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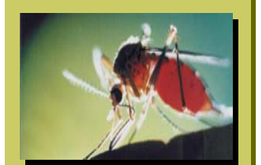
In addition to the technical experts solicited by the consultant team, over 200 representatives of agencies, associations, governments, organizations and interested individuals are participating in some aspect of the project, either through direct work efforts or membership in one of the committees providing input to the County. The Committees include the Steering Committee (Brian L. Harper, M.D., MPH, Chair), the Technical Advisory Committee (Jack Mattice, Chair) and the Citizens Advisory Committee (Adrienne Esposito, Chair) Groups with representation include:

Federal	State	Academia	Organizations	Civic Associations
US Environ. Protection Agency	Dept. of Environ. Conservation	SUNY Stony Brook	Nature Conservancy	Mastic Beach
US Geological Survey	Dept. of State	Southampton College	Sierra Club	Panamoka
US Fish and Wildlife Service		Suffolk Community College	Citizens Campaign for Environ.	Nesconset-Sachem
US National Park Service			North Fork Environ. Council	
			Ducks Unlimited	

For more information log onto http://www.suffolkmosquitocontrolplan.org

Steve Levy
Suffolk County Executive

Inside this issue:



SUFFOLK COUNTY
VECTOR CONTROL & WETLANDS MANAGEMENT LONG-TERM PLAN
http://www.suffolkmosquitocontrolplan.org

Volume 1, Issue 1 **October 2005**

The Project

In 2003, Suffolk County began developing the nationally unprecedented Vector Control and Wetlands Management Long-Term Plan. The *Plan* integrates the goals of optimizing environmental quality and minimizing public health risk from mosquito-borne diseases and exposure to pesticides. A paramount objective is to preserve and restore wetlands managed by Vector Control via open marsh water management, natural reversion of ditched areas, and other alternatives. Another primary objective is to reduce the amount of pesticides used to control mosquitoes.

The *Plan* is unique for a number of reasons, including its rigorous risk assessment which evaluates physical, biological, and chemical stressors to human health and the ecology. Numerous internationally renowned experts have been enlisted in the fields of mosquito control, disease transmission, toxicology/risk, cancer, wetlands biology, marine ecology and chemistry. A tremendous amount of local field data was collected to support Plan initiatives, involving comprehensive studies of 21 wetlands systems. An exhaustive monitoring program collected extensive data on pesticides in air, water, sediment, and biota, measuring chemical levels to as low as 1 part-per-trillion, the state-of-the-art.

Why do this study now, after over 70 years of mosquito control in Suffolk County? Determining the best methods to control mosquitoes is more relevant to the protection of public health than ever, with the appearance of West Nile virus and the intermittent reappearance of Eastern Equine Encephalitis. Also, the County recognizes the need to implement progressive wetlands restoration and pesticides reduction strategies. The *Plan* process, with its active Citizens and Technical Advisory Committees, has finally provided the forum to develop and implement such sustainable management programs, working with the New York State Department of Environmental Conservation, Fire Island National Seashore and other agencies and stakeholders.

The Plan

The Draft *Plan* has been issued and is available for review at the following website: www.suffolkmosquitocontrolplan.org. The process for adopting the *Plan*, and the associated Generic Environmental Impact Statement, is expected to last well into 2006.

The tidal wetlands management approach represents a dramatic change in County direction, from routine ditch maintenance to reversion as an interim policy. This change is predicated on the ability to implement OMWM, as was done in the *Plan*'s Wertheim demonstration project (see p. 4). From a total of 17,000 acres of tidal wetlands over 4,000 acres have been identified as candidates for OMWM, with an additional 4,000 acres slated for reversion. The remaining 9,000 acres will be assessed over the coming decade. Goals of OMWM include controlling mosquitoes, minimizing or eliminating pesticide usage, enhancing biodiversity, and controlling *Phragmites* (a nuisance invasive species).

