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THE EDMONTON TORNADO: A PUBLIC SURVEY

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1. INTRODUCTION

On Friday, July 31, 1987 a devastating tornado tracked through the eastern edge of the City of Edmonton, Alberta. To collect meteorological information and document the experiences of the victims, a full page questionnaire (Fig. 1) was published in Edmonton's two leading newspapers: the Edmonton Journal (Saturday, August 8, 1987, circulation 165,000) and the Edmonton Sun (Sunday, August 9, circulation 128,000). The Division of Meteorology at the University of Alberta received a total of 815 completed questionnaires from eye witnesses to the unprecedented tornado and hail storm which struck greater Edmonton (population 550,000). Copies of all the returned questionnaires have been donated to both the Provincial and University Archives. Both archives include lists of data condensed in tabular form and also stored on computer disks. This report was written to share our experiences and to encourage other researchers to conduct similar surveys.

2. THE TORNADO

The tornado was first sighted at 1455 MDT, approximately 8 km south of the Edmonton city limit. It tracked northward for just over one hour (Fig. 2) at 35 to 40 km/h along the eastern edge of the city, usually with strengths between F1 and F3 on the Fujita scale (Fujita, 1973), occasionally dropping to F0. In the industrial area west of Sherwood Park, the tornado intensified to F3 and F4 leaving a path of severe destruction approximately 3 km long and 700 m wide (Wallace, 1987; Bullas and Wallace, 1987). The tornado caught the eastern edge of two residential areas; Millwoods in the south and Clairview north of the river. Unfortunately, just before the tornado dissipated, it struck the Evergreen Trailer Park where 133 mobile homes were destroyed.

Twenty-seven fatalities resulted from this tornado, 15 of which were at Evergreen. This large number of fatalities is one short of the Canadian tornado record which occurred on 30 June 1912 in Regina, Saskatchewan. In addition to the above fatalities, 195 injuries (personal communication, Emergency Preparedness Canada, Edmonton) occurred due to the tornado. Surprisingly, no injuries were attributed to the record hailfall which accompanied the tornado (Fig. 2).

The tornado caused extensive property damage with over 60,000 insurance claims split evenly between building and automobile damage (Wood, 1988). The total settlement, over 250 million dollars, is the largest payout ever recorded for a natural disaster in Canada. Of these claims, over 50,000 were for hail damage, most of which occurred in the 125 km² area shown in Figure 2 wherein hailstones the size of tennis balls or larger fell.

The hail damage in Edmonton is not entirely unprecedented in recent Alberta history. On 28 July 1981 a hail storm struck several areas in greater Calgary (population 550,000) with walnut to golfball size hail and locally, tennis ball size (Makowsky, 1981). This storm caused Canada's greatest insurance payout to that time, over 100 million dollars. It damaged 20,000 automobiles and 10,000 homes.

3. SURVEY DEVELOPMENT

On 2 August 1987 a study of the tornado track was conducted under the coordination of the Alberta Weather Centre, with assistance from the University of Alberta and the Alberta Research Council. Having seen the extent of the damage, it became apparent that a public survey was advisable. Within a day, funding was promised from the Central Research Fund at the University of Alberta and a commitment to publish the survey was obtained from the City of Edmonton. Alderman Julian Kinisky, who had some meteorological background, obtained the commitment from the city.

* Alberta Research Council, Edmonton
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A Public Request to share your Storm Experiences

Meteorologists at the University of Alberta would like all Edmonton-area residents to share their experiences of the July 31 tornado by mailing this survey.

We would like to hear from people in Calmar, Beaumont and other badly hit areas. Within the City, we would like responses from all sectors, so that the extent of hail and rain damage can be accurately determined.

THE COMPLETED SURVEYS WILL BE PUT TO THE FOLLOWING USES:

1 To assess public opinion on the efficiency of our storm warning system. Your responses will be tabulated immediately so that a study can be conducted into possible improvements in this system. For this reason, it is important that we hear from you within a week.

