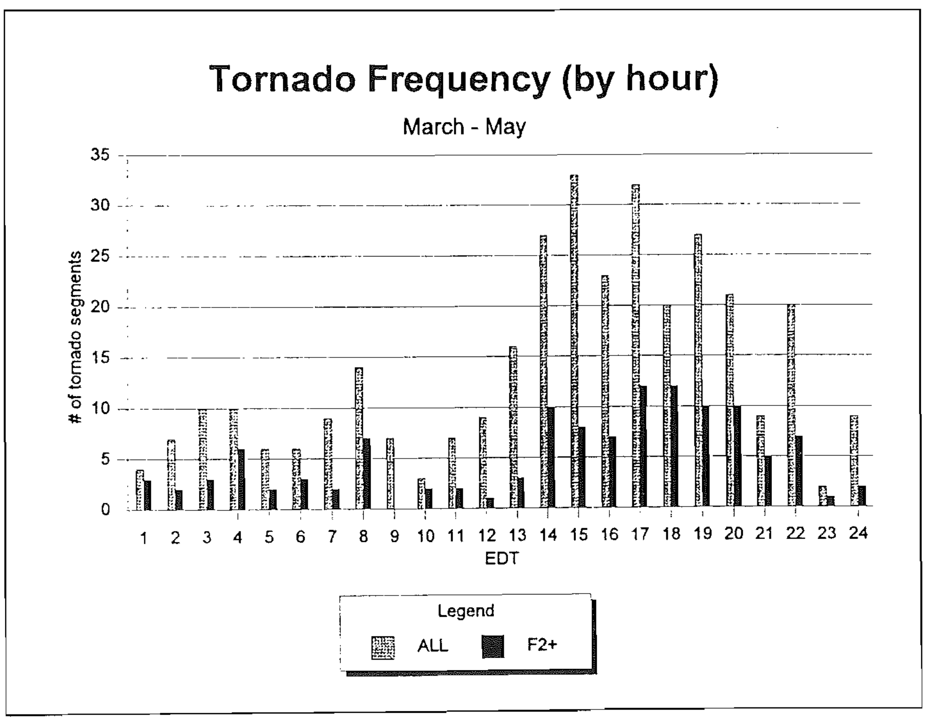

Figure 9

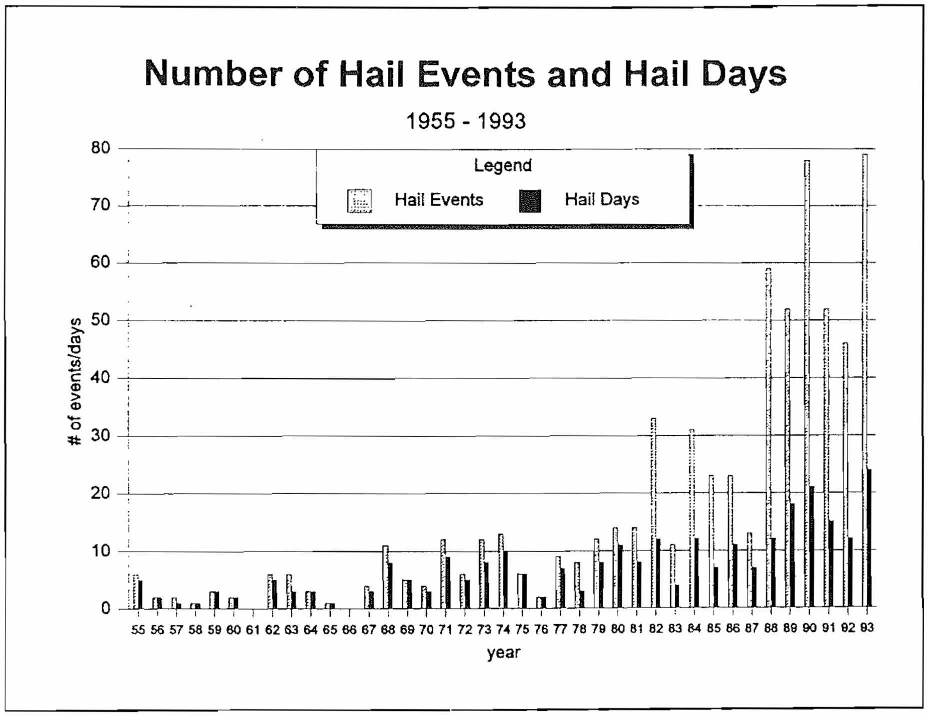

Figure 10

