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EVACUATION IN CANCUN DURING HURRICANE GILBERT*+

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This paper describes the evacuation of the population of Cancun, Mexico during Hurricane Gilbert, and identifies some of the correlates of their evacuation behavior. The information was collected during a post-disaster visit conducted one week after impact (September 13, 1988) and as part of a survey a year later of a random sample of 431 persons 18 years old and older who resided in Cancun at the time of the disaster. One-fourth of the respondents evacuated. The majority of the evacuees found shelter in the homes of friends, neighbors, and relatives and were gone from their homes a week or less. Socio-demographic variables such as the number of persons in the household, gender, age, and marital status were not very useful predictors of evacuation behavior. Lower socioeconomic status (SES) and higher numbers of family contacts did not increase the probability of evacuation. The findings underscore the importance of calculations of risk for understanding evacuation behavior. The environmental context and physical characteristics of residences are significant variables impacting on the perceptions of risk and on subsequent evacuation behavior.

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BACKGROUND INFORMATION ON CANCUN

Cancun was selected in 1967 as a tourist area by FONATUR, the Mexican Federal Government's agency in charge of fomenting national tourism.

The land was initially an *ejido*, and it was confiscated by the government to carry out the planned tourist center. The initial development involved connecting the Island of Cancun to the mainland and constructing the airport, completed in 1973. Afterwards, FONATUR sold the land to corporations.

The first hotel opened in 1974. At present there are 39 hotels in the tourist zone and approximately 10,000 rooms available for tourists. The area generates eighteen percent of the national tourist hard-currency earnings.

Formally, development is guided by a master plan affecting land use and building patterns. The plan limits the number of floors of hotels, guarantees public access to beaches, and preserves the five mile zone separating the tourist zone from the City of Cancun in the mainland (Sintesis, 1985).

In spite of the plan, Cancun has developed rapidly and unequally. The area has the highest rate of urban growth in the country. The urban services and amenities available to the permanent residents, such as public transportation services, parks, paved streets, health facilities, schools, libraries, post offices, telephone and telegraph services, government public assistance offices, stores, decent living quarters, water and other utilities, drainage and sewage, have lagged behind the push to maximize tourism.

The unequal development is reflected in the bifurcated character of the city. On the one hand there are the ultra-modern hotels and the central city of Cancun where the majority of buildings are made of reinforced concrete, the population density is relatively low, many lots of land are unused, and municipal services are excellent. On the other hand there are the peripheral, unplanned and underserved high-density communities, many of them called *colonias*, where the majority of the population lives.

A significant proportion of this unplanned urban growth has taken place along the road from Merida to Puerto Juarez, and also along the road to Punta Sam, in the Municipality of Isla Mujeres. Parenthetically, the rapid and unplanned urban growth, and the resulting deforestation and contami-

nation of the water reserves, now threatens the ecological balance of the area, especially the Laguna de Bojorquez, and the area adjacent to Puerto Juarez, including the Laguna de Puerto Juarez.

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In September 1988 Hurricane Gilbert, a category 5 hurricane on the Saffir-Simpson Scale, struck Jamaica and the Yucatan Peninsula (Mexican states of Yucatan and Quintana Roo), as well as Tamaulipas, Nuevo Leon, and Campeche. While the exact dollar amount of the immense losses incurred in Quintana Roo is not available, the scope and depth of the destruction is generally known: throughout the state approximately 35,000 people lost their homes and other possessions; 83 vessels sank. The Mexican Ministry of Tourism put the costs of the structural losses in Cancun, Cozumel, and Isla Mujeres at 200,000 million pesos (Castro Sarinana, 1988). Approximately 87 million dollars were unearned from tourism during October, November, and December of 1988. The state finances declined 65 percent during this period.

This paper describes the evacuation behavior of the population of Cancun. The results are derived from a post-disaster study conducted one week after impact (September 13, 1988), as well as in a survey a year later which questioned a random sample of the population of Cancun.

