A Phase 1 Meta-Evaluation of a Mosquito-Borne Disease Program

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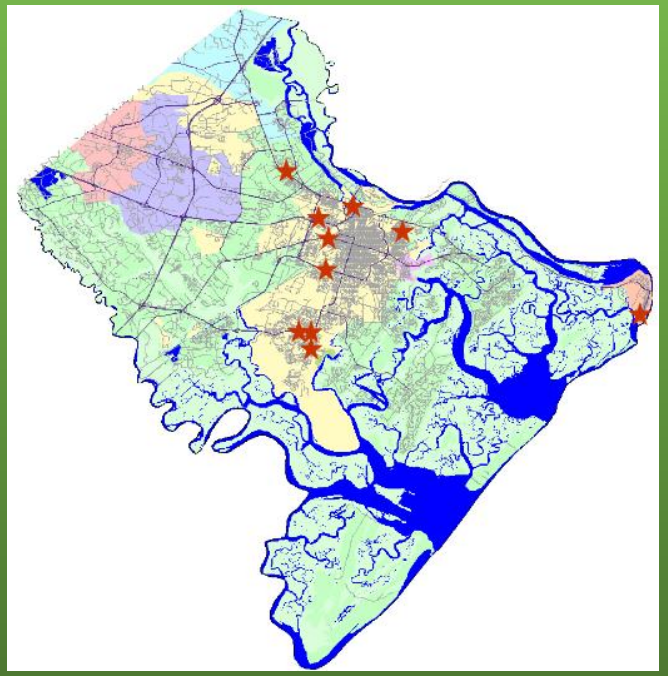
Introduction

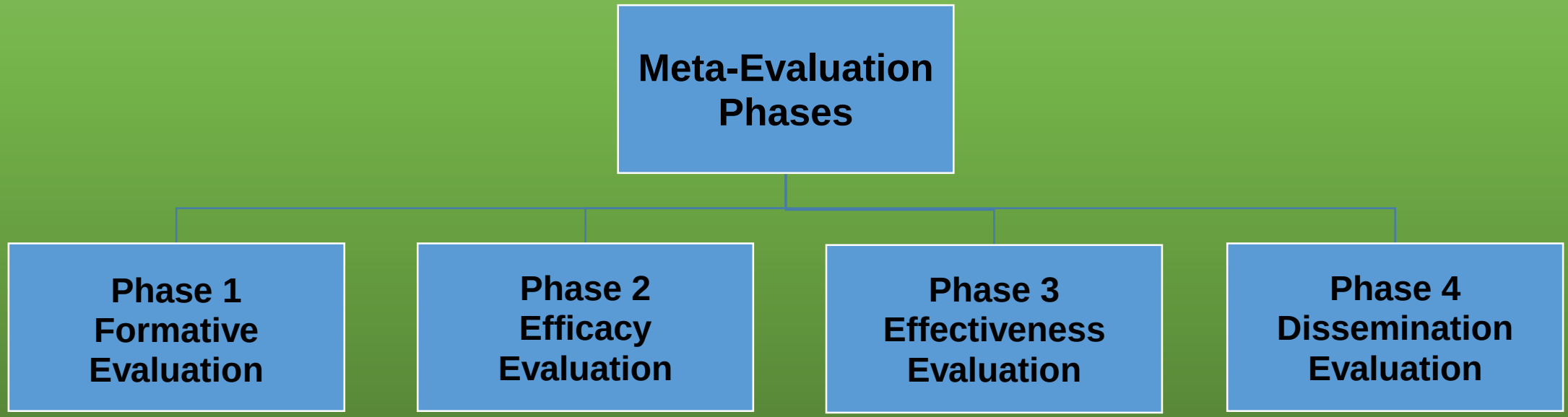
- **The ME is based upon "Adaptations for WNV Surveillance and Control in Chatham County", H. Lewandowski and R. Moulis, Tech Bull FMCA 8:20-23, 2008.**
  - **At the end of 2003, "For the effort expended, staff members were not satisfied with the West Nile virus control results.."**
  - **Comprehensive program review (2003)**
  - **Response and results (2004)**
- **Personnel interviews**
- **Examination of archival data**
- **Meta-analysis**



What is a Meta-Evaluation?

A systematic methodological review and rating of the validity of a program

- **Fundamentally, a meta-evaluation is an evaluation of an evaluation**
- **Four phases:**



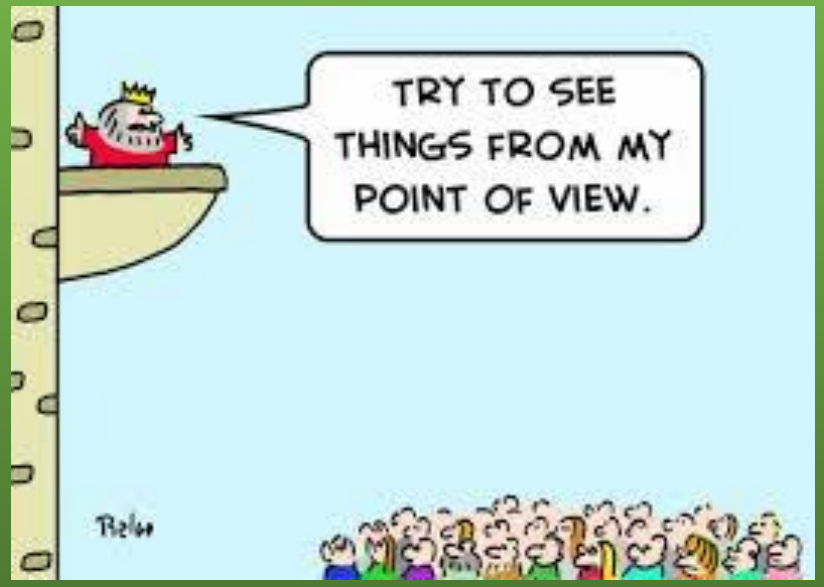
Phase 1 – Formative Evaluation

- **An evaluation of an existing or new untested intervention, under optimal program-practice conditions to document:**
  - **Feasibility of program implementation**
  - **Acceptability of program materials and methods**
  - **Evaluates process**
  - **Efficacy to produce significant immediate, short term and intermediate changes**
- **Theory-based developmental study to determine the feasibility-fidelity of program practice**

Scientific Aims of Phase 1 Formative Evaluation

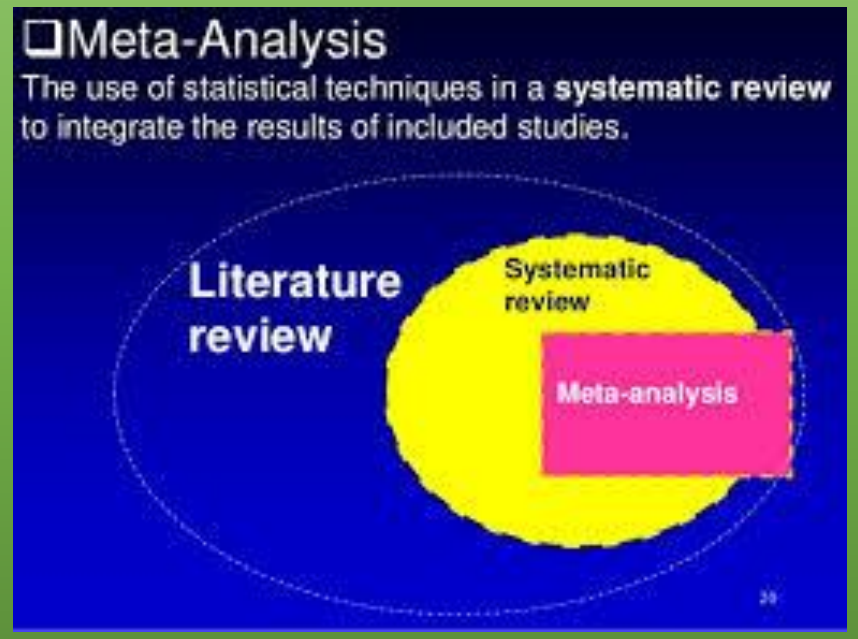
Document the internal validity of a program:

1. **Program/practices can be delivered by trained staff under optimal practice conditions to a sample of the target population (process evaluation).**
2. **Intervention and observational assessment methods were acceptable to the providers and clients (qualitative evaluation).**
3. **Significant changes to indicator rates were documented (impact-outcome evaluation).**
4. **The resources expended and efficiencies were documented (cost-effectiveness/benefit economic evaluation)**



Meta-Analysis

- A statistical analysis of empirical research that is completed
- Four principal uses of an MA
  1. **Increase statistical power**
  2. **Resolve controversy among conflicting studies**
  3. **Improve effect size estimates**
  4. **Answer new questions not addressed in individual studies**



A Comprehensive WNV Surveillance Program was in place in 2003

Comprehensive Program Review of 2003*

1) Testing of pesticide resistance to malathion and permethrin

2) Mapping of WNV indicators

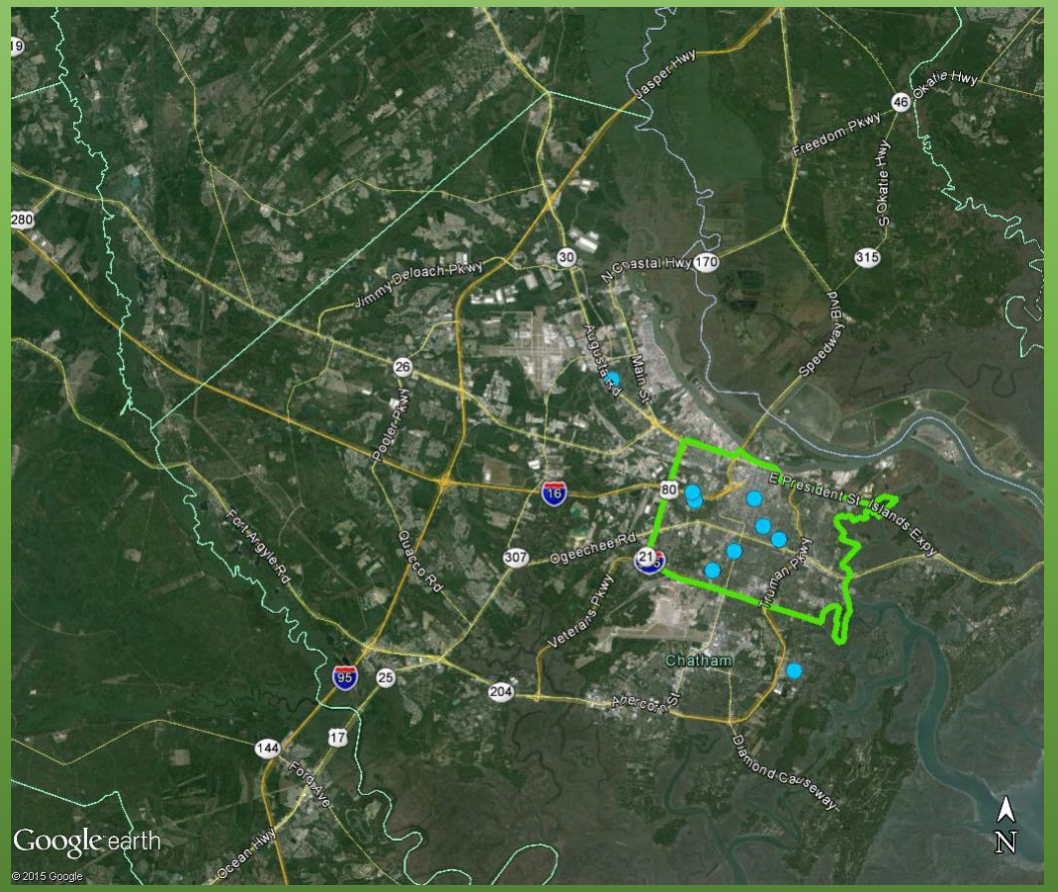
a. Infected birds

b. Infected mosquitoes

c. Sentinel chickens

d. Human cases

3. Timing of surveillance



High Risk Area - green
Human cases - blue

*from Lewandowski and Moulis, 2008

2004 Response and Results*

1) Tested fewer total and fewer bird species (crows, blue jays and predatory birds)

2) Sentinel chickens discontinued because of late detection of WNV

3) Emphasis placed on mosquito analysis

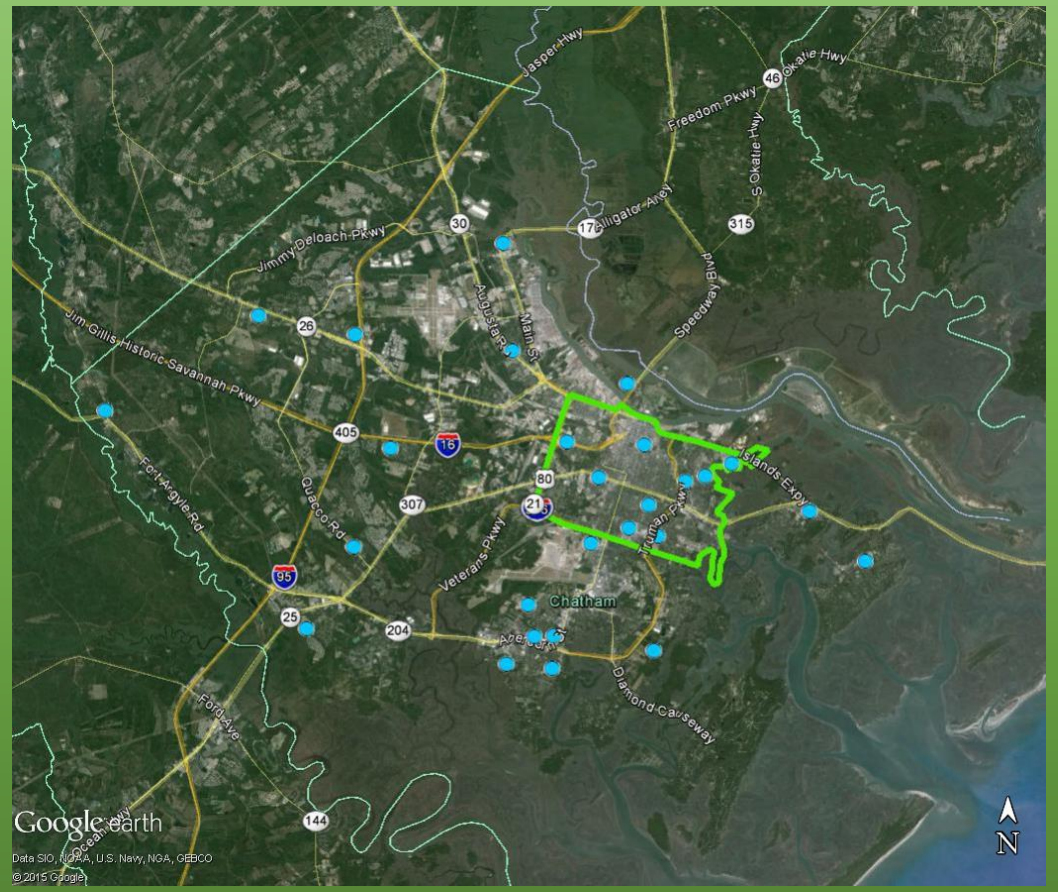
4) Gravid traps placement based on historic information