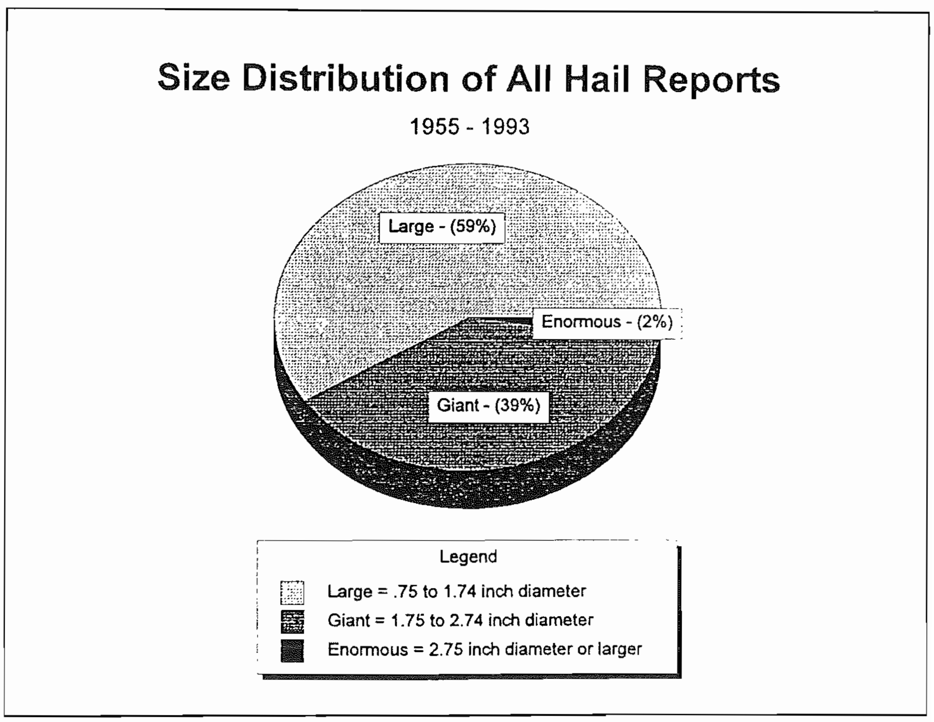

Figure 11

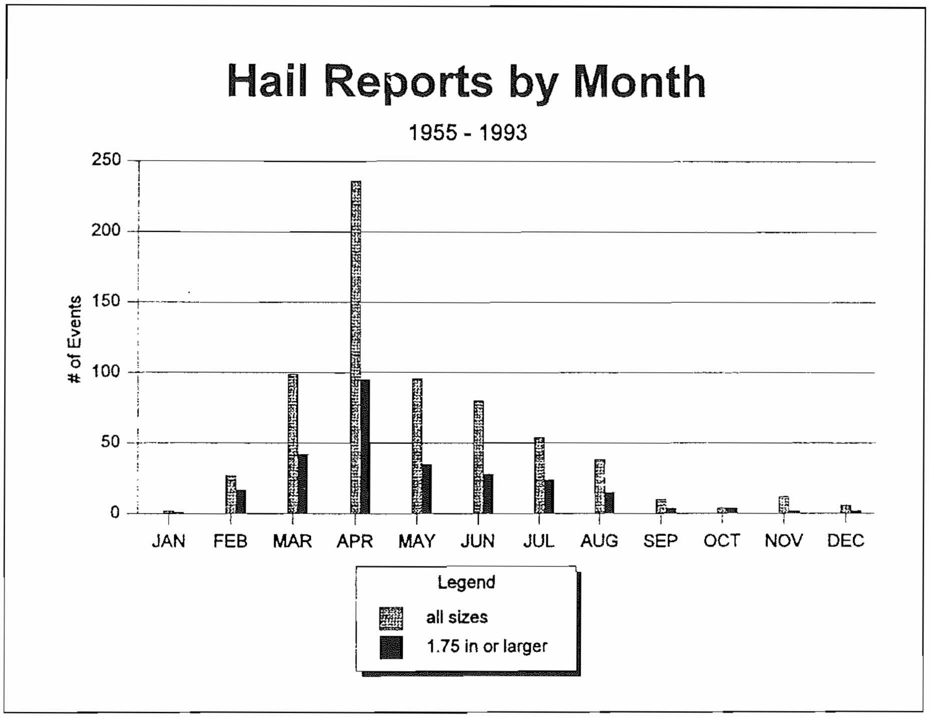

Figure 12

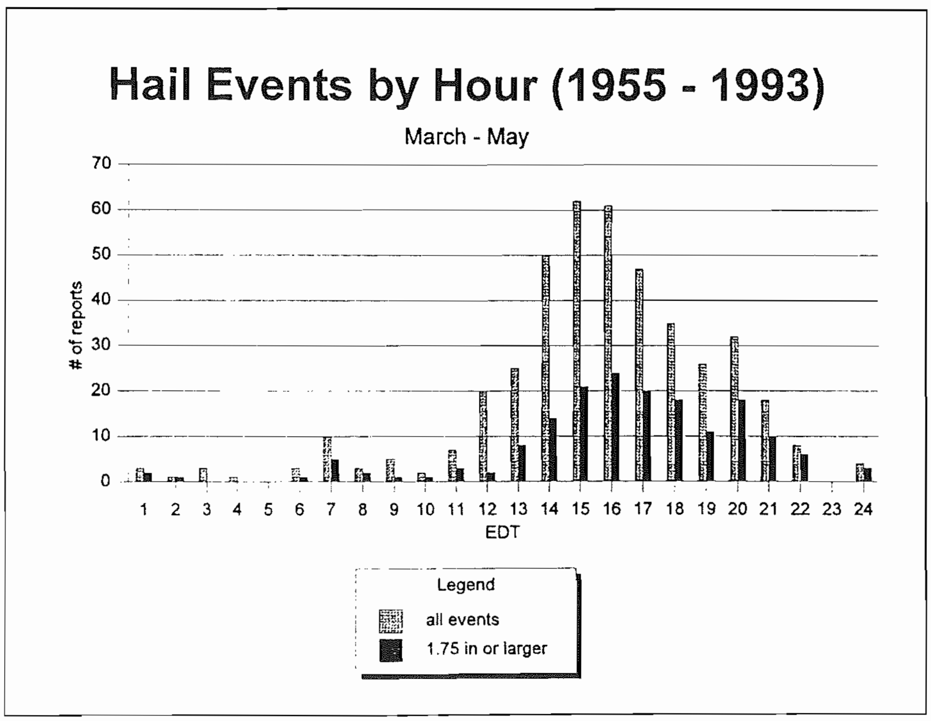

