Public Perceptions of GE Mosquito Control Efforts in Key West: An In-Person Survey of 205 K.W. Residents, January 1-5, 2013

Summary and Technical Report

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EXECUTIVE SUMMARY

Key West residents were interviewed at their residences between January 1 and January 5, 2013. The topic of the survey was mosquito control and the potential use of genetic engineering (GE) of mosquitoes to prevent dengue outbreaks. The Florida Keys Mosquito Control District (FKMCD) in Monroe County provided the majority of funding for this study, while the College of Humanities and Social Science Research Office and a National Science Foundation IGERT in Genetic Pest Management at North Carolina State University provided additional funding. A total of 205 interviews were completed, for a 27% response rate, and with a margin of sampling error of +/-6.8%.

A sample of only Key West residents was obtained because the FKMCD is considering using GE technology only in Key West that inserts (1) a fluorescent marker into mosquitoes that are released for their identification and (2) a gene that when passed on leads to the death of most offspring of GE male mosquitoes that successfully mate. This approach to mosquito control is designed to suppress only the native population of *aedes agypti* because it spreads dengue fever. Public perceptions about GE mosquito control technology are rare, and these results can be used to help guide policy decisions.

According to the survey results, all but four respondents said mosquito control is an important issue to them. Most believed that mosquitoes are a nuisance where they live (68%), but a majority was "only worried a little" or unworried at all about dengue fever.

A majority of respondents (63%) hold a favorable view of the FKMCD, while just 8% hold an unfavorable view (the remaining percentage said they felt "neutral").

Respondents, though, were evenly divided about whether it is safe to use chemicals and insecticides to control mosquitoes. In fact, a slightly higher percentage of respondents said it was safe to use GE mosquitoes. A majority (60%) supports the FKMCD to use GE technologies for mosquito control. In addition, a slim majority trusts the FDA to decide if GE mosquitoes are safe.

One important finding is that support for GE mosquitoes in Key West occurs alongside residents' significant awareness about it. Nationally, most Americans had never heard about the topic (http://geneticengsoc.ncsu.edu/first-ever-national-survey-on-genetically-engineered-mosquitoes-shows-mixed-support). Yet, fewer than 20% of Key West respondents, they had heard "nothing" about it prior to taking the survey. That difference in awareness is important because scholars describe a process called "risk amplification" that is partially generated by news media coverage of new technologies. This study, though, fails to find evidence that GE is perceived as risky via exposure to news media. When looking at the cross-tabulations of respondents' exposure to information with their attitudes about GE technologies, for example, most sources of information were unrelated to opinions about GE and the FKMCD, and the negative relationships were isolated to two sources used by a fraction of the sample.

Instead, according to the multivariate analysis (Appendix B, regression modeling), the only significant factors for predicting support for using GE mosquito control are ***risk acceptance in general*** (the belief that we should use new technologies unless they are proven unsafe, as opposed to delaying their adopting until proven safe), ***FDA approval***, worry about ***dengue fever***, ***perceptions about how safe GE is compared to using chemicals and insecticides***, and ***exposure to anti-GE opinions*** (a 2012 town hall meeting & an online petition to ban GE in Key West). Interestingly, feelings about the FKMCD were weakly related to support for using GE, and the only meaningful predictors of opinions about the FKMCD were ***perceptions that chemicals and insecticides are safe*** to use and ***talking with others about GE mosquitoes***.

Nevertheless, these results should be interpreted cautiously. Foremost, the sample size for this study is small. Results have a high margin of sampling error (+/-6.8 for the full sample), and the margin of sampling error is higher than the mail survey (+/-4%). Secondly, residents' views about using GE do not appear to be crystallized so they could easily change in a dynamic information environment. For example, respondents had difficulty identifying potential benefits and hazards of using GE mosquito control (Appendix C). In that analysis, the most common potential benefit cited was "fewer mosquitoes", but reducing the population is only a process towards the end of making dengue less prevalent. The next most frequent answer about benefits was to not list anything. Yet, the data indicate presently a majority of Key West residents hold favorable views about the FKMCD and they also support using GE mosquitoes.

The following lists the variables that were found to be statistically significant and insignificant for explaining opinions about the FKMCD and GE mosquito control techniques.

Explaining opinions about the FKMCD

Statistically significant variables explaining opinions about the FKMCD

1. Perception about whether it is safe to use chemicals and insecticides for mosquito control (safer = more favorable views).
2. Talking with neighbors about GE mosquitoes (having talked = more favorable views).

Variables that **do not** significantly explain opinions about the FKMCD

1. Support for using GE technology in KW.
2. Being a landlord.
3. Owning a small business.
4. Perception that mosquitoes are a nuisance.
5. Worry about dengue fever.
6. Gender.
7. Education.
8. Being a year-round resident.
9. Reliance on any specific source of information about GE mosquitoes other than taking with neighbors.

Explaining opinions about using GE technologies

Statistically significant variables explaining opinions about using GE technology

1. Perceptions about how safe it is to use GE technology compared to chemicals and insecticides for mosquito control (GE safer = more supportive).
2. Trust in the FDA (more trust = more supportive).
3. Worry about dengue fever (more worry = more supportive).
4. Risk acceptance (greater tolerance for risk = more supportive).
5. Exposure to anti-GE online petition (exposure = less supportive)

Variables that **do not** significantly explain opinions about using GE technologies

1. Opinions about the FKMCD
2. Being a landlord
3. Owning a small business
4. Perception that mosquitoes are a nuisance
5. Awareness of the topic of GE mosquito control technology
6. Gender
7. Education
8. Being a year-round resident
9. Reliance on any source of information about GE mosquitoes other than the anti-GE online petition

INTRODUCTION & METHODOLOGY

This report describes how residents of Key West evaluated the FKMCD and mosquito control efforts, including the potential to use GE technologies for mosquito control. A primary concern of the FKMCD is controlling the population of mosquitoes that spread dengue fever. A brief opinion survey was taken between Jan 1-5, 2013, by 205 part-time and full-time residents (See Appendix A for the survey instrument). Surveys were conducted in a face-to-face format by trained interviewers following standard sampling techniques (see Appendix D). Respondents who agreed to take part in the study were provided an Ipad to self-administer the survey using an application developed by QuickTap, or they could request interviewer assistance. The survey had a 47% contact rate, a 27% response rate, and a margin of sampling error of +/-6.8%. The study used a combination of closed-ended and open-ended answer options to measure respondents' opinions.