METHODS

Field work began in Cancun one week after impact by a four-person team sent to the area by the Committee on Natural Disasters, National Academy of Sciences and National Academy of Engineering (U.S.). Subsequently a general survey of Cancun's population was conducted. The survey was completed in October 1989 by Grupo Asesor en Mercadotecnia y Metodologia Aplicada, S.C. (GAMMA). The survey focused on questions about the experiences of people during and in the aftermath of the storm. The population sampled was persons 18 years old and older who resided in Cancun at the time of impact.

Mexican Census projections for the population of the City of Cancun in 1989 were used to estimate the probability of inclusion in the sample. Sample strata containing a minimum of 25 respondents for each of 18 sampling cells—identified by the combined use of an index of socioeco-

nomic status (high, medium, low), age (18-30, 31-40, 41 and older), and gender—were established. Initially, updated city maps were used to identify 112 city squares (manzanas) in accordance to the estimated socioeconomic status of their inhabitants. This SES estimation was accomplished through direct observation of the extent and quality of the urban facilities and household facades, as well as dwelling sizes, services, and type of construction. Within each of these city squares the first household in the sample was selected at random, and subsequent households entered the sample through the use of an increment number (systematic sample from a random start).

The estimated SES of the city squares used in the sample is highly correlated with the estimated SES of the households in the sample (Somers' D=.90, with household SES as dependent), as well as with a scale of household possessions (Somers' D=.61, with household possessions as dependent). The index of household possessions (Alpha=.79) includes as items the ownership of refrigerators, showers, gas water heaters, VCRs, air condition units, house heating, cablevision, and telephone.

The distribution of the weighted number of respondents by the estimated SES of city squares indicates that respondents in the most impoverished parts of Cancun, those who suffered the most devastation in their homes and possessions, are underrepresented in the sample. The distribution among SES categories is as follows: low low = 0.2 percent, low medium = 41.3 percent, low high = 9.7 percent, medium low = 4.6 percent, medium medium = 17.6 percent, medium high = 6 percent, high low = 11.3 percent, and high medium = 9.4 percent. Less than one percent of the sample is in the low low SES category.

Because of the underrepresentation of the very poor, estimates of the impact of the hazard presented in this report are conservative. Indeed, Hurricane Gilbert had an enormous impact on the life circumstances of very poor people. For example, in two colonias (Regiones 95 y 96 de Cancun) close to 90 percent of the houses (mostly *palapas*, or small, one room houses made of pieces of wood, sheet metal, and thatched or cardboard roofs) were destroyed (the results of the survey also show that palapas experienced widespread destruction).

Approximately 60 percent of the more than 200,000 inhabitants of Cancun and its environs live in palapas in the colonias surrounding the city. The majority of these palapas were destroyed or severely damaged by the storm, many of them losing their roofs and walls. Field observation one

week after impact revealed that many families were living in palapas without roofs and walls, and that in the colonias the debris was very much in evidence even as electricity and other essential services had not been reestablished.

The decision to sample persons 18 years of age and older who resided in Cancun at the time of Hurricane Gilbert meant that the sample is, on average, much older than the general population of the city. Moreover, factors that are related to increasing age, such as marital status and occupation, are also affected. The mean age of the respondents was 32 years old (SD.=11.3, range=18-75 years old). They were nearly equally divided into males and females (51.4 percent males). More than two-thirds (68%) of the respondents were married while 4.2 percent were in consensual marriages; about one fifth (22.1%) were single. Very few respondents were either divorced (3.2%) or widowed (2.2%). The average size of household was 4.97 persons (SD. 2.7, range 1-21). Nearly three-fourths (72%) of the female respondents were housewives. More than half (55%) of the male respondents were employees, businessmen (comerciantes), and public service workers.

Within the households, respondents were selected for interviewing in such a way so as to satisfy the socioeconomic, gender, and age characteristics of the sampling universe. The SES index includes the following variables: the age, education, and occupation of the head of the family living in the household, and possession of the following appliances and services: refrigerators, showers, wood or gas water heaters, black and white and/or color television sets, VCRs, air condition units, CATVs, telephones, cars, bank credit cards, maid services, and parabolic television antennas. Interviews were conducted with 431 persons. By using appropriate proportional multipliers based on the ratio of sample numbers to census population numbers, the sample size of 431 represents a projected data base of 28,482. The results presented in this paper are based on the weighted numbers (population projections).

