HURRICANE IVAN BEHAVIORAL ANALYSIS

Prepared for the
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EXECUTIVE SUMMARY
Hurricane Ivan Behavioral Study

As part of the Hurricane Ivan post-storm assessment, interviews were conducted with 3200 households in the Florida Keys, Florida Panhandle, Alabama, Mississippi and Louisiana using Computer-Assisted Telephone Interviewing between May23 – June 24, 2005. The data were analyzed using GIS techniques and multivariate regression analysis in addition to standard procedures.

The overall evacuation rate for Hurricane Ivan in these regions was 45%, but higher for the Florida Panhandle (69%) and Florida Keys (62%). The highest rates were in the highest risk zones in each region. About one quarter (28%) of evacuees did not report living in an evacuation zone, and the rate of over-evacuation was highest in regions with the least hurricane experience. Most said they would make the same decision next time, confirming the notion of a rather persistent group of evacuators and non-evacuators. However, in the Florida Panhandle where the impact was greatest, 18% of those who did not leave said they would the next time.

Beliefs about the safety of their homes was a primary factor in evacuation decisions, followed by traffic concerns. Multivariate analysis of other factors revealed the following significant positive factors on evacuation: hearing an official notice, living in an evacuation zone, and having a good income. These factors had a negative effect: being male, being African American or black, having a household member who had to work, and having window protection.

Other findings include: Many do not know whether they live in an evacuation zone; a growing use of the internet, both before and during a storm; considerable confusion about the meaning of watches and warnings; and very little mitigation. An important finding was that 80% said they had been through a major hurricane. Given their location, this is highly unlikely; therefore, there is a lot of “false” experience that could influence future storm decisions.

Most evacuees did not encounter serious traffic delays and reached their destination, usually the home of a friend or relative, close to the normal time. The longest delays occurred in Louisiana. Those who left in a timely manner (24-36 hours before the storm) encountered the longest traffic delays.

The bottom line is that most people pay attention to hurricanes and base their evacuation decisions on their evaluation of the safety of their home as a shelter, the storm conditions, and their household circumstances. Under the best conditions, evacuation takes a long time – in this case it was about 68 hours between the time the first and the last household left home.

A number of recommendations are made, both in terms of emergency management policies and procedures, and regarding future behavioral studies.

HURRICANE IVAN BEHAVIORAL ANALYSIS

I. INTRODUCTION

As part of the post-storm assessment of the effects of the very active 2004 Hurricane Season in the Atlantic and Gulf of Mexico regions, the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (USACE) tasked Dewberry to conduct a behavioral analysis related to the impact of Hurricane Ivan on households in Florida, Alabama, Mississippi and Louisiana. This behavioral portion of the Ivan post-assessment examines mitigation, preparation and evacuation activities, as well as storm impact, as reported by respondents representing a random sample of 3200 households.

The purpose of these post-storm assessments is to allow FEMA and the USACE to calibrate, correct, and improve the models and products that serve as primary preparedness, assistance and mitigation tools for emergency managers.

A. The Storm

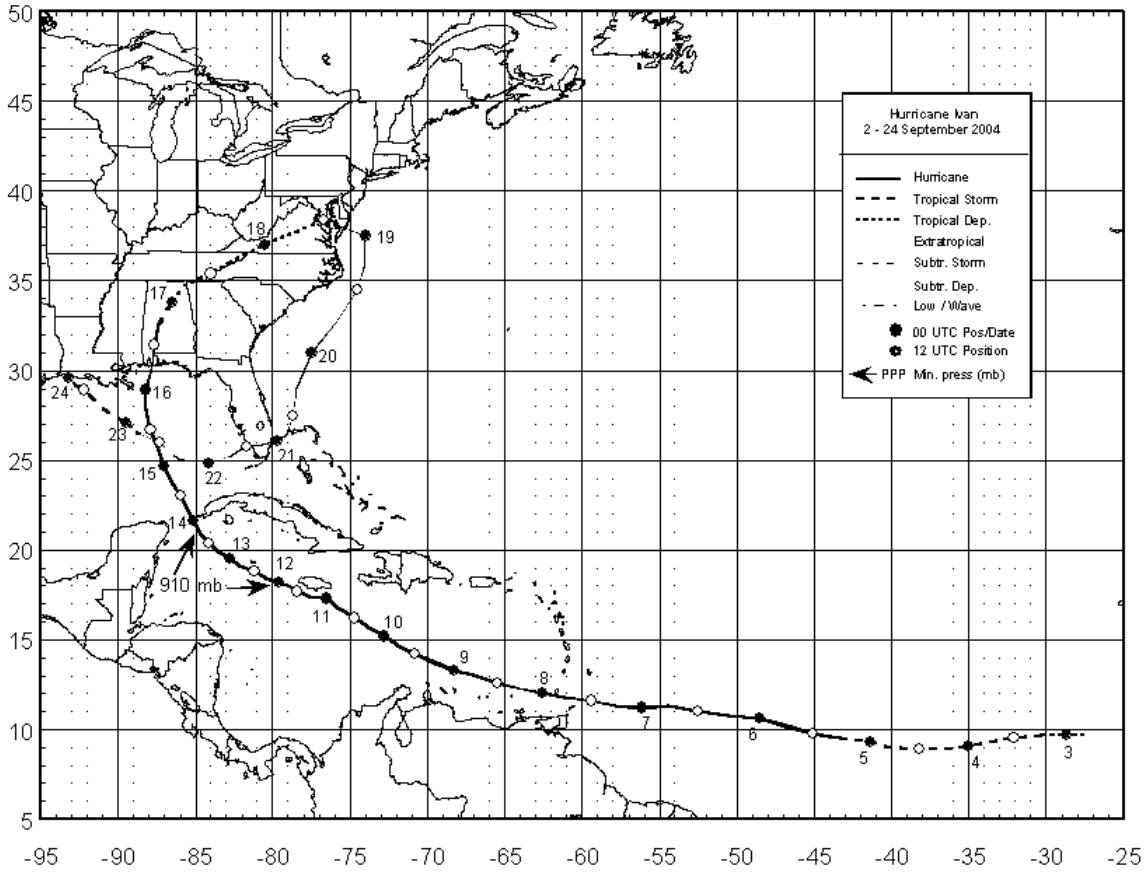
In order to interpret the behavioral data collected on Hurricane Ivan, it is important to understand the context in which the respondents experienced this storm. Hurricane Ivan was the third and most dangerous storm to hit Florida in the summer of 2004. It was a long-lived storm that reached Category 5 strength three different times, causing considerable damage in the Caribbean before making its first U.S. landfall as a Category 3 storm just west of Gulf Shores, Alabama at 2 AM CDT on September 16th.[1]

This storm system then turned northeastward across eastern Mobile bay, weakened to a tropical storm as it crossed Alabama, continued across the U.S. as a tropical depression, and exited as a tropical low over the Delaware – Maryland - Virginia peninsula on September 18th. It then moved southward in the Atlantic, crossed Florida on September 21st and emerged into the Gulf of Mexico where it again became a tropical depression, making its second landfall in southwestern Louisiana on September 24th before finally dissipating over Texas.

[1] Stewart, Stacy. 2004. Tropical Cyclone Report: Hurricane Ivan. National Hurricane Center. www.nhc.noaa.gov/2004ivan.shtml.

Figure 1 depicts the unusual track of this storm system.

Figure 1. Hurricane Ivan Track

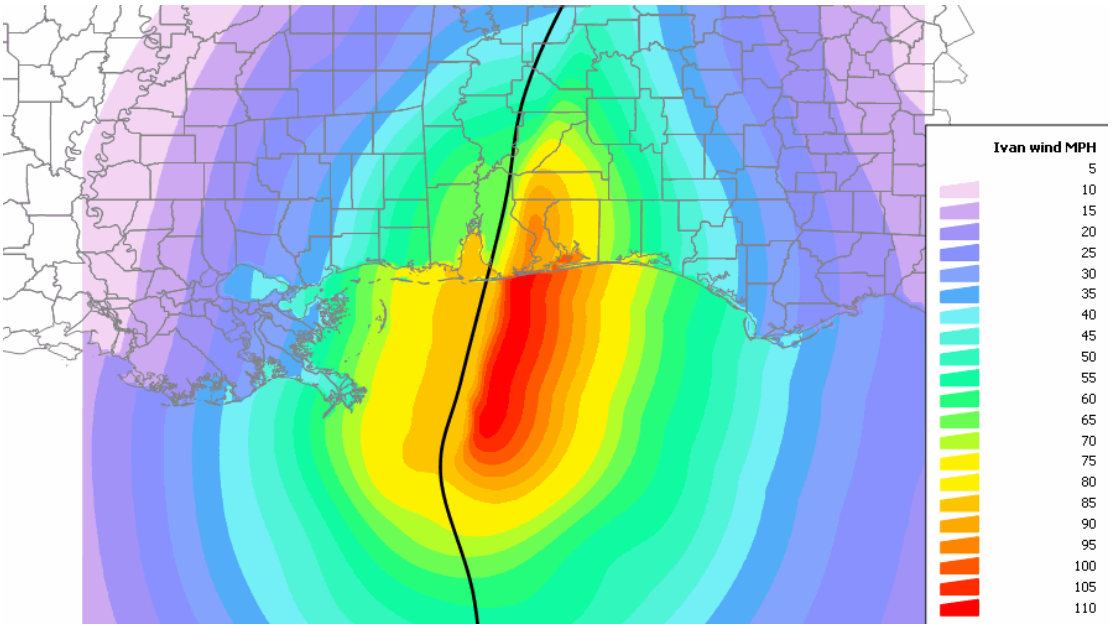


This cyclone system existed for 22 days and produced a track more than 5600 nautical miles. Of importance to this report, this storm was in the news for several weeks, menaced the Gulf coastal areas for days, and impacted various regions of the U.S. over an eight-day period. Residents of the states included in this report – Florida, Alabama, Mississippi and Louisiana – were threatened at two different times.

Hurricane Ivan had sustained winds of 120 mph at the time of first landfall over Perdido Key in the Florida Panhandle area. It was a wide storm with an eye diameter between 40-50 miles across and hurricane force winds extending up to 105 miles from the center.

Figure 2 depicts the windfields at the time the highest winds reached the area on September 16th.

Figure 2. Hurricane Ivan Windfields



In addition to hurricane winds, Ivan spawned at least 34 tornados. The highest storm surge varied from 10-15 feet and the storm produced heavy rainfall across the U.S. A total of 66 deaths were attributed directly or indirectly to this storm system. It was the most destructive hurricane to impact the Florida Panhandle-Alabama area in more than 100 years, causing widespread power outages, flooding, and structural and environmental damage. Total losses are estimated at more than $14 billion.

B. Impacts by Region

Each state included in the survey presents a unique context in terms of its geography, history (including hurricane experience), government (including emergency management practices), and, of course, Hurricane Ivan impact. In the case of Florida, two distinctly different areas were threatened and/or experienced the storm – the Florida Keys and the Florida Panhandle, and, for this reason, their results are analyzed separately. For purposes of data interpretation these two Florida regions, together with Alabama, Mississippi and Louisiana, will be presented as five regions or study zones. It is important to understand the circumstances under which the respondents from each of these regions experienced Hurricane Ivan.

1. Monroe County (Florida Keys)[2]

Hurricane Ivan was a dangerous storm as it moved through the Caribbean, leaving a trail of death and destruction. It followed two other hurricanes, Charley and Jeanne, which had slammed into Florida within the past month. When Hurricane Ivan threatened the Florida Keys (Monroe County), a mandatory evacuation was ordered on September 10th. This was the third mandatory evacuation of the year for tourists, but the first in three years for residents. The closest approved shelter for Monroe County residents is 150 miles north in Miami-Dade County. Fortunately for the Keys and Florida's southern coastline, Ivan shifted westward on September 11th.

Evacuation from Florida Keys. www.foxnews.com

Thus, Monroe County residents responded to a major hurricane that did not impact their households and communities. It is in the context of a serious "false alarm" that Keys respondents participated in this study.

2. Florida Panhandle

The northwestern panhandle of Florida was included in the hurricane watch area on September 14th that soon became a hurricane warning. When the storm made landfall, Escambia and Santa Rosa counties were in its most severe northeast quadrant, experiencing 120 mph winds, a 10-15 surge, 16 inches of rainfall, and several tornados.[3] Ivan was the most destructive hurricane to impact this region in

Condos on Perdido Key. www.pensacolanewsjournal.com

[2] Throughout this report the names Monroe County, Florida and the Florida Keys are used synonymously.
[3] National Weather Service. National Hurricane Center. *Tropical Cyclone Report: Hurricane Ivan*. 2-24 September. www.nws.noaa.gov.

more than 100 years. There was widespread destruction, beach erosion, flooding and 14 deaths. Approximately 75,000 homes were damaged and 50,000 people displaced. More than half of the damaged homes were households with annual incomes of less than $30,000. A quarter-mile section of the I-10 bridge was destroyed. Nearly 150,000 Panhandle homeowners, renters and businesses applied for FEMA assistance and more than $100 million in low-interest loans were approved.

Survey respondents from the Florida Panhandle were likely to have been impacted severely by Hurricane Ivan. At the time of the survey thousands of households were still living in temporary or damaged homes.

3. Alabama

Church steeple in Altmore, AL. www.sub.namb.net

The Alabama coastline was included in the September 14th warning area. A mandatory evacuation was ordered for Gulf Shores, Orange Beach and Fort Morgan. The eye of Hurricane Ivan made landfall at Gulf Shores, Alabama. Baldwin County sustained 75 mph winds with one peak gust measured at 145 mph, a 5-9 foot surge, and 7-8 inches of rainfall. The Mobile National Weather Service office issued an Inland Hurricane Wind Warning for southwest Alabama. Major destruction occurred in Escambia, Conecuh, Monroe and Wilson counties.

Since the eye went through Gulf Shores, no doubt many of the survey respondents from Alabama believe they experienced the full force of a Category 3 hurricane. In realty, the storm's worst effects occurred to the east in the Pensacola area. Nevertheless, many homes and communities were impacted.

4. Mississippi

The Governor ordered a mandatory evacuation of the 78 miles of coastline in Harrison, Jackson and Hancock counties and the Mississippi Emergency Management Agency reported that most of the evacuation

Pascagoula, MS. AP Photo/The Mississippi Press, Christy Pritchat

was completed 10 hours before landfall. Extra shelters were opened inland for evacuees who could not find a safe refuge. It was estimated that 75,000 evacuated Harrison County alone. Mississippi coastal communities were spared the worse effects, but did experience a 4-5 foot storm surge, peak winds of over 90 mph, and up to 6 inches of rainfall. The effects included significant beach erosion, some environmental and structural wind damage, lowland flooding, and power outages. Two deaths were attributed directly to the storm. More than $4 million in disaster aid was distributed in the 23 counties included in the disaster declaration.

Mississippi coastal residents were menaced by this storm for several days prior to landfall and were told to evacuate. The counties included in this study were under hurricane watch and warning. While they missed the brunt of the storm, residents of the counties included in this study experienced heavy winds and rainfall.

5. Louisiana

Ivan evacuation from New Orleans. AP Photo

Due to its extremely hazardous geography, Louisiana officials take every hurricane threat seriously. The New Orleans area was included in the warning on September 14th and 1.4 million residents were urged to leave. Officials hesitate to issue a mandatory evacuation due to the large number of low-income residents without cars. The Superdome served as a special needs shelter. It is estimated that about 600,000 citizens tried to evacuate. Contra-flow procedures were put into effect for the interstate routes out of the city. Serious gridlock was reported in some areas. Once again the area escaped catastrophe as the center of the storm passed to the east. However, it did experience 70 mph winds and about 7 inches of rain, causing some damage and power outage. Southwest Louisiana was affected by the storm system's second landfall as a tropical storm on September 23rd, causing minor flooding. Respondents from Louisiana have been hearing about the grave danger posed by hurricanes for years, but have not had a direct hit since 1965.

The responses to this survey should reflect the extent to which Louisiana residents took the threat seriously. During the evacuation officials implemented contra-flow procedures on a portion of the evacuation route, and questions about contra-flow were included in the survey for Louisiana respondents only.

C. Survey Methodology

1. Sampling Technique

In consultation with representatives from the contracting agencies, counties and parishes in and adjacent to the path of Hurricane Ivan in the four states were selected to be included in the study. A random sample was then selected from these regions and used to complete a total of 3200 telephone interviews. The sample was drawn from a database of listed phone numbers to enable latitude/longitude geocoding of each sample point.

Table 1. Counties and Parishes Included in Study

County	No. of Interviews
Alabama	
Baldwin	200
Mobile	200
Louisiana	
Jefferson Parish	200
Orleans Parish	200
Plaquemines Parish	100
St. Bernard Parish	100
St. Charles Parish	100
St. John Parish	100
St. Tammany Parish	100
Mississippi	
Hancock	200
Harrison	200
Jackson	200
Florida	
Bay	150
Escambia	200
Franklin	100
Gulf	100
Inland Counties*	150
Monroe	200
Okaloosa	150
Santa Rosa	150
Walton	100
TOTAL INTERVIEWS	3200

* Includes Liberty, Calhoun, Holmes, Washington, and Jackson counties.

The survey sample of 3200 was stratified into units by county with at least 100 interviews per county to enable valid inferences to be made about each county. The only exception is four inland counties in the Florida Panhandle with small populations (Holmes, Jackson, Washington, and Calhoun). These counties were combined into a group called "Inland Counties" with 150 sample cases drawn proportionally to their respective populations. Within each county sample phone numbers were drawn proportional to the population, thus the more populated areas of the county contributed more interviews. In the Florida Panhandle

counties, zip code areas near the coast were over-sampled to allow greater precision in estimates across areas of different risk levels.

For Mississippi, Alabama, and the Florida Panhandle GIS files were obtained delineating evacuation risk zones. There are four of these zones: “Cat 1+” evacuates for any hurricane, “Cat 3+” evacuates for a category 3 and higher hurricane, “Cat 4+” evacuees only for a category 4 or 5 hurricane, and “No Evac Zone” means no evacuation is required (except mobile home parks and other localized risk areas subject to flooding). Data on evacuation zones were not available for the coastal Louisiana parishes or for Monroe County, Florida. Given their geography, it was assumed that these entire regions were told to evacuate.

The following tables depict the sample distribution and demographics. (See Appendix for weighted numbers by county/parish).

Table 2. Total Sample by Regions and Risk Zones*

Evacuation Zone	Louisiana		Alabama		Mississippi		Fl Panhandle		FL Keys	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cat 1+	0	0	73	14	152	45	71	7	0	0
****No Evac. Zone Data Assume 1+**	1232	100	0	0	0	0	0	0	102	100
Cat 3+	0	0	101	20	65	19	100	10	0	0
Cat 4+	0	0	65	13	60	18	144	14	0	0
No Evac Zone	0	0	267	53	65	19	703	69	0	0
Total	1232	100	506	100	342	100	1018	100	102	100

* Weighted to make proportional to population

2. Sample Demographics

Based on sample specifications, interviews were completed with 3200 residents of Florida, Alabama, Mississippi, and Louisiana. The demographics of these respondents are summarized in Table 3 and reflect the diversity of the target populations with one exception. Educational and income levels are higher than expected for these populations, but this may be explained, at least in part, by the over-sampling of coastal residents who tend to be more affluent.