2 Meteorologists at the University of Alberta, the Alberta Weather Centre, and the Alberta Research Council would like to use your comments to better assess the severity of the storm. If you have hailstone samples, we hope that you can save them in sealed plastic bags in a cold freezer. Within a month or two a graduate student doing research may contact you in the hope that you will make your hailstones, no matter what size, available for study.

3 Within six months we will photocopy all responses to the survey, organize them by name and area, and file them with the Edmonton Public Library for use by present and future generations. Please remember that it is critically important to study past storm occurrences in great detail if we are to learn from our experience and attempt to minimize damage in the future.

If you live out of town, please feel free to give land locations in quarter section, township and range. Also feel free to approximate times when events occurred. If you cannot recall, just put a question mark in the space.

We deeply sympathize with those who lost loved ones and their homes in the storm. However, we hope that they, too, will share their experiences through this survey.

Please mail your completed forms to
R CHARLETON
METEOROLOGY DIVISION
GEOGRAPHY DEPARTMENT
UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA
T6G 2H4

N/A - Not Applicable
~ - Approximate
? - I don't know

Todays Date .....

Your Name .....

Your Home Address .....

.....

.....

Your Type of Work .....

.....

Your Phone Numbers .....

Where Did You Encounter the Severe Weather?

.....

.....

Time of Encounter (Use ~ if approximate)

Friday, July 31, 1987, ... p.m. to ..... p.m.

How Much Warning? ..... minutes

How were the Times Above Determined? (Check)

☐ Stopped Clock ☐ Memory ☐ Other .....

Type of Encounter (Check)

☐ Tornado ☐ Hail ☐ Violent Wind ☐ Violent Rain

☐ Other .....

What First Made You Aware of the Danger? (Check)

☐ Weather Forecast ☐ Unusual Cloud ☐ Rainfall
☐ Weather Radio ☐ Funnel Cloud ☐ Talking
☐ Radio or TV Report ☐ Hail Noise ☐ Screaming
☐ Electricity Failure ☐ Wind Noise ☐ Other

Please Explain: .....

.....

What Response Did You Take to the Warnings?

Please Explain: .....

.....

.....

TORNADO REPORT

Was Funnel Seen? ☐ Yes ☐ No (Check)

Did it Touch Ground? ☐ Yes ☐ No (Check)

Time Began ..... Lasted ..... min.

Closest Distance .....

Direction From You .....

Funnel Type (Check)



☐ Multiple ☐ Smoke-Like ☐ Columnar ☐ Cone ☐ Rope
☐ Unknown ☐ Other

If Multiple, How Many? .....

From Which Direction Did it Move? .....

Unusual Noise? ☐ Yes ☐ No (Check)

Unusual Sky Colour? ☐ Yes ☐ No (Check)

If Yes, Describe: .....

.....

Video Movies? ..... Photos? .....

WIND REPORT

Damaging? ☐ Yes ☐ No (Check)

Time Began: ..... Lasted ..... min.

Describe .....

.....

How Damaging? (Check) ☐ Twigs Off Trees ☐ Branches Off
☐ Shingle Damage ☐ Trees Down ☐ Windows Broken

☐ Other .....

HAIL REPORT

Largest Size (Check) ☐ Shot ☐ Pea ☐ Grape ☐ Walnut
☐ Golfball ☐ Tennis ☐ Larger .....

Most Common Size: .....

Spacing on Ground: .....

Time Began: ..... Lasted: ..... min.

Describe Largest Stone and Measure It, Please: .....

.....

Frozen Samples: ..... Photos? .....

RAIN REPORT

How Much? (Check) ☐ Light ☐ Heavy ☐ Flooded Eaves
☐ Flooded Sewers ☐ Flooded Road ☐ Other .....

.....

Time Began ..... Lasted: ..... min.

Describe: .....

.....

DAMAGE REPORT

Number of Human Fatalities ..... Number of Human Injuries .....