In terms of mosquito control, the Plan continues to emphasize the existing "Integrated Pest Management" approach, which relies on surveillance, source reduction and biological control, with chemical control used only as a last resort after consultation and approval of the Department of Health. Already, the County is implementing a recommendation to improve aerial spray methods to minimize pesticide delivery and mosquito control. Enhancements to surveillance will be recommended, and criteria will be specified to set thresholds for chemical usage.

Ultimately, the Plan is the beginning, not the end. It will be followed with annual reports on wetlands management, amounts, types and locations of chemicals used and triennial updates. An adaptive management approach, and continuing input from committees and stakeholders, will ensure that plan updates are timely and effective.

Virginia Rail, Wertherm NWR
Photo courtesy of Ducks Unlimited

Culex pipiens house mosquito

Dipping for mosquito larvae

What's Been Done?

The program has proceeded on time and within budget, with many significant early actions already implemented. For example, the use of enhanced spray technology, based on local meteorological conditions, will optimize mosquito control while minimizing amount of and exposure to pesticides. Also, the Literature Review has validated OMWM, which is widely practiced on the eastern seaboard, as an essential technique for mosquito control and habitat enhancement. These findings have supported implementation of the successful Wertheim Open Marsh Water Management demonstration project (see page 4), the first of its kind in New York State. A Caged Fish Study (see page 3) has determined that any observed impacts on organisms could not be attributed to Vector Control chemicals. Rather, any observed impacts were attributable to other stresses, such as low dissolved oxygen. A comprehensive evaluation was done of the laws and regulations that govern mosquito control in Suffolk County, including the interaction with Local Waterfront Revitalization Plans (LWRP) and the National Environmental Protection Act (NEPA). Additionally, an extensive literature review was made to assess the collective experience of vector control experts and researchers in related environmental and human health disciplines. Detailed searches of the scientific, medical, and public health literature have been performed on the various aspects, alternatives and effects of mosquito control. This effort is discussed in more detail on pages 6 and 7.

The consultants have performed a comprehensive overview and developed a detailed description of the operations of Suffolk County Vector Control, including surveillance and monitoring techniques, pesticide usage and water management strategies, and notification and response procedures. In addition, Suffolk's mosquito control program was compared to its counterparts in neighboring counties and states. As part of this effort, innovative techniques and products were evaluated for their effectiveness and applicability on Long Island.

The County's unique and representative wetlands areas, in regards to mosquito control, have been included in the project as Primary Study Areas. Data for the following have been mapped and incorporated into the County's Geographic Information System (GIS): wetlands, mosquito traps, pesticide applications, and water control data. The first digitized map identifying all the tidal wetlands in Suffolk was produced. Additionally, water quality data from Suffolk County and other agencies has been assembled and mapped in the County's GIS. These data collections and maps will document past conditions and establish trends for use in determining future needs.

What's to come?

A risk assessment is being conducted to evaluate the potential human health and ecological effects of the County's Vector Control program, as set forth in the proposed Management Plan. Three types of impacts will be assessed for both human and ecological receptors:

- Risk of mosquito-borne disease
- Risk associated with pesticide use
- Risk associated with water management

For each of these, risks will be evaluated for a baseline condition, assuming no active mosquito management. Then risks will be evaluated for the implemented Management Plan. A final document will be developed with modifications based on the results of the impact assessment.

A Draft Generic Environmental Impact Statement (DGEIS) will be prepared to fully assess the potential environmental impacts of the Management Plan. A final document will be developed from comments received on the DGEIS for adoption by the Suffolk County Legislature.

Release of the Risk Assessment, Draft Management Plan and Draft GEIS are scheduled to occur in October 2005.

Book 6: Vector Control Pesticides - Human Health Impacts

Two categories of human health risks are examined: risks that may result from exposure to infected vectors and potential risks due to exposure to insecticides used by Suffolk County Vector Control. The potential for chemicals used for mosquito control to cause breast cancer and/or childhood diseases is also discussed. The spread of mosquito-borne pathogens and documentation of the infection rates that constitute a human health risk are examined. Researchers include Susan Teitelbaum, PhD (Mount Sinai).