Figure 13

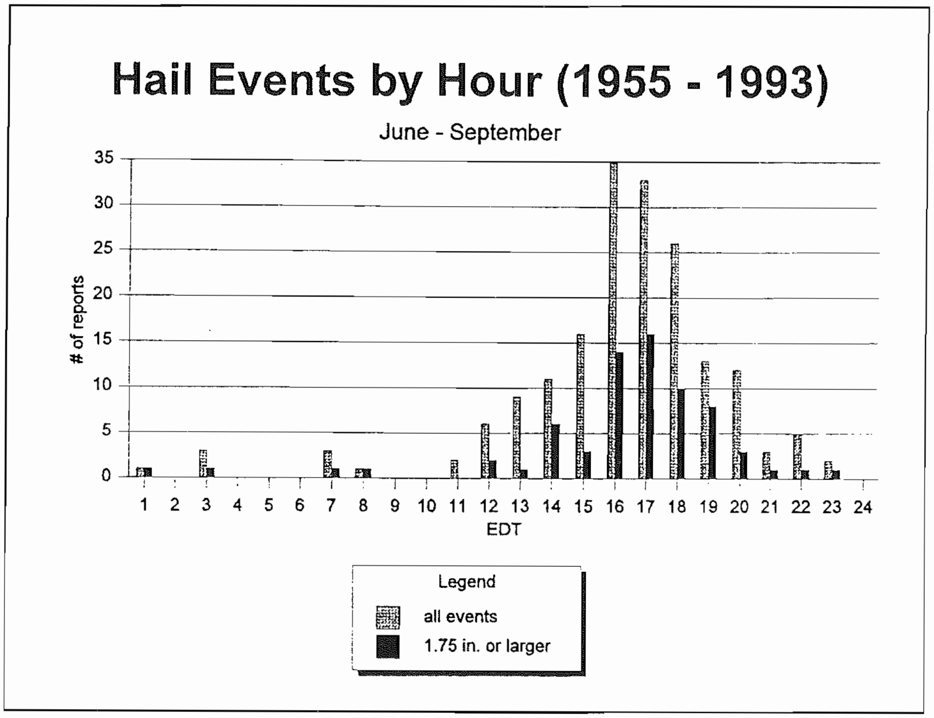

Figure 14

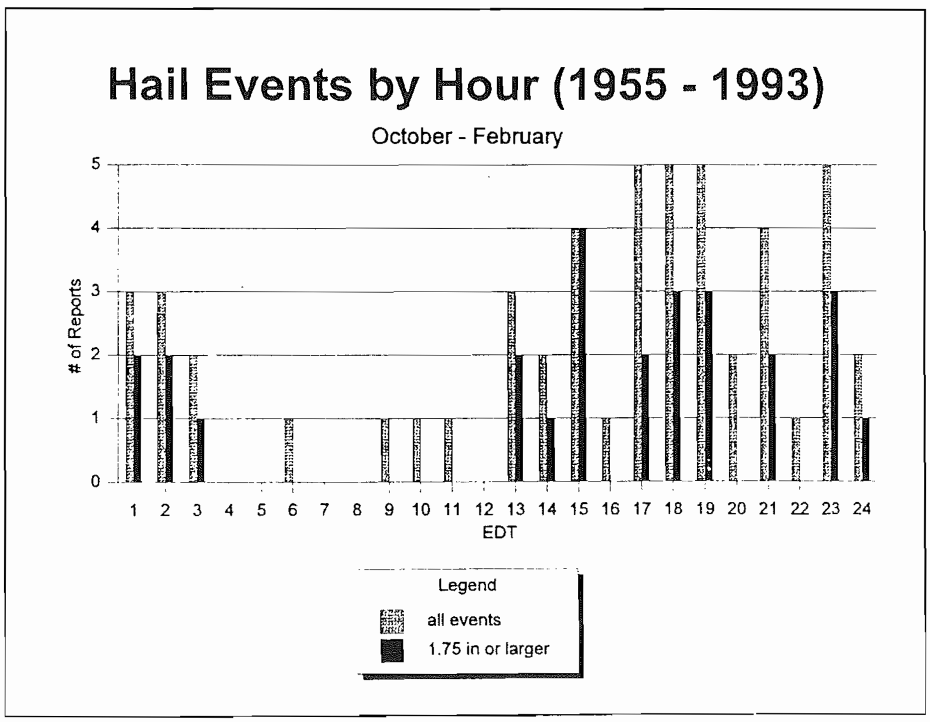

Figure 15