Table 3. Sample Demographics*

	Percent of Total Sample
Gender	
Female	51
Education	
Some High School or Graduate	30
Some College	26
College Graduate	26
Post-Graduate	15
Race/Ethnicity	
Caucasian or White	84
African American or Black	9
Hispanic	15
Own Home	89
Size of Household	
Live Alone	15
2 Persons	42
3-4 Persons	32
5+	10
Children under 18	
None	53
1 – 2	25
3 or more	6
Elderly 80 Years or Over	6
Special Needs Household Member	5
Pets	60
Income	
Less than $15,000	8
$15,000-$24,999	9
$25,000 - $39,999	15
$40,000 - $79,999	26
$80,000 or More	20

* Percentages do not add up to 100% due to missing values or omission of some categories from the table, and/or rounding to nearest percent.

3. Housing Characteristics

a. Type of Home

It is important to know the type of housing in which the respondents reside. The vast majority live in single family homes, but there is some variation by regions, with more Louisiana and Monroe County residents living in multiple family units. Between 7-9% of respondents from the Florida Keys, Alabama, Mississippi and the Florida Panhandle live in mobile or manufactured homes.

Table 4. Type of Home by Region (Percent)

Type of Home	Louisiana	Alabama	Mississippi	FL Panhandle	FL Keys
Single Family Home	81	88	87	85	76
Multiple	17	4	4	5	17
Mobile or Manufactured	2	8	9	9	7

b. Construction Material of Home

There was considerable regional variation in the materials used to construct these homes.

Table 5. Construction Material of Home by Region (Percent)

Construction Material	Louisiana	Alabama	Mississippi	FL Panhandle	FL Keys
Brick	60	60	55	50	3
Cement Block	2	4	4	15	63
Other	4	4	4	4	6

c. Elevation of Home

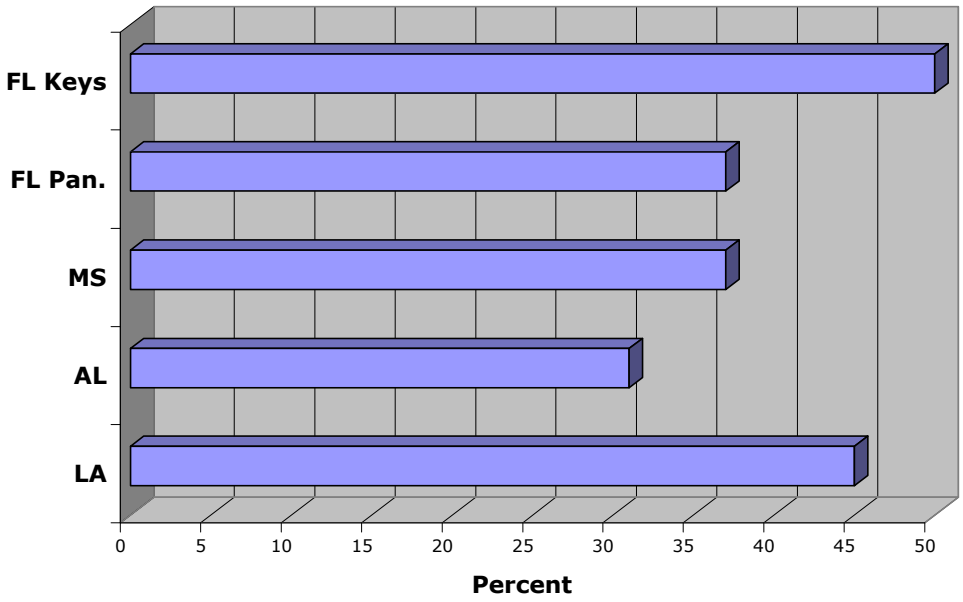
When asked if their home or building was elevated on pilings or fill material to raise it above flood water, about 30% of the total sample answered in the affirmative.

d. Age of Mobile or Manufactured Home

About 54% of owners of mobile or manufactured homes said their homes were built to the stronger wind standards required after 1993. The next figure reveals some regional differences in older homes with the Florida Keys and Louisiana coastal parishes having the largest stock of older mobile homes.

Figure 3.

Mobile Homes Built Before 1993



	LA	AL	MS	FL Pan.	FL Keys
Before 1993	45	31	37	37	50

In the regions included in this study, the highest percent of households living in mobile homes was found in Mississippi (9%) and the Florida Panhandle (9%), the oldest stock is located in the highly vulnerable areas of the Florida Keys and coastal Louisiana.

4. Questionnaire

The survey instrument used to conduct the behavioral analyses of the other 2004 hurricanes – Charley, Frances and Jeanne – was modified slightly for this assessment to include suggestions from representatives of FEMA and the Corps of Engineers. The final questionnaire included questions on evacuation decisions and behavior, home mitigation and/or preparation, household circumstances, and economic impacts, as well as household information needs. Questions on contra-flow lanes were added for the Louisiana sample.

5. Data Collection

The interviews were conducted using a Computer Assisted Telephone Interviewing (CATI) system. Each interview lasted approximately 20 minutes. The interviews took place between May 23 and June 24, 2005.

6. Analysis and Interpretation

One problem with simple tabulations based on a stratified sample is that an area with a smaller population will have a disproportionately larger effect on survey results than an area with a larger population and the same sample size. In order to correct for this, results are weighted by geographic area so that estimates over the entire study area are more accurate. When the entire sample was used in the analysis, the data were weighted to keep county and parish sample effects proportional to their population. For example, 200 interviews each were done in Hancock and Harrison Counties in Mississippi. Hancock has a population of 32,163 and Harrison 140,213. Without weighting, Hancock interviews would each affect the results more than four times as much as Harrison interviews.

As true of all surveys based on a proportion of the total population, data estimates will vary from the true numbers. When the entire sample of 3200 interviews are analyzed as a group, this variation or *margin of error* is approximately ± 2%. Or, stated in terms of *confidence levels*, in 95 out of 100 cases the margin of error will be ± 2%. When results from areas with smaller sample sizes are analyzed independently, the margin of error will increase. For example, the margin of error will be approximately ± 7% for the states with a sample size of 200 (i.e. Alabama, Louisiana and Mississippi). What this means is that a 5% difference would not be statistically significant within a state, though it would be for the entire sample.

In all tables and graphs percents are rounded to whole numbers. Therefore, they will not always add up to 100%. In some cases the graphs depict combined questions that were not mutually exclusive, and thus will add up to more than 100%.

II. FINDINGS

A. Evacuation Decision

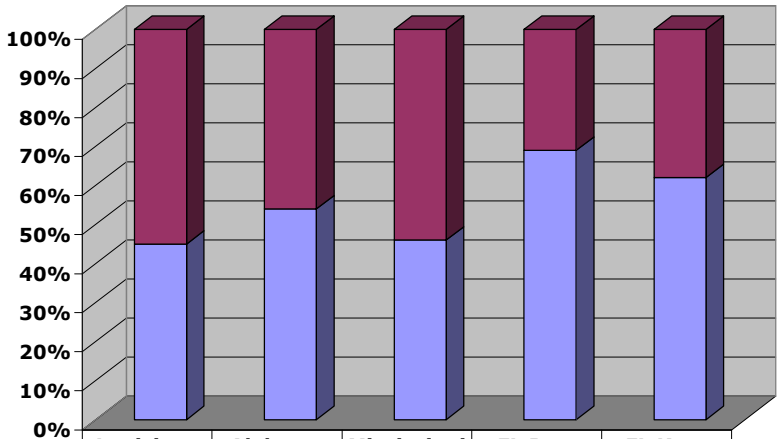
The major topic of this behavioral analysis is evacuation behavior. It is crucial for emergency managers and other officials to understand, not only who will or will not evacuate, but the factors involved in household evacuation decisions.

1. Evacuation Participation

Results from the total random sample indicate that 45% of the total population from these regions evacuated for Hurricane Ivan. Of more interest are regional differences.

Figure 4.

Evacuation by Region

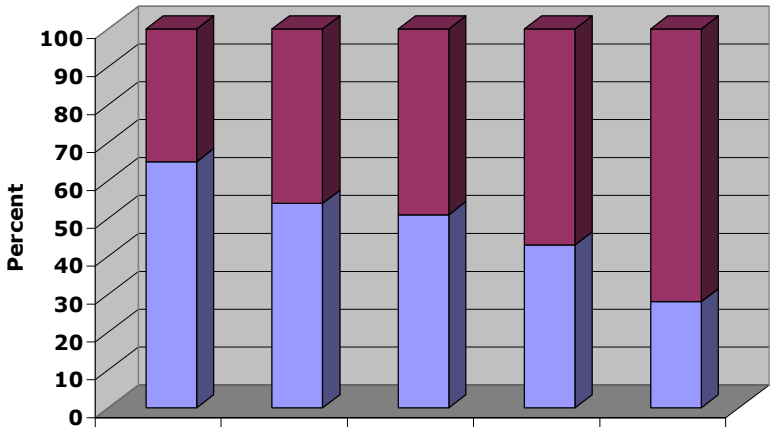


	Louisiana	Alabama	Mississippi	FL Pan.	FL Keys
Did Not Evacuate	55	46	54	31	38
Evacuated	45	54	46	69	62

The Florida Panhandle has the highest rate, and this is logical considering the storm's track. The next highest rate is for the Florida Keys where an evacuation had to be called when the track was still uncertain, and Alabama where the storm actually made landfall. It should be noted that 55% in the Louisiana coastal parishes and 38% from the Florida Keys did not leave. This could have been a major problem had the storm track changed.

Figure 5.

Evacuation by Evacuation Zone



	Cat 1+	No Data, Assume All Evac Zone	Cat 3+	Cat 4+	No Evac Zone
Did Not Evacuate	35	46	49	57	72
Evacuated	65	54	51	43	28

When examining evacuation according to risk zones, the data fall in the expected direction, with more people evacuating from the higher risk (lower category) zones. However, it is important that 28% of the sample not living in an evacuation zone in fact evacuated. Conversely, 35% of those living in the zone expected to evacuate for a Category 1 and higher storm (in other words, all hurricanes) did not evacuate.

It is interesting to see how the evacuees and non-evacuees are distributed geographically. The following three GIS-based maps show the dispersion in each region. While respondents closer to the coast were more likely to evacuate, these maps clearly show that many people from inland areas also left their homes.

Figure 6. Louisiana-Mississippi-Alabama Respondents According to Evacuation Action

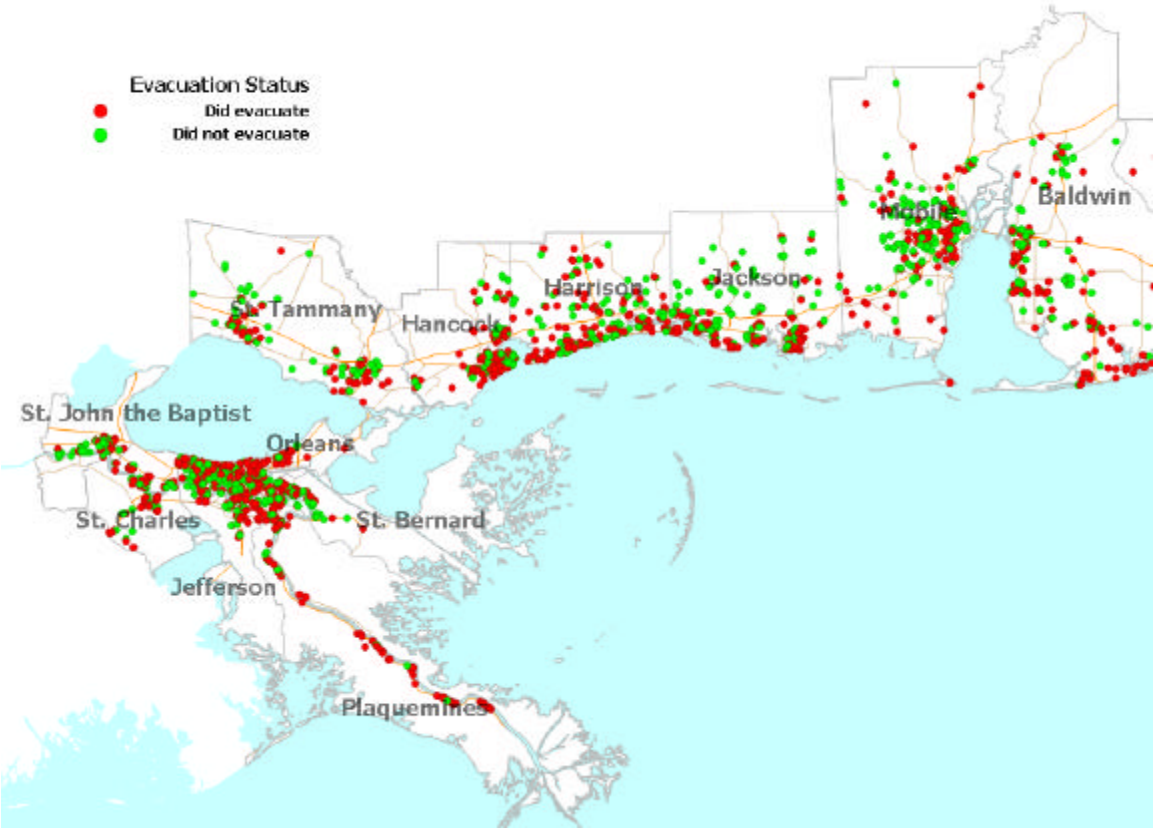


Figure 7. Florida Panhandle Respondents According to Evacuation Action

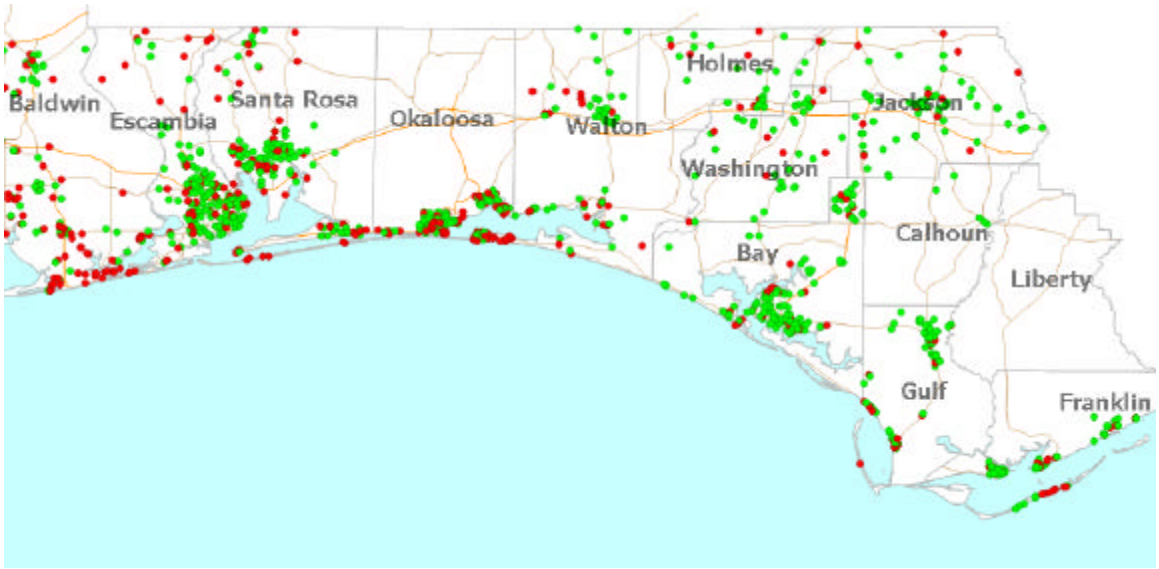
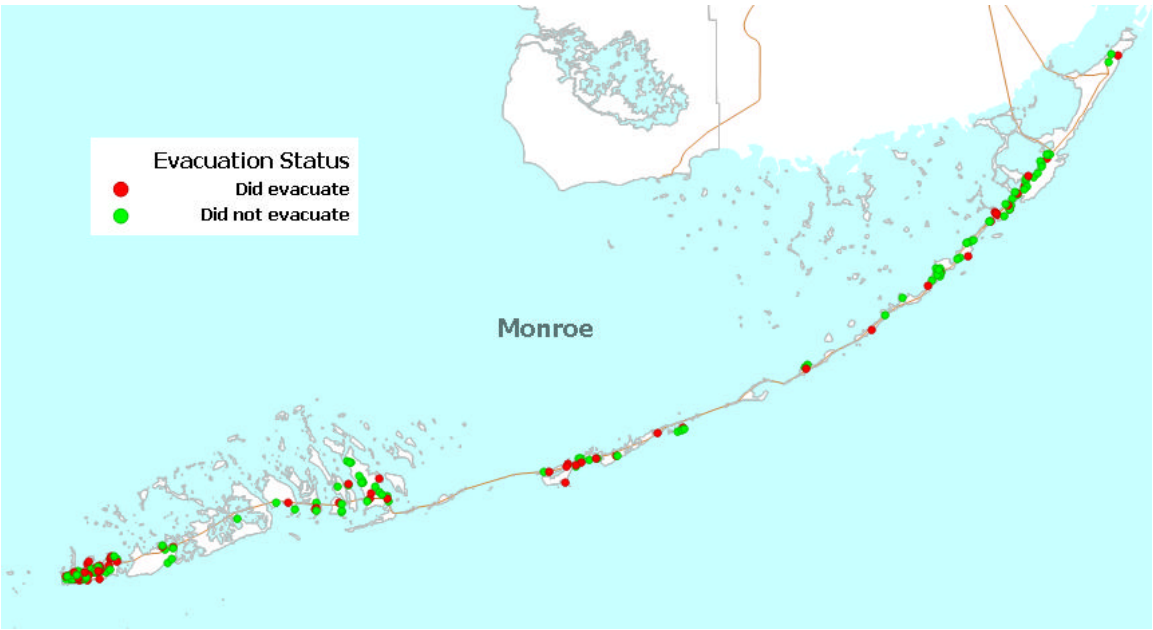


Figure 8. Monroe County Respondents According to Evacuation Action



It is evident that many respondents evacuated who were not living in areas under an evacuation order or recommendation, although at a lower rate. Conversely, many coastal residents did not leave for Hurricane Ivan.

2. Reasons Given for Evacuating

It is important to understand how households make their evacuation decisions. Two open-ended questions were designed to probe respondents to explain their

decision to evacuate or to stay in their home. The answers fall into several categories as depicted in the next table.

Table 6. Reasons Given for Evacuating

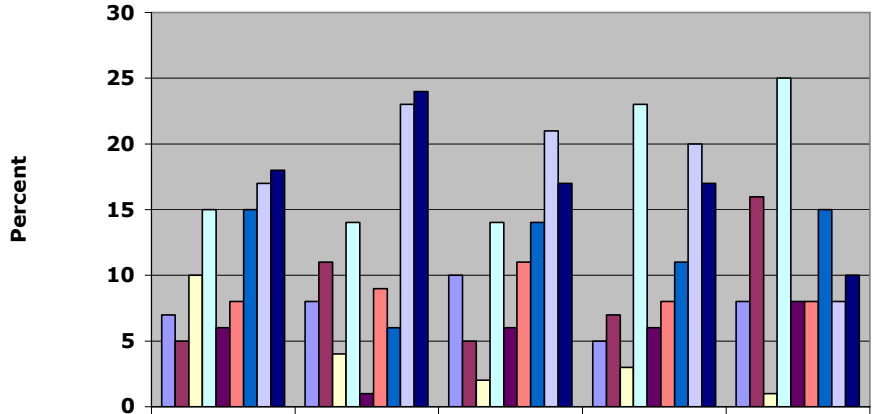
Concern	Percent
Concerns about safety of home	19
Official advice	17
Storm track	13
Storm severity	9
Storm experience	7
Friend or relative advice	7
Media advice	7
NHC advisories	5
Other	16

When evacuees were asked their reasons for leaving, the most common first response had to do with the safety of their home, followed by official advice, and characteristics of the storm, such as track and severity. Advice from friends, the media, and the National Hurricane Center (NHC) were given as the main reason only 7% of the time. Of course, it is through the NHC and media that they most likely learned about the storm's track and severity.