Personnel

The principal investigator of this study is Michael Cobb, an Associate Professor of Political Science at North Carolina State University. Dr. Cobb crafted the survey instrument while John Willingham, a graduate student in Political Science at the University of Georgia helped to design and manage the field sample. Joseph Bond, William Klobassa, Elizabeth Pitts, Masson Rizzo and Gabriel Zilnik (NCSU) conducted the in-person interviews, while Bond, Pitts and Rizzo took part in coding the open-ended answers.

Study Design

Survey data were collected via probability sampling of geographic clusters across the island (Appendix D). Students from NC State University were trained in survey interviewing procedures, and were randomly assigned each day to at least two locations in Key West; they were instructed to request interviews at residences following a randomization pattern to generate a representative sample. Given the topic, the sampling process emphasized interviewing residents in the geographic areas likely to result in any potential field-trial, as well as the neighborhood likely to serve as a control group.

Survey Design

The survey was administered "off-line" using a software application downloaded on Ipad called "QuickTap." This basic approach to using survey technology is referred to as "computer assisted self-interviewing," or CASI. It is effective at reducing the cognitive burden of in-person interviewing and reduces measurement errors associated with asking obtrusive and sensitive questions. The use of Ipad technology also facilitated the recording of multiple open-ended comments, since respondents could directly type them rather than have interviewers transcribe them.

The survey was written by Dr. Cobb, and designed to be complementary to the larger opinion survey of the entire Florida Keys also administered in January by mail. Questions asked measured selected respondent demographics and their opinions about mosquito control efforts in

Key West. Most questions on the survey were of the "forced-choice" format, but several times respondents were invited to identify in their own words what they perceived to be the potential benefits and hazards of using genetic engineering for mosquito control, and which ones they were most hopeful or worried about.

Results from this sample can be compared to the mail survey and evaluated as a stand-alone study that accurately represent the opinions of Key West residents, but these data come with a higher than desirable margin of sampling error (+/- 6.8%) due to the small sample size. Caution should therefore be exercised when interpreting survey answers. In addition, as with all surveys, minor changes in question wording, question placement, and response rates can sometimes generate different findings.

Sample Demographics

The sample includes 52% males, and the average age of respondents was 56 years old (the median age = 59). Respondents are, on average, highly educated; 18% possessed a high school degree (or did not have one); 23% attended some college or earned a two-year degree; 30% graduated from a four-year college; and another 30% completed at least some post-graduate studies. Most (66%) were homeowners (rather then renting); another 15% reported being a landlord in Key West, while 14% said they owned a small business. Most (59%) were also year-round residents; 19% reported living in Key West in the winter only.

Demographic Data and Privacy

We collected limited demographic data about respondents, such as their age and gender. We initially recorded residential addresses to ensure that data quality and sampling procedures were followed correctly, but that information has been removed from all data files and reports that have been made public. Thus, these survey results are reported only in the aggregate, and individual level responses cannot be attributed to any personally identifiable respondent.

RESULTS

Is Mosquito Control an Important Issue?

The first question on the survey asked respondents if mosquito control was an important issue to respondents. In the event mosquito control was unimportant to a large percentage of respondents, these answers could have been used to then sort opinions about mosquito control by whether respondents cared about the topic of the survey. According to the results, though, just four respondents said mosquito control was unimportant to them (Table 1; note: reported percentages can exceed 100% due to rounding). The high degree of issue salience suggests most Key West residents will hold meaningful opinions about mosquito control, and that they will have already thought about the potential use of GE mosquito control methods.

Table 1.

Very Unimportant	1	1%
Unimportant	3	2%
Important	34	17%
Very Important	167	82%
N =	205	

Opinions about the FKMCD

Respondents were then asked if they held a favorable or unfavorable opinion about the FKMCD (Table 2). This question was placed second on the survey, before other questions about mosquito control could bias opinions. Results show a majority (63%) holds a favorable opinion of the FKMCD, while a very small percentage has a negative view (9%; the remainder feel neutral).

Table 2.

Very Unfavorable	3	2%
Unfavorable	14	7%
Neutral	59	29%
Favorable	81	40%
Very Favorable	48	23%
N =	205	

Nuisance

The third question asked residents if they thought mosquitoes were a nuisance where they lived. Answers to this question might predict attitudes toward the FKMCD, if respondents blame the FKMCD for any problems. These answers might also predict support for GE approaches to mosquito control if respondents find the nuisance level intolerable and think existing control methods are inadequate. Most respondents agreed (68%) with the statement that mosquitoes were a nuisance; just 4% strongly disagreed with this assessment (Table 3).

Table 3.

Strongly Disagree	8	4%
Disagree	57	28%
Agree	66	32%
Strongly Agree	74	36%
N =	205	

Are Chemicals and Insecticides Safe?

Respondents where then asked if they were concerns about the safety of current mosquito control methods. Asking about whether chemicals and insecticides are safe to use around humans could also predict support for GE control methods, if GE is perceived to be safer or at least not any more hazardous. In this case, only about half of the sample said using chemicals and insecticides was safe (53%). Interestingly, very few respondents thought chemicals or insecticides were "very" safe or unsafe (Table 4).

Table 4.

Very Unsafe	12	6%
Unsafe	81	41%
Safe	90	45%
Very Safe	16	8%
N =	199	

Risk Acceptance

One abstract principle that guides public opinions about new technologies is their levels of risk acceptance about uncertain hazards. Thus, respondents were asked a question about the "precautionary principle" which is often a guide to policy decisions in these situations. Specifically, respondents were asked if they agreed or disagreed that new technologies should be adopted unless they are *proven to be unsafe* (as opposed to being adopted only after being *proven safe).* Surprisingly, 88% agreed with the more risk acceptance answer (Table 5).