5) Larvacide used where WNV historically detected

6) Resmethrin and Naled replaced malathion

7) Adulticide applications used earlier in season and at dusk

8) Control based on *C. q.* numbers rather than waiting for WNV detection

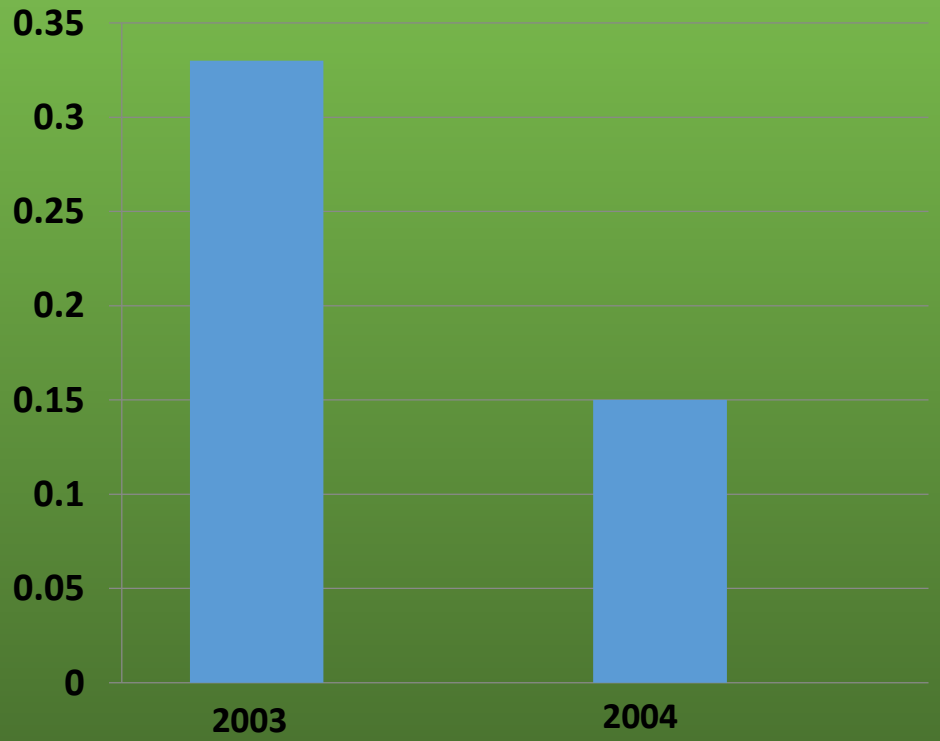


High Risk Area - green
Gravid traps - blue

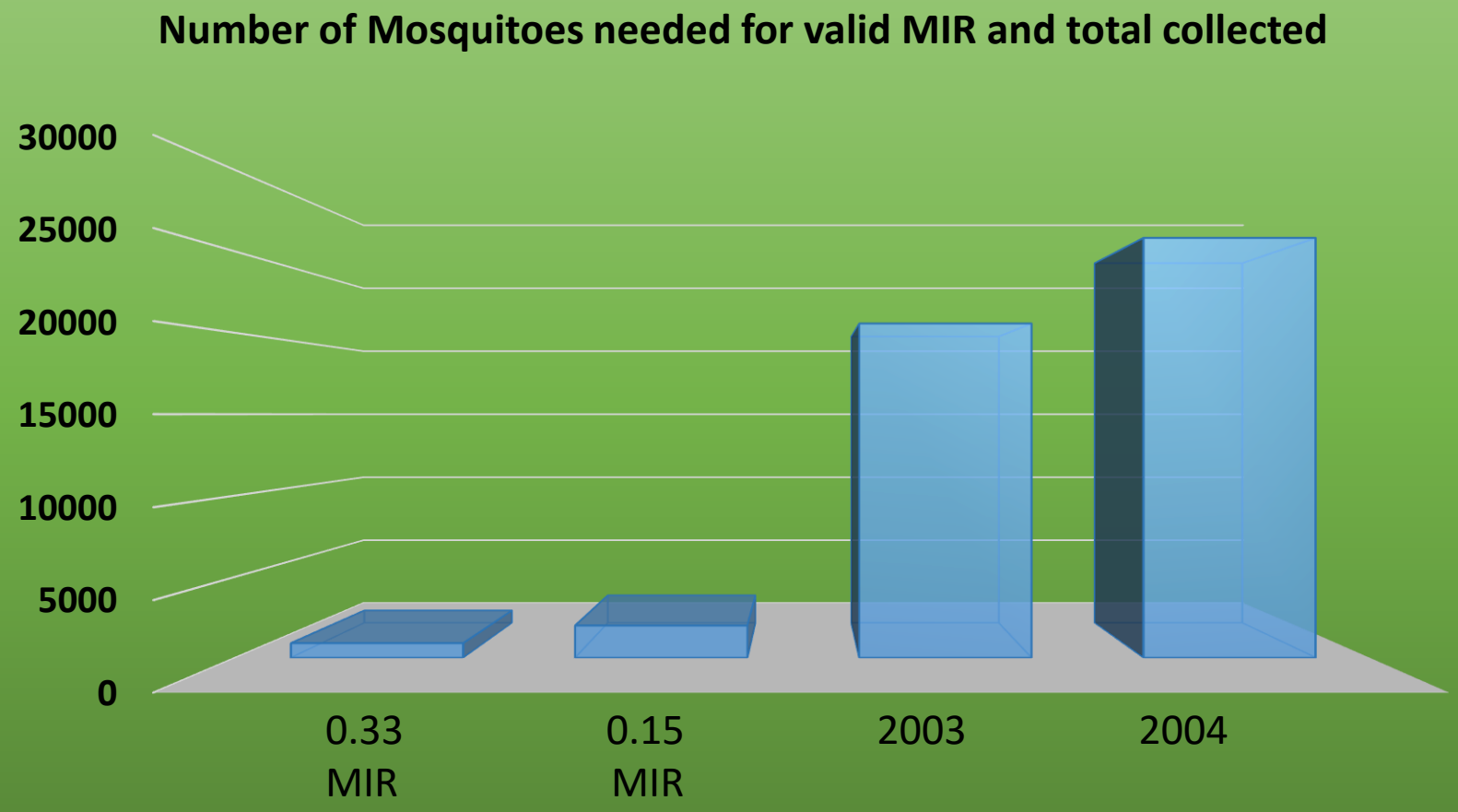
*from Lewandowski and Moulis, 2008

Comparison between numbers of mosquitoes collected and tested 2003/2004

- **The proportion of pools of *C. q.* positive for WNV were significantly higher in 2003 than 2004 (Z-Score = 5.9612, $p \leq 0.05$)**
- **The mean number of total *C. q.* captured per gravid trap in 2003 was significantly higher than in 2004 from four primary sites using Kolmogorov Smirnov Test (mean 141.6, 41.3, $p < 0.05$)**
- **The MIR of WNV in *C. q.* in 2003 was significantly higher than in 2004 (Z-Score = 9.43, $p \leq 0.05$)**



Sample Size Was Sufficient in both years to Detect WNV in *C. q.* population at 95% certainty



At MIR of 0.33 sample size needed at 95% was 906

At MIR of 0.15 sample size needed at 95% was 1995

Comparison between Sampling Dead Birds 2003/2004 (where n=3+)

Year	N Tested	Combined Pos	Species at 33%+ Pos	Confidence Level
2003	371	7%	Blue Jay American Crow Wood Thrush Common Grackle	99%
2004	27	0%		48%

Estimated cost reduction of number of species tested = 93%
To have 95% confidence level at 33% positive rate requires 78 birds