Book 7: Vector Control Pesticides - Environmental Impacts

Literature on the impacts of mosquito control chemicals on terrestrial and aquatic wildlife is evaluated. Information on ecotoxicological characteristics are reviewed and summarized for each of the 11 primary list mosquito control agents identified for this study. Dose-response and hazard data in a variety of wildlife species, including non-target insects and insectivorous birds is presented. The review includes toxicity, fate and persistence of mosquito control pesticides in the coastal marine environment. Researchers include Judi Durda, MS (Integral Consulting).

Book 8: Marine and Non-Target Impacts

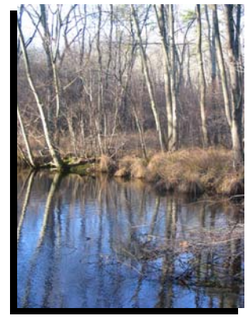
The potential impact of vector control chemicals on other aquatic organisms is reviewed, including marine invertebrates and fish. Vector control pesticides can affect fresh water and marine fish by causing immediate acute toxicity on exposure. The potential impact on the aquatic food chain is examined. Impacts on commercially important marine species such as lobsters are reviewed including a detailed summary of the "Lobster Initiative", a major effort to understand recent lobster mortalities.

Book 9: Salt Marshes and Mosquito Control

The ecology and food chains of natural salt marshes are reviewed as well as the impacts of OMWM. Salt marshes are inherently ephemeral coastal ecosystems that continually evolve in response to changing environmental conditions. Wetland health and ecological functions are reviewed in detail. Also reviewed are examples of OMWM from the Eastern United States, the impact of OMWM on mosquito control efforts and the loss of wetlands on Long Island. Researchers include Steven Goodbred, PhD (Stony Brook University).

Book 10: Upland Habitats and Mosquito Control

Upland natural and man-made freshwater habitats, including open water bodies, marshes, and streams are reviewed. The boundaries between fresh and saltwater wetlands in these systems are often difficult to define and are constantly changing due to the influence of tidal cycles and freshwater inputs. In Suffolk County, several types of freshwater wetland communities exist, including many rare systems that are found in few places on earth. This is due, in part, to the glacial development of the region and to the coastal influences of the surrounding tidal waters. Stormwater control structures, which can improve surface water quality by removing solids and coliform bacteria, also have potential as mosquito breeding sites. These structures are reviewed along with techniques to minimize their vector breeding potential. Researchers include Wayne Crans, PhD (Rutgers University).



Carlls River wetland

Managed New Jersey Swamp

Red maple swamp

Snowy egret in spartina patens

Literature Review

Mosquito gravid trap

The literature review was conducted to assess the collective experience of vector control experts and researchers in related environmental and human health disciplines. Detailed searches were performed of the scientific, medical, and public health literature. The goal was to provide data for the risk assessment, to determine state-of-the-art mosquito control techniques and alternatives, including wetlands management and to identify technology to support early implementation actions and demonstration projects. The program has already benefited through the implementation of OMWM and the incorporation of new spray technology that minimizes pesticide delivery and enhances mosquito control. The information has been assembled in the following components.

Book 1: Long Island Mosquitoes

Suffolk County is home to approximately 42 species of mosquitoes and approximately 20 species have the ability to influence the quality of life and/or the health of County residents. Information is provided about the life cycles, distribution, abundance, potential for disease transmission, and susceptibilities to control techniques of the major species of concern. Techniques used by the County and others for measuring mosquito abundance and for correlating control measures to mosquito population and disease prevalence are examined. Preeminent researchers included Wayne Crans, PhD (Rutgers University) ad Richard Pollack, PhD (Harvard University).