Table 5.

Strongly Disagree	10	5%
Disagree	13	7%
Agree	113	58%
Strongly Agree	59	30%
N =	195	

Worry about Dengue Fever

Another factor capable of shaping opinions about mosquito control efforts is worry about dengue fever. The literature on risk perceptions suggests increased worry over risks can increase respondents' willingness to adopt new technologies with uncertain hazards. According to these results, a majority of the sample (58%) is either unworried or "only worried a little" about dengue fever. It is possible that many respondents are not worried because they reported already having had dengue and believe they are now immune, though systematic data on incidences of dengue fever were not collected to test that hypothesis. Also surprisingly, the percentage worried about dengue in Key West is not much lower than the percentage of all Americans who reported being unworried about catching any disease from an insect bite in the 2012 summer survey (67%).

Table 6.

Not worried at all	57	28%
Only worried a little	62	30%
Somewhat worried	52	26%
Very worried	33	16%
N =	204	

Awareness

To measure how aware respondents are about GE technologies for mosquito control, they were given a 10-pt scale to record their answers. They were told that "1" stood for having heard nothing about it, while "10' stood for hearing very much about it. Just 18% of respondents said they had not previously heard about this issue, and 11% placed themselves at the maximum level of awareness ("10"). The average score on this scale was 5.5, and the median score was 6. Answers were then re-categorized as low, average, and high levels of awareness, and these distributions are reported in Table 7.

Table 7.

Less aware	88	43%
Average awareness	48	23%
More aware	69	34%
N =	205	

Support the use of GE Mosquito Control Technology?

A central question for this study is whether residents support or oppose the possible use of GE mosquito control technology in Key West. While a plurality of respondents did not have an opinion in the nationally representative survey, a majority of those in Key West (60%) supports its use, with almost as many remaining respondents feeling neutral as opposed to it (Table 8).

Table 8.

Strongly Oppose	21	10%
Oppose	26	13%
Neutral	34	17%
Support	76	38%
Strongly Support	45	22%
N =	202	

Is GE technology Safe?

This question is complementary to the previous question about support for using GE technologies (Table 9). It is also useful to directly compare the perceived safety of GE technology versus chemicals and insecticides (Table 9b). A solid majority (66%) believes GE is safe, and those that think it is "very unsafe" compromise just 11% of the sample (Table 9a). One caveat is that a significant percentage of respondents chose not to answer this question, indicating attitudes about risk could be fluid, and that support for using GE technology is not dependent on risk perceptions alone.

Table 9a.

Very Unsafe	19	11%
Unsafe	42	23%
Safe	96	53%
Very Safe	24	13%
N =	181	

Which is safer?

When the perceptions of chemical safety are subtracted from perceptions of GE safety, the result is that GE is thought to be marginally safer. While the plurality (47%) said that the two control methods were equally safe or unsafe, 19% thought chemicals were safer and 34% thought GE was safer.

Table 9a.

GE less safe	34	19%
Equally safe/unsafe	83	47%
GE more Safe	59	34%
N =	176	

FDA

A final attitudinal measure on the survey inquired about respondents' perception of the role of the Food and Drug Administration in approving a permit to use GE mosquito control technology in the US (Table 10). Would respondents find the FDA approval trustworthy, and use this to help form their opinions about whether the technology is indeed safe to use? Interestingly, a slimmer majority (58%) said they would trust FDA approval of its safety than simply thought it was safe to use.

Table 10.

No	86	42%
Yes	117	58%
N =	203	

Media

Media and information sources were also asked about on the survey. This section summarizes the use of different kinds of information respondents reported using to learn about GE mosquito control technologies, not their primary sources of news in general. These results are presented in Table 11 by the percentage of respondents who reported using each of the following sources of information (multiple sources could be selected). By far, newspaper was the most likely source of information, but several other sources were used often too, such as TV and discussion with others. Very few respondents, by way of comparison, said they attended a town hall meeting in March, 2012, where the FKMCD explained their interest in using GE technologies, or saw the online "viral" petition calling for a ban on GE technologies in Key West.

Table 11.

Information Source	
FKMCD Webpage	4%
Attended Town Hall Mtg.	5%
Saw Petition	6%
Scientific Article	16%
Other	18%
TV	24%
Interpersonal Discussion	27%
Newspaper/Magazine	**51%**

Cross-Tabulations

This section presents theoretically relevant and statistically significant cross-tabulations between measures related to opinions about (a) the FKMCD and (b) the potential use of GE mosquito control technologies. Very few significant relationships were identified, so the full set of possible cross-tabulations are not presented. If a relationship between variables on the survey is not presented in this section that is because those variables were unrelated. In addition, the validity of the simple relationships presented here is explored more rigorously by constructing multivariate statistical models in order to isolate the unique contribution of each variable correlated with opinions about the FKMCD and GE mosquitoes. Those results are presented in Appendix B, and should be given more weight than these simple bivariate relationships.

Opinions about the FKMCD

		Unfavorable	Neutral	Favorable
Safety of Chemicals				
Very Unsafe	(n = 12)	25%	25%	50%
Unsafe	(n = 81)	12%	31%	58%
Safe	(n = 90)	3%	28%	69%
Very Safe	(n = 16)	13%	13%	75%
Awareness of GE				
Less aware	(n = 88)	8%	35%	57%
Average	(n = 48)	2%	29%	69%
More aware	(n = 69)	13%	20%	67%
R is a landlord				
No	(n= 174)	6%	31%	63%
Yes	(n = 31)	19%	16%	65%
R lives in KW all year				
No	(n= 85)	5%	37%	59%
Yes	(n = 120)	11%	23%	66%
R talks with others about GE				
No	(n= 150)	7%	33%	59%
Yes	(n = 55)	11%	16%	73%

Opinions about the FKMCD (continued)

R read news about GE		Unfavorable	Neutral	Favorable
No	(n = 101)	3%	34%	63%
Yes	(n = 104)	14%	24%	63%
R read scientific article about GE				
No	(n = 172)	8%	32%	60%
Yes	(n = 104)	9%	12%	79%

Correlates of Opinions about the FKMCD, Summary

Overall, opinions about the FKMCD are favorable. Yet, few variables that were measured on the survey correlate with these attitudes. This finding is probably due the nature of questions asked in the survey, which were directed towards measuring opinions about GE. In the cross-tabs, year-round residents and those who thought using chemicals for mosquito control was safe were more favorable towards the FKMCD. Landlords were less favorable.