The "other" reasons represent specific answers that were given by only one or two respondents. However, many were related to concerns about loss of utilities, flooding later cutting off roads, or being alone; having children, elderly, or special needs family members; seeing everyone else leaving; believing home of friends or relatives was a safer or more pleasant refuge; or already having a trip planned.

The following figures illustrate differences by region and risk zone.

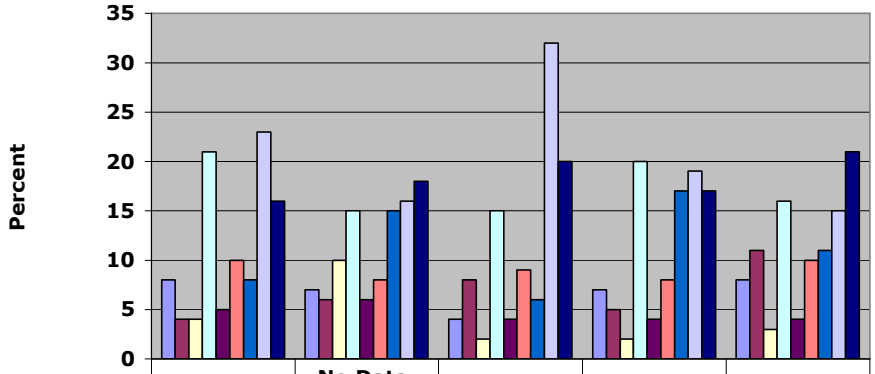
Figure 9. Reasons for Evacuating by Region



	LA	AL	MS	FL PAN.	FL Keys
Storm Experience	7	8	10	5	8
Friend or Relative Advice	5	11	5	7	16
Media Advice	10	4	2	3	1
Official Advice	15	14	14	23	25
NHC Advisories	6	1	6	6	8
Storm Severity	8	9	11	8	8
Storm Track	15	6	14	11	15
Concerns About Home Safety	17	23	21	20	8
Other	18	24	17	17	10

In Figure 9 where the data are examined by region, a few important differences emerge. Various concerns about the safety of their home were the most common first answer given by Alabama, Louisiana, and Mississippi evacuees. However, if you combine concern about the storm's severity and track, together they have the highest rate in Louisiana and Mississippi and second in the Florida Keys. Official advice carries the most weight in the Florida regions. This is probably related to greater hurricane experience, as well as the proactive nature of the Florida emergency management community. An unusual finding is the higher reliance on the advice of family or friends by evacuees from the Florida Keys compared to the other regions.

Figure 10. Reasons Given for Evacuating by Risk Zone



	Cat 1+	No Data, Assume All Evac.Zone	Cat 3+	Cat 4+	No Evac.
Storm Experience	8	7	4	7	8
Friend or Relative Advice	4	6	8	5	11
Media Advice	4	10	2	2	3
Official Advice	21	15	15	20	16
NHC Advisories	5	6	4	4	4
Storm Severity	10	8	9	8	10
Storm Track	8	15	6	17	11
Concerns About Home Safety	23	16	32	19	15
Other	16	18	20	17	21

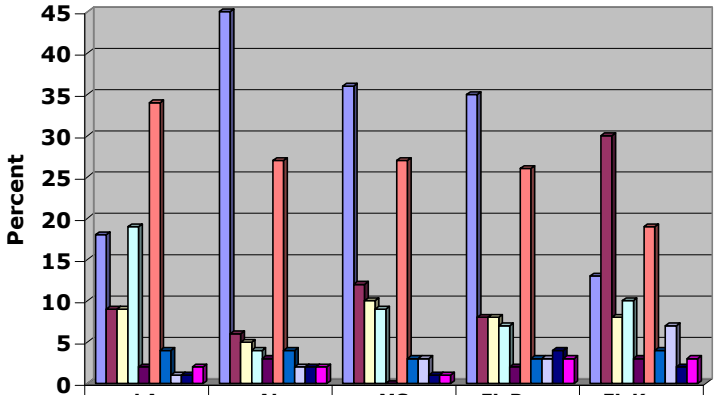
Reasons for evacuation were similar across risk zones. Official advice and concerns about the safety of their homes were important to all.

3. Reasons Given for Not Evacuating

The reasons given for not evacuating were also analyzed by region and risk zone and are reported in the next figures.

Figure 11.

Reasons for Not Evacuating by Region



	LA	AL	MS	FL Pan.	FL Keys
House Well Built	18	45	36	35	13
Storm Track	9	6	12	8	30
Storm Severity	9	5	10	8	8
Traffic	19	4	9	7	10
No Evac. Order	2	3	0	2	3
Other	34	27	27	26	19
Job	4	4	3	3	4
Protect Property	1	2	3	3	7
Pets	1	2	1	4	2
No Place to Go	2	2	1	3	3

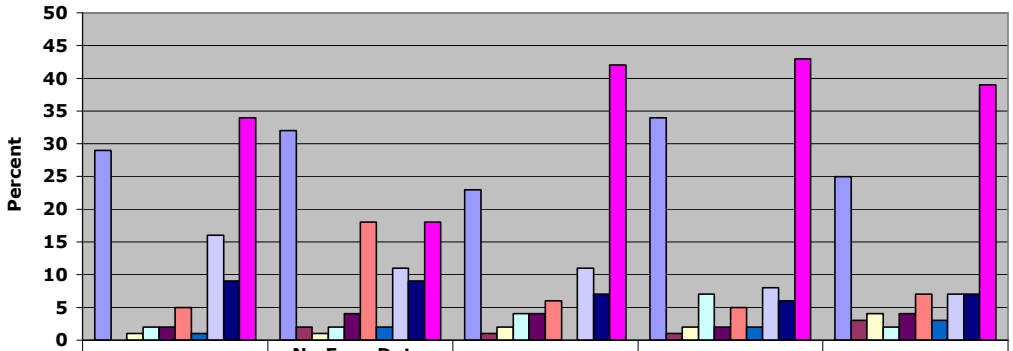
When non-evacuees were asked what made them decide not to leave their homes, the most common reason given in Alabama, Mississippi and the Florida Panhandle was the belief that their home was well-built – in other words, they felt safe. This was confirmed in another question where non-evacuees were asked specifically if they felt safe staying in their home during the storm and 89% said yes, with no important variation across regions.

In Louisiana traffic was more of a concern when deciding not to evacuate, and in the Florida Keys the storm track was the most common reason for not leaving. These answers make sense, given the regional contexts. Both Louisiana and the Florida Keys have high flood risk, but the Ivan track was uncertain for the Keys, and evacuating from southern Louisiana can present serious traffic problems.

This was an open-ended question and between one-fifth and one-third of the total sample explained other reasons for not evacuating, but these also tended to fall into a few categories, including some variation of "I didn't feel like it;" "we never evacuate;" "it's never been necessary," or "God will take me if he wants to." About 2% said they had no place to go, and about 3% said they would not leave their pets.

Figure 12.

Reasons for Not Evacuating by Risk Zone



	Cat 1+	No Evac Data, Assume Evac Zone	Cat 3+	Cat 4+	No Evac Zone
Other Reason	29	32	23	34	25
No Place to Go	0	2	1	1	3
Pets	1	1	2	2	4
Protect Property	2	2	4	7	2
Job	2	4	4	2	4
Traffic	5	18	6	5	7
No Evac. Order	1	2	0	2	3
Storm Track	16	11	11	8	7
Storm Severity	9	9	7	6	7
House Well Built	34	18	42	43	39

There was little variation in responses by risk zone.

4. Factors Predicting Evacuation

Other research has shown that evacuation decision-making is a complex process for households, usually involving consideration of multiple factors. While safety of the home and storm characteristics are major factors, many other factors are involved in the decision. To get at this complexity, a number of key evacuation-related questions were converted to variables representing presence or absence of a factor. This enables testing to see whether and how much each factor helps predict evacuation rates. The next table lists these factors and shows whether each, by itself, is a significant predictor of evacuation. Factors that appear to significantly predict evacuation are listed in bold.

Table 7. Single Factors Correlating with Evacuation Likelihood*

	Correlation	Probability relationship is only a chance result
Male	-0.089	0.000
Official notice to evacuate	0.361	0.000
Lived in evacuation zone	0.292	0.000
Household member had work during Ivan	-0.016	0.357
Had any window protection	-0.075	0.000
Business owner	-0.017	0.346
Hurricane experience before	-0.037	0.037
Single family home	-0.065	0.000
Age	-0.073	0.000
Children under 17 in household	0.106	0.000
Persons 80 or more years old in household	-0.001	0.941
Renter	0.028	0.115
Have pets	0.037	0.035
African-American or Black	-0.026	0.144
Income $40,000 or more	0.056	0.005
College graduate	0.107	0.000

* Bold indicates that the factor is a statistically significant predictor that people are more likely to evacuate (positive correlation) or less likely to evacuate (negative correlation).

Additional single factors that appear to be associated with evacuating include:

- Receiving official evacuation notice;
- Living in an evacuation zone;
- Having a household pet;
- Having higher income;
- Having more education.

Additional factors that appear to be associated with not evacuating include:

- Being male;
- Having window protection;
- Having previous hurricane experience;
- Living in a single family home;
- Having an older household member;
- Having children under 17.

However, a number of these may be measuring the same underlying factor. For example, education and income may both be measuring socio-economic status. In order to examine this, these factors were subjected to multivariate regression analysis to determine which factors are still clear predictors of evacuation even after the effects of all the others are included. The results of this analysis are included in the next table.

Table 8. Logistic Multiple Regression Models for Evacuation Likelihood

			Model 1		Model 2		Model 3	
			Evacuation Policy Factors Model		Hurricane Experience/ Preparation/Demographic Factors Model		All Factors Together Model	
	Simple Correlatio	Significan ce	Change In Odds	Significan	Change In Odds	Significan	Change In Odds	Significan
Male	**-0.089**	**0.000**			**0.75**	**0.00**	**0.66**	**0.00**
Official Notice To Evacuate	**0.361**	**0.000**	**3.37**	**0.00**			**3.47**	**0.00**
Lived In Evacuation Zone	**0.292**	**0.000**	**2.57**	**0.00**			**2.69**	**0.00**
Household Member Had Work During Ivan	-0.016	0.357					**0.75**	**0.03**
Have Any Window Protection	**-0.075**	**0.000**			**0.78**	**0.01**	**0.74**	**0.02**
Business Owner	-0.017	0.346			0.99	0.96	0.96	0.81
Hurricane Experience Before	**-0.037**	**0.037**			0.87	0.21	0.78	0.11
Single Family Home	**-0.065**	**0.000**			**0.76**	**0.05**	0.75	0.14
Age	**-0.073**	**0.000**			**1.42**	**0.00**	1.19	0.24
Children Under 17 In Household	**0.106**	**0.000**			1.19	0.30	1.09	0.68
Persons 80 + Years In Household	-0.001	0.941			1.13	0.44	1.03	0.90
Renter	0.028	0.115			**1.31**	**0.01**	1.23	0.12
Have Pets	**0.037**	**0.035**			0.81	0.18	1.00	0.99
African-American Or Black	-0.026	0.144			**1.47**	**0.00**	**1.57**	**0.00**
Income $40K +	**0.056**	**0.005**			**1.51**	**0.00**	**1.32**	**0.03**
College Grad	**0.107**	**0.000**			**0.99**	**0.05**	1.00	0.71
Constant (Effect On Evacuation If All Factors In Model Are Zero)			**0.26**	**0.00**	0.25	0.38	0.02	0.40
Approximate Percent Of Variance In Evacuation Explained By Model			18.0%		6.0%		23.0%	

Receiving an official notice to evacuate and living in evacuation zone are still the strongest predictors. In the first model, hearing an official notice to evacuate makes a household about 3 times more likely to evacuate; living in an evacuation

zone has a similar effect. These factors alone account for about 18% of the difference between evacuators and non-evacuators.

The second model includes all the household characteristics from the simple correlations, but only explains about 6% of the difference. The strongest factors in this model are income, being African American or black, being a renter, and having older members. However, having window protection, living in a single family home and being a college graduate and male also have some effect.

In the third model which includes all of the factors, official notice, living in an evacuation zone, being African American, and income are the most significant factors in explaining the differences between those who evacuate and those who do not, but being male and having a household member who had to work has some effect. This third model, using all the factors, accounts for about 23% of the difference between evacuees and non-evacuees. It is interesting to note that when multivariate analysis is done, pets are no longer a significant variable. The effect must be correlated with other factors and alone does not appear to be a predictor of evacuation decisions.

In conclusion, in addition to home safety and storm characteristics, the following factors appear to make a unique contribution toward explaining the decision to evacuate for Hurricane Ivan:

- Hearing an official notice;
- Living in an evacuation zone;
- Having an income over $40,000.

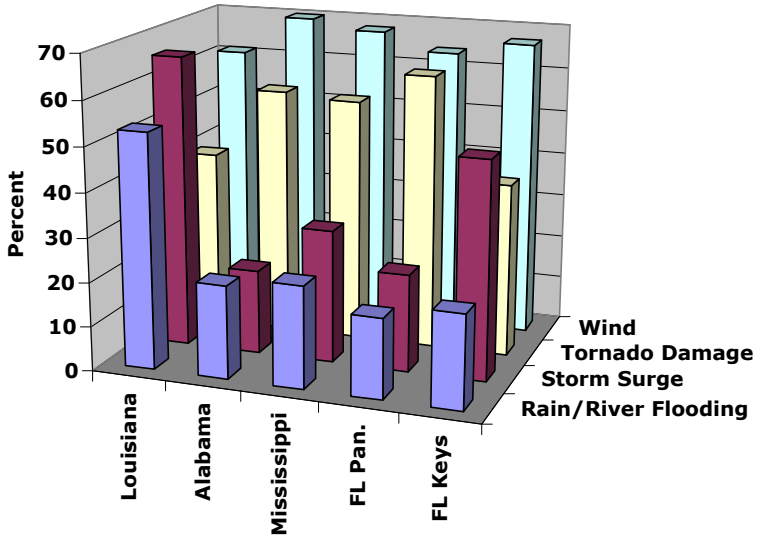
While the following appear to be make a unique contribution toward explaining the decision to stay:

- Having a household member who had to work;
- Being male;
- Being African American or black;
- Having window protection.

5. Important Storm Concerns in Evacuation Decision

Respondents were next presented several questions asking about specific concerns about the storm itself when deciding whether to leave. Each factor was asked as a separate question, and they could rate more than one factor as being important.

Figure 13. Important Storm Concerns by Region*



	Louisiana	Alabama	Mississippi	FL Pan.	FL Keys
Rain/River Flooding	53	21	23	18	21
Storm Surge	66	19	30	22	49
Tornado Damage	40	56	55	62	39
Wind	61	70	68	64	67

* There were separate questions and not mutually exclusive.

When it comes to storm characteristics, the greatest concerns were hurricane wind damage, followed by tornado damage, and storm surge. The greatest concern about surge and flooding was in coastal Louisiana, followed by the Florida Keys. This was confirmed later in the interview when specific questions about the safety of their home in different strength hurricanes were asked. Wind was a great concern in all regions.

6. Other Concerns

a. Jobs

About 31% of both evacuees and non-evacuees reported that someone in their household had to go to work during the evacuation, but only 10% of the total sample said it kept them from evacuating. About 20% of non-evacuees with household members working said this was a factor in their decision to stay. In this sample the people who had to work during the evacuation were more likely to live in areas where evacuation was ordered, and thus more likely to evacuate, even though having to work in general made them less likely to evacuate. In the simple correlation earlier in this report these effects canceled each other out. However, in the multiple regression analysis, controlling for the effect of evacuation orders, the negative effect of working during Ivan on evacuation was evident. Among evacuees who had someone in the household working, about

60% said it was a delaying factor. The effects were highest in Louisiana and lowest in the Florida Panhandle.

b. Schools

Since having children in school could be a factor in evacuation household decision-making, respondents were asked if the schools in their communities closed early enough for them to evacuate. This was not a problem for more than 90% in each region.

c. Special Needs

Another possible barrier to evacuation could be a special needs family member, but this was only reported as a factor in 5% or less of the households. Of these special needs households, more than half reported this as a factor affecting their evacuation decision. About 44% (or a total of 56 households) needed special shelter care, and 16% required transportation.

d. Pets

Nearly 60% of the respondents reported having household pets. Of these, 72% of evacuees and 66% of non-evacuees said having pets did not affect their evacuation decision. This agrees with the regression model which does not show having pets to be a significant predictor of evacuation.

7. Effect of Mitigation on Evacuation

Only about 18% of the total sample said the things they did to protect their property affected their evacuation decision. Of these, about one-third evacuated anyway.

8. Evacuation Notice

Respondents were asked a series of questions about evacuation notices, including whether an official evacuation order was issued for their region, and if so, whether it was recommended or mandatory, how they first heard it, whether someone came into their neighborhood telling people to evacuate, whether it was issued early enough, and if it was clear as to whom it applied and what they needed to do.

a. Official Evacuation Order

When asked specifically if an official told them to evacuate, affirmative answers varied considerably by region: Monroe 75%, Louisiana 63%, Mississippi 50%, Alabama 34% and the Florida Panhandle 28%.

b. Recommended or Mandatory

Most respondents from Monroe County, Alabama and Mississippi said the evacuation for Hurricane Ivan was mandatory while the majority from Louisiana and the Florida Panhandle heard only that they should evacuate.

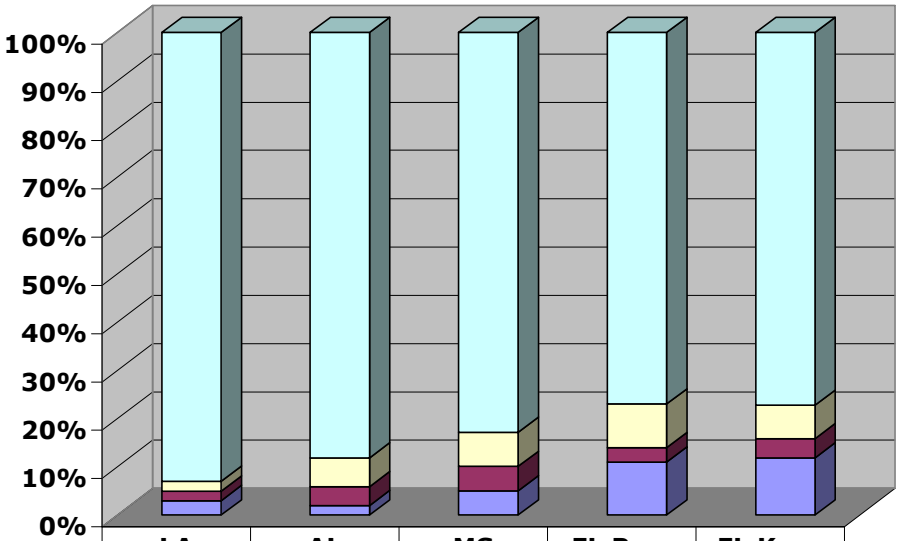
c. Source of Evacuation Notice

Of those who said an evacuation order was issued, about 87% said they first heard about it on radio or television. Word of mouth was a distant second with rates of 5%.