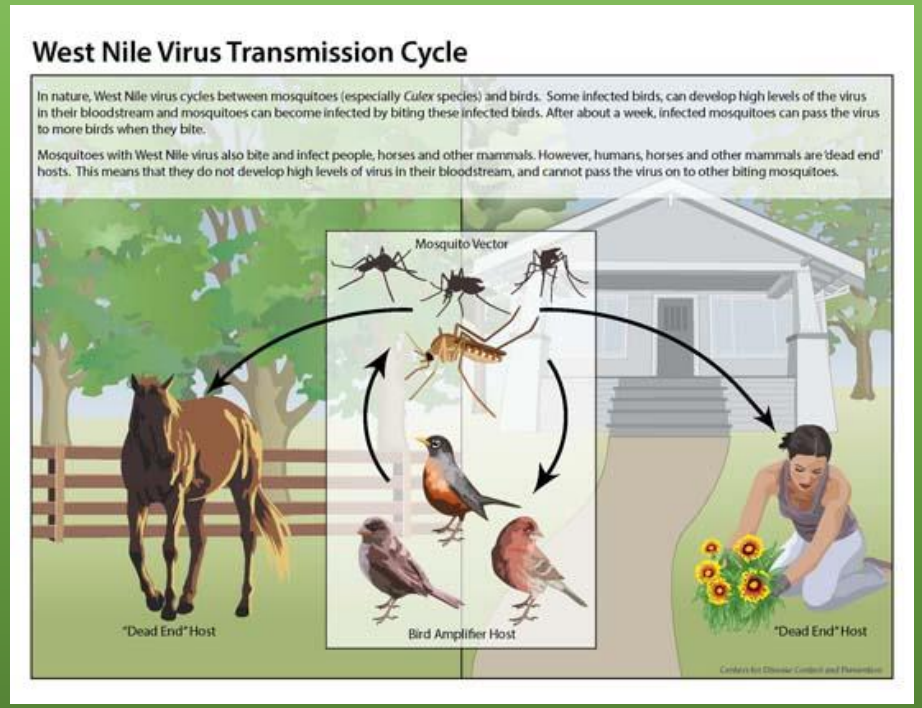
Comparison 2003/2004 Chicken WNV Testing

Year	N Tests	N Pos	WNV unique sites
2003	250	6	1
2004	0	-	-

Cost reduction of surveillance flock = 50%

Comparison of WNV positive indicators 2003/2004*

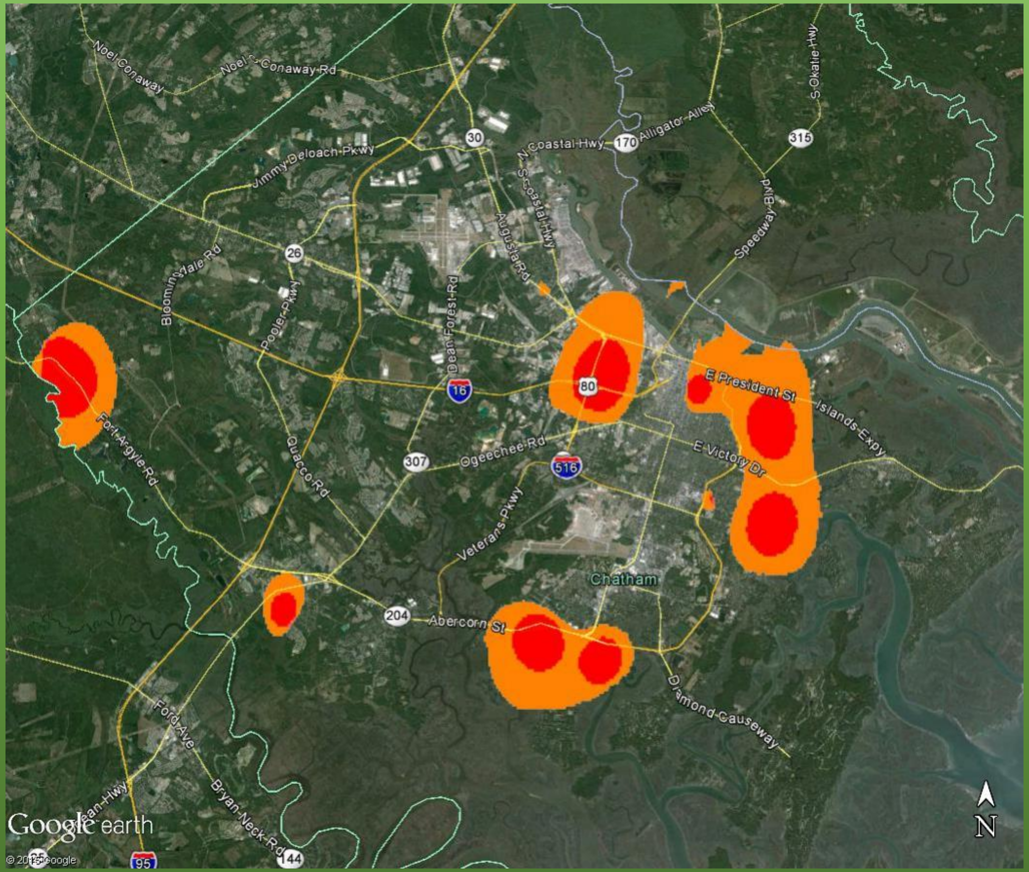
Infected Organisms	2003	2004
Birds	27	0
Mosquito pools	67	38
Sentinel chickens	6	*
Horses	1	0
Human Cases	9	1



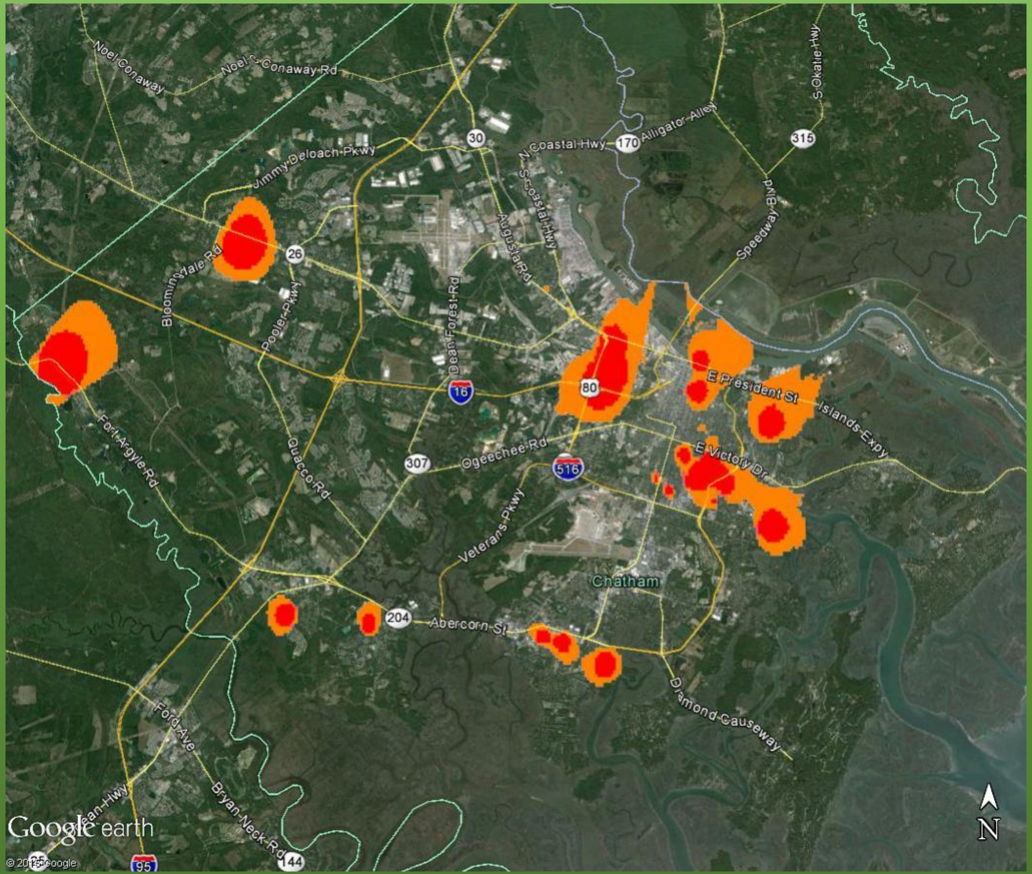
(Lewandowski and Moulis, 2008)

Likelihood of finding a WNV sample at P ≥ 50% (orange) and P ≥ 70% (red) in vectors and wild birds using Geospatial Statistics Inverse Distance Weighted Measurement (IDW)