Yet, it was possible that the GE controversy is shaping attitudes towards the FKMCD, rather than the other way around, so that relationships as explored. The direction of effects was inconsistent, so no conclusions can be drawn from them. Knowing more about GE, for example, simply polarized attitudes (respondent who are more aware held both more favorable and less favorable views). Meanwhile, those who reported talking about GE had more favorable views about the FKMCD, as did those who said they read a science article. On the other hand, those who read the newspaper about GE had less favorable views. There is no obvious reason why the effects of talking versus reading the newspaper would have opposite effects on opinions about the FKMCD. Regardless, these effects sizes are not very large, and most of these relationships are insignificant according to multivariate analyses reported in the executive summary and located in Appendix B.

		Opinions about GE Mosquito Control		
Views about the FKMCD		Opposes	Neutral	Supports
Unfavorable	(n = 17)	41%	6%	53%
Neutral	(n = 58)	24%	24%	52%
Favorable	(n = 127)	21%	15%	65%
Mosquitoes a Nuisance				
Disagrees	(n = 64)	27%	8%	66%
Agrees	(n = 138)	22%	21%	57%
Safety of Chemicals				
Very Unsafe	(n = 12)	50%	0%	50%
Unsafe	(n = 80)	27%	19%	55%
Safe	(n = 90)	21%	14%	64%
Very Safe	(n = 16)	6%	25%	69%
We should use new technologies unless….				
Disagrees	(n = 23)	70%	13%	17%
Agrees	(n = 170)	17%	16%	68%
How safe is GE?				
Very unsafe	(n = 19)	74%	5%	21%
Unsafe	(n = 42)	48%	19%	33%
Safe	(n = 95)	7%	17%	76%
Very safe	(n = 24)	0%	4%	96%
Trust the FDA?				
No	(n = 84)	44%	16%	41%
Yes	(n = 117)	9%	17%	74%

Opinions about GE Mosquito Control (Cont.)

R's Sex		Opposes	Neutral	Supports
Female	(n = 96)	26%	21%	53%
Male	(n = 106)	21%	13%	66%
R used FKMCD Webpage for GE				
No	(n = 194)	21%	18%	61%
Yes	(n = 8)	75%	0%	25%
R Read a scientific article about GE				
No	(n = 170)	21%	19%	60%
Yes	(n = 32)	34%	6%	59%
R saw the online petition against GE				
No	(n = 190)	21%	17%	62%
Yes	(n = 12)	58%	8%	33%
R attended town hall mtg. about GE				
No	(n = 191)	21%	17%	62%
Yes	(n = 11)	64%	9%	27%

Correlates of GE Opinions, Summary

Overall, residents support using GE mosquito control technologies. In simple cross-tabulations, a few variables correlate with support. More favorable views of the FKMCD are weakly related to being more supportive of using GE, for example, but more important relationships are the perceived safety of chemicals and GE, trusting the FDA approval of GE, and risk acceptance (the general disposition to prefer adopting new technologies unless they are proven unsafe). Interestingly, the perception that mosquitoes are a nuisance is negatively related to support for GE. Although only small percentages of the sample reported using the FKMCD for information about GE, or reading a science article, attending the town hall meeting and seeing the anti-GE petition, all of these behaviors correlated with less support for GE mosquito control. It is not

possible to determine the causal order of sources of information and opinions about GE, although in this case these relationships are likely the result of information seeking behavior among residents who had previously formed their negative attitudes prior to looking for information about it.

CONCLUSIONS

This section briefly summarizes the core findings of the survey. In January, 2013, residents of Key West were interviewed about mosquito control issues, in particular the potential to use GE technologies to control the species of mosquito that spreads dengue fever.

According to the results, **a majority of residents hold favorable views about the Florida Keys Mosquito Control District**, while a small percentage holds negative views. Yet residents believe mosquitoes are nuisance and do not agree that it is safe to use chemicals and insecticides to control them. Dengue was a concern to many, but the majority did not worry about it much. Attitudes about the FKMCD were not predicted well by the answers to other questions on the survey, as **I find that only perceptions about the safety of using chemicals and talking with others about GE control techniques explained opinions about the FKMCD in the multivariate analyses (Appendix B).**

A majority of residents supports the use of GE technologies to control mosquitoes and think it is safe. More respondents said the GE approach is safer than using chemicals and insecticides. **Opinions about using GE technology are predicted by respondents' tolerance for risk, their comparison of how safe GE is versus insecticides and chemicals, how worried they are about dengue, trust in the FDA, and exposure to anti-GE information in the online petition (Appendix B)**. It is unclear, however, whether more negative opinions correlated with exposure to the petition resulted from seeing it, or preceded it. Regardless, few people reported seeing it, so the magnitude of its effects on aggregate level opinions is limited.

Last, respondents were given the chance to identify in their own words the potential benefits and hazards of using GE (Appendix C). The plurality answered that fewer mosquitoes was a potential benefit, while the next largest group did not offer a response (or said they did not know). The plurality did not identify a hazard, and the next most common answer was the denial of possible hazards. This suggests people have not thought too much about the issue, even though they reported being relatively well aware of it.