Oxygen measurement in mosquito ditch

Book 2: Mosquito-Borne Diseases

Information is presented on the incidence of mosquito-borne disease worldwide, in the United States, and Suffolk County. Factors affecting the spread of disease include the greater mobility of people, animals, and goods as stresses leading to failures in formerly well-established public health services. The impact of West Nile Virus on non-human species is discussed as well as its potential impact on humans and the environment. Information on serosurveys for West Nile Virus, conducted worldwide, is also presented.

Book 3: Mosquito Monitoring

Techniques used to monitor larval and adult mosquito populations are discussed. A variety of adult traps are reviewed along with collection techniques for mosquito larvae from different habitats. Mosquito-borne disease surveillance techniques are also discussed.

Book 4: Overview of Mosquito Control

This book discusses the general principles of Integrated Pest Management, which is a hierarchical approach to mosquito control utilizing surveillance, source reduction, larval control and adult control. Public education is another essential component of the program, used to establish the purpose for and to reinforce the activities associated with, the four elements listed above. The various mosquito control agents that are utilized to accomplish mosquito control are discussed. Innovative and alternative methods of mosquito control are also reviewed, as well as methods used for household and personal protection.

Larvicide application by backpack sprayer

Book 5: Mosquito Control Pesticides

Mosquito control agents utilized by Suffolk County are presented and prioritized for investigation. Control may result from killing the mosquito or otherwise preventing it from engaging in behaviors that are deemed to be destructive. Pesticides may be natural or manmade and are applied to target areas in various formulations and delivery systems. Chemical and biological agents used for controlling mosquito larvae and adults, both historically and currently, are reviewed along with a detailed description of pesticide labeling requirements. Recent pesticide applications by Suffolk County are also presented.

Caged Fish Study

During the Summer of 2004, a caging study was conducted by the Marine Sciences Research Center at SUNY Stony Brook and Southampton College, under the direction of Professor Anne E. McElroy. After five spray events, no consistent evidence of acute mortality or sublethal effects due to pesticide exposure was observed after operational sprays, although transient periods of low dissolved oxygen at these sites may have influenced results obtained. The purpose of the study was to assess potential effects of Ultra-Low-Volume (ULV) application of Scourge® (resmethrin, a mosquito adulticide) and Altosid® (methoprene, a mosquito larvicide) on estuarine fish and shrimp in several salt marshes in Suffolk County, New York. The study was part of a larger effort to assess the ecological risk of vector control activities in the County. Juvenile sheepshead minnow *(Cyrpinodon variegatus)* and adult grass shrimp *(Palaemonetes pugio)* were used as test organisms. Organisms were deployed in most cases the day before a spray event, and their survival was monitored daily for five days (one day pre-spray and four days post-spray). Deployment occurred in cages placed in ditches or small creeks located within four marshes including Timber Point, Flax Pond, John's Neck and Havens Point. Two of the areas were sprayed with chemicals and two were used as controls. Five spray events were monitored - three larvicide applications (August 3, 10 and September 1, 2004) and two adultcide applications (August 18 and 25, 2004). Temperature and dissolved oxygen at each site were monitored and recorded at 30-minute intervals throughout each study. Fish growth and shrimp prey capture ability were also assessed as sublethal endpoints in organisms retrieved from each experiment, and static renewal toxicity tests were also performed on shrimp in the laboratory using water collected from each site 30 minutes after spraying. A workshop presenting the results of the study was held on May 13, 2005 in Hauppauge, New York.

Placing test organisms into cages

Setting mosquito cages

Fish and shrimp cages deployed in ditch

Open Marsh Water Management

Open Marsh Water Management (OMWM) uses a guild of techniques that have been developed to control mosquito production and avoid the adverse environmental impacts of traditional water management practices such as ditching. Managing mosquito habitats in an environmentally positive manner to minimize the breeding of larvae limits the development of adult populations and enhances natural resources thereby reducing the use of pesticides.

Mosquito ditches in tidal marsh

Using OMWM techniques, mosquito control is achieved by improving habitat for killifish, which are natural predators of mosquitoes. The killifish readily consume mosquito larvae that develop on the marsh. OMWM achieves these habitat improvements by altering the