As shown in the next two figures, there was little variation by region or evacuation zone.

Figure 14.

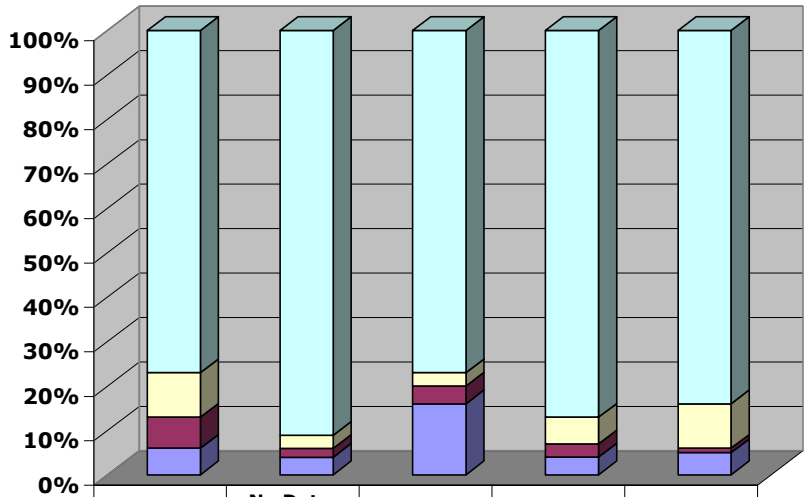
First Source of Evacuation Notice by Region



	LA	AL	MS	FL Pan.	FL Keys
Radio/TV	93	89	82	77	78
Word of Mouth	2	6	7	9	7
Direct from Authorities	2	4	5	3	4
Other	3	2	5	11	12

There were no important regional differences except that Floridians were somewhat more likely to get their information from other secondary sources, such as the internet.

Figure 15. First Source of Evacuation Notice by Risk Zone



	Cat 1+	No Data, Assume Evac. Zone	Cat 3+	Cat4+	No Evac
Radio/TV	77	92	77	87	84
Word of Mouth	10	3	3	6	10
Direct from Authorities	7	2	4	3	1
Other	6	4	16	4	5

A confusing finding is that those in Category 3+ were more likely to use other sources in addition to the radio and TV.

d. Timing and Utility of Notice

In the total sample 87% felt evacuation notices were issued early enough with the regional differences ranging from 79% in Louisiana to 95% in the Florida Keys. A similar percentage (88%) felt they were useful, ranging from 82% in Louisiana to 94% in Mississippi.

8. Information Sources

a. National Hurricane Center

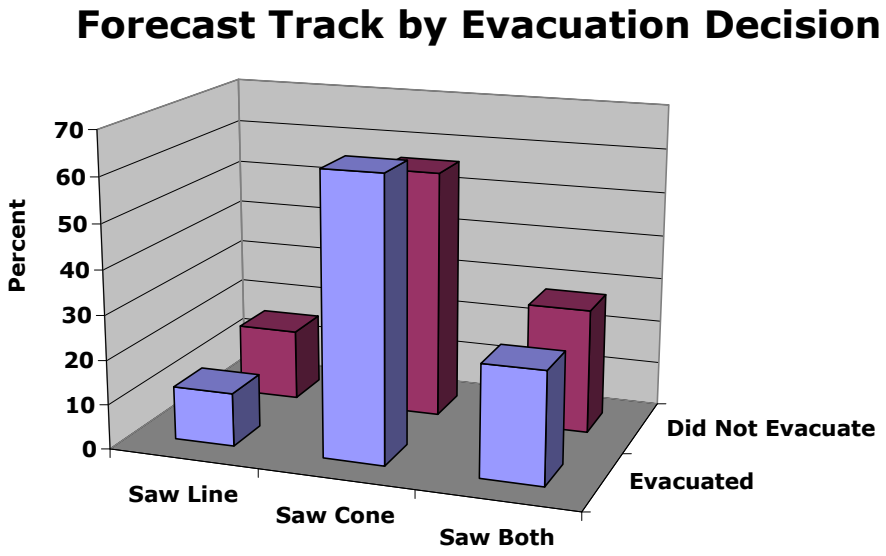
Across all regions, between 78-85% of respondents reported that the NHC watches and warnings were an important factor in their evacuation decision. However, as will be described later in this report, many did not have a clear understanding of the meaning of these terms.

b. Forecast Track or Cone

Between 95-97% said they saw the hurricane's track on television and about 90% said it was an important factor in their evacuation decisions. They were then asked: "Did the map have a line showing exactly where the storm was predicted

to go or did it show a wider area, like a cone, saying the storm would go someplace in that larger area, but you couldn't tell exactly where?" Of the total sample, about 64% reported seeing a cone, 12% a line, and 24% both. The next figure gives the correlation between what they saw and their evacuation decision.

Figure 16.



	Saw Line	Saw Cone	Saw Both
Evacuated	12	63	25
Did Not Evacuate	16	56	28

There is some indication that those who only saw the line were less likely to evacuate. This is logical given that a smaller geographical area would appear to be threatened, compared to those who saw the wider cone.

c. National Weather Service

In a separate question respondents were asked if they sought information from their local National Weather Service (NWS), and between 35-40% of the total sample said they sought information from their local NWS office, with the exception of Monroe County where the rate increased to 53%.

d. Other Information Sources

Respondents were given a list of other possible information sources and asked the extent to which they relied on each for hurricane information and the following table reports those who relied on each source a great deal.

Table 9. Information Sources Relied on a Great Deal by Region (Percent)

Source	LA	AL	MS	Panhandle	Monroe	TOTAL
Local TV stations	79	75	71	65	54	71
Weather Channel	43	47	55	53	60	50
Local radio stations	36	47	34	44	31	40
Other cable	24	23	27	30	31	27
Word of mouth	15	16	14	14	9	14
CNN on cable	14	16	16	17	14	16
Internet	12	13	18	15	40	16

When asked about information sources in general, the results were fairly consistent regardless of region. The primary source was local television stations, followed by the Weather Channel, local radio, and other cable. Internet usage varied from about 12% in Louisiana and Alabama to nearly 40% in Monroe County. Its surprisingly high usage in the Florida Keys may be explained by a combination of relative affluence and hurricane experience, and is consistent with reported use of their local NWS.

9. Suggestions to Improve Evacuation Information

About two-thirds (62%) of evacuees felt officials did not need to do anything additional to improve evacuation information. However, the regional differences in those who felt the information could be improved are important: Louisiana 47%, Mississippi 34%, Florida Panhandle 32%, Monroe County 24%, and Alabama 22%. The most common suggestions were to provide more information about evacuation routes, to issue it sooner, and to update it more often.

10. Plans if Worsened

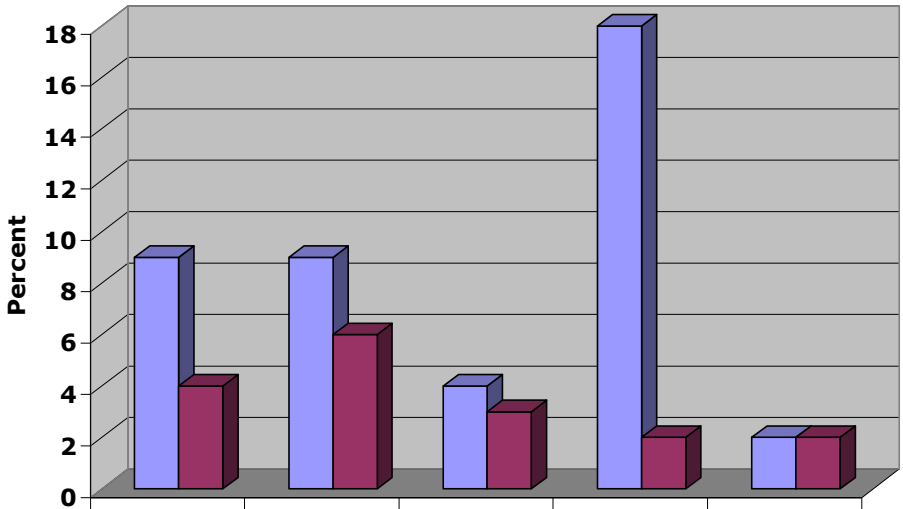
It is interesting that two-thirds of these non-evacuees reported that they had made plans to go someplace safer if the threat got worse, and over half said they would have left if Ivan had been going to hit their area directly. The issue, of course, is that this might have been too late to evacuate safely.

11. Evacuation Decision Next Time

When respondents were asked an open-ended question about whether they would do anything differently in the same situation again, over 60% said they would not. About 11% of those who did not evacuate said they would evacuate, and only 4% of evacuees said they would not evacuate. Regional differences are depicted in the following figure.

Figure 17.

Evacuation Decision Next Time



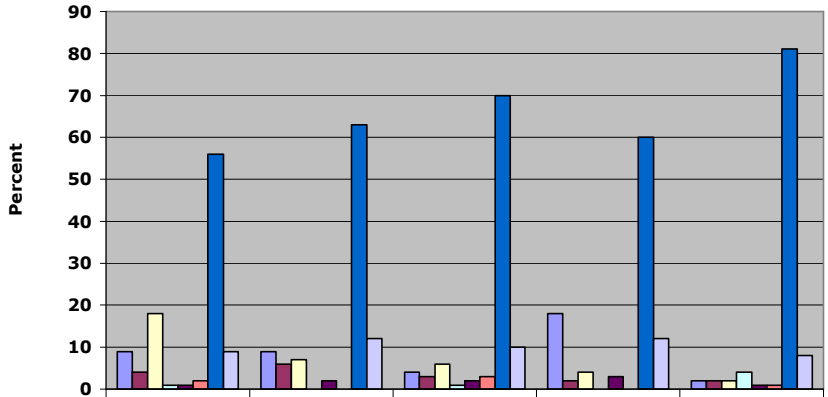
	LA	AL	MS	FL Pan.	FL Keys
Non-Evacuee Would Evacuate	9	9	4	18	2
Evacuee Would Not Evacuate	4	6	3	2	2

It is interesting that more of the non-evacuees would make a different decision next time. Not surprisingly, given Ivan's path, this is highest in the Florida panhandle. Nevertheless, most people in all regions would make the same decision next time. This is in line with other studies that show people tend to be evacuees or non-evacuees, and this decision is relatively stable.

There were several other questions about what they would do differently the next time and the next figures summarize these for the entire sample.

Figure 18.

Would Do Differently Next Time by Region

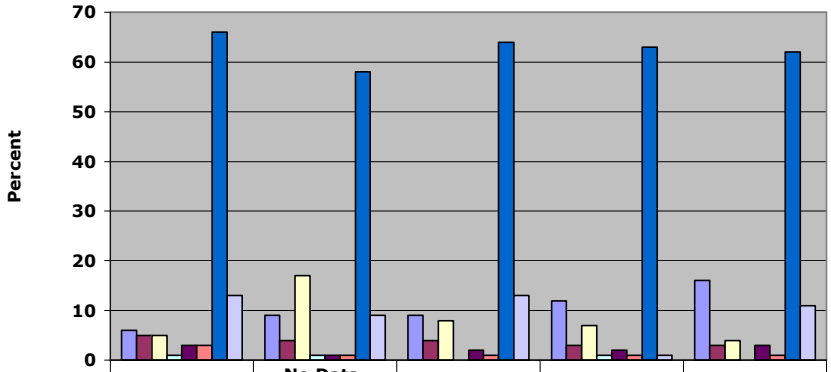


	LA	AL	MS	FL Pan.	FL Keys
Non-Evacuee Would Evacuate	9	9	4	18	2
Evacuee Would Not Evacuate	4	6	3	2	2
Evacuee Would Leave Earlier	18	7	6	4	2
Evacuee Would Leave Later	1	0	1	0	4
Evacuee Would go to Different Place	1	2	2	3	1
Evacuee Would Use Different Route	2	0	3	0	1
Would Not Do Anything Different	56	63	70	60	81
Other	9	12	10	12	8

It is interesting that 18% of the Louisiana sample would leave earlier.

Figure 19.

Would Do Differently by Risk Zone



	Cat 1+	No Data, Assume Evac Zone	Cat 3+	Cat 4+	No Evac
Non-Evacuee Would Evacuate	6	9	9	12	16
Evacuee Would Not Evacuate	5	4	4	3	3
Evacuee Would Leave Earlier	5	17	8	7	4
Evacuee Would Leave Later	1	1	0	1	0
Evacuee Would go to Different Place	3	1	2	2	3
Evacuee Would Use Different Route	3	1	1	1	1
Would Not Do Anything Different	66	58	64	63	62
Other	13	9	13	1	11

Most of these respondents would do things the same way the next time in a similar situation.

B. Evacuation Behavior

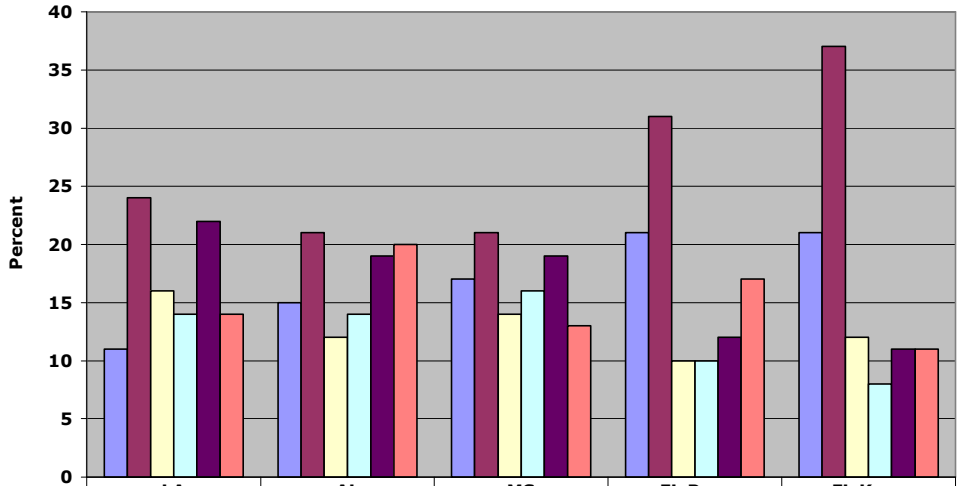
The next series of questions relate to the actual evacuation experiences of Ivan evacuees, both before and after leaving their home.

1. Evacuation Response Rates

Evacuees were asked how long it was from when they decided to evacuate until they actually left their home. The next figure provides an overview of these response rates by region.

Figure 20.

Response Time to Evacuate by Region



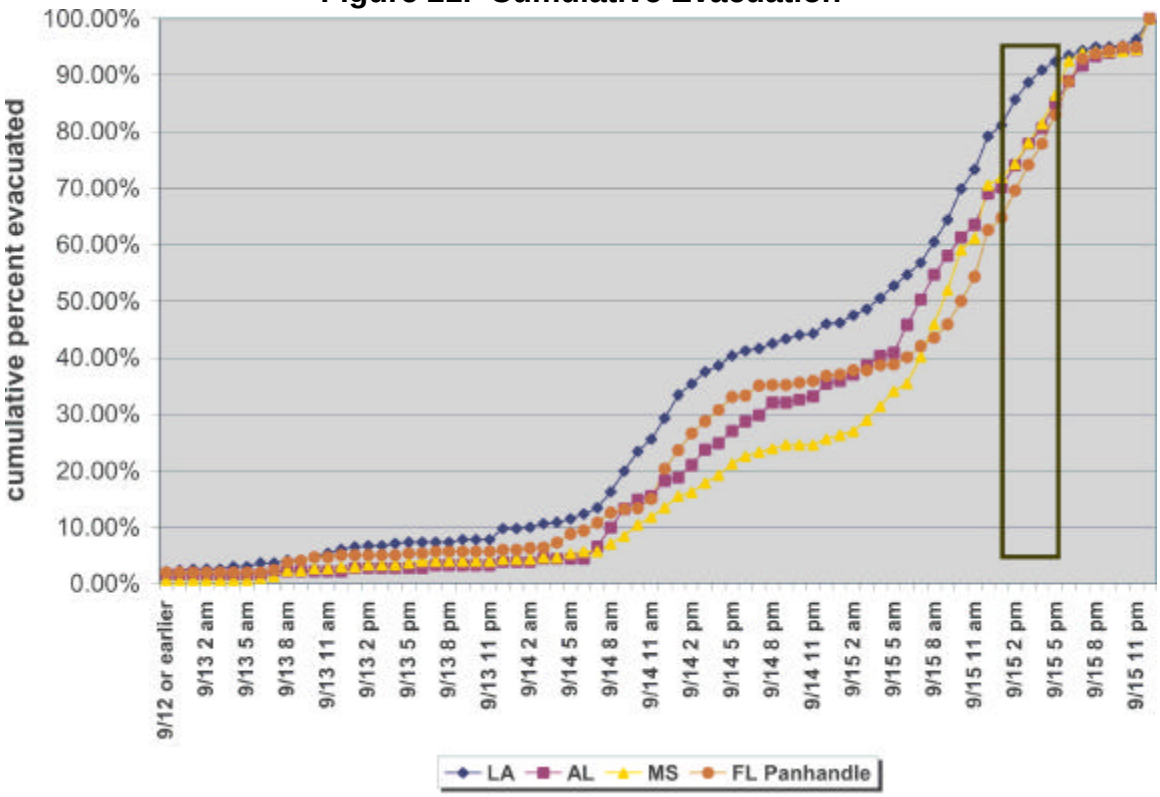
	LA	AL	MS	FL Pan.	FL Keys
More than 24 hours	11	15	17	21	21
12 to 24 Hours	24	21	21	31	37
7 to 12 Hours	16	12	14	10	12
4 to 6 Hours	14	14	16	10	8
2 to 3 Hours	22	19	19	12	11
1 Hour or Less	14	20	13	17	11

The responses are distributed throughout the time frame from one hour or less to more than 24 hours. The most common response was that they left within 12-24 hours after deciding to evacuate. However, respondents in the Florida sample tended to decide earlier before leaving. This may be an effect of previous evacuation experience. In the case of the Florida Keys it may have been affected by the staged timing of evacuation by officials, where people who planned to evacuate had to wait for the evacuation time specified for their area of the Keys.

2. Time of Departure

The next figure shows the cumulative evacuation curve for all the areas except for Monroe County. The box indicates the approximate forecasted arrival of tropical force winds along coastal Louisiana, Mississippi, Alabama, and the Florida panhandle.

Figure 21. Cumulative Evacuation



During most of the time period depicted, Keys evacuees had already evacuated and were returning. In general the timing is the same for all the other regions, although more people in Louisiana completed their evacuation somewhat earlier.

3. Miles Traveled to Destination

Evacuees were asked how many miles they traveled to their refuge. Given that several traveled more than a thousand miles, median is the most appropriate average measurement to use, and the median distance traveled ranged from 225 miles for Monroe County to less than 60 in the Florida Panhandle.