Nevertheless, these results should be interpreted cautiously. Despite their lack of opposition to GE mosquito control, for example, residents had difficulty identifying potential hazards and benefits of using it. The results from the open-ended question suggest opinions about GE could be highly malleable. In addition, the sample size for this study is small, and thus it has a high margin of sampling error. Yet, given the distributions in these answers, **I am comfortable concluding that a majority of Key West residents hold favorable views about the FKMCD and they support using GE technology for mosquito control.**

Appendix A: Survey Instrument

Q1. Is mosquito control an important or unimportant issue to you?

Very Unimportant
Unimportant
Important
Very Important

Q2. Do you have a favorable or unfavorable opinion about the Florida Keys Mosquito Control District (FKMCD)?

Very Unfavorable
Unfavorable
Neutral
Favorable
Very Favorable

Q3. Do you agree or disagree with this statement: "Mosquitoes tend to be a nuisance where I live."

Strongly Disagree
Disagree
Agree
Strongly Agree

Q4. How safe do you think it is for humans to live in areas where chemicals and insecticides are sprayed to kill mosquitoes?

Very Unsafe
Unsafe
Safe
Very Safe

Q5. Do you agree or disagree with this statement: "We should use promising new technologies unless it can be demonstrated they cause harm."

Strongly Disagree
Disagree
Agree
Strongly Agree

Q6. How worried are you about getting dengue fever in Key West from a mosquito bite?

Not worried at all
Only a little worried
Somewhat worried
Very worried

Q7. Scientists have created genetically engineered (GE) mosquitoes to control the natural population of mosquitoes. Before today, how much had you read, heard or seen about this technology? Record your answer on the following scale where "1" stands for "nothing at all" and "10" stands for "very much".

"1" = "nothing at all – "10" = "very much"

Q8. The FKMCD is considering releasing genetically engineered mosquitoes in one part of Key West to control the species of mosquitoes that spreads dengue fever. Their plan is to release only males because they don't bite. If the GE males mate, they are designed to pass on a lethal gene that leads to the death of their offspring.

Strongly oppose
Oppose
Neutral
Support
Strongly support

Q9. How safe do you think it is for humans to live in areas where GE mosquitoes are released?

Very Unsafe
Unsafe
Safe
Very Safe

Q10. Do you trust the Food and Drug Administration to decide if it is safe to release GE mosquitoes?

No
Yes

Q11. IF GE mosquitoes are released, what kinds of potential benefits do you think could occur?

Open-Ended

Q12. Among the potential benefits of using GE technology that you just entered, which ONE are you most hopeful about?

Open-Ended

Q13. If GE mosquitoes are released, what kinds of potential hazards do you think could occur?

Open-Ended

Q14. Among the potential hazards of using GE technology that you just listed, which ONE are you most worried about?

Open-Ended

Q15. What is your gender?

Male
Female

Q16. What is your highest level of formal education?

High school degree or less
Some college or an Associates degree
College degree (4-year)
Post-graduate study

Q17. Are you any of the following in Key West" (check all that apply):

A homeowner
A landlord
A small business owner
A large business owner

Q18. Do you live in Key West all year, or in winter only?

I live in KW all year-round
I live in KW in the winter only

Q19. What sources of information have you used to learn about GE mosquitoes? (check all that apply):

I visited the FKMCD webpage
I watched a TV show
I talked with others about it
I read a newspaper
I read a scientific article
I saw the online petition against releasing GE mosquitoes
I attended the town hall meeting in March, 2012
I used some other source

Appendix B: Multivariate Regression Models

Multivariate regression models were constructed to determine the validity of the bivariate correlations between survey answers that are presented as cross-tabulations. The reduced models presented here, that exclude insignificant variables, isolate the only significant relationships that persisted when controlling for the influence of all other variables.

The results show that residents' opinions about GE are influenced by a wider set of factors compared to attitudes about the FKMCD. Opinions about GE are correlated with abstract principles (risk acceptance), self-interest, (worry about dengue, perceptions that GE compared to insecticides is safe), information (online petition), and trust in regulators (the FDA). Opinions about the FKMCD are harder to explain, although the instrument was not optimally designed for this purpose. Only the perception that chemicals are safe to use and talking with others about GE technology (positively) explain attitudes about the FKMCD.

Table 1. Regression analysis of determinates of opinions about the FKMCD and GE mosquito control technology

	GE Mosquito Control	FKMCD
Should use new technologies	.85**	--
Worry about dengue	.24*	
Trust FDA	1.45**	
Chemical Safety*	.62**	.56**
Saw Petition	-1.34**	
Attended Town Hall Mtg.	-2.36**	
Talk with others about GE	--	.61**
Pseudo R2	.40	.06
N =	173	199

Method is ordered logit. Entries are regression coefficients. Dependent variables are opinions about the Florida Keys Mosquito Control District (5-pt variable from very unfavorable to very favorable), and support for using GE mosquito control technologies (5-pt variable from strongly oppose to strongly support); *p<.10; **p<.05. For the GE model, "safety" is coded as difference between the perceived safety of GE technology versus chemicals and insecticides.

Appendix C: Open-Ended Responses

Respondents were asked to in their own words identify potential benefits and hazards of using GE technologies for mosquito control, and then to pick one of each kind that they were most hopeful or worried about. Most respondents did not identify a specific benefit or hazard in the second part of the question, so this brief analysis presents just the first benefit and hazard respondents identified. The coding schemes for this analysis are presented below (Table A1). Iterations of inter-coder reliability were conducted on both sets of codes. Three coders reached simple agreement of 95% in the case of coding benefits in the first round. It took three rounds to reach the same level of agreement for coding of hazards. The coding scheme is summarized below for both benefits and hazards.

Benefits Codes

1 = Mosquito Control; (Fewer mosquitos/Less biting of humans & pets)

2 = Health; Disease prevention (dengue or other illnesses; humans and pets)

3 = Ecosystem–safer; less use of chemicals; quality of life

4 = Economic (including research); tourism, cost-savings, etc.