Vectors

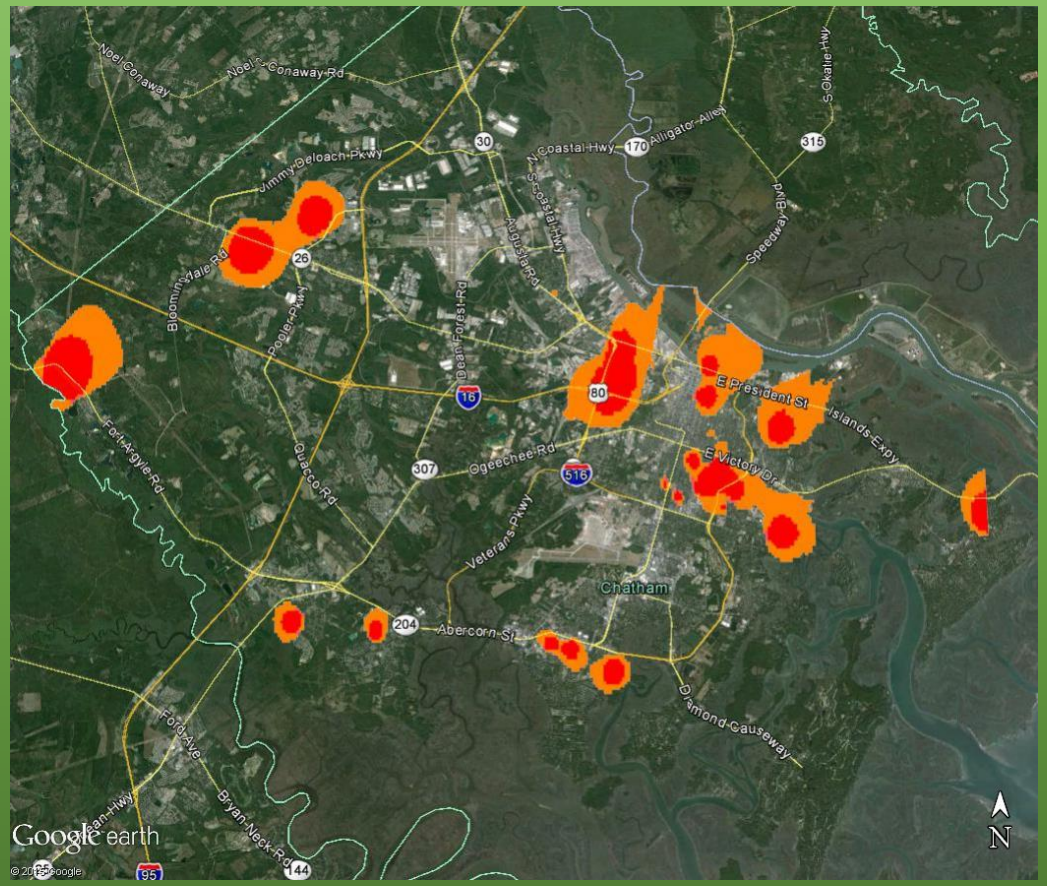


Vectors/Wild Birds

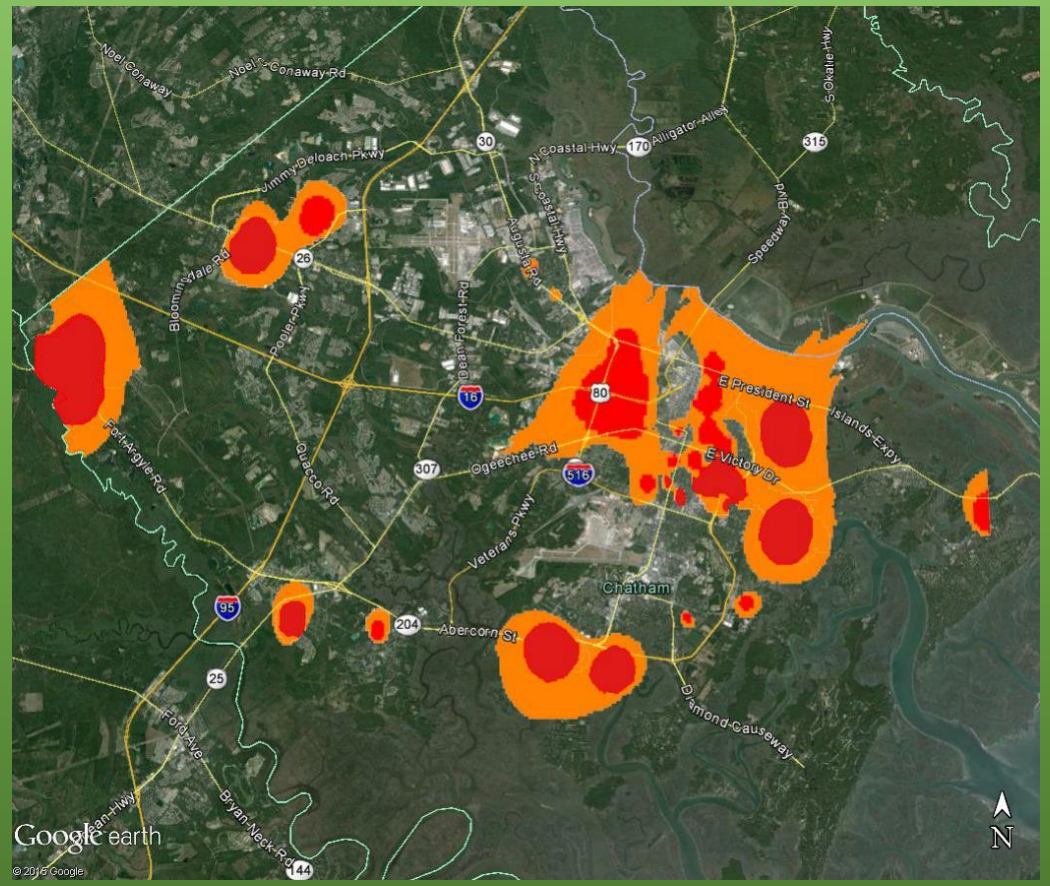


Likelihood of finding a WNV sample at P ≥ 50% (orange) and P ≥ 70% (red) using Geo Stats IDW

