II. FINDINGS

A. Evacuation Decision

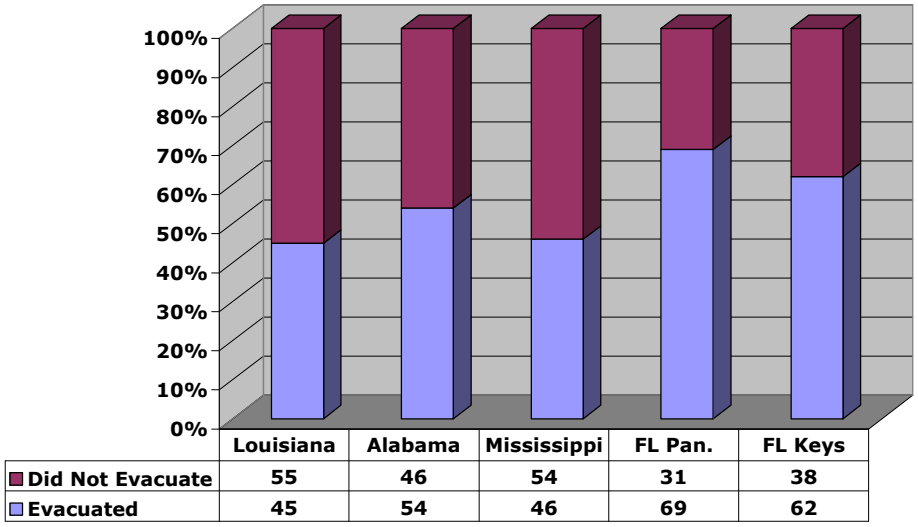
The major topic of this behavioral analysis is evacuation behavior. It is crucial for emergency managers and other officials to understand, not only who will or will not evacuate, but the factors involved in household evacuation decisions.

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.

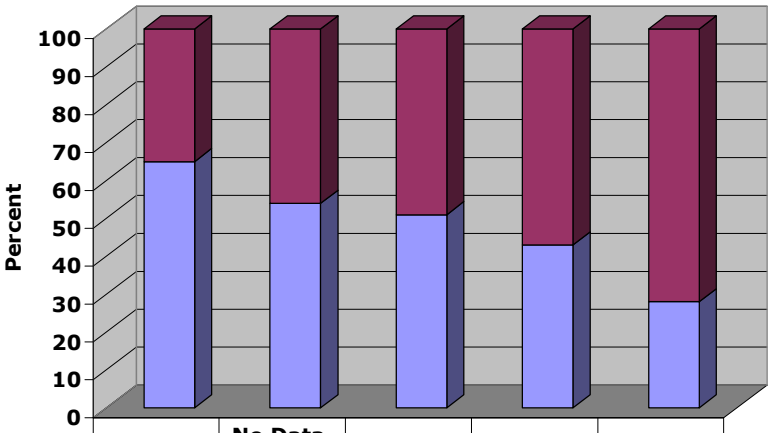
Figure 4.

Evacuation by Region



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.