The administration of the questionnaire took between 25 and 30 minutes. It included both open and closed-ended questions about basic socioeconomic and demographic information as well as the concerns of the respondents regarding future hurricanes, their evaluation of the activities and relative influence of various officials and organizations involved in the reconstruction effort, the positive and negative effects of Hurricane Gilbert

on Cancun, the effects of the hurricane on their homes, the source, type, and satisfaction with the reconstruction assistance received, the extent and type of personal participation in the reconstruction effort, and their sheltering experiences and kinship relations.

RESULTS

The initial analyses present information on the warnings given to the population of Cancun. This is followed by an overall description of the evacuation. The final section discusses the correlates of the evacuation decision.

Timing of Warnings

The first warning, known as "green alert," occurred Tuesday morning, September 13, around 10 a.m. The second warning, or yellow alert, occurred at 3 p.m. of the same day. The final warning, or red alert, went out at 11 p.m. Tuesday night. The most severe winds came during the early morning hours of Wednesday, approximately from 2 a.m. to 6 a.m. A number of respondents stated that by 10 p.m. Tuesday the winds were so strong that it was very difficult to walk in the streets or to drive a car. They felt that the final alert went out too late.

A content analysis of the local newspaper (*Novedades de Quintana Roo*) reveals that the newspaper did not include in its daily editions prior to impact sufficient, consistent, and accurate warnings about Hurricane Gilbert. Nor did the newspaper include information about the disaster plan and the preventive measures that were needed (Aguirre 1989).

Evacuation

The massive protective evacuation of most of the population in the tourist hotel area began Tuesday morning. It ended in the evening (Aguirre, 1989). In general, the evacuation of the hotel zone was done well in advance of the time of impact, and was effective in protecting lives. Approximately 5,000 tourists were evacuated from the tourist zone. There were no fatalities or serious injuries among the tourists who evacuated and remained away from the tourist zone. A successful vertical evacuation occurred at the Hotel Cancun Viva. The evacuation of the hotel zone served to informally alert

(Sorensen and Mileti 1988, Kirschenbaum 1990) the local population that a real threat was at hand.

The efforts to carry out the preventive evacuation (Perry et al. 1981, p. 4) of the population of the Municipality Benito Juarez, where Cancun is located, were somewhat less effective. City officials knew on Sunday that there was a high probability that Hurricane Gilbert would impact the city and its environs. The municipality activated the disaster plan Monday morning. At that time a meeting of the chairs of the various local disaster committees took place, and it was decided to evacuate the tourists first and then to evacuate the general population.

The authorities evacuated nearly 50,000 people from the sections of the municipality close to the coast Tuesday afternoon and evening. This decision was appropriate, because most of these colonias had been built in marshy, low-level ground, and flooded severely during the storm, in many instances an average of one and a half to two meters. There is a good deal of local conflict antedating the hurricane, involving recurrent severe flooding and sewage spills, between the neighbors in these colonias and the land development companies which sold them the land.

As in other disasters, in Cancun not everyone was willing to evacuate from the colonias that officials designated at high risk. The Region 95 Colonia had close to 8,000 inhabitants. About 100 families refused to evacuate and were rescued early Wednesday morning (2 a.m.) by the Mexican Army. A similar problem occurred in the Unidad Lombardo Toledano, which is adjacent to Puerto Juarez and very close to the sea. On Tuesday, the neighbors were told to evacuate. The majority of the families in this colonia refused to evacuate and also had to be rescued by the army early Wednesday morning.

Apparently, a major reason for the unwillingness of many families in the colonias to evacuate was their concern for the safety of their belongings. The fear of looting was exacerbated by the chronic lack of public services to these areas of the city, and by the absence in the colonias of public safety and military patrols, which had been mobilized to protect the banks, stores, homes, and other businesses in the hotel zone and in the central part of the city (cf. Perry 1979).