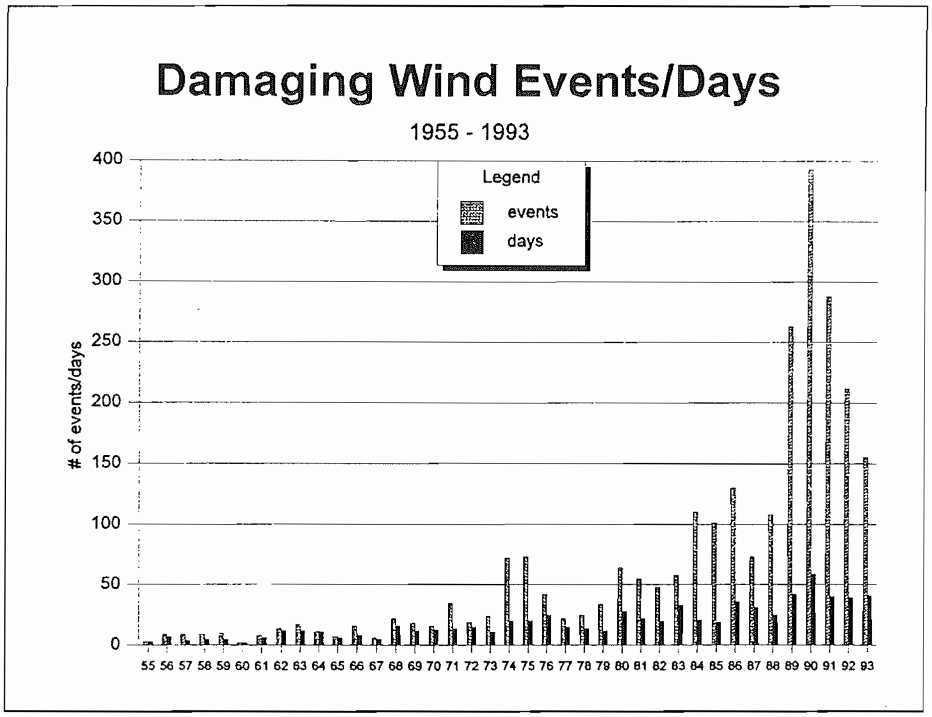

Figure 16

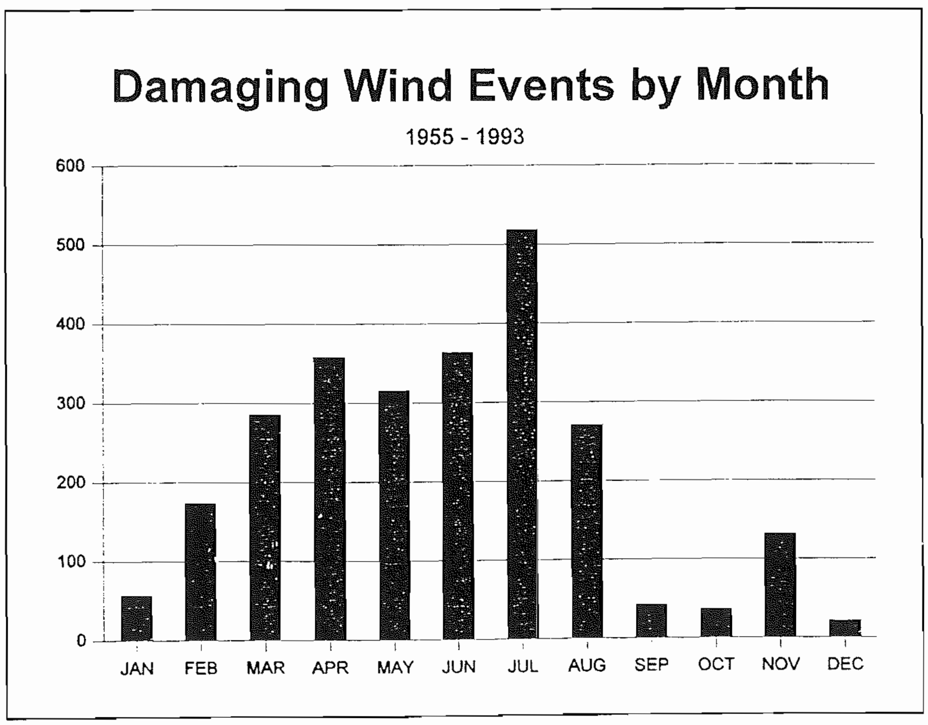

Figure 17

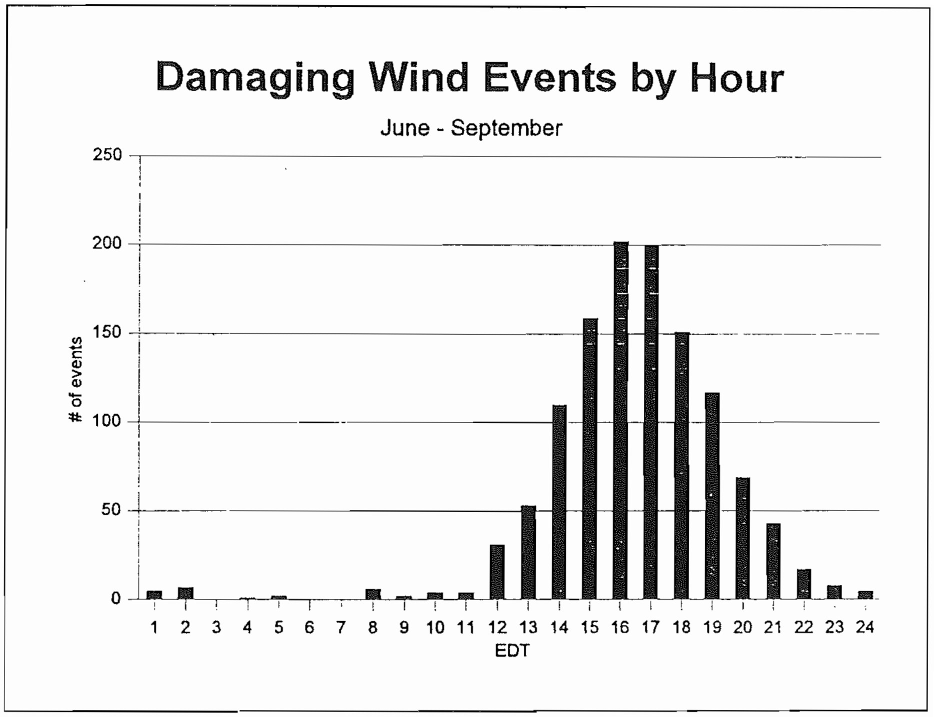