	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

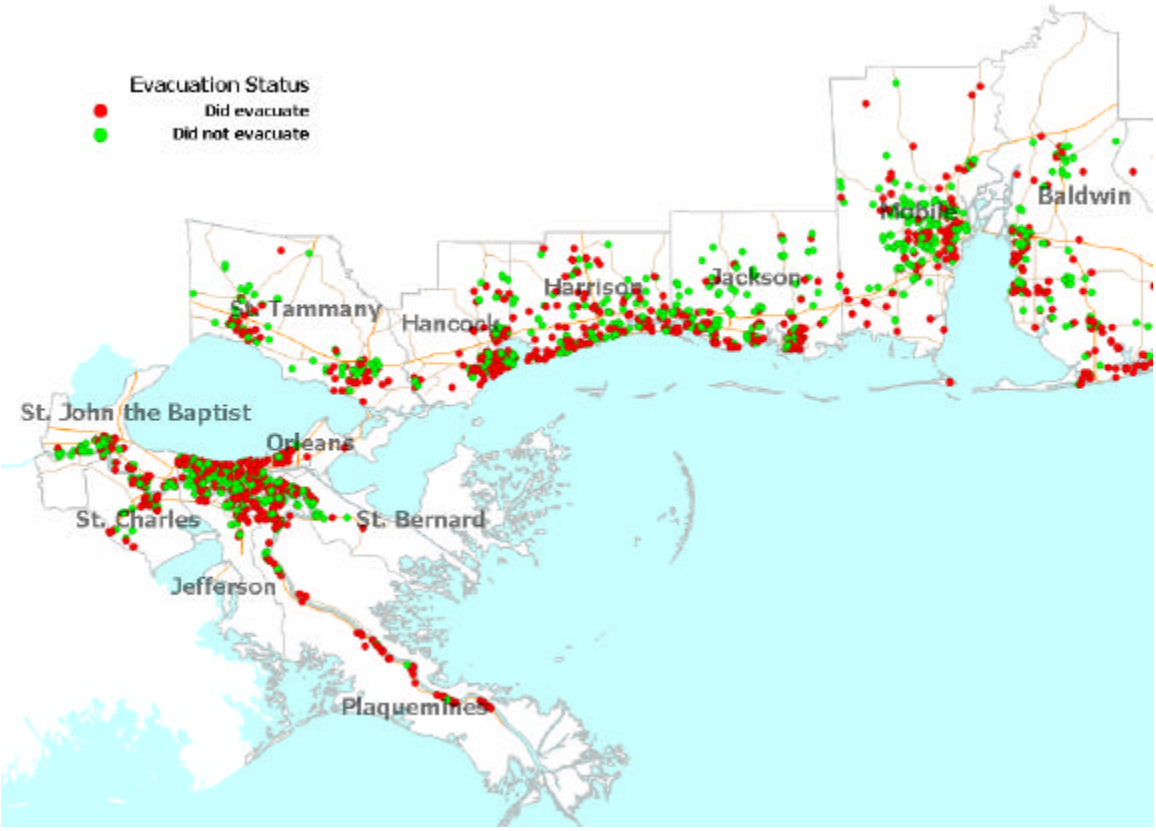


Figure 7. Florida Panhandle