Vectors/Reservoirs

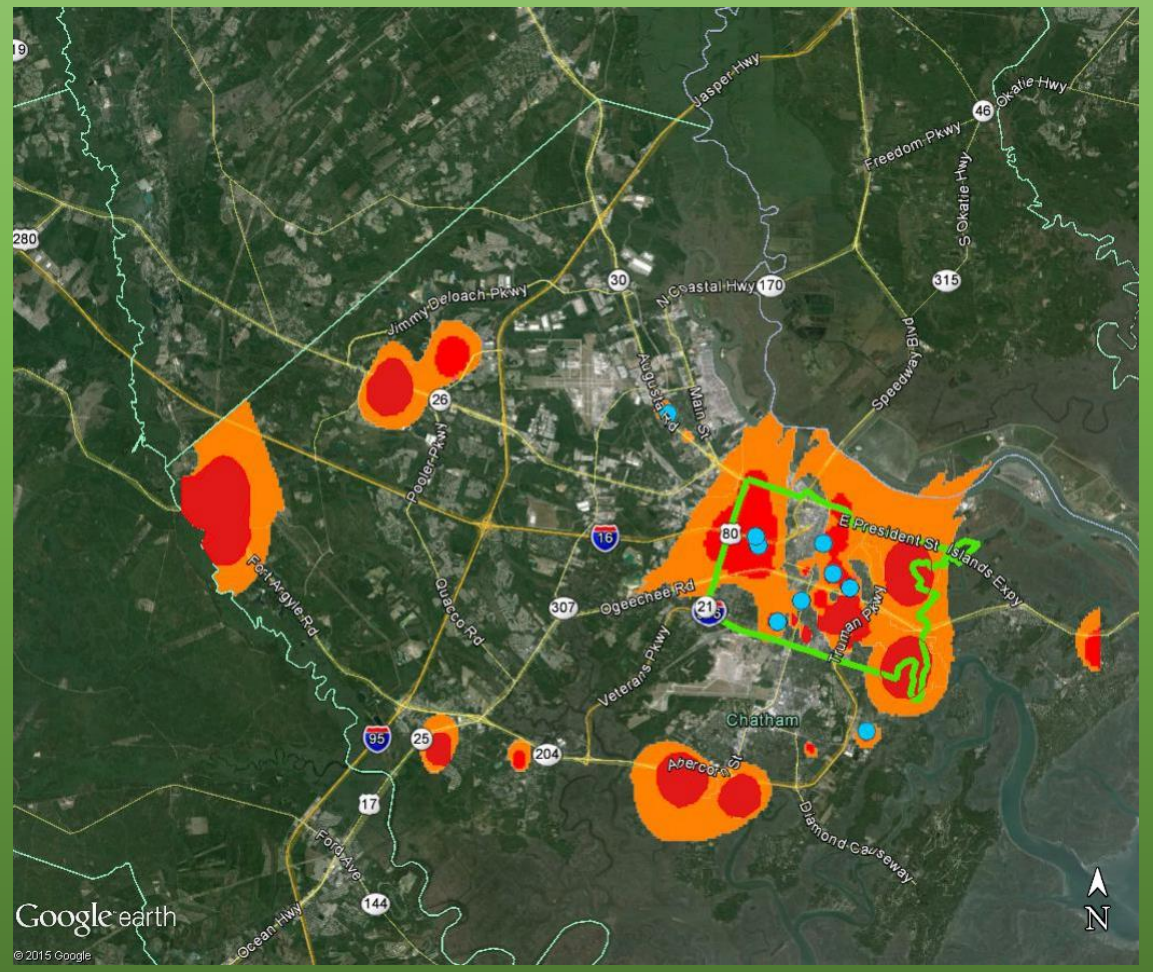


Vectors/Reservoirs/Humans



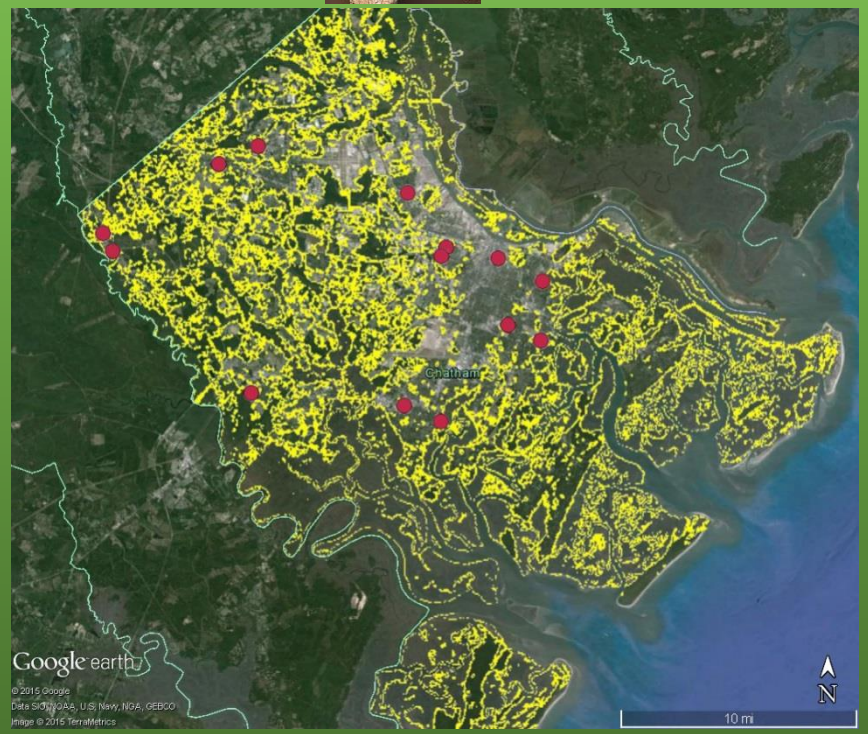
Comparison between surveillance methods and finding WNV+ in habitats 70%+ (in red)

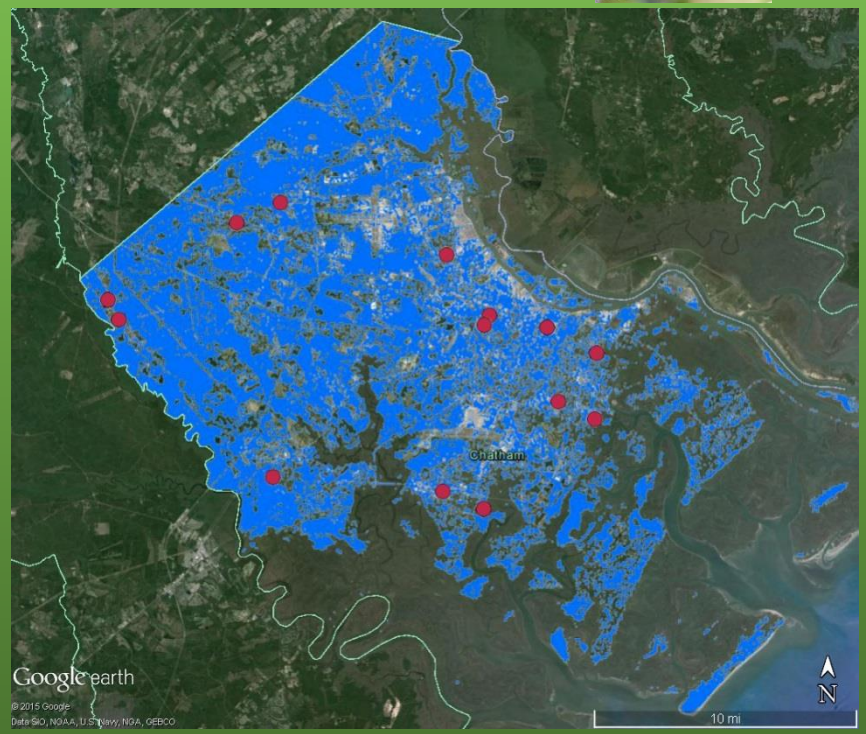
Source	Z - Vector/Wild Bird/Chicken	Z - Vector/Wild Bird	Z - Vector
Vector/Reservoir /Human	1.81*	2.14*	1.83*
Vector/Wild Bird/Chicken		ns	1.8*
Vector/Wild Bird			1.8*



2003/2004 GAP Analysis and Avian Amplifiers

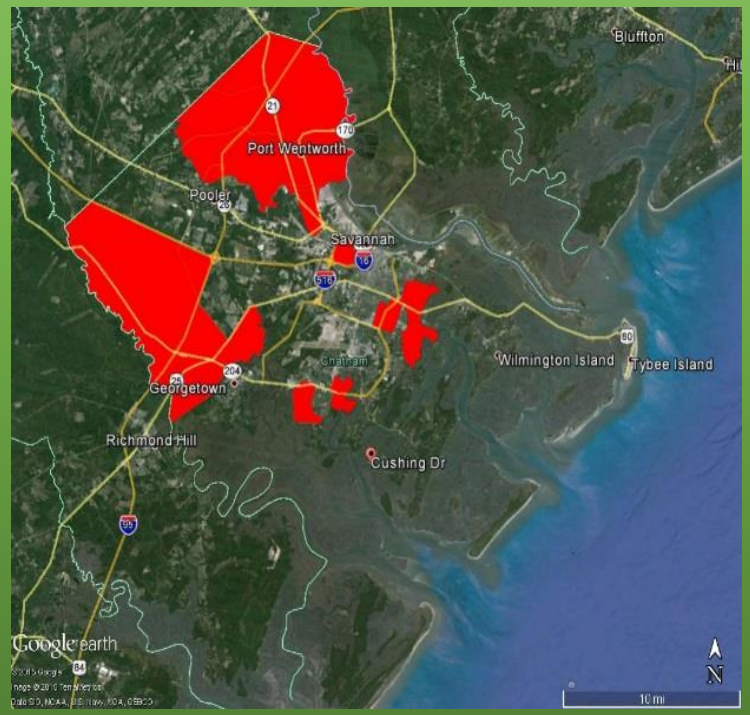
1. **WNV + Mosquito/Reservoir factors were geospatially correlated with the predicted distribution of the Northern Cardinal population in Chatham County $p<0.05$**
2. **But not spatially correlated with American Robin (Ubiquitous), Blue Jay (Scattered), House Finch (Urban) or White Eyed Vireo populations (rural)**