Figure 18

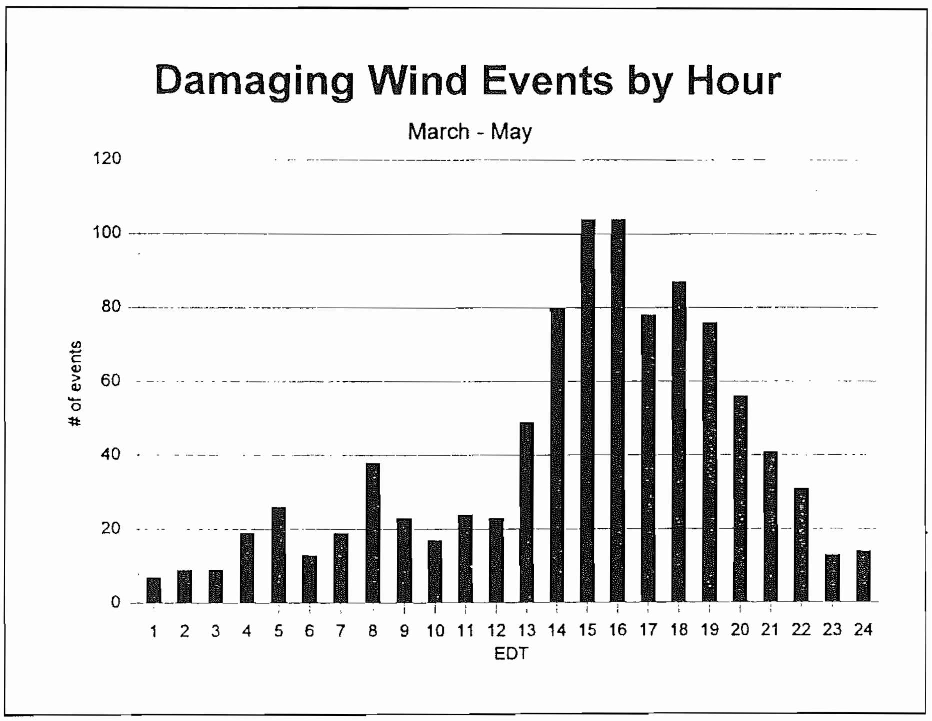

Figure 19

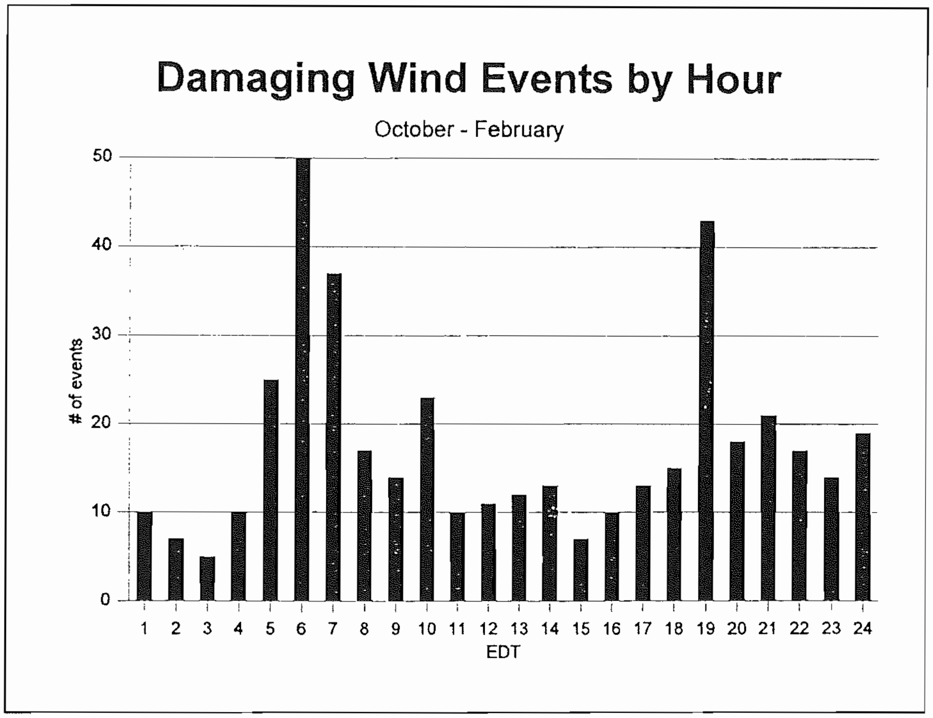
Damaging Wind Events by Hour
October - February
# of events
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
EDT

Figure 20