Respondents According to Evacuation Action

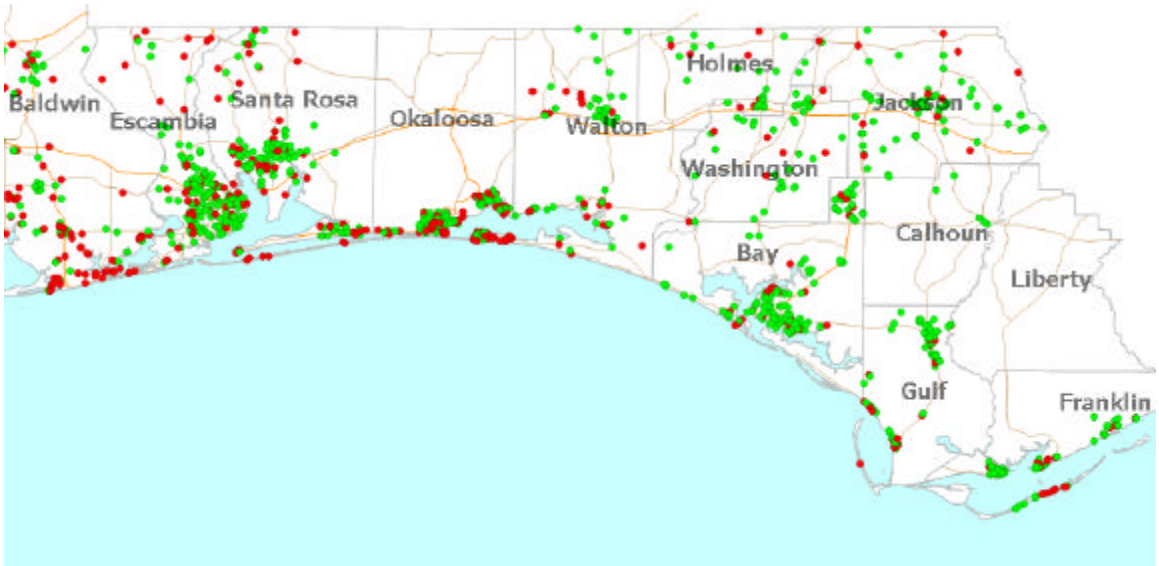
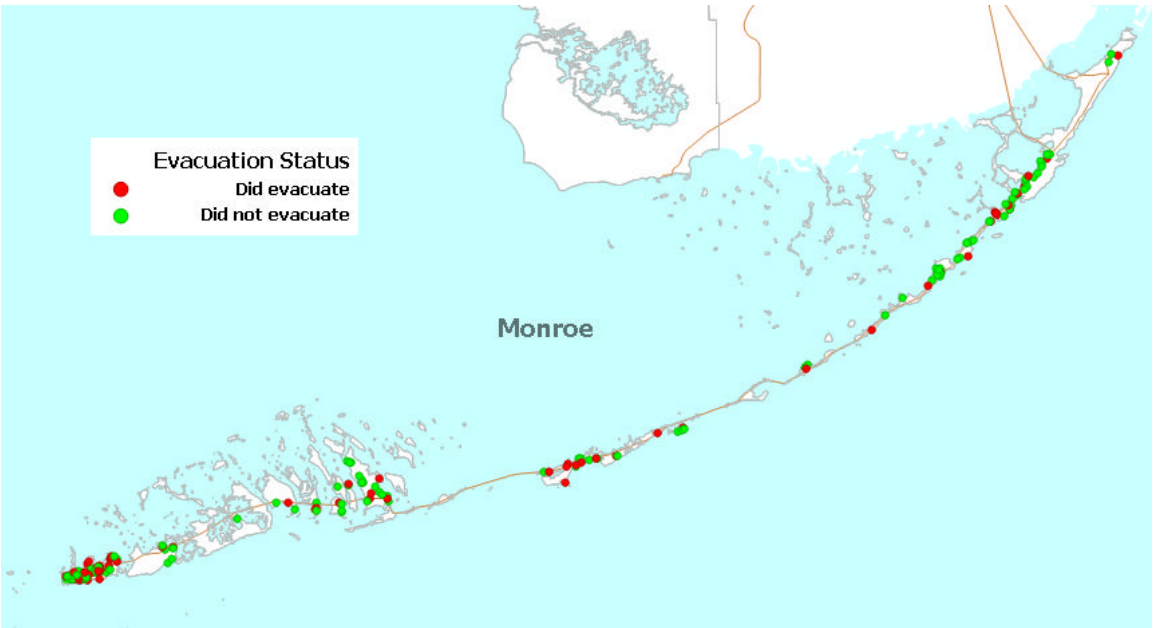