5 = Generic optimism & something good, but it's not said explicitly

6 = Not one; None [this code is not "I don't know" or "can't say", but literally none/no benefits & the direct refutation of possible benefits

7 = Gibberish

8 = It's a known-unknown; specific benefits are not identifiable right now so we need more research (not research because of opposition or even the acknowledgement of benefits—we need it because we don't know what the benefits will be

9 = I don't know (Unsure/Uncertain; unknown) & No answer at all (blank fields)—use only when no other codes apply

Hazards Codes

1 = Mosquito control ineffective; it won't work (more mosquitos/more biting)

2 = Health; mutated mosquitoes; a scarier species of mosquito is created (more disease; worse diseases or other illnesses) Engineering gone amok.

3 = Ecosystem–fish/birds starve; a new, different already existing species of insect/mosquito move into that ecological niche (balance is worse).

4 = Economic; harm to tourism, cost-more to implement

5 = Generic pessimism and something bad will happen

6 = Not one; None [not "I don't know," or "can't say", but literally suggesting the absence of hazards, not uncertainly or lack of info] (& direct refutation of possible hazards)

7 = Gibberish

8 = It's not that we don't know something bad will happen—its a known-unknown so we need more research, without indicating support or the acknowledgement of hazards; insufficient research to know the certain negative outcomes.

9 = I don't know, Can't think of any (Unsure/Uncertain; unknown) & No answer at all (blank fields)—use only if this is the only answer.

Analysis: Benefits

It is unclear whether benefits were hard for respondents to predict, or whether they were insufficiently engaged with the interview to enter this information into the Ipad, but roughly one-third of the sample did not list a single potential benefit (Table A1). Similarly, the plurality of respondents simply identified the goal implicit in the question, better control of mosquito populations. Another 14% focused on preventing diseases mosquitoes carry, while 8% instead rejected the premise that benefits were likely. Just 12 respondents, or 5% of the sample, identified a potential benefit outside of the most obvious goals of mosquito control and slowing the spread of diseases.

Table A1. First Potential Benefit of GE Mosquito Control Cited by Respondent

Category Named		Frequency	Valid Percent	Cumulative Percent
Valid	Mosquito control	81	40%	40%
	Personal Health	29	14%	54%
	Ecosystem	5	2%	56%
	Generic Good	5	2%	59%
	Not One	16	8%	66%
	Gibberish	3	2%	68%
	Known Unknown	2	1%	69%
	I don't know/NA	64	31%	100.0
	Total	205	100.0	

Analysis: hazards

Similar to the findings about potential benefits, the plurality answer about hazards was actually no answer. Over one-third of respondents did not identify a possible hazard. The second most frequent response, though, was the rejection of potential hazards, which was identified less than half as often regarding possible benefits. Interestingly, about one in five respondents disputed the notion that possible hazards existed. Of the remaining responses, roughly equal percentages said (1) worse mosquito control, (2) more disease and freakish outcomes, (3) damage to the ecosystem, and (4) something bad for sure, but we can't know just yet without more research.

Table A2. First Potential Hazard of GE Mosquito Control Cited by Respondent

Category Named		Frequency	Valid Percent	Cumulative Percent
Valid	Mosquito control	14	7%	7%
	Personal Health	29	11%	18%
	Ecosystem	5	9%	27%
	Generic Bad	5	3%	30%
	Not One	16	21%	51%
	Gibberish	3	4%	55%
	Known Unknown	2	9%	64%
	I don't know/NA	64	36%	100.0
	Total	205	100.0	

Appendix D: Methodology Statement for Key West Survey, January 1-5, 2013

Introduction

Dr. Michael Cobb (associate Professor of Political Science), NC State University, and John Willingham (PhD candidate), University of Georgia, led a team of five NC State students (four graduate students, on undergraduate) to conduct in-person interviews in Key West about mosquito control and their opinions about the potential to use genetic engineering technology to control mosquitoes. Successful interviews were recorded for 205 residents of Key West. In all, contact was attempted at 834 presumed residences (homes, apartments and trailers). After discounting addresses that were businesses, gated homes that were inaccessible, and potential respondents who could not conduct the interview in English, this left 761 valid residences where contact was attempted. As a result, the sampling generated a 27% response rate, and included a 16% refusal rate. The sampling strategy for a face-to-face sample in Key West, administered Jan 1-5, 2013, is described below.

Sample Description

Target population: Key West citizens, 18+ (Monroe County, Key West, Florida)
Sample size: N= 205; response rate = 27%; contact rate = 46%; refusal rate = 16%; margin of sampling error = +/-6.8%.

In Key West, Florida, households across the island were randomly selected for face-to-face interviewing. This project uses a multi-stage cluster sample without stratification. Primary sampling units (PSU) are represented by grid cells designed by Willingham. Starting points within each grid cell are represented by addresses found at the center of each PSU, a major landmark or an easily identifiable point with each PSU. Stock Island, beach resorts, and naval areas were excluded from the sample. This study is not based on a probability proportion to size sample design.

The field plan was designed so that interviewers were anticipated to obtain about 2 interviews per hour. Each day is divided into 2 blocks: a morning session comprised of 3 hours, and an afternoon session comprised of 3 hours. Interviewers were randomly assigned a different PSU for the two time blocks. Thus, within a given day, interviewers were expected to obtain roughly 12 interviews, although they are encouraged to get more.

Sampling Frame: The island was divided into 84 grid cells. The size of each grid-cell is *roughly* .25 sq. miles (this typically includes 4-6 city blocks). Smaller grid cells are used for more densely populated residential areas in the Western part of the island (see map below—the white areas represent the PSU grid cells).

1. 1st stage (Gridding): The first stage divided the island into 84 grid cells for cluster sampling. Each grid cell is roughly .25 sq. miles or 4-6 city blocks; however, some grid cells were larger or smaller than .25 sq. miles depending on major roads and significant markers of island boundaries of delimitation. The "gridding" process was performed using *Google Earth*. Also, the size of the grid cell was designed to be smaller in the more densely populated residential areas on the Western part of the island, whereas larger grid cells are used for less densely populated areas on the Eastern part of the island. Stock Island, naval bases and beach resorts were excluded from the sample gridding.