The evacuation efforts also involved attempts to relay information about the hurricane to the crew of boats and other vessels in the harbor.

Radio transmission equipment was set up in the Municipal Palace to send weather information to the local marinas for relay to boat captains. Eighteen of the deaths in the Cancun area were shrimp fishermen who perished at sea attempting to save their boats. Three people died in the central city when a wall collapsed on them. A small child drowned in one of the colonias during the sea surge.

Experiences During the Emergency Period

Twenty-five percent of the respondents evacuated. The majority of the evacuees found shelter in the homes of friends, neighbors, and relatives (Sorensen and Mileti 1988, p. 12). The specific locations where evacuees sought refuge are shown in Table 1.

Table 1
Evacuation Destinations

house of friends and neighbors	32.1 percent of the respondents
house of family member	31.8
storage building	1.3
hotel	6.0
store	2.2
food store	.2
private office	.9
private clinic	.3
business	.2
dancing hall	.9
school	10.9
Social Security Building	1.3
Local Transit Office	.6
church building	1.3
DIF Building	.9
Building of Federal Commission	.6
City Hall Building	2.5
Telephone Co. Building	1.3
Merida, Valladolid	4.8

Very few people stayed away from their homes more than seven days: 20.6 percent, one day or less; 71.6 percent two to seven days; 7.8 percent more than seven days.

Moreover, all of the respondents who were gone from their houses more than one month, and 24 percent of the respondents who were gone from

three to four weeks, found temporary housing in the homes of friends, neighbors, and relatives. The rest of the respondents who stayed away from their homes for three or four weeks went to Merida, although where they sheltered in that community is not known.

The importance of friends, neighbors, and kin in the provision of housing is underlined by a question that asked the respondents where they stayed after the hurricane had passed: 89 percent stayed in their houses; 9.3 percent went to live with relatives and friends; and less than one percent built their own permanent housing. Only one percent of the respondents obtained permanent housing from the government!

The majority (58%) of the respondents were either dissatisfied or very dissatisfied with the assistance they had received from public and private institutions. Perhaps this is the case because there were no long-term, sustained, wide-ranging United Nations, Mexican Red Cross, or state and federal governments' programs to alleviate the impact of the storm. In spite of the severe housing crisis created by the storm there were no housing assistance programs. Instead, it was mostly an individual effort, and people tried to fix their houses the best way they could.

Correlates of the Evacuation Decision

Table 2 presents the patterns and correlates of the evacuation decision studied in this research. Three categories of predictors were included in three separate MCA models (not shown). The first model included as predictors direct measures of standard social and demographic characteristics of the respondents (size of household, SES, gender, age, marital status, frequency of kin visits).

The second model included indirect measures of the respondents' evaluations of the safety of their houses at the time of their decision. This risk assessment is measured by the sturdiness of the construction materials of the walls and roofs of the houses, and, retrospectively, by the level of storm damage to the walls and roofs. The prediction, in agreement with existing research and theorizing (see Perry and Lindell 1990, Drabek 1986, pp. 105-107), is that the respondents' probabilities of evacuation should be higher as the quality of the building materials of their homes declined and—to the extent that their safety assessment was accurate—as the damage occasioned by Hurricane Gilbert to their homes increased.

The third model included two measures of the communication links—telephone and television connections—available to the respondents. Given the seriousness of the storm and the failure of the local newspaper to give timely and accurate news about the threat, it was hypothesized that people with these communication links would have been more likely than their counterparts to gain a more realistic appraisal of the situation. Such an appraisal would have affected their tendency to evacuate, although not enough is known which would permit the prediction of the direction of the relationship among these variables.

Table 2 shows, in its first panel the bivariate distributions and correlations (etas) for the predictors in the three models. To simplify the presentation of the findings and save space, panels two and three present only the multivariate results for the final MCA models which included the predictors with the largest standardized regression coefficients (betas). Because of the hypothesized importance of family relations in the decision to evacuate, the results in panel two are for people with relatives in Cancun, while the results presented in panel three are for the entire sample.