Number of Animal Fatalities ..... Number of Animal Injuries .....

Describe Property Damage (Objects Moved, Their Weight Anchored?) .....

.....

Are Photos Available? ☐ Yes ☐ No (Check)

Who Took The Photos and Where Do They Live: .....

.....

Who Else May Have Information? Name, Address, Phone

.....

.....

Further Comments .....

.....

If you have any further questions, please feel free to call us at 432-5672, 432-5405, or 432-5406.

Fig. 1. The survey as printed in the Edmonton Sun.

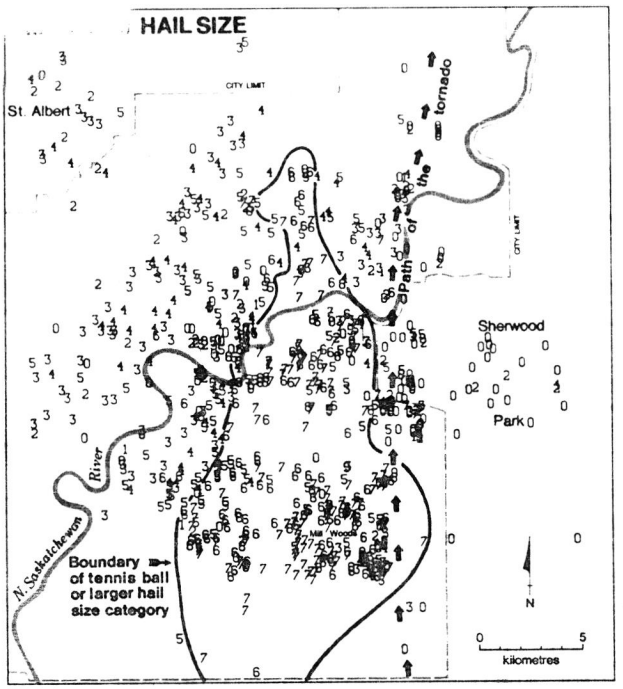

Fig. 2. Map of the Edmonton area showing the tornado track, 691 hail size reports, and 64 locations (indicated by '0') where survey respondents chose not to complete a hail report. The plotted digits 1 through 7 correspond to maximum hail size of shot, pea, grape, walnut, golfball, tennis ball, and larger, respectively.

The survey is based, to a large extent, on a form used by the Volunteer Weather Watchers (VWW) who are organized each summer by the weather forecast offices of the Atmospheric Environment Service. We wrote a draft of the preamble shown in the upper half of Fig. 1 and then decided to divide the questions into six sections so that respondents, after filling in the basic information area on the left, could complete separate tornado, wind, hail, rain, and damage reports as were appropriate to their experiences.

The basic information area of the form was designed to address two objectives. First, it seemed appropriate to obtain personal information, including the respondent's profession for archival reasons. Second, it was decided to document as early as possible the respondent's impression of how and when they were warned of the peril. The warning information was important because during the week following the tornado a great deal of concern developed about the effectiveness of the severe weather warning system. These concerns resulted in the federal Minister of the Environment requesting a review of the weather warning system headed by Dr. Keith Hage, Professor Emeritus with the Division of Meteorology at the University of Alberta. The Hage Report (Hage, 1987) included, among many other materials, preliminary results of our survey and the results of a random telephone survey conducted by Criterion Research Corporation, Edmonton.

The questions on the tornado, hail, wind, rain, and damage are similar to those found in the VWW form. In addition, we included requests for photographs, video movies, hail measurements, frozen hail samples, and names of other persons who might have information. These additional requests produced extremely valuable information on the tornado and hailfall. As we did not request that these reports be based solely on the respondent's own experiences, several respondents apparently used news reports to fill in the blanks. The sketches of tornado shapes included on the form are similar to those found in the VWW form. We suspected that they would cause some confusion to the general public, but at least these shapes provided the respondents with a starting point to sketch their own tornado as many were inclined to do.