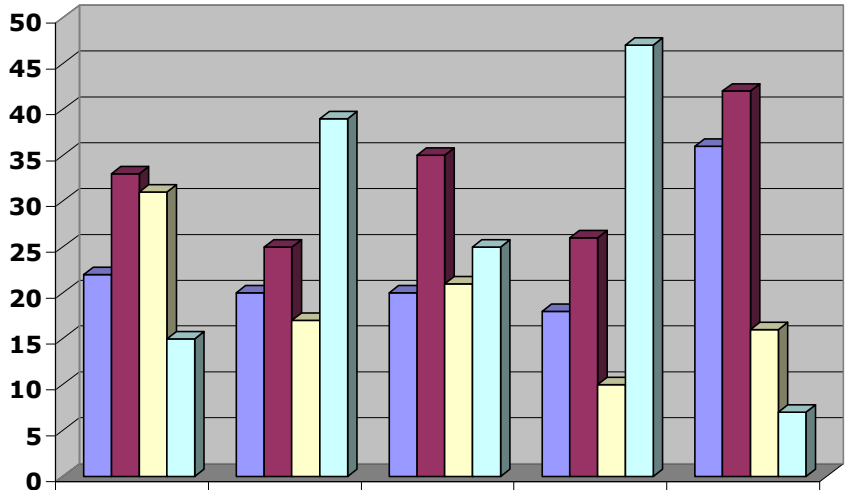
Table 10. Miles Traveled

Region	Average Miles	Median Miles
Louisiana	198	125
Alabama	156	77
Mississippi	177	128
Florida Panhandle	166	50
Florida Monroe County	272	230
Overall	182	117

The next figure depicts another way to look at distance traveled -- how many households traveled each distance.

Figure 22.

Households Traveling Each Distance (Percent)



	LA	AL	MS	FL Pan.	FL Keys
Over 300 miles	22	20	20	18	36
101-300 Miles	33	25	35	26	42
25-100 miles	31	17	21	10	16
Under 25 miles	15	39	25	47	7

Residents of the Florida Keys traveled the farthest, not surprising given their location.

4. Time to Destination

There was considerable variation in travel times to destination. As shown in Table 11, Louisiana and Florida Keys residents had the longest travel times.

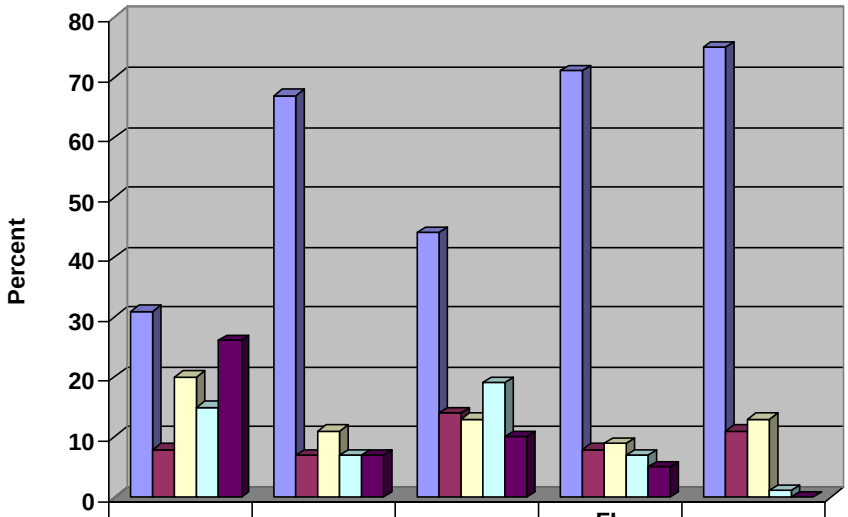
Table 11. Time to Destination

Region	Average Number of Hours
Louisiana	8.0
Alabama	4.5
Mississippi	5.0
Florida Panhandle	4.5
Florida Monroe County	7.0
Overall	**6.5**

5. Time Compared to Normal

Respondents were asked to compare their travel time with how long it would normally take to reach that destination. The next figure illustrates regional differences in how much longer the trip took than normal.

Figure 23.



	LA	AL	MS	FL Panhandle	FL Keys
evac time same as normal	31	67	44	71	75
one hour longer	8	7	14	8	11
2-3 hours longer	20	11	13	9	13
4-6 hours longer	15	7	19	7	1
over six hours longer	26	7	10	5	0

The most common response was that it took the same amount of time. Of most interest, over 60% of Louisiana evacuees said the trip took at least 2 hours longer, and for 26% the trip was more than 6 hours longer. The region with the second largest differences in trip times was Mississippi. Evacuation from the Keys appears to have gone well, in terms of time taken.

It is interesting to see the results geographically as illustrated in the next figures.

Figure 24. Trip Time Compared to Normal –Gulf Regions

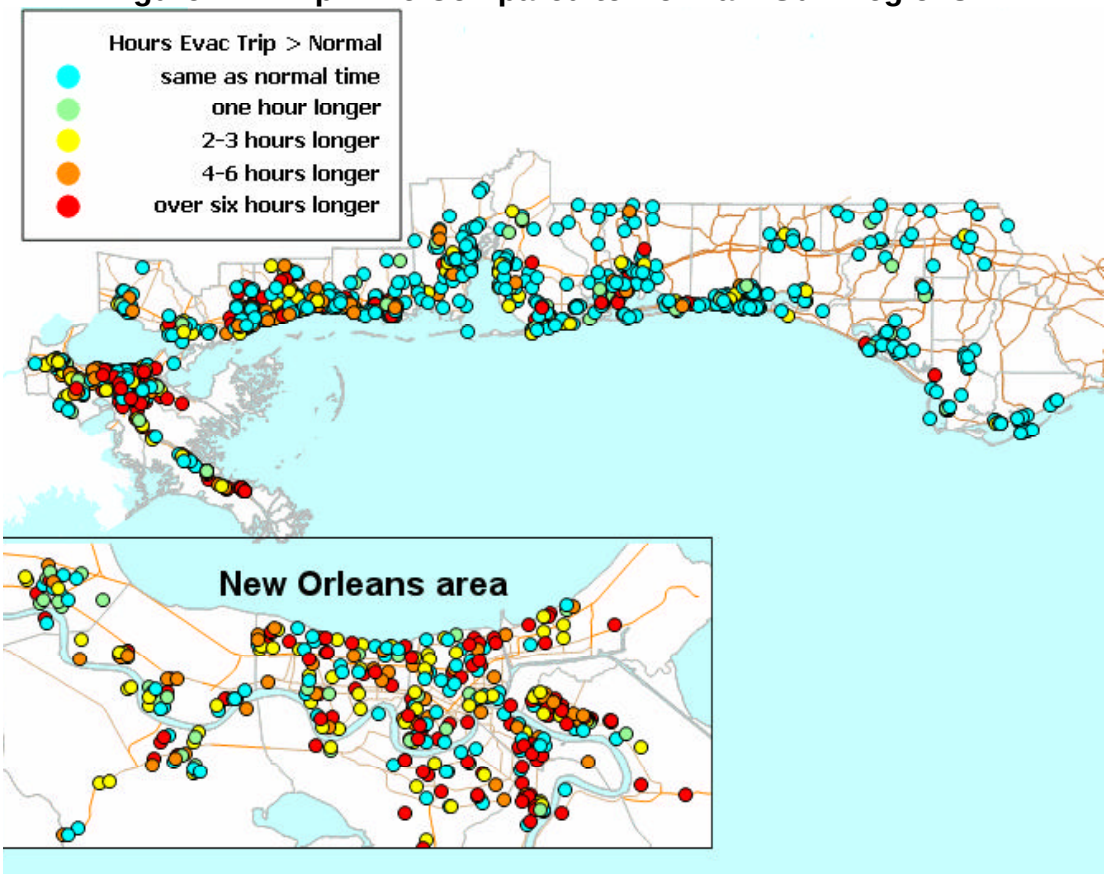
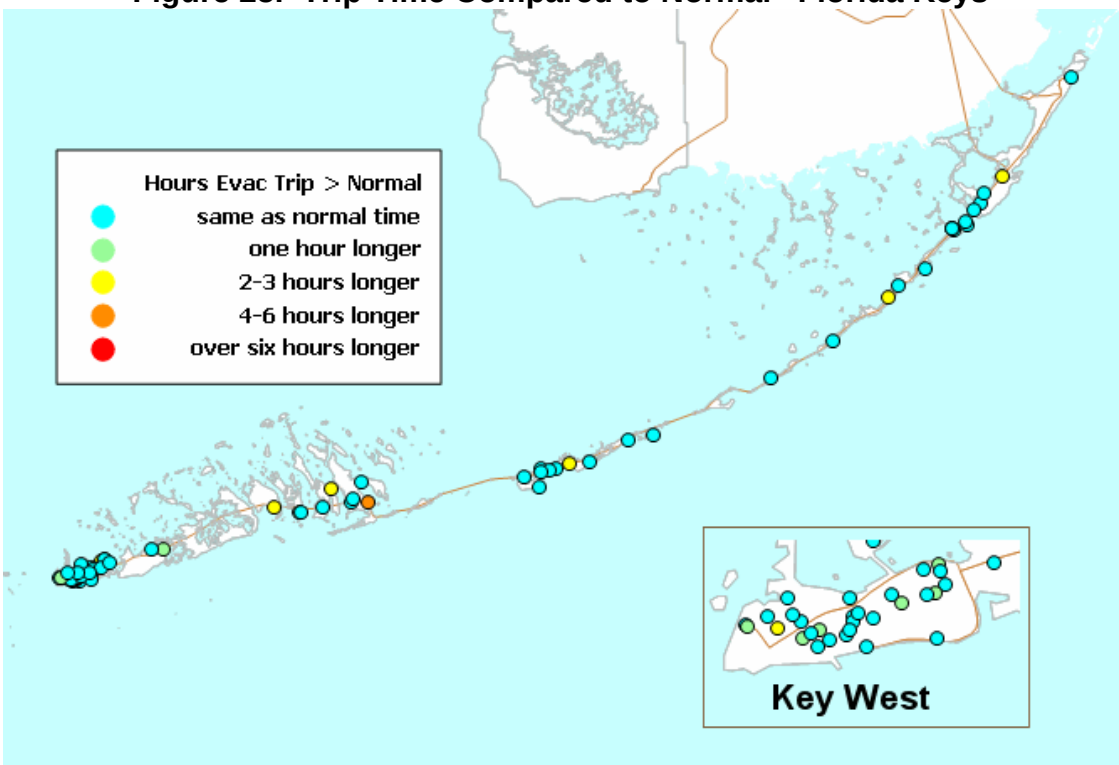


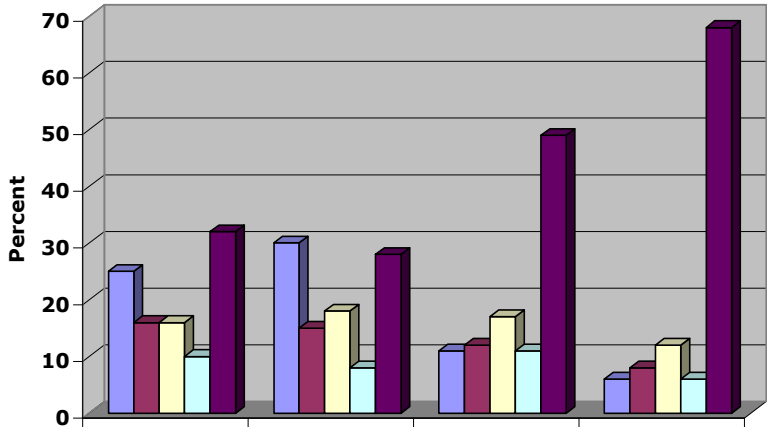
Figure 25. Trip Time Compared to Normal –Florida Keys



The next set of figures looks at how long before landfall evacuating respondents left home, and its relation to traffic delays. This is significant because the longest delays are during the time when evacuation was supposed to have taken place.

Figure 26.

When Left and Hours to Destination - Total Sample



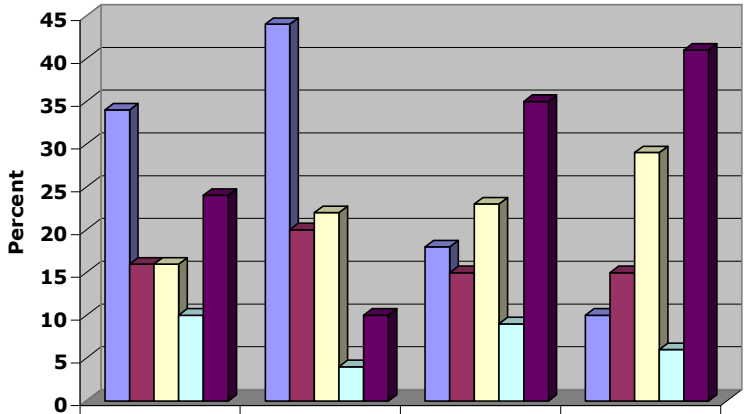
	36 or More	24-36 Hours	12-23 Hours	Less Than 12
More Than Six Hours	25	30	11	6
4-6 Hours Longer	16	15	12	8
2-3 Hours Longer	16	18	17	12
One Hour Longer	10	8	11	6
No Longer	32	28	49	68

Hours Left Before Landfall

In general people who waited until the day tropical storm force winds were forecast to arrive faced less traffic delays. Of course, if more people followed this example, last minute delays and risk would have greatly increased. As shown in the next figures, this finding was true in every region.

Figure 27.

When Left and Hours to Destination - Louisiana



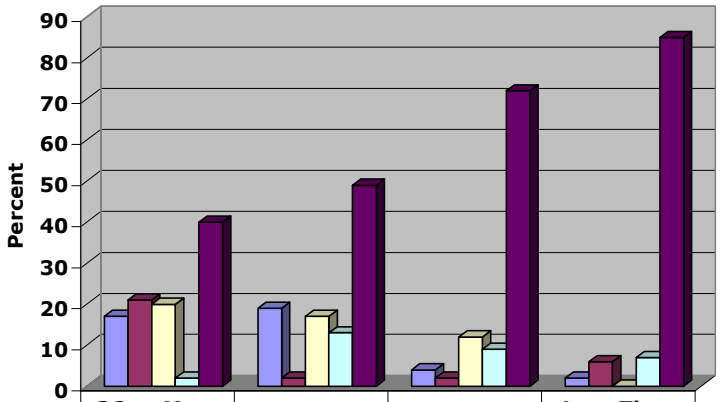
	36 or More	24-36 Hours	12-23 Hours	Less Than 12
More Than Six	34	44	18	10
4-6 Hours	16	20	15	15
2-3 Hours	16	22	23	29
One Hour	10	4	9	6
No Longer	24	10	35	41

Hours Left Before Landfall

The most serious delay were reported by Louisiana evacuees who left when they were supposed to, between 24-36 hours before landfall.

Figure 28.

When Left and Hours to Destination - Alabama

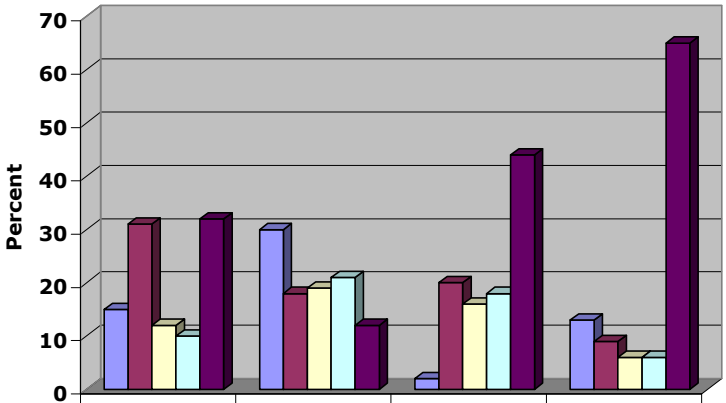


	36 or More Hours	24-36 Hours	12-23 Hours	Less Than 12 Hours
More Than Six	17	19	4	2
4-6 Hours	21	2	2	6
2-3 Hours	20	17	12	0
One Hour	2	13	9	7
No Longer	40	49	72	85

Hours Left Before Landfall

Figure 29.

When Left and Hours to Destination - Mississippi



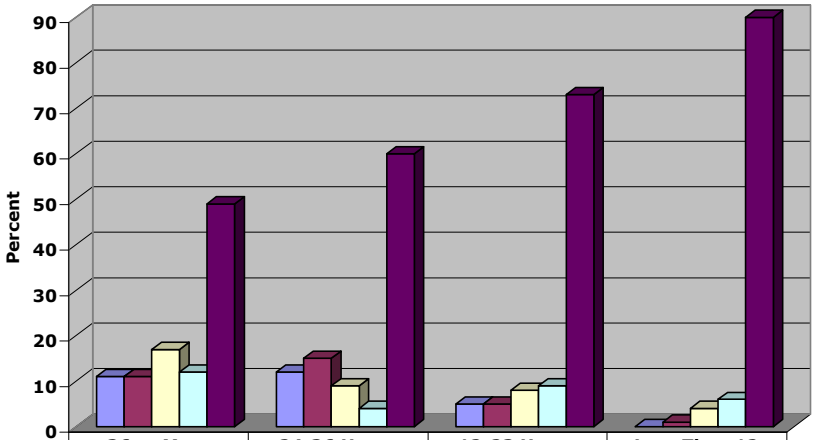
	36 or More Hours	24-36 Hours	12-23 Hours	Less Than 12 Hours
More Than Six	15	30	2	13
4-6 Hours	31	18	20	9
2-3 Hours	12	19	16	6
One Hour	10	21	18	6
No Longer	32	12	44	65

Hours Left Before Landfall

Again, while less than Louisiana, those living in the Mississippi counties included in the study who left 24-36 hours before landfall experienced the longest delays.

Figure 30.

When Left and Hours to Destination - Florida Panhandle



	36 or More	24-36 Hours	12-23 Hours	Less Than 12
More Than Six Hours	11	12	5	0
4-6 Hours Longer	11	15	5	1
2-3 Hours Longer	17	9	8	4
One Hour Longer	12	4	9	6
No Longer	49	60	73	90

Hours Left Before Landfall

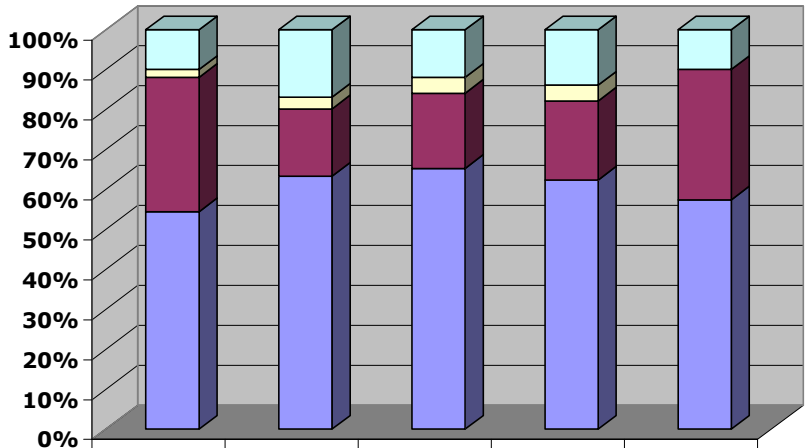
Surprisingly few delays occurred in the Florida Panhandle, especially considering the number of people who evacuated**.**

6. Type of Refuge

Evacuees were asked where they sheltered from the storm. As shown in the next figure, the majority in every region stayed with friends or relatives, with hotels ranking second.