Figure 8. Monroe County Respondents According to Evacuation Action



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

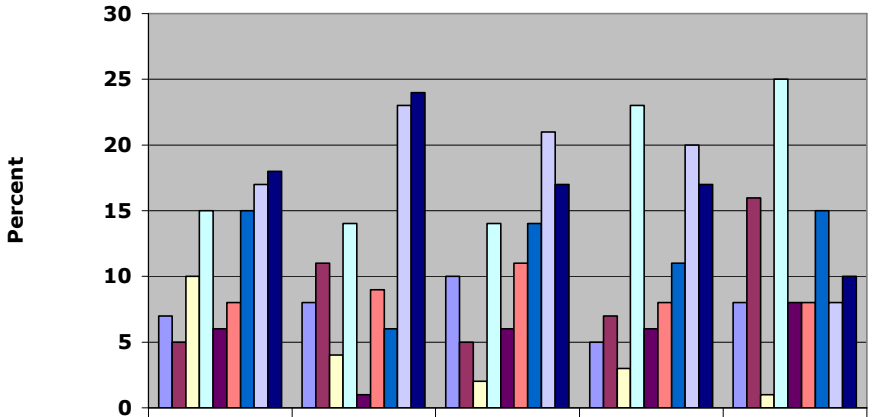
When evacuees were asked their reasons for leaving, the most common first response had to do with the safety of their home, followed by official advice, and characteristics of the storm, such as track and severity. Advice from friends, the

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.

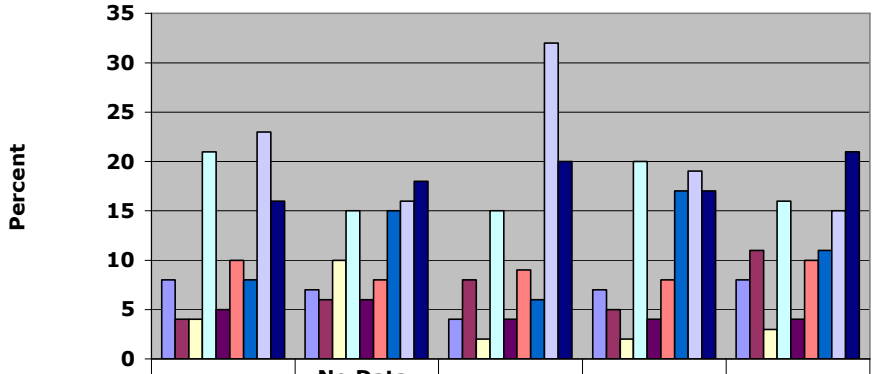
Figure 9. Reasons for Evacuating by Region



	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

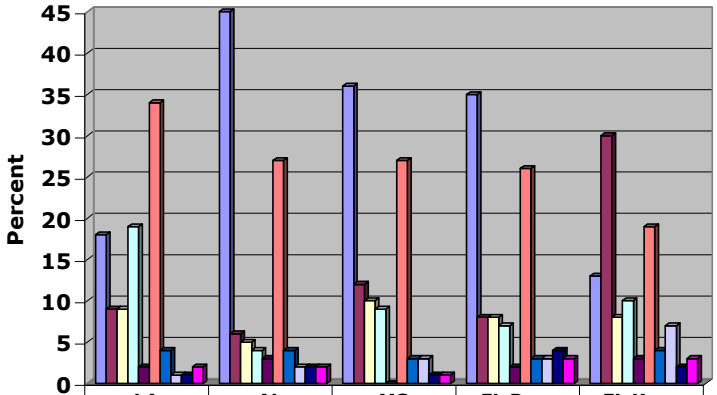
Reasons for evacuation were similar across risk zones. Official advice and concerns about the safety of their homes were important to all.

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

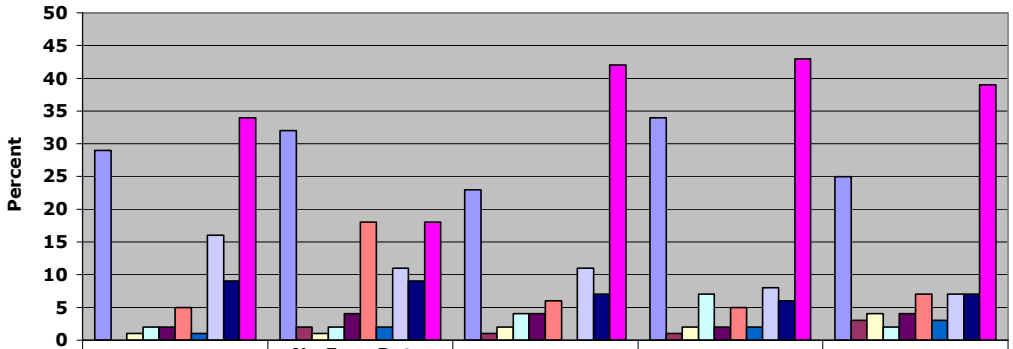
When non-evacuees were asked what made them decide not to leave their homes, the most common reason given in Alabama, Mississippi and the Florida Panhandle was the belief that their home was well-built – in other words, they felt safe. This was confirmed in another question where non-evacuees were asked 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.