The preliminary layout and wording of the survey was reviewed by the City of Edmonton and subsequently it was professionally edited, layed out and published by the Edmonton Journal. The questionnaire in the Edmonton Sun (Fig. 1) was exactly the same but modified to fit their page shape. Many individuals at the University of Alberta, City Hall, and the newspapers deserve congratulations because development of the survey, from conception to publication, took less than a week.

4. MANPOWER AND TABULATION

Telephones at the Division of Meteorology were manned during the weekend of publication. Extra survey forms were used to document the telephone enquiries. By mid-week, approximately 100 surveys arrived each day in the mail. Within two weeks of publication, over 95% of the 815 surveys had been received. Approximately one survey was completed for each 350 newspapers published. Of the final total, 755 forms were obtained from the part of greater Edmonton shown in Fig. 2. What was surprising to the authors was the extensively detailed information provided. It was obvious that the respondents were anxious to have their experiences recorded in the public archives and assessed by U of A researchers.

During the month that followed the tornado, over sixty hail samples were collected from the respondents. Measurements verified the large hail sizes reported in the surveys. By early October, the survey forms from the Edmonton area were tabulated according to the land location at which the observations were made. A number of parameters, including warning time, maximum hailstone size, and tornado shape were also tabulated at that early date. This information was submitted for inclusion in the Hage Report (Hage, 1987).

During the next two winters, approximately twenty undergraduate students received term assignment credit by tabulating other parameters from the survey forms and by measuring hailstones. A full listing of parameters tabulated to date and hailstone weights and sizes is included in the Archive Report (Charlton et al., 1989). The data have been extensively verified by double checking the information, and by phoning survey respondents to clarify ambiguous points. To facilitate easy access, the surveys and the tabulated data are now sorted by land location.

Shortly after the survey was published we became aware of the University's strict interpretation of the guidelines governing confidentiality in human research. In keeping with these policies, the Archive Report submitted to the public archives at the Provincial Museum has had all names, addresses, and telephone numbers removed. The copy submitted to the University Archive contains all names, etc., and is, therefore, available only to bona fide researchers.

5. RESULTS

Appeals to the public to document tornado tracks and hail damage have been made in the past. For instance, Rowe and Meaden (1985) located most of a series of 102 tornadoes in England as a result of public requests. Detailed statistics on hailfall go back approximately 30 years in central Alberta. Much of that hail data was collected through the cooperation of rural Albertans, and has provided valuable knowledge in understanding the behaviour of hail storms (Wojtiw, 1986). However, recent computer searches of the information system of the Natural Hazards Research and Applications Information Center at the University of Colorado, Boulder, indicate that our tornado survey is the first of its kind. Apparently it is unique in terms of the use of daily newspapers, the quantity of responses, and the diversity of public data accumulated on a single tornado or hail storm.

An example of the type of assessment that can be made from the data is as follows. The main tornado, not including reports of rotating cloud, etc., was viewed by 36% of respondents in the eastern half of the city. We presume that those who observed the tornado recollect clearly how and when they were warned. Using their reported warning times and geographical location it was possible to determine whether during the lifetime of the tornado the perceived warning time increased as a result of media coverage. The median warning time for tornado observers listening to radio or TV peaked, at 15 minutes warning, when the tornado had existed for 30 minutes. For those without radio or TV assistance there was no similar peak in reported warning time and the median warning time before viewing the tornado was only 5 minutes. (Most of this second group of respondents claimed to have been warned by weather conditions or electrical power failure.) The foregoing points are explained to some degree as follows. During the first 45 minutes of the tornado's lifetime, the tornado was clearly visible to observers north of its location. As the tornado tracked northward, however, it became obscured by cloud and precipitation. This caused the "perceived" warning time to fall off even though radio warnings were well into their second half hour, and some TV stations had broadcast short warnings.