2. 2nd stage (PSU Selection): Once the island of Key West was divided into grid cells in *Google Earth*, the next step was to create a database of all grid cells. Once compiled, the grid cells were selected randomly for surveying as follows: for the first two days, PSUs were selected exclusively for the Western part of the island. Therefore, only grid cells 1-41 (incl. 84) were possible for random selection in day 1 and 2. On days 3 and 4, only grid cells 42-83 were used for random selection since these grid cells made up the Eastern part of the island. A random draw is made within each group of grid cells using a random number generator. The goal of this process was to ensure that both sides of the island were sufficiently covered by field teams. Once interviewers exhausted a grid cell, they were instructed to call the supervisor for a new, randomly selected PSU assignment. Some PSUs can be selected more than once, particularly in the Western part of the island where the control and treatment areas of the potential release of GE mosquitoes are located (see the color coded portions of them map). Emphasis is placed on getting a higher number of interviews in these areas. In order to exhaust all possibilities for gathering interviews within a particular PSU, interviewers are also instructed to call their supervisor for assistance in staying *within* the boundaries of their respective grid cell. To avoid ad-hoc PSU replacement, interviewers were instructed, at times, on where to go to find new residential areas, particularly in areas with a high density of businesses.

3. 3rd stage (Starting Point Selection): After selecting the PSU, starting points (SP) are selected. For each PSU, a central location, major landmark, intersection, or street, is identified in advance as a SP and listed in a database.[1] Each PSU contains a single SP. Typically, the SP is represented by the address of a landmark, monument, business or residence. The goal was to have interviewers start from this address, select a random direction to walk in, and then conduct the random walk and skip pattern. This method prevents bias derived from only interviewing in the center of the grid cell, as interviewers are essentially conducting their interviews in a straight line out from the SP until they run out of houses or reach the boundary of the grid cell. If the interviewer exhausted all households on a particular path, he or she was instructed to phone the supervisor for a new SP within that particular grid cell. In these cases it is necessary to purposively select a new address to ensure that the interviewers are able to conduct interviews in a residential area, as opposed to industrial, business, or military areas. To increase geographical coverage, generally, no more than 8 interviews were conducted in any single PSU by the same interviewer within a given day.

4. 4th stage (Household Selection): Interviewers gather at the selected starting point, and head in different directions to start their walking pattern. Using the day code (adding the digits of the day together, until arriving at a single digit – see example below), the interviewer skips the appropriate number of dwellings and starts his/her assignment at the next dwelling, counting from the left. Using the appropriate sampling interval (which is every 3rd house in Key West due to the small size of the island), the interviewer selects additional other dwellings on this street to approach. Field Example: If the interview is being conducted on January 03, the interviewer would add 0+3= 3, thereby skipping 3 dwellings, and would start on the 4th dwelling on the right side of the street. If there are multiple households within the selected dwelling, the interviewer relies on a household selection grid (a table of random numbers) to determine the specific household for interview.

5. 5th stage (Respondent Selection): To reduce interview length times and increase participation rates, interviewers were encouraged to interview the first available adult (18+) who agrees to be interviewed in each selected household. That is, we did not sample within households given the limited resources and truncated time period, in order to increase participation rates.

Non-Response

Interviewers were not permitted to substitute PSUs without supervisor permission. If a PSU did not yield any interviews, the interviewer contacted the supervisor for a randomly selected

[1] Note: see Appendix I for a listing of all PSUs and SPs.

replacement PSU. Interviewers were required to make 3 separate contacts before substituting households. Rather than simply using the household next door, the interviewer is instructed to continue in their skip pattern in order to choose a substitution house; this means picking up the skip pattern from their last successful interview. For all selected addresses that received a non-response or non-contact, these addresses are collected and multiple contacts were attempted when possible. Non-response and non-contact information is recorded by interviewers using the table of disposition codes below.

Disposition Codes

	HH 1	HH 2	HH 3	HH 4	HH 5	HH 6	HH 7
Successful interview	1	1	1	1	1	1	1
Reasons for Unsuccessful calls							
No one at home	2	2	2	2	2	2	2
Impossible to contact the family/child answered the call, etc	3	3	3	3	3	3	3
Member of the family asks to postpone the interview until another time	4	4	4	4	4	4	4
Family member refused	5	5	5	5	5	5	5
Respondent is not able to participate in the interview (illness, drunk, etc) Please specify reason_____	6	6	6	6	6	6	6
Respondent is not at home	7	7	7	7	7	7	7
Respondent doesn't have time and asks to postpone the interview until a more appropriate time	8	8	8	8	8	8	8
Direct refusal	9	9	9	9	9	9	9
Incomplete interview	10	10	10	10	10	10	10
Respondent couldn't speak any language in common with the interviewer	11	11	11	11	11	11	11
Gated community (No Access)	12	12	12	12	12	12	12
Respondent did not approve of the topic	13	13	13	13	13	13	13
Respondent does not typically take part in surveys	14	14	14	14	14	14	14
Other (please specify reason):	99	99	99	99	99	99	99

Completed Disposition Codes for KW Sampling

N = 834

1 (successful interview);	N = 205
2 (no one at home/answers door);	N = 382
3 (child on person home);	N = 5
4 (request to postpone);	N = 3
5 (family refusal);	N = 25
6 (respondent unable to function);	N = 2
7 (selected respondent not at home);	N = 21
8 (selected respondent postpones);	N = 9
9 (direct refusal);	N =105
10 (incomplete interview);	N = 2
11 (language barrier);	N = 4
12 (gated community or home—no access);	N = 34
99 (invalid/unable);	N = 37
Business/rentals (N = 17)	
Other (N = 20)	

Training

The field team was comprised of 5 interviewers and 2 field managers. Brief training sessions were held on Dec. 31, 2012, and again on January 1st 2013. During these sessions, interviewers were trained on the following:

1. Project background
2. Sample creation
3. Questionnaire review
4. Field planning and project background
5. Interviewing techniques (rapport building and etiquette)
6. Pre-testing
7. Household selection techniques (random walk, skip patterns, etc.)
8. Respondent selection techniques (first available or next birthday)
9. Quality control procedures using the administration sheets, such as PSU replacement

In particular, the training session stressed the important of quality control and selection techniques for households and respondents. The sampling process was also covered in detail. The goal was to ensure that each interviewer had a clear understanding of the methodology.