The dependent variable was scored "1" if the respondents did not evacuate, and "2" if they did. In the first panel, the grand mean, 1.25, reflects the fact reported earlier that 25 percent of the sample evacuated. Negative deviations from the grand mean indicate that respondents in the category in question evacuated less than the total sample. Positive deviations indicate the reverse.

Differences in the magnitudes of the Beta coefficients and R squares associated with separate analyses which entered as blocks to social, communication, and building measures (not shown), indicate that most of the variance is explained by the indirect building measures. The communication and socio-demographic variables by themselves accounted for approximately 5 percent of the total variance explained by the model.

While at the bivariate level respondents at the lowest SES level evacuated more, on average, than respondents in the other SES categories, this pattern is reversed once other controls are introduced (see panel 2 and 3). Once these statistical controls are included poorer respondents evacuate less often than their wealthier counterparts in spite of their less secure homes and greater average level of risk.

Table 2
Correlates of the Decision to Evacuate

Variable	N	Panel 1 Unadj. Dev.	Panel 2 Adjusted Dev.	Panel 3 Adjusted Dev.
No. Persons in House				
1. 1, 2	3,578	-.05		
2. 3, 4	9,670	-.02		
3. 5>	14,247	.03		
		(.06)[a]		
SES Index				
1. Low	14,012	.08	-.06	-.05
2. Medium	2,127	-.02	.13	.07
3. High	11,356	-.10	.07	.05
		(.21)[a]	(.16)[b]	(.11)[b]
Gender				
1. Male	14,293	-.04		
2. Female	13,203	.04		
		(.08)[a]		
Age				
1. 18-23	6,596	.02		
2. 24-28	6,575	.08		
3. 29-75	14,324	-.05		
		(.12)[a]		
Marital Status				
0. Married	18,912	-.01		
1. Others	8,583	.01		
		(.02)[a]		
Cable TV				
0. No	19,378	.07	.06	.05
1. Yes	9,104	-.14	-.13	-.10
		(.23)[a]	(.21)[b]	(.15)[b]
Telephone				
0. No	21,789	.04	.00	.01
1. Yes	6,693	-.14	.00	-.02
		(.18)[a]	(.00)[b]	(.02)[b]
Freq. Kin Visits[c]				
1. 1≥ per wk.	16,204	-.02	-.03	
2. Less	4,485	.09	.10	
		(.10)[a]	(.13)[b]	

Notes:
[a] Eta
[b] Beta
[c] Available only for those with kin in Cancun

Table 2 (continued)
Correlates of the Decision to Evacuate

Variable	N	Panel 1 Unadj. Dev.	Panel 2 Adjusted Dev.	Panel 3 Adjusted Dev.
Damage to Walls				
1. None	23,762	-.04	.00	.00
2. Some	2,168	.14	-.07	.02
3. A lot	935	.23	-.08	-.10
4. Total	1,617	.30	.19	.03
		(.23)[a]	(.12)[b]	(.04)[b]
Damage to Roof				
1. None	21,107	-.12	-.05	-.06
2. Some	2,115	.19	.10	.07
3. A lot	1,723	.50	.34	.31
4. Total	3,537	.35	.06	.17
		(.48)[a]	(.24)[b]	(.26)[b]
Material of Walls[d]				
1. Best	23,747	-.08	-.04	-.02
2. Good	3,144	.45	.20	.14
3. Regular	1,289	.45	.33	.17
4. Worst	302	-.25	-.41	-.40
		(.45)[a]	(.26)[b]	(.17)[b]
Material of Roof [d]				
1. Best	4,143	-.07	.01	.00
2. Good	17,697	-.12	-.03	-.05
3. Regular	636	.13	.16	.11
4. Worst	6,006	.40	.05	.14
		(.48)[a]	(.09)[b]	(.18)[b]
Grand Mean:		1.25	1.26	1.25
Multiple R Squared:			.30	.29

Notes:

[a] Eta

[b] Beta

[c] Available only for those with kin in Cancun

[d] The building materials in Spanish, their English language translations in parentheses, and their grouping into the scale used in the analysis are presented below:

Best (Highest quality) Cemento, piedra (concrete and stone); block (concrete masonry units, or CMU); Tabicon (solid, medium sized CMU); Tabique (bricks).