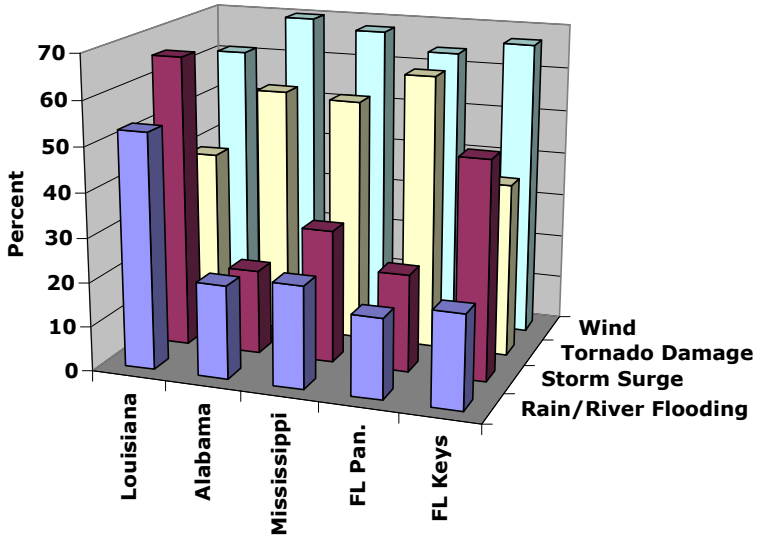
While the following appear to be make a unique contribution toward explaining the decision to stay:

- 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.

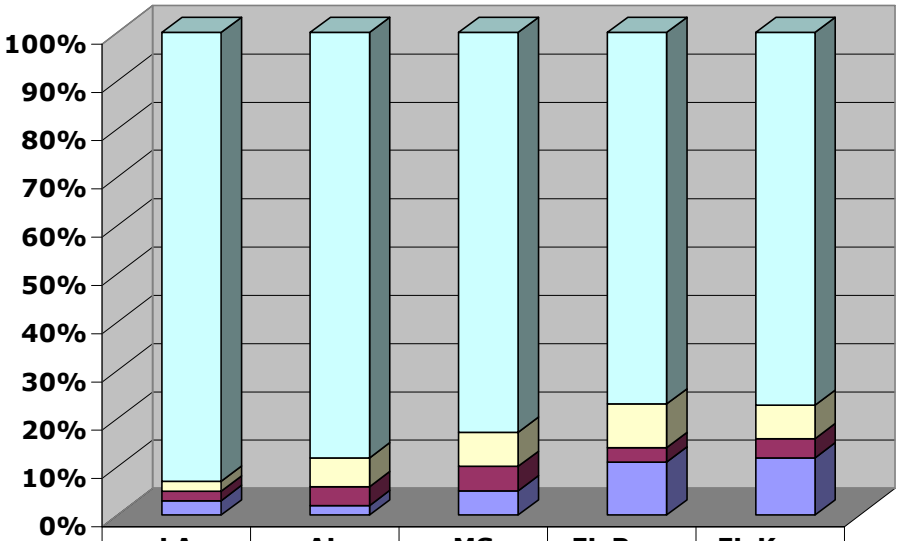
c. Source of Evacuation Notice

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.