Interviewers were also provided with a book by Herbert Asher to read about the practice of survey research, *Polling and the Public*.

Throughout the project, numerous quality control measures were implemented. Main items emphasized to the field teams included:

1. Field organization
2. Proper survey techniques
3. Household and respondent selection
4. Recording of refusal and non-contact information using the grid
5. Interviewer safety
6. Interviewer etiquette

At the end of each day, field managers reviewed problematic areas with each individual interviewer. In addition, the field managers checked the survey data daily, as well as each administration packet for accuracy and to ensure that project guidelines are followed properly.

The following table highlights important project milestones:

Activity	**Start Date**	**End Date**
Survey Instrument Design	Dec 16, 2012	January 1, 2013
Sample Development	December 21, 2012	December 31, 2012
Pre-test	Jan 1, 2013	Jan 1, 2013
Key West Visit	December 28, 2012	January 6, 2013
Training of Interviewers	December 31, 2012	January 1, 2013
Fieldwork	December 31, 2012	January 5, 2013
Data processing	January 1, 2013	January 6, 2013
Call backs	January 3, 2013	January 5, 2013
Methods Report	January 1, 2013	January 6 2013

The following are census data about *Key West Parameters*[2]

Parameter	**Data**
Total Pop. (2011)	24,909
Gender (2010)	
Male	55%
Female	45%
Age (2010)	
Under 18	14.5%
18-64	72.7%
65+	12.8%
Race (2010)	
White	66.1%
Hispanic	21.2%
Black	9.7%
Asian	1.6%
Other	1.4%
Education[3]	
University or higher	28.1%
High School	60.9%
Below High school	11%
Household Data (2007-2011)	
Home Ownership	46.1%
Households (total)	9,191
Person per HH	2.55

[2] US Census Bureau (2007-2011): http://quickfacts.census.gov/qfd/states/12/1236550.html
[3] As a percent of Key West residents age 25+ from 2007-2011

Key West sample demographics

Given the small sample size in this study, and that measurement of demographic characteristics was limited and not always recorded the same metric as census data, the following results are meant to be descriptive rather than strictly diagnostic about the representativeness of the Key West sample.

Males = 52%;
Mean Age = 56 years-old
Median = 59 years-old
Education: 18% high school or less; 23% some college or 2 year degree; 30% college graduate; 30% post-graduate studies
Homeowner = 66%
Landlord = 15%
Small Business owner = 14%
Year-round resident = 59%

The following are SPs in Key West by PSU ID (Selected PSU/SPs are highlighted in GREY)

PSU ID	SP Address	PSU ID	SP Address	PSU ID	SP Address
1	323 Whitehead St.	30	1011 Virginia St.	59	1603 Rose St.
2	314 Simonton St.	31	1026 White St.	60	George St. and Rose St.
3	2 Duval St.	32	1311 Eliza St.	61	Dennis St. and Blanche St.
4	806 Caroline St.	33	1105 Leon St.	62	5th St. and Juanita Ln.
5	300 Grinnell St.	34	1800 North Roosevelt Blvd.	63	Patterson Ave. and 6th St.
6	419 Porter Ln	35	Fort Taylor Ct.	64	2419 Patterson Ave
7	500 Whitehead St.	36	309 Louisa St.	65	Seidenburg Ave. and 6th St.
8	512 Simonton St.	37	1313 Simonton St.	66	Staples and 7th St.
9	800 Fleming St.	38	750 United St.	67	Fogarty Ave. and 8th St.
10	425 Grinnell St.	39	1008 Seminary St.	68	Staples and 8th St.
11	500 White St.	40	1302 White St.	69	Government Rd. and Linda Ave.
12	208 Southard St.	41	1400 United St.	70	Lucy Ln. and 10th St.
13	625 Whitehead St.	42	1612 United St.	71	2801 Staples Ave.
14	717 Simonton St.	43	Fogarty Ave. and George St.	72	Fogarty Ave. and 12th St.
15	Carsten Ln.	44	1100 Bay St.	73	2932 Seidenberg Ave.
16	Canfield Ln.	45	1205 4th St.	74	2907 Riviera Dr.
17	Ashe St. and Angela St.	46	1435 Simonton St.	75	Venetian Dr. and Airport Blvd.
18	1418 Angela St.	47	800 Washington St.	76	17th Terrace and Northside Dr.
19	111 Olivia St.	48	1001 Von Phister St.	77	19th Terrace
20	907 Whitehead St.	49	1419 White St.	78	3738 Eagle Ave.
21	900 Simonton St.	50	1409 Von Phister St.	79	3515 Flagler Ave.
22	909 Windsor Ln.	51	Thompson St. and Van Phister St.	80	3301 Pearl Ave.
23	910 Grinnell St.	52	1835 Flagler Ave.	81	3312 Northside Dr.
24	825 White St.	53	2010 Staples Ave.	82	STOCK ISLAND[4]
25	903 Eisenhower Dr.	54	Staples Ave. and 4th St.	83	Halsey Dr.
26	215 Amelia St.	55	1500 Reynolds St.	84	1287 Truman Water Front
27	1011 Whitehead St.	56	1000 Atlantic Blvd.		
28	1100 Simonton St.	57	1801 White St.		
29	1100 Margaret St.	58	Steven Ave. and Laird St.		

[4] Excluded from sample frame

The following map (imperfectly) plots the (1) successful interviews in green, (2) attempted contacts in yellow, and (3) refusals in red.