Good Mamposteria (composite wire and wood concrete slabs); Lozas, losetas (prefabricated concrete slabs); Madera (wood); Adobe.

Regular Asbesto, lamina (composite asbestos and cement corrugated laminate); Varas, palma (palm trees, thin tree trunks).

Worst (Lowest quality) Carton (cardboard);Retazos diferentes (remnants of building materials); Metal corrugado (galvanized corrugated sheet metal).

Both at the bivariate and multivariate levels of analysis, the greater the frequency of family visits, the smaller the tendency to evacuate becomes. This pattern contradicts U.S. findings (Drabek 1986, p. 114) which indicate that a viable network of family ties encourages evacuation behavior. Seventy percent of the respondents had kinfolk living in Cancun whom they visited regularly (the respondents' mean number of relatives was 6.6 persons (sd=10.7), and the mean frequency of visits with kin is 2.5 visits per week).

People without telephones evacuated more often than those with telephones, but this bivariate pattern (panel 1), very much affected by differences in SES, disappeared entirely once SES and other predictors were included as controls in the equations. The possession of telephone services by itself does not explain differences in the decision to evacuate or not. On the other hand, cable TV subscription decreased the tendency of the respondents to evacuate, and this is true both in the bivariate and multivariate analyses.

Future disaster research in Mexico should study the relationship between the receipt of authoritative information emanating from cable T.V., its impact on the emerging definition of the situation of Mexicans threatened by hurricanes and other hazards, and their tendency to evacuate. The findings of this research indicates that receiving more authoritative information does not necessarily increase the probability of evacuation. How the information is interpreted by recipients must be assessed.

The relations among roof and wall materials, roof and wall damage, and tendency to evacuate, support in part the predictions of this research that evacuation is an act brought about by people's **prevision** of the likely safety of their homes against hazards. As predicted, at the bivariate level the proportion of people who evacuated increased with greater amounts of reported damage to walls and roofs, and with lower quality of materials of roofs and walls. These findings are generally invariant in the multivariate models, although once controls are put in place it is clear that the damage to roof is much more important in explaining evacuation behavior than the damage to the walls. These results, based on respondents' subjective reports of damage and of building materials, are not contradicted by the on-sight findings of the Committee on Natural Disaster's post-disaster team (Perry et al. 1989).

CONCLUSION

Twenty five percent of the population of Cancun evacuated, a city-wide evacuation proportion comparable to the norm reported by Drabek (1986, p. 103) for the U.S. Hopefully, other studies will attempt to replicate this finding in the aftermath of other hurricanes impacting Mexico, to assess the importance of local and regional traditions, previous disaster experiences, culture, politics, social stratification, and sizes of populations, on the evacuation tendencies of Mexican populations.

Moreover, as is the case in the U.S. (Quarantelli 1982, Drabek 1986, p. 117), most people who evacuated found temporary shelters in the homes of relatives, neighbors, and friends and stayed gone from their homes for short periods of time. Furthermore, as has been repeatedly found in the U.S. (Quarantelli 1980), socio-demographic variables such as the number of persons in the household, gender, age, and marital status were not very useful predictors of evacuation behavior.

Finally, the findings underscore and corroborate the importance of calculations of risk for understanding evacuation behavior. There is considerable research support for the generalization that "evacuation compliance is greatly enhanced if the warning recipient believes that the pending disaster will result in direct and personal harm (Perry 1990, p. 9)." The findings show that respondents' evaluations of the environmental context and physical characteristics of residences are important components of perceptions of risk, determining subsequent evacuation behavior. The findings support Baker's conclusion (quoted in Drabek 1986, p. 108) that the "elevation of the respondent's home above mean sea level" was one of the most important predictors of evacuation. Clearly, how housing is perceived affects evacuation behavior.

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