Figure 31.

Type of Refuge by Region



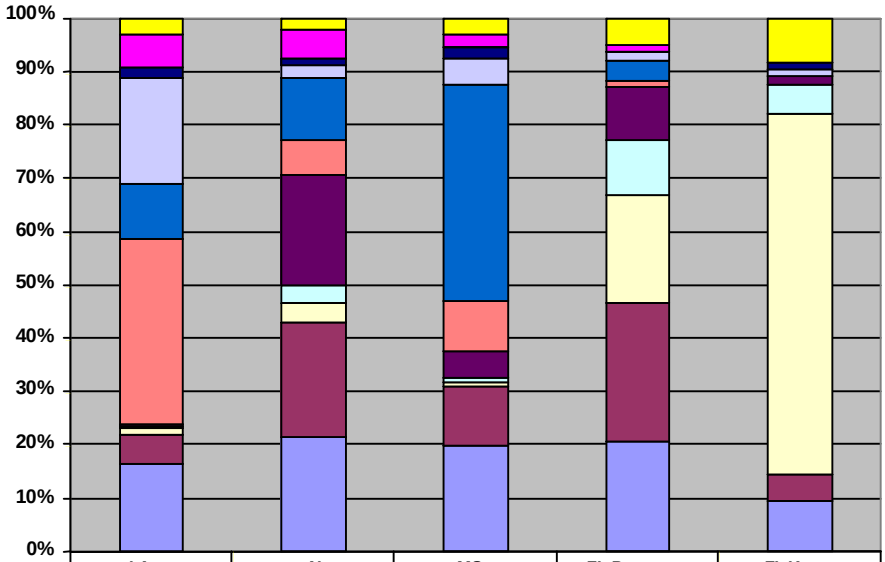
	LA	AL	MS	FL Pan.	FL Keys
Other	10	17	12	14	10
Public Shelter	2	3	4	4	0
Hotel	34	17	19	20	33
Friends/Relatives	55	64	66	63	58

Only 3% of the total sample used public shelters. The rates for Mississippi and the Florida Panhandle were the highest at 4%. Monroe County only has shelters for Category 1 or 2 storms. For others the designated shelter is in Miami-Dade County, 150 miles north of Key West. None of these respondents sheltered there.

7. Destination of Evacuees

Evacuees were asked if their evacuation refuge was located in their neighborhood, county or parish, or another state. Of the total sample, 19% remained in their own neighborhood and about 13% stayed within their own county or parish. For those who left their local area, regional destinations provide important information to evacuation officials.

Figure 32. Destination by Region



	LA	AL	MS	FL Pan.	FL Keys
OTHER	3	2	3	5	8
TENNESSEE	6	5	2	1	0
ARKANSAS	2	1	2	0	1
TEXAS	20	3	5	1	1
MISSISSIPPI	10	12	41	4	0
LOUISIANA	35	6	10	1	0
ALABAMA	1	21	5	10	1
GEORGIA	0	3	0	11	5
FLORIDA	1	4	1	20	68
WITHIN OWN COUNTY/PARISH	5	21	12	26	5
NEIGHBORHOOD	17	22	20	21	9

Most evacuees stayed within their own neighborhood, county or parish, or state. Destinations were most varied for evacuees from Alabama and the Florida Panhandle.

When asked if this was their intended destination when they left home, 88% answered affirmatively.

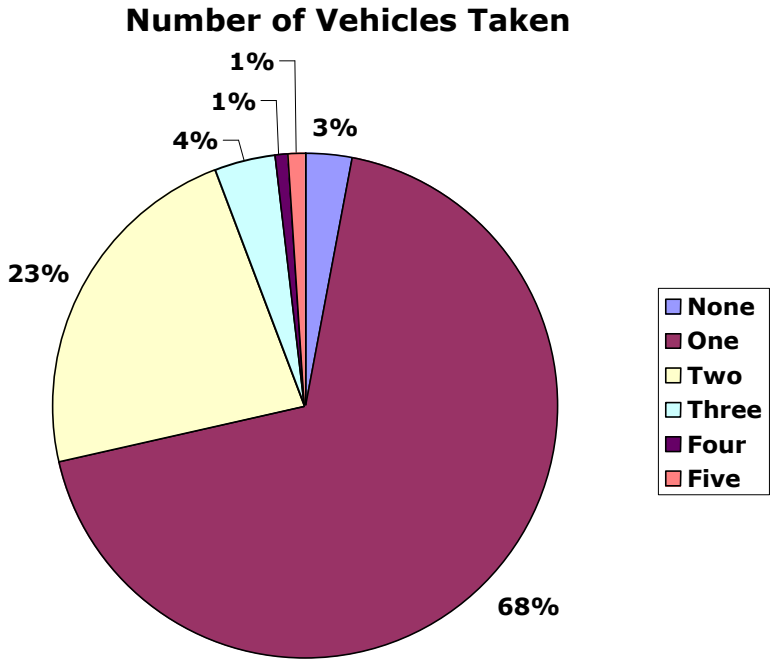
8. Route and Travel Information

When asked what route they used, about half said they used the same route they always use, but in Louisiana only 35% gave that answer. About 3% followed officials' recommendations, and only 1% of the total sample reported being forced by officials to use a route. Over two-thirds in all regions said they were able to get the traffic information they needed while on the road.

9. Vehicles Taken

Those who evacuated were asked how many vehicles were available for household evacuation. Most households owned two cars, but there was some variation, with Florida Panhandle households averaging slightly more and the Florida Keys slightly fewer. Of the vehicles available, evacuees were asked how many were taken and the results are depicted below.

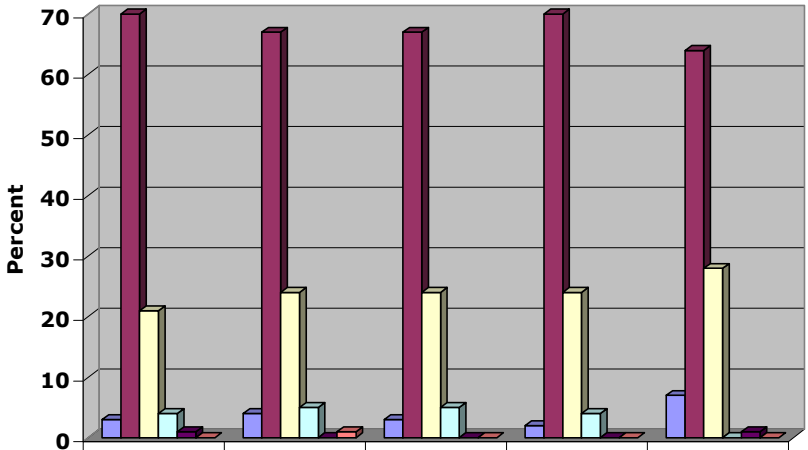
Figure 33.



The vast majority (69%) of evacuees took only one car, with 23% taking two. Only 3% of these households did not take their own car.

Figure 34.

Vehicles Taken by Region



	LA	AL	MS	FL Pan.	FL Keys
None	3	4	3	2	7
One	70	67	67	70	64
Two	21	24	24	24	28
Three	4	5	5	4	0
Four	1	0	0	0	1
Five	0	1	0	0	0

Across regions there were no significant differences in number of cars taken per household.

Respondents were also asked about the percent of total available household cars they took when they evacuated, and the rate varies from 71% to 73% except for Monroe County where it rises to about 80%. Across all regions only about 7% took a motor home or pulled an RV, camper or boat, but in Monroe County the rate was 11%.

10. Contra-Flow

During the Hurricane Ivan evacuation, Louisiana officials implemented contra-flow procedures for part of the evacuation route. Questions about contra-flow were asked of Louisiana respondents only, and about three-quarters said it did not affect their evacuation decision.

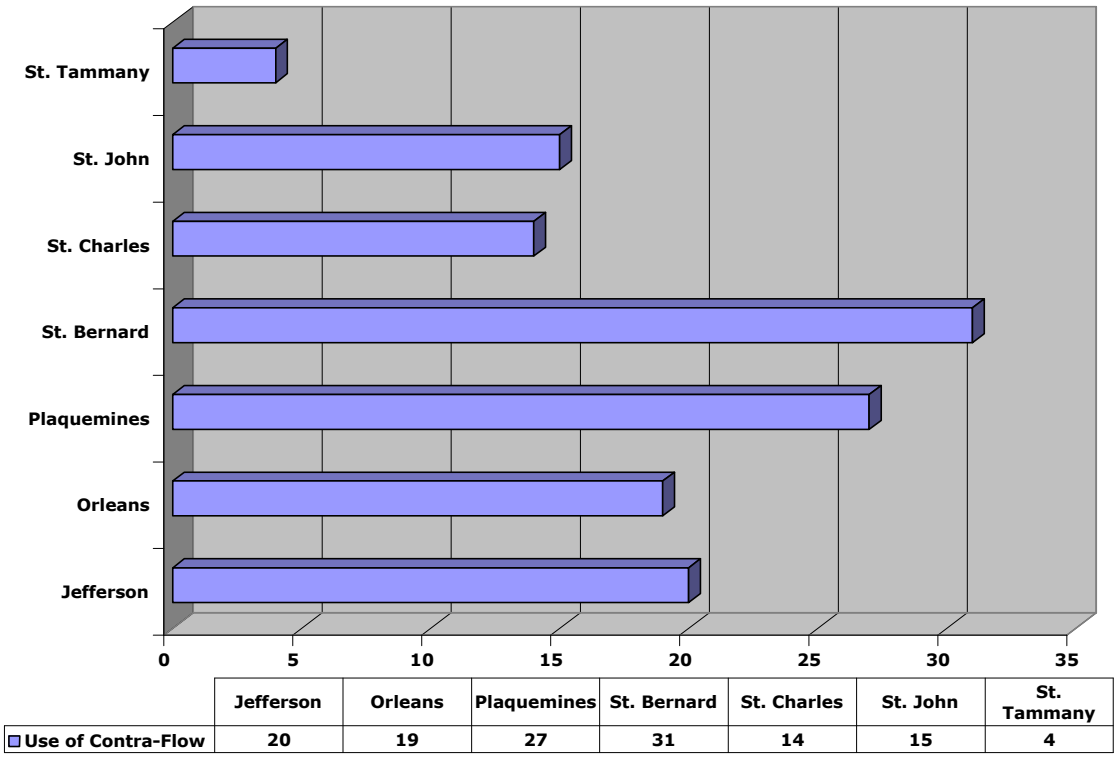
Table 12. Effect of Contra-Flow on Evacuation Decision

Contra-Flow Effect in Louisiana	Percent
Yes	13
No	76
Didn't Know About It	4
Evacuated Before Contra-Flow Lanes Established	7

An important finding is that, of the Louisiana residents who said contra-flow affected their decision, over half (56%) said it made them *more* likely to evacuate while one-quarter said it made them *less* likely to leave.

Less than 20% of Louisiana evacuees reported actually driving on a contra-flow road while evacuating, and of those, there were about the same number of reports of it causing additional problems (37%) as there were people who felt it improved traffic flow (38%), with the rest being undecided. The next figure provides a breakdown of those who drove on contra-flow lanes by parish.

Figure 35. Use of Contra-Flow Lanes by Parish



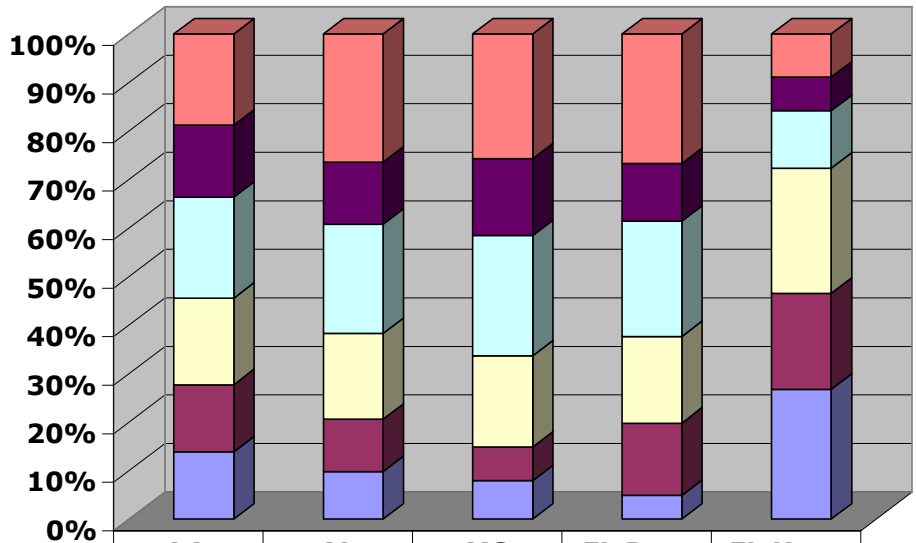
Officials should note that 61% of the Louisiana sample said contra-flow lanes would make them more apt to evacuate next time. However, much of this additional evacuation could be earlier: about 60% also said they would likely

leave early the next time to avoid contra-flow. The vast majority (84%) are aware that contra-flow plans have been revised to address the problems encountered during the Ivan evacuation.

11. Daily Expenditures of Evacuees

When evacuees were asked how much money their household spent per day while away from home, with the exception of Monroe County, most reported spending less than $99 per day.

Figure 36.



	LA	AL	MS	FL Pan.	FL Keys
Less Than $25	19	27	26	27	9
$25-$49 Day	15	13	16	12	7
$50-$99 Day	21	23	25	24	12
$100-$149 Day	18	18	19	18	26
$150-$200 Day	14	11	7	15	20
Over $200 day	14	10	8	5	27

For the Monroe County residents, evacuation was much more expensive, with nearly 75% spending more than $100 and more than a quarter spending over $200 per day. This could be related to these experienced evacuators using the trip to take vacations (something reported in research on earlier evacuations from the Keys), as well as higher costs of lodging, etc. in Florida.

12. Days away

Time away from home ranged from one day or less to more than one week. About half of the respondents in Louisiana and Mississippi were away from home between two and three days. The time was slightly less for residents of Alabama

and the Florida Panhandle and longer for evacuees from Monroe County, the majority of whom were gone four or more days. This is especially interesting given their higher level of expenditures. Clearly, evacuation is a more expensive proposition for residents of the Florida Keys.

13. Supplies While Away

About three-fourths reported taking an evacuation supply kit (food, medicine personal items, and extra clothing) with them. Slightly over 40% had it packed before the storm, except for Monroe County where the rate was nearly 60%. Over 80% reported having everything they needed.

14. Return Information

More than one-quarter of the respondents who evacuated said it was not easy finding information about getting back into their communities. It appeared to be most problematic for Monroe County evacuees, with 40% indicating this was a problem. Television was the primary source of information, followed by radio, and word of mouth from friends and relatives. Compared to the others, Florida respondents were more likely to call authorities for information. It is interesting that more than 3% of the total sample used the internet for this purpose.

C. Knowledge and Information

1. Responsibility for Evacuation Notices

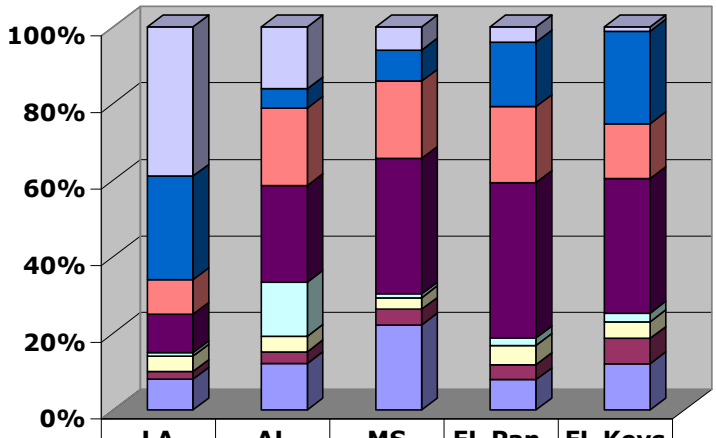
As part of this post-Ivan assessment, respondents were asked several questions to assess their general knowledge about hurricanes and hurricane procedures. The first asked who is responsible for deciding whether or not people need to evacuate and issuing evacuation notices. While there was a wide range of answers, the most common answer in Louisiana was the parish administrator, and for the other regions it was the local emergency managers.

Table 13. Who Is Responsible for Evacuation Notices

	Percent
Mayor	21
County or Parish Administrator	19
Police or Sheriff	15
Local Emergency Management Director	25
Governor	3
National Weather Service	4
National Hurricane Center	3
Other	10

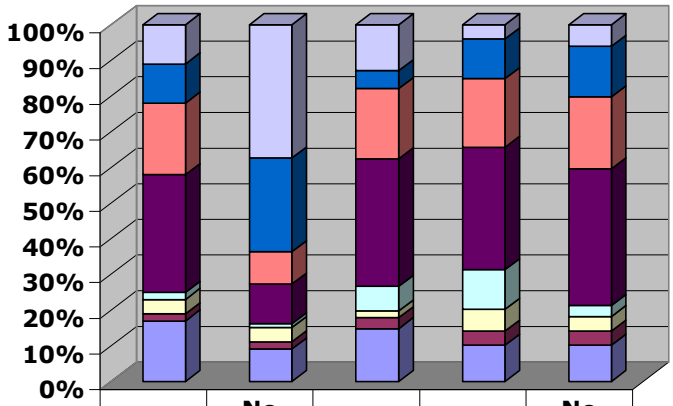
Considerable regional variation occurred with this question that will be of interest to officials.

Figure 37. Who Gives Evacuation Orders by Region



	LA	AL	MS	FL Pan.	FL Keys
Mayor	39	16	6	4	1
County/Parish Adm.	27	5	8	17	22
Police/Sheriff	9	20	20	20	13
Local Emerg. Mgr.	10	25	35	41	32
Governor	1	14	1	2	2
NWS	4	4	3	5	4
NHC	2	3	4	4	6
Other or Don't Know	8	12	22	8	11

Figure 38. Who Gives Evacuation Orders by Risk Zone



	Cat 1+	No Data	Cat 3+	Cat 4+	No Evac.
Mayor	11	37	13	4	6
County/Parish Adm.	11	26	5	11	14
Police/Sheriff	20	9	20	19	20
Local Emerg. Mgr.	33	11	36	34	38
Governor	2	1	7	11	3
NWS	4	4	2	6	4
NHC	2	2	3	4	4
Other or Don't Know	17	9	15	10	10

2. Knowledge of Evacuation Zone

Respondents were asked two questions related to their knowledge of whether or not they live in an evacuation zone. About one-quarter of the respondents said that before Hurricane Ivan approached they did not know if their home was in an evacuation zone, except for Monroe County where only 8% gave this response. When asked if they *now* know whether they live in an evacuation zone, nearly three-quarters said yes. This varied from 97% in Monroe County, to 58% in the Florida Panhandle.

3. Knowledge of Watches and Warnings

Respondents were tested on their knowledge of the terms watch and warning and the results are tabled below. They were asked how many hours before expected landfall does the National Hurricane Center issue a Hurricane Warning and the choices were 12 hours, 24 hours, 36 hours, and Don't Know. The question was then repeated for Hurricane Watch. Of the total sample, 62% chose the correct definition for hurricane watch, and only 40% knew the definition for hurricane warning. The next table gives the percent of respondents who knew the correct definition of each by region.