Direct comparisons between Criteon's telephone survey in the Hage Report and our survey are difficult to make. For instance, the randon telephone survey of 100 east Edmonton residents determined that 80% of the people at home claimed that they were aware that a tornado was approaching Edmonton. Our surveys from east Edmonton indicate that only 38% of all respondents, whether they saw the tornado or not, felt that they had a non-zero warning time. One might ask, "What is the use of being warned of an approaching tornado if the perceived warning time is zero minutes?" However, closer inspection of our survey indicated that 63% of respondents located within two kilometers of the tornado path felt they had a non-zero warning time. Were people closer to the tornado more likely to believe they actually were forewarned, albeit often by only one to five minutes? Comparison with the telephone survey suggests that our respondents were likely to be those who were disillusioned by a lack of warning, particularly if they were not located near to the tornado path. Alternatively, the telephone survey may have overestimated the number of people who were warned of the tornado's approach because it was conducted one and one-half months later (Sept. 15 to 18) leaving adequate time for uninvolved

Edmontonians to form false impressions as to their experiences on that fateful day.

The survey had other direct benefits. It provided over one hundred photographs to the researchers. As might be expected, most of the close-up photos of tornadic clouds are under-exposed, but a few images are truly awesome. The survey was also instrumental in locating nine spectacular video tapes which have now been incorporated into a movie by the Alberta Weather Centre in Edmonton.

After examining the preliminary results of the survey and collecting the hail samples, it became apparent that the storm may have resulted in record-sized hailstones for Alberta or even all of Canada. Initially, no record-breaking stones had been located. However, a final attempt to locate record sized hailstones was made in the spring of 1988 through the local newspapers. This proved to be successful. The Smegal stone (Virginia Park, Edmonton) and the Tews stone (Mill Woods, Edmonton), both weighed 264 grams at the time of collection. The Tews stone, which had lost considerable weight by handling, was a fraction of a gram heavier than the Smegal stone. The Tews stone now holds the Alberta record, previously held by the Wilson stone (249 grams, SE of Wetaskiwin, Alberta, 6 July 1975). The Canadian record remains with the Gawel stone (290 grams, near Cedoux, Saskatchewan, August 27, 1973). The former records were reported in Wojtiw and Lozowski (1975).

6. FINANCES

The cost of publication of the survey was borne by the City of Edmonton and was on the order of $9000. Funding by the Central Research Fund was $5000. Thus, the total extraordinary cost of conducting the survey and preparing the archive report is approximately $14,000, a modest price for the collection and analysis of record breaking meteorological and historical information.

7. SUGGESTIONS AND CONCLUSIONS

Overall, the authors are pleased with the layout of the survey form and with the information supplied by the respondents. The form could probably be used essentially 'as is' if another disaster occurs. The comment section was extremely useful and provided additional information not obtained from the box type questions. The authors suggest that future editions of the survey should contain equal or larger spaces for explanatory notes in all sections and that respondents should be encouraged to attach letters of explanation, as several of ours did without prompting.

Perhaps the question, "What first made you aware of the danger? (check)" should have been supplemented with a similar one stating, "What first made you aware that a tornado was approaching Edmonton? (Check one)" with the choice, "not aware beforehand" added. This would have brought the question into line with a similar one in the telephone survey. Another reasonable change would involve moving the "How much warning?" question to lie below the "Type of encounter" question and repeating it again following the "tornado approaching Edmonton" question suggested above.

Actually, in nearly every case, the comments given in the warning section clearly explained what sources of information were used and what actions were taken. There were, however, some interpretive problems involving persons who made complex trips during the storm and, also, in situations where two people tried to put their experiences from separate locations on a single form. Such problems were usually corrected by a single telephone call.

The authors feel privileged to have had a part in the assembly and study of this survey for the citizens of Edmonton. Currently a scientific study of the meteorological data is being completed. The authors hope that sociologists, historians, and journalists will also find the information useful and that meteorologists will use the Edmonton public survey as a basis for future studies.

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