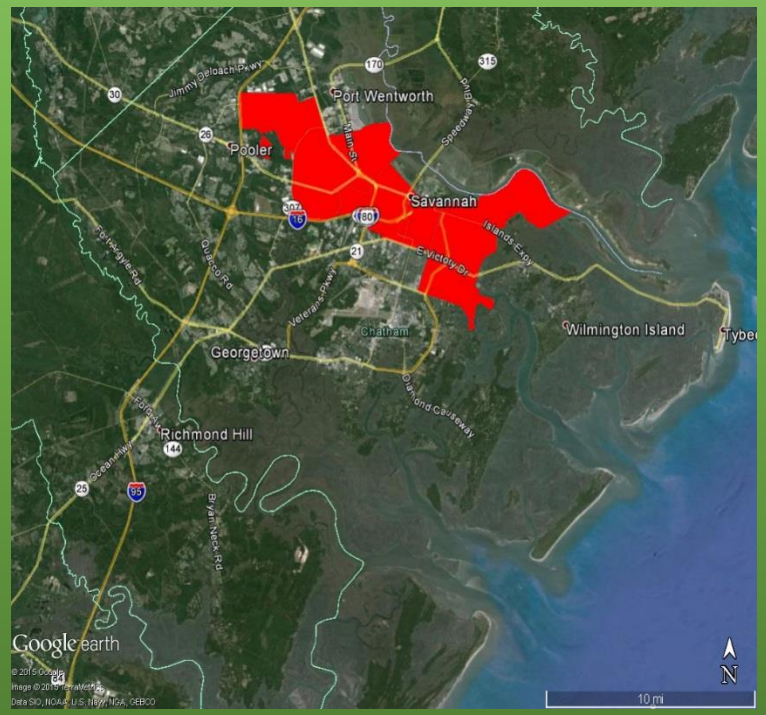
Median household income and race are important factors for being at risk from WNV in Chatham County ($p < 0.05$)

Areas where highest proportion of African-American population at risk



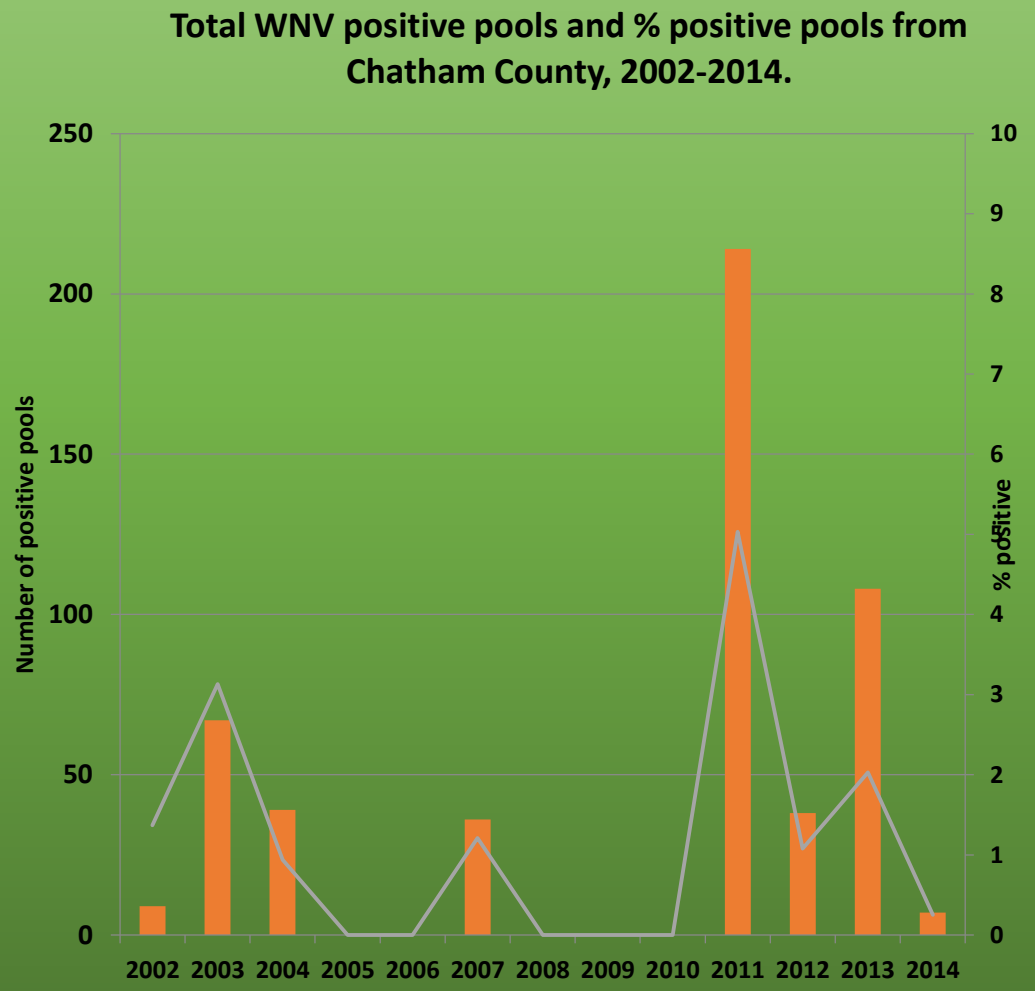
Areas where highest proportion of Caucasian population at risk

Areas where indigent population at highest risk



Preliminary Analysis of 2003-2014 Data

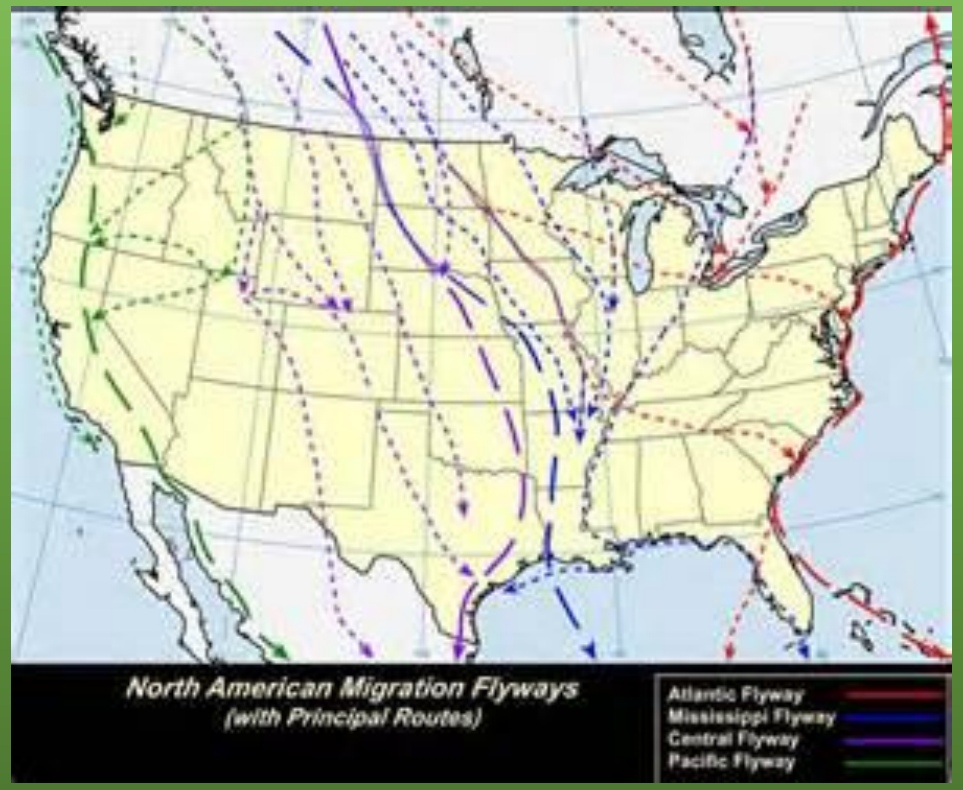
1. **Validates 2003/2004 program review - WNV cases in Chatham County were correlated with number positive mosquito pools ($p<0.05$)**
2. **Preliminary Model indicates:**
   a. **minimum of 18 positive pools required to reach one human WNV case**
   b. **54 positive pools will produce 1 to 4 WNV cases**