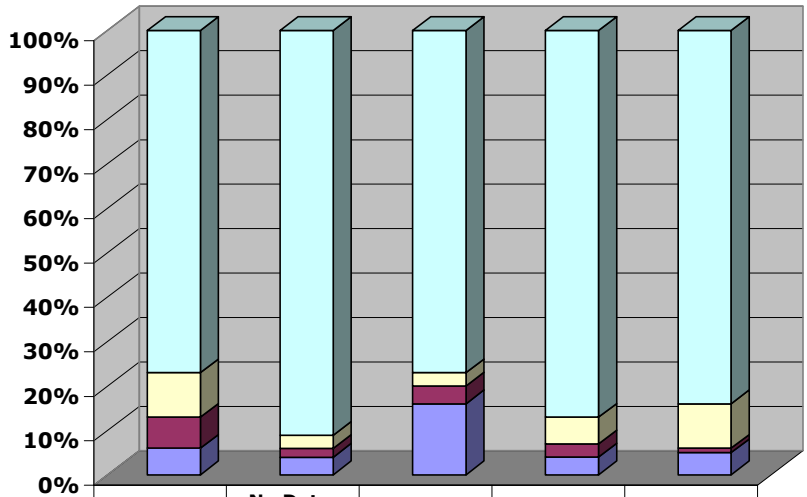
First Source of Evacuation Notice by Region



	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

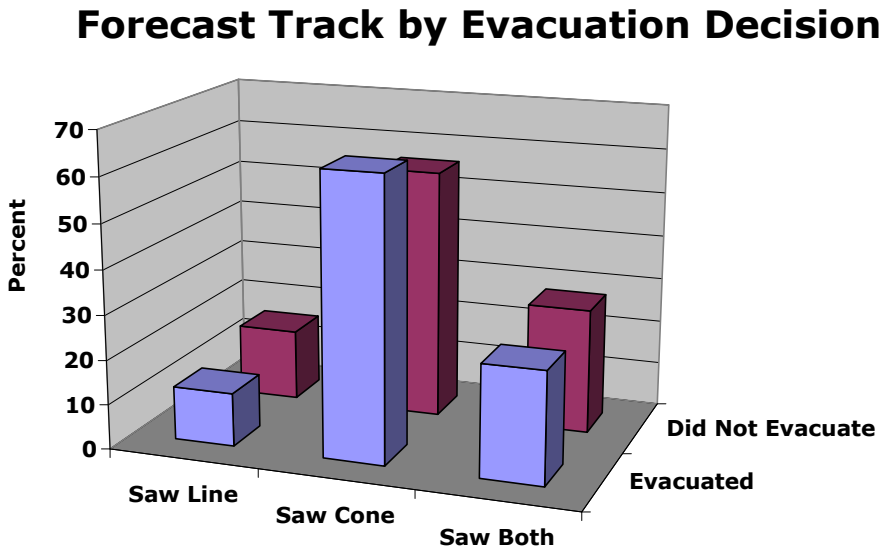
Across all regions, between 78-85% of respondents reported that the NHC watches and warnings were an important factor in their evacuation decision. However, as will be described later in this report, many did not have a clear understanding of the meaning of these terms.