Table 14. Respondents Correctly Defining Watches and Warnings (Percent)

	Louisiana	Alabama	Mississippi	Florida Panhandle	Florida Keys	Total
Hurricane Watch	63	63	64	60	70	62
Hurricane Warning	40	35	43	40	41	40

There was little regional variation with 60%-70% knowing the meaning of watches, and 35%-43% correctly defining warnings. Given the hurricane experience of many of these respondents, and the efforts of the NWS and media to educate the public, it is surprising that so many still do not understand these terms. This adds to the growing evidence that the use of these terms warrants further study.

4. Hurricane Experience

When respondents were asked if they had ever experienced a major hurricane, 80% said yes. Regional variations ranged from 76% to 85% with the highest rate being from Mississippi. Given the limited number of major hurricane landfalls in these areas, it appears that there is a great deal of “false” hurricane experience, i.e. people who think they have gone through a major storm, but have not.

Not surprisingly, three-fourths of Florida Panhandle and Alabama respondents said they experienced a major hurricane in 2004, while most of the others believed they had not.

5. Topics Needing More Information

Several questions asked respondents whether they needed more information on a variety of topics.

Table 15. Topics Needing Further Information

	Louisiana	Alabama	Mississippi	Florida Panhandle	Florida Keys
Insurance	67	77	68	76	69
Safe rooms	64	62	64	62	60
Sheltering in place	70	65	64	65	65
Roadway info.	83	74	73	76	55
Evacuation routes	81	70	73	69	45
Vulnerability	73	67	66	67	59
Mitigation	63	57	54	58	57
Shelters	70	62	63	64	57

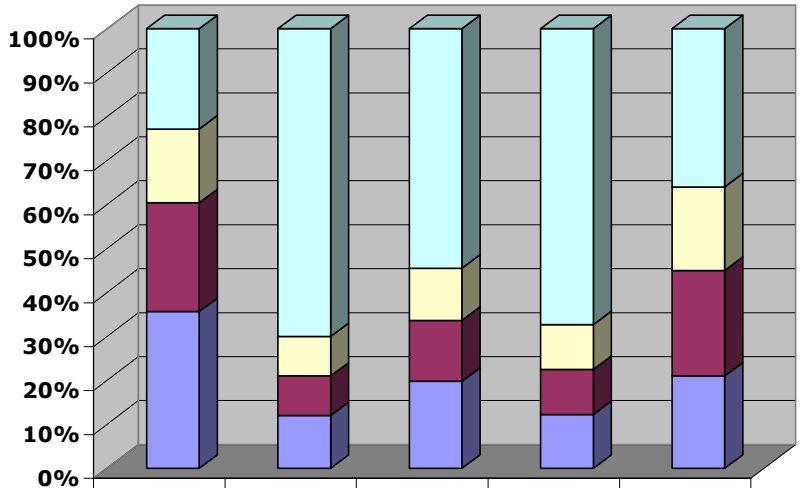
Based on this sample there appears to be considerable need for more information on insurance, safe rooms, sheltering in place, roadway information, evacuation routes, vulnerability, mitigation techniques, and sheltering. There was little variation across regions, although people in Louisiana were more likely to express a need for more information on roadways and evacuation routes.

D. Home Safety, Mitigation and Damage

1. Beliefs about Safety of Home

Respondent were asked a series of questions to gauge their beliefs about the safety of their homes from hurricanes of varying intensities. The questions were worded as follows: “I want you to think about a hurricane threatening this area with sustained winds over 155 mph. That would make it a category 4 hurricane on the Saffir-Simpson scale, nearly a category 5 – what meteorologists would call a very dangerous hurricane. If a hurricane like that made landfall near your location with sustained winds of 155 mph and then passed directly over your home, do you believe that your home would be flooded by storm surge, wave action, or river flooding severe enough to pose a threat to your safety if you stayed in your home?” This was followed by a second question asking about safety from wind. The questions were then repeated for two more examples – sustained winds of 125 mph, and then 100 mph. The following two figures indicate the responses related to flooding and wind damage by region.

Figure 39. Perceived Flooding Risk from Hurricanes of Varying Intensities by Region

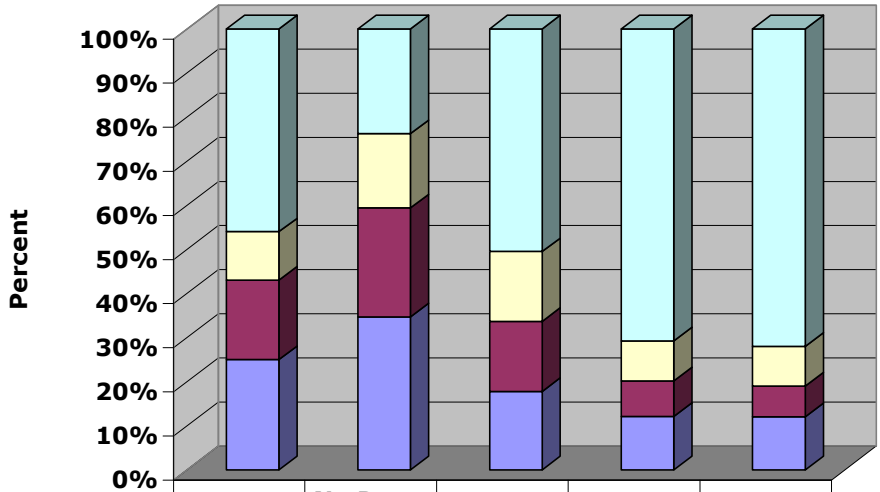


	LA	AL	MS	FL Pan.	FL Keys
No Flood Risk	23	70	55	66	36
Safe in 155 mph Storm	17	9	12	10	19
Safe in 125 mph Storm	25	9	14	10	24
Safe in 100 mph Storm	36	12	20	12	21

Interpreting these results poses a challenge. For example, it seems unusual that 36% of Monroe County and 23% of Coastal Louisiana residents believe their homes pose no flood risk in spite of the fact that most of the land is at or near sea level. One explanation could be that they live in the upper stories of buildings; however, only 17% of Monroe County and 17% of Louisiana respondents live in multiple units. Others may feel safe because their homes are built on pilings; yet, it is quite conceivable that a storm surge could exceed the height of the pilings. It would appear that a considerable number of Monroe County residents have unrealistic views of their flooding vulnerability.

The next figure looks at the results across risk zones. Some regional variation may result from the fact that the question combined “storm surge, wave action, or river flooding”. As expected, those from the more vulnerable areas are more concerned about flood risk.

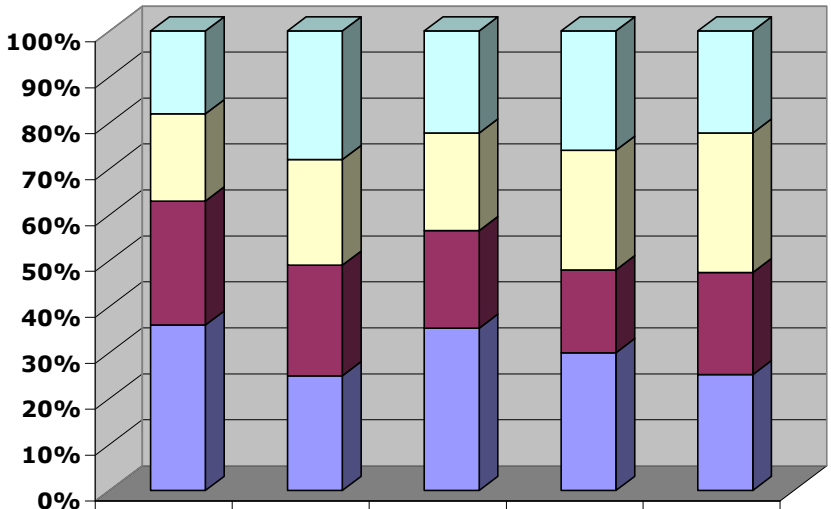
Figure 40. Perceived Flooding Risk by Risk Zone



	Cat 1+	No Data, Assume Evac Zone	Cat 3+	Cat 4+	No Evac
No Flood Risk	46	24	51	70	72
Safe in 155 mph Storm	11	17	16	9	9
Safe in 125 mph Storm	18	25	16	8	7
Safe in 100 mph Storm	25	35	18	12	12

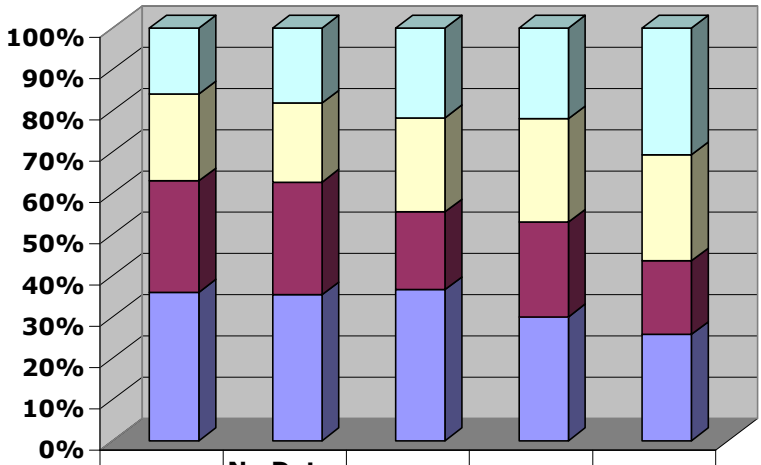
The next set of questions asks about risk for wind damage from storms of different intensities. There are no major differences either by region or by risk zone.

Figure 41. Perceived Wind Risk from Hurricanes of Varying Intensities by Region



	LA	AL	MS	FL Pan.	FL Keys
No Wind Risk in Any Storm	18	28	22	26	22
Safe in 155 mph Storm	19	23	21	26	30
Safe in 125 mph Storm	27	24	21	18	22
Safe in 100 mph Storm	36	25	35	30	25

Figure 42. Perceived Wind Risk from Hurricanes of Varying Intensities by Risk Zone



	Cat 1+	No Data, Assume Evac Zone	Cat 3+	Cat 4+	No Evac.
No Wind Risk in Any Storm	16	18	22	22	31
Safe in 155 mph Storm	21	19	23	25	26
Safe in 125 mph Storm	27	27	19	23	18
Safe in 100 mph Storm	36	35	37	30	26

Again, there are some disturbing responses. The extent to which residents in all regions believe their home would be safe in a 155 mph storm, or any size storm, appears unrealistic.

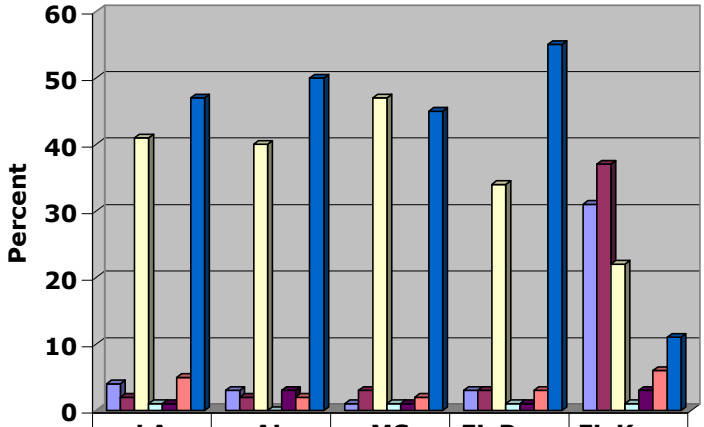
2. Mitigation

Respondents were asked several questions about various preparation or mitigation activities they may have taken, either prior to hurricane season or before Ivan.

a. Window Protection

Respondents were asked what, if any, window protection they had before Ivan. The responses about protection are illustrated by region and risk zone in the next two figures.

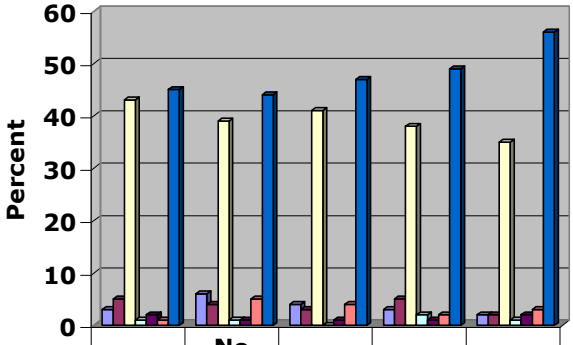
Figure 43.
Window Protection Before Ivan by Region



	LA	AL	MS	FL Pan.	FL Keys
Permanent Roll-Down Metal Panels	4	3	1	3	31
Removable Metal Panels	2	2	3	3	37
Plywood Sheets	41	40	47	34	22
Security Film	1	0	1	1	1
Impact-Resistant Glass	1	3	1	1	3
Other	5	2	2	3	6
None	47	50	45	55	11

Most homes that have any window protection have plywood panels, with the exception of Monroe County, Florida where 31% have invested in permanent roll-down metal panels and another 37% in removable metal panels. Unfortunately, there was little variation by risk zone.

Figure 44. Window Protection Before Ivan by Risk Zone

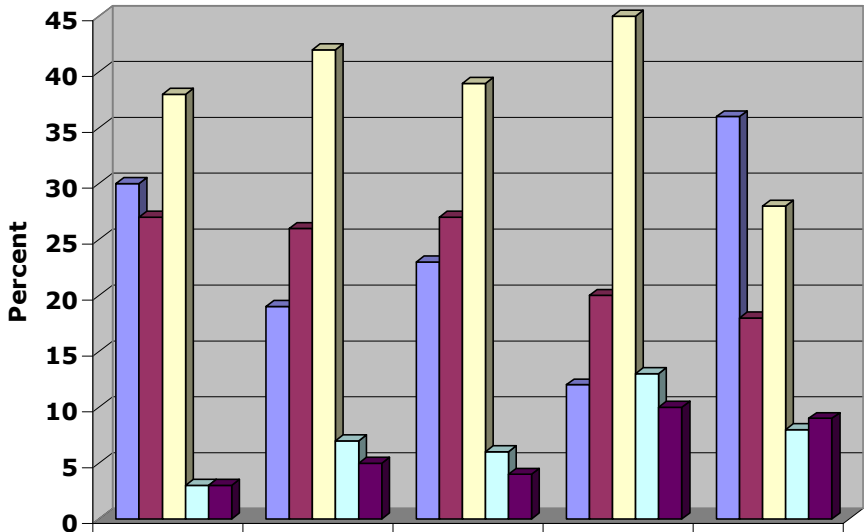


	Cat 1+	No Data, Assume	Cat 3+	Cat 4+	No Evac. Zone
Permanent Roll-Down Metal Panels	3	6	4	3	2
Removable Metal Panels	5	4	3	5	2
Plywood Sheets	43	39	41	38	35
Security Film	1	1	0	2	1
Impact-Resistant Glass	2	1	1	1	2
Other	1	5	4	2	3
None	45	44	47	49	56

b. Amount Spent on Mitigation

Respondents were then asked how much they had spent to protect their home and property from Hurricane Ivan. The results are illustrated by region and risk zone in the next two figures.

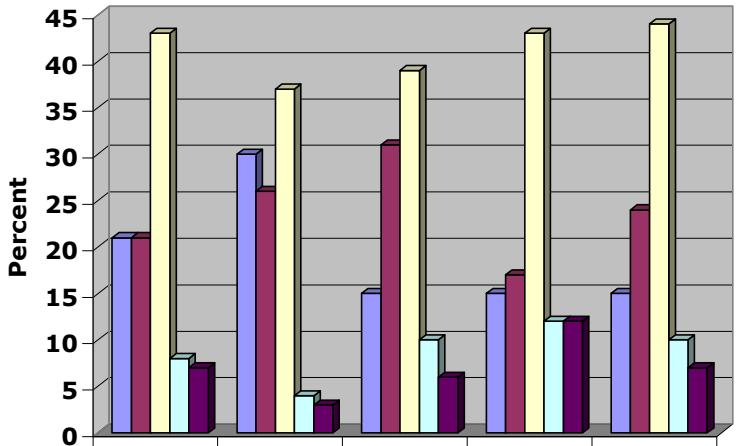
Figure 45. Amount Spent Protecting Home from Ivan by Region



	LA	AL	MS	FL Pan.	FL Keys
Zero	30	19	23	12	36
Less than $100	27	26	27	20	18
$101-$500	38	42	39	45	28
$501-$1000	3	7	6	13	8
More Than $1000	3	5	4	10	9

The most common amount given for all regions except the Keys was between $101-$500. The amount spent on Ivan in the Florida Keys was relatively low, perhaps because they had already purchased mitigation.

Figure 46. Amount Spent Protecting Home from Ivan by Risk Zone

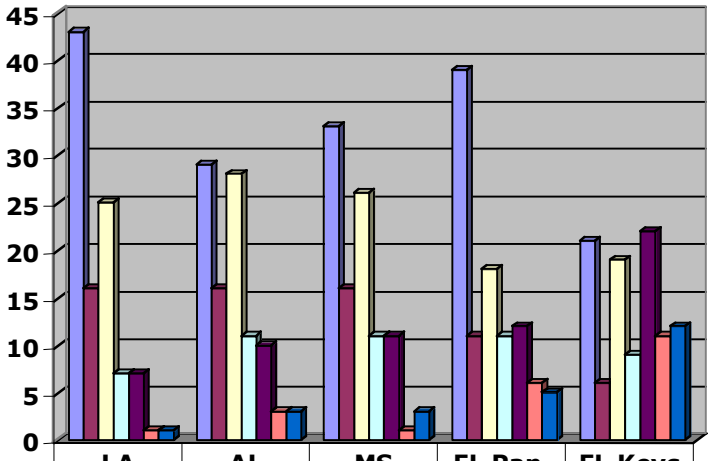


	Cat 1+	No Data, Assume Evac. Zone	Cat 3+	Cat 4+	No Evac
Zero	21	30	15	15	15
Less than $100	21	26	31	17	24
$101-$500	43	37	39	43	44
$501-$1000	8	4	10	12	10
More Than $1000	7	3	6	12	7

Interpreting these data by risk zone is difficult. It appears that people not living in an evacuation zone had in fact spent the most to protect their home and property from Hurricane Ivan. Perhaps this is because those in riskier areas had already mitigated.

To examine this possibility the next questions asked how much they had spent altogether, this year and in previous years, to protect their homes. The next two figures depict the total amount spent by region and risk zone.

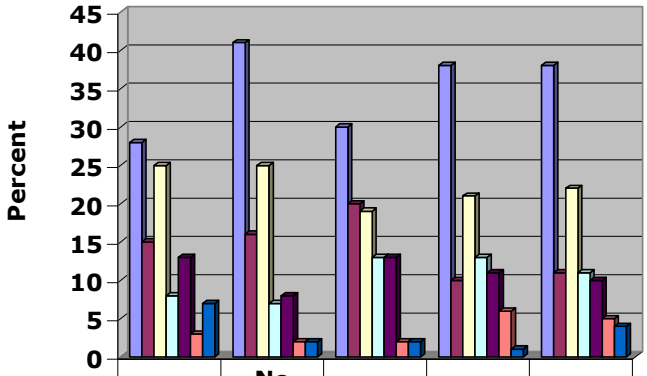
Figure 47. Total Spent on Mitigation by Region



	LA	AL	MS	FL Pan.	FL Keys
None	43	29	33	39	21
Less than $100	16	16	16	11	6
$100-$499	25	28	26	18	19
$500-$999	7	11	11	11	9
$1000-$4999	7	10	11	12	22
$5000-$9999	1	3	1	6	11
$10,000 or More	1	3	3	5	12

The most common answer across all regions except the Florida Keys was that they had spent nothing on home mitigation. As might be expected, given recent storm history, the highest reports of spending in excess of $1000 occurred in the Florida Keys and Panhandle, 45% and 33%, respectively.