Preliminary Analysis of 2003-2014 Data

3. The predicted number of positive pools only explains 57% of the variation in human cases; other possible contributing factors being analyzed include:

a. **Temp/Weather**
b. **Overwintering mosquitoes**
c. **Microhabitat**
d. **Overwintering resident birds**
e. **Migrant birds**



Conclusion Phase 1 Meta-Evaluation

1. **Feasibility**
   a. **The changes made in the WNV control program in 2004 were readily accomplished**
   b. **Additional gravid traps deployed**
   c. **WNV sentinel chickens in urban area eliminated**
   d. **Wild bird collection reduced**
   e. **Pellet/Briquette placement in high risk areas**
   f. **Began mosquito control earlier in season**

2. **Acceptability/Fidelity of program materials and methods**
   a. **Staff adopted new IPM strategy (e.g. briquettes/pellets, new pesticides)**
   b. **Reduction of wild bird collection may reduce surveillance over broad area**
   c. **Private landowners cooperated in allowing gravid trap placement on their property with easy access**
3. **Efficacy**
   a. **Contributed to significant short term and intermediate reduction of WNV human cases?**
   b. **Increased efficacy of pesticides, decreased cost of chicken/wild bird surveillance**
   c. **Inclusion of maps in decision mapping provided targeted IPM**

Conclusion Phase 1 Meta-Evaluation

4. **Process Evaluation**
   a. **Trained staff were able to sample mosquitoes and apply new pesticides**
   b. **Staff were able to communicate effectively with customers in target areas**
5. **Qualitative Evaluation**
   a. **No negative impact from staff using new pesticides**
   b. **Some negative feedback from community from changing from early morning to evening spraying**
6. **Quantitative impact/outcome**
   a. **Reduction of WNV indicators**
   b. **Reduction of the number of human cases**
   c. **Reduction of positive mosquito pools**
   d. **Detection of WNV positive birds, mosquitoes and sentinel chickens**

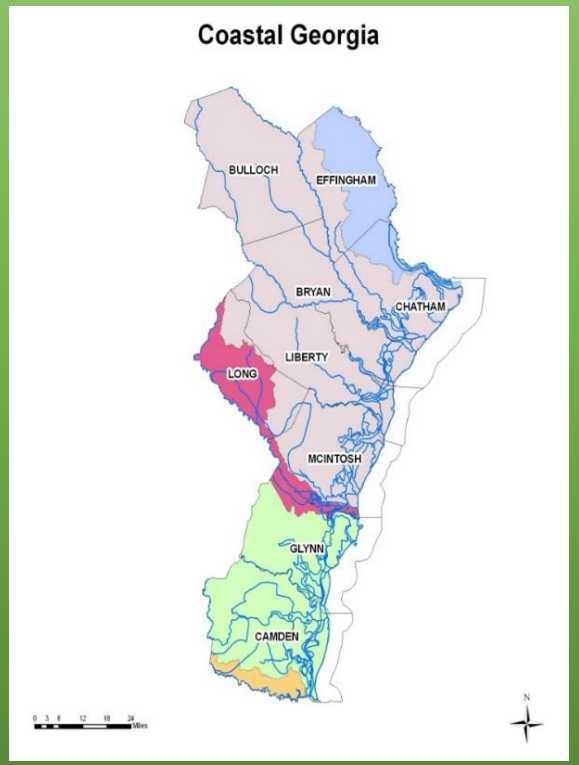
may not provide adequate measures to predict or control human cases

Conclusion Phase 1 Meta-Evaluation

7. **Cost-Effectiveness/Benefit Evaluation**
   a. **Cost benefit was gained from eliminating inner city sentinel chickens and the reduction of wild bird collection however there was a decrease in confidence that WNV was detected in the environment**
   b. **Cost/Benefit analysis of changing pesticides and delivery mechanisms (e.g. briquettes/pellets) was not conducted**
8. **A Meta Evaluation of the multi year WNV program is being conducted**
   a. **Phases 1 through 4 for each year (2002 -2015)**
   b. **Develop WNV Risk Assessment Model applicable to Chatham County**

Preliminary recommendations based upon Phase 1 Meta-Evaluation of WNV Program

1. **Complete Phases 2-4 of ME of multi year WNV program**
2. **Conduct meta analysis within each phase**
3. **Phase 2 – Efficacy, expand assessment and develop WNV Risk Program Model**
   a. **Initiate winter wild bird sero-prevalence monitoring in amplifier hosts**
   b. **Initiate wild bird WNV antigen detection in susceptible hosts**
   c. **Monitor vector/reservoir species**
   d. **Include human case records in analysis (following HIPA guidelines)**
   e. **Optimize trap placement using gap analysis**
   f. **Conduct meta analysis to evaluate efficacy**
   g. **Modify WNV risk map based on continued surveillance**
4. **Phase 3 - Determine long term Efficacy of Program, Validate WNV Risk Program Model**
   a. **Evaluate mosquito control efforts and surveillance towards high risk areas**
   b. **Include socio-economic, race and other demographic analyses**
5. **Phase 4 - Determine if WNV Risk Program Model for Chatham County is applicable for other Georgia coastal counties**



Acknowledgements

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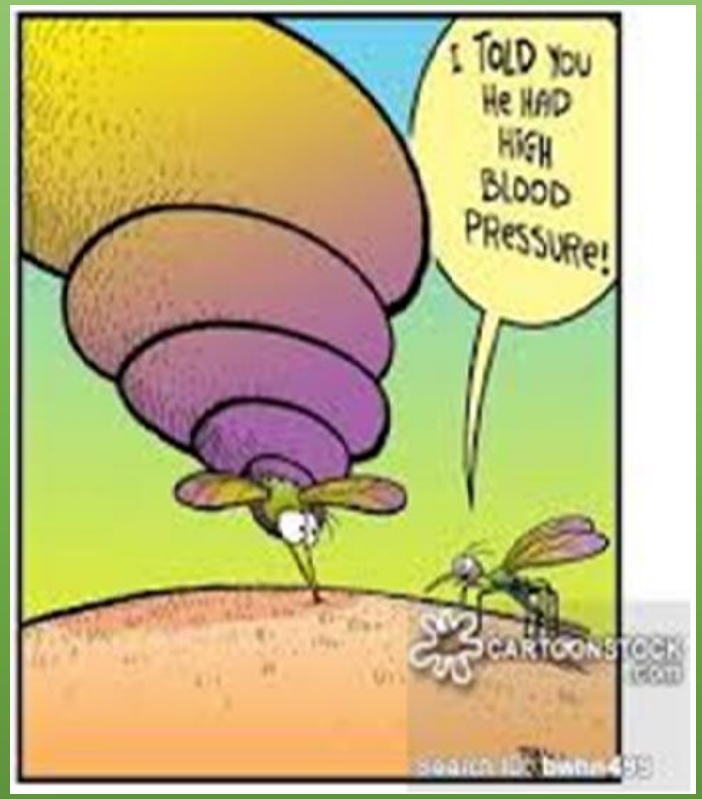
- **Pamela Thompson**
- **Reginald Campbell**


I TOLD YOU HE HAD HIGH BLOOD PRESSURE!
CARTOONSTOCK