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

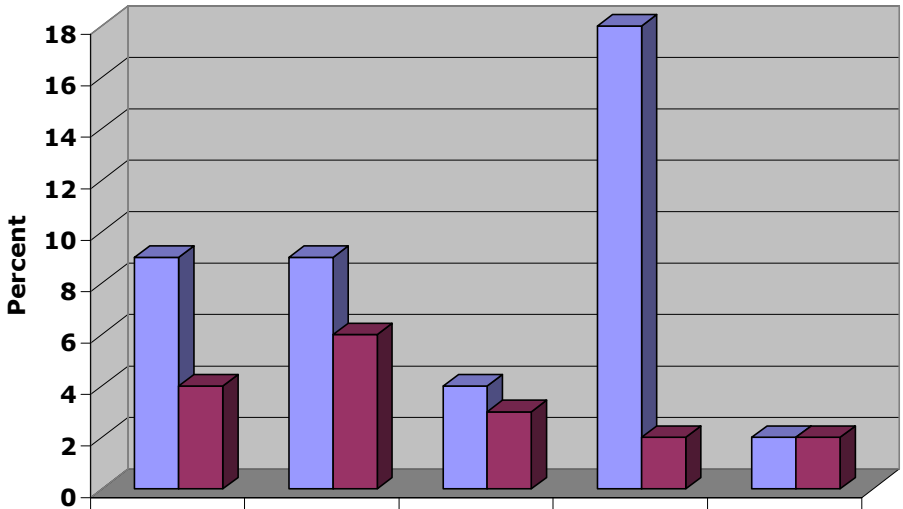
It is interesting that two-thirds of these non-evacuees reported that they had made plans to go someplace safer if the threat got worse, and over half said they would have left if Ivan had been going to hit their area directly. The issue, of course, is that this might have been too late to evacuate safely.

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



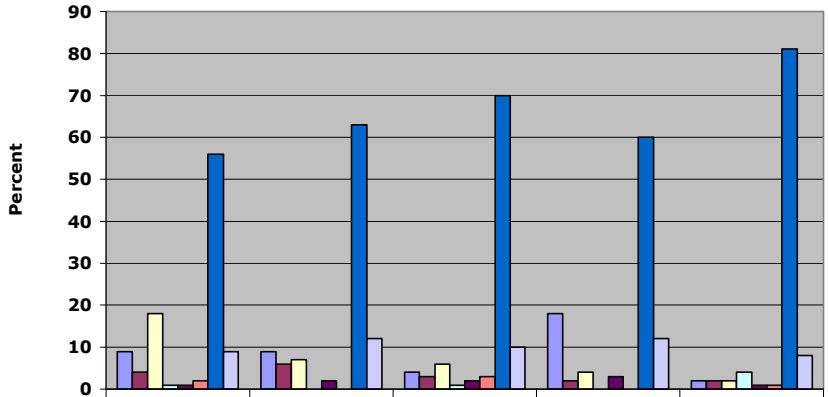
	LA	AL	MS	FL Pan.	FL Keys
Non-Evacuee Would Evacuate	9	9	4	18	2
Evacuee Would Not Evacuate	4	6	3	2	2

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

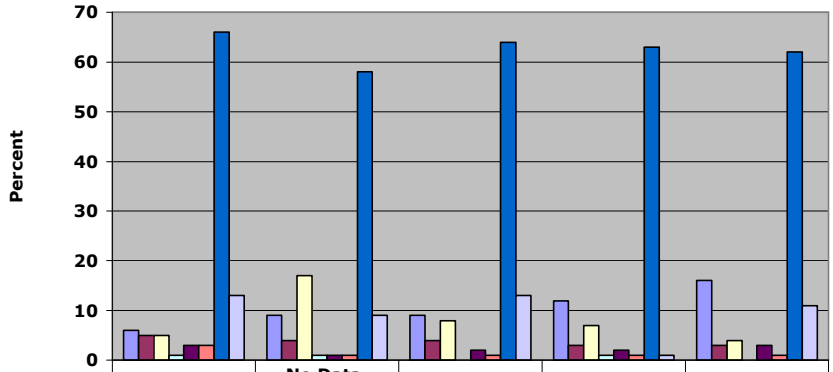


	LA	AL	MS	FL Pan.	FL Keys
Non-Evacuee Would Evacuate	9	9	4	18	2
Evacuee Would Not Evacuate	4	6	3	2	2
Evacuee Would Leave Earlier	18	7	6	4	2
Evacuee Would Leave Later	1	0	1	0	4
Evacuee Would go to Different Place	1	2	2	3	1
Evacuee Would Use Different Route	2	0	3	0	1
Would Not Do Anything Different	56	63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