Figure 48. Total Spent on Mitigation by Risk Zone



	Cat 1+	No Data, Assume Evac	Cat 3+	Cat 4+	No Evac Zone
Zero	28	41	30	38	38
Less than $100	15	16	20	10	11
$100-$499	25	25	19	21	22
$500-$999	8	7	13	13	11
$1000-$4999	13	8	13	11	10
$5000-$9999	3	2	2	6	5
$10,000 or More	7	2	2	1	4

When the data are examined by risk areas, the results are confusing. The lowest rates of mitigation appear to occur in those areas for which there were no evacuation zone data, but were assumed to be high risk, i.e. the Louisiana parishes included in the study, and Monroe County, Florida. As might be expected, more households in Cat 1+ areas had spent $10,000 or more on mitigation, but it was still only 7%.

c. Awareness of Government Programs

Most of the sample (85%) across all regions indicated they were not aware of any government programs to help pay for mitigation.

3. Hurricane Effects

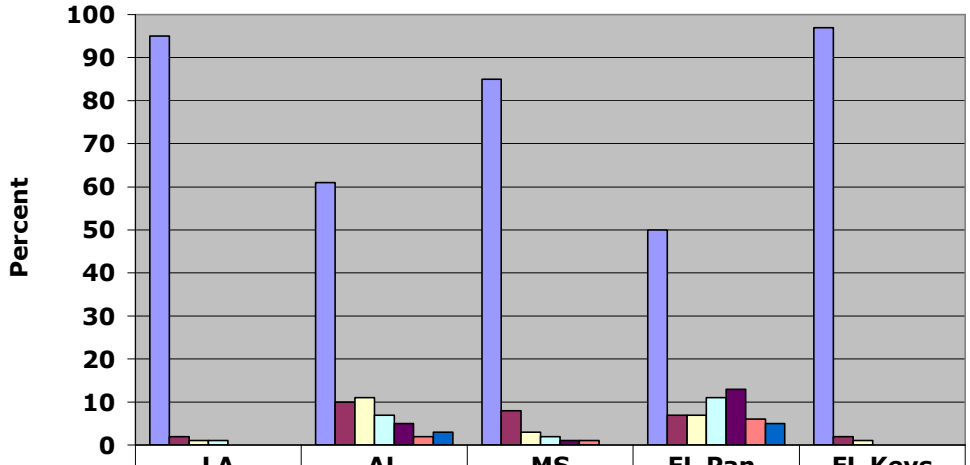
a. Jobs

Only 5% indicated that Hurricane Ivan had negatively affected their jobs. Of these, 30% reported losing less than one week of work, 16% two weeks, and 18% three weeks. About 10% said they were still out of work.

b. Home Damage

As expected, home damage from Ivan varied by region.

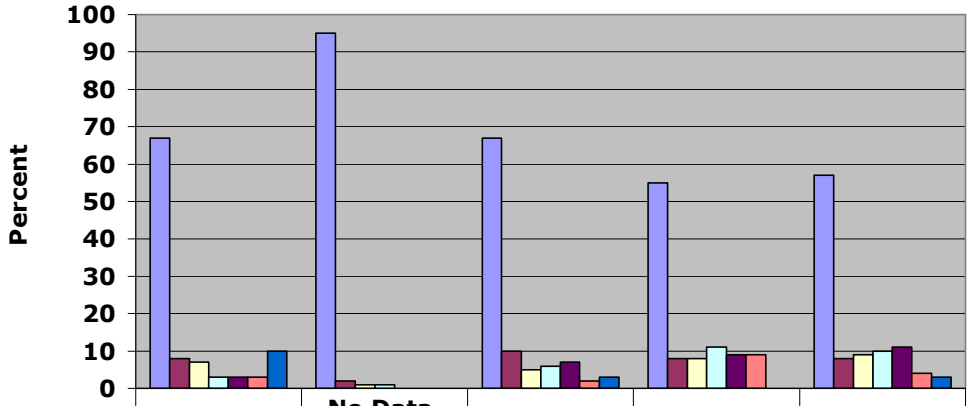
Figure 49. Damage from Hurricane Ivan



	LA	AL	MS	FL Pan.	FL Keys
None	95	61	85	50	97
Less than $1000	2	10	8	7	2
$1000-$4999	1	11	3	7	1
$5000-$9999	1	7	2	11	0
$10000-$24999	0	5	1	13	0
$25000-$49999	0	2	1	6	0
$50000 or More	0	3	0	5	0

Given the storm's path, it is not surprising that the highest reports of costly damage were for the Florida Panhandle, followed by Alabama. However, some damage from Hurricane Ivan was reported in every region.

Figure 50. Damage from Hurricane Ivan by Risk Zone

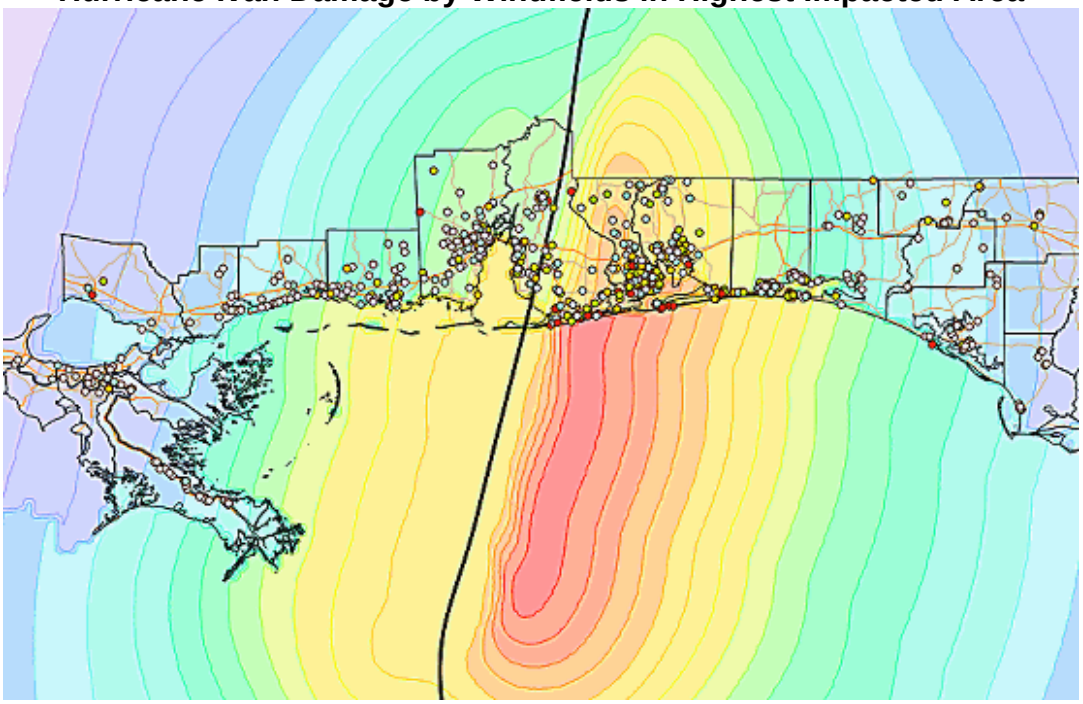


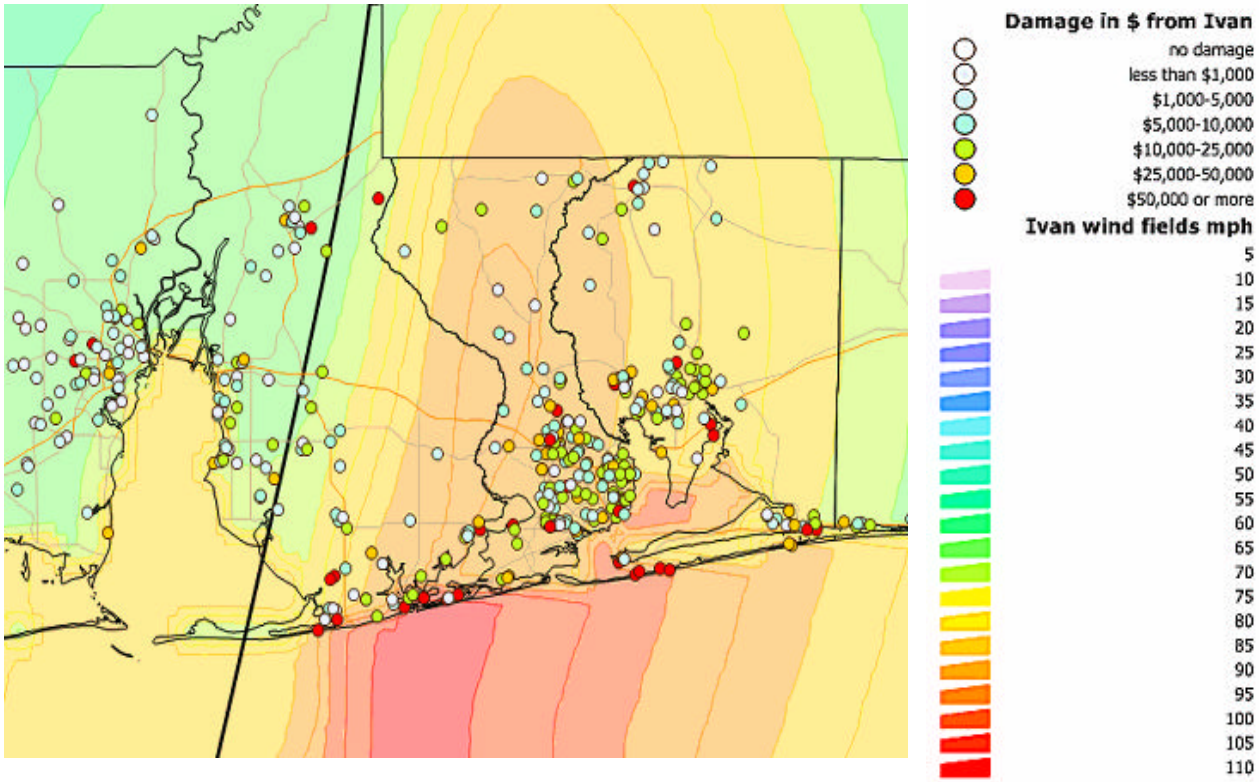
	Cat 1+	No Data, Assume Evac. Zone	Cat 3+	Cat 4+	No Evac.
None	67	95	67	55	57
Less than $1000	8	2	10	8	8
$1000-$4999	7	1	5	8	9
$5000-$9999	3	1	6	11	10
$10000-$24999	3	0	7	9	11
$25000-$49999	3	0	2	9	4
$50000 or More	10	0	3	0	3

Again, as expected, the most costly damage occurred in the Category 1+ zone. It is especially interesting to see how much damage was reported in the less risky zones, however. There are several possible explanations, including the likelihood that this self-reported and unverified damage is inflated. Also, it may not take much to damage older or poorly maintained property. Past research has documented how relatively low winds can cause damage in poorer neighborhoods where the houses are likely to be less well constructed and maintained.

In order to see the relationship between wind levels and damage, the following two maps were created. There is more damage in areas of higher winds, but there are also scattered instances of damage in areas with lower wind speeds. This widespread scattered damage at all hurricane wind speeds may be one of the lessons of the 2004 hurricane season in Florida.

Figures 51 and 52.
Hurricane Ivan Damage by Windfields in Highest Impacted Area





4. Plans to Move

When respondents were asked if they had any plans to move to a place with less danger from hurricanes, about 9% of the total sample answered affirmatively. There were only slight regional differences: Louisiana 10%; Alabama 7%; Mississippi 6%; Florida Panhandle 8% and Florida Monroe County 10%.

III. Conclusions

Over the entire study area the evacuation rate was 45%, comparable to that recorded for Hurricane Georges in the same region. As expected, given the track of Hurricane Ivan, the rate was much higher this time for the Florida Panhandle (69%), and the Florida Keys (62%). The highest evacuation rates were in the highest risk zones, indicating that most people were measuring their vulnerability in a reasonable manner. However, looking at the issue another way, many people who should have evacuated, did not, including 55% from the coastal Louisiana parishes.

Over-evacuation was less of a problem, but about one-quarter (28%) of those who evacuated did not live in an evacuation zone. Some of these may be from mobile homes or other vulnerable living situations, but it appears that many people living in inland areas evacuated who probably should not have. For example, 43% of those living in a Category 4 or 5 evacuation zone left. The over-evacuation is more pronounced in areas where people do not have as much previous evacuation experience.

Belief about the safety of their homes was the primary reason given for the evacuation decisions by both evacuees and non-evacuees. Those who stayed were more likely to believe their homes were safe, and to have taken some mitigation action. Traffic was the next mentioned reason for not leaving, particularly in those areas where it has been a problem, particularly Louisiana. However, fewer people from the Keys were concerned about traffic in this survey than in the Hurricane Georges study.

Household evacuation decision-making tends to be a complex process in which more than one factor is considered. A number of variables have been found to be correlated with evacuation decisions in past research, and in this study simple correlations occurred with many of these same factors, such as an official evacuation notice, gender of decision-maker, pets, income, education, hurricane experience, type of housing unit, presence of children or older household members, and having window protection.

A unique contribution of this study is that multivariate analysis was done to determine which of these factors are unique, that is, they make a contribution toward explaining evacuation decisions irrespective of the other factors. The analysis revealed that evacuees are more likely to have heard an official notice,

to live in an evacuation zone, and to have higher income. Those who chose not to evacuate are more likely to be male, African American or black, have a household member who has to work, and have window protection.

The significance of living in an evacuation zone and hearing an official notice point out how important it is for citizens to have correct information. While about three-quarters of all respondents said they knew whether they were in an evacuation zone, this still means that many do not, including 58% in the Florida Panhandle. There is also a great deal of confusion about official notices, whether they were given, who is responsible for them, whether they are recommended or mandatory, and to whom they apply.

Most people said they would make the same decision the next time in a similar situation. This is in agreement with past evacuation studies and supports the notion of a fairly stable division between evacuees and non-evacuees. The largest rate (18%) saying they would make a different decision next time occurred with Florida Panhandle respondents who did not evacuate, and thus experienced the storm. Interestingly, about two-thirds of the non-evacuees in the total sample said they had made tentative plans to leave if the storm had gotten worse. This could result in serious traffic jams under hazardous conditions.

One of the most important findings of this study has to do with the timing of evacuation, particularly in relation to traffic delays. Most people in the impact area started leaving about 30 hours before the first hurricane force winds. As might be expected, those leaving at least 24 hours before the storm (as they are advised) experienced the longest delays. However, those who left less than 12 hours before the storm experienced the least delay. This is not the message officials wish to convey.

In general, traffic delays were not a serious problem during the Ivan evacuation. The average travel time was six hours and most evacuees reached their destination within the normal time period. The fewest traffic delays were reported in the Florida Panhandle and Alabama, and the most occurred in the coastal Louisiana parishes where 44% of those who left 24-36 hours before the storm experienced delays of more than six hours. Contra-flow procedures were in effect, but most of the Louisiana respondents either were not aware of contra-flow lanes, or did not use them, and they were also more likely to say they needed more traffic information. A considerable number of Louisiana evacuees (18%) said they would leave earlier next time.

As with other studies, the vast majority of households first heard about the evacuation on television. What is different is that, while still small, a growing number are turning to the internet for additional information, and this is particularly true in the Florida Keys. The NHC and NWS are valued information sources with most people paying attention to their advisories. However, there is still considerable confusion about the meaning of hurricane watches and

warnings. More people now report seeing the cone than the center track in the forecasts. This may be explained in part by the attention given to this issue after Hurricane Charley. It is interesting to note that those who reported seeing only the forecast track line were less likely to evacuate.

Most evacuees stayed with relatives or friends, and did not travel very far – the median distance was a 117 miles. Most (69%) took one car. As expected, given the geography, the longest distances and time traveled were reported by residents of the Florida Keys and Louisiana. While Keys residents tended to travel furthest (230 miles), Louisiana evacuees took the longest average time – eight hours to travel an average of 198 miles. Most spent less than $100 per day while gone, but again the exception was for the Florida Keys where about three-quarters (73%) spent more.

An important finding that is not new, but needs emphasis, is that an evacuation takes time. Even under the best circumstances it takes a minimum of several hours for households to make their decision and prepare to leave, and that time varies across households. In the case of Ivan it was more than 68 hours from the time the first person and the last person left in the Gulf regions. While the goal should be to shorten this, it must be recognized that evacuation is a several day process, especially in Louisiana and the Florida Keys.

One finding from this work that should be of concern to officials is the high rate (80%) of these respondents who said they had experienced a major hurricane in the past. Based on where they live, this cannot have been the case. Granted, some may have gained the experience while living elsewhere, but this would not account for the high rate. It is common for people who are on the fringes of a storm to later say they went through it because they experienced some heavy winds and rain. Since they have not truly experienced a hurricane's fury, they are likely to have a false sense of their home's resiliency.

Based on damage reports many homes located outside what is considered the impacted area sustained damage from wind and/or rain. This has been reported in other storms as well. Explanations include poorly constructed homes, poorly maintained homes, areas with many trees, especially if they have not been trimmed, and lack of mitigation. Inland residents tend not to feel hurricane vulnerable, but the extensive inland damage caused by the 2004 storms should be a wake-up call.

Very little home mitigation had been completed in these regions. The rates are somewhat higher in Florida, but still most had spent less than $500 total on home protection. Again Florida Keys respondents were the exception, with 5% having either roll-down shutters or removable metal panels.

In summary, Hurricane Ivan evacuation went as expected based on past behavioral studies. An important lesson emphasized in these findings is that

most people are paying attention to hurricanes. They listen to the media broadcasts, hurricane advisories, and official evacuation notices, and then make their own evacuation decisions based on a complex array of factors related to their individual households and homes. However, these decisions are not as informed as they should be. There is still considerable misunderstanding about the destructive forces of hurricanes, the relative safety of their homes, the meaning of hurricane advisories, the best traffic routes, and the concept of sheltering in place where possible.

APPENDIX A
Figure A-1. Weighted Sample Breakdown by County/Parish

		Count	Percent
County/Parish	Baldwin County	136	4%
	Bay County	178	6%
	Escambia County	346	11%
	Franklin County	13	0%
	Gulf County	17	1%
	Hancock County	41	1%
	Harrison County	179	6%
	Inland Counties	118	4%
	Jackson County	121	4%
	Jefferson Parish	435	14%
	Mobile County	370	12%
	Monroe County	102	3%
	Okaloosa County	141	4%
	Orleans Parish	454	14%
	Plaquemines Parish	24	1%
	Santa Rosa County	147	5%
	St. Bernard Parish	64	2%
	St. Charles Parish	43	1%
	St. John The Baptist	38	1%
	St. Tammany Parish	175	5%
	Walton County	58	2%
	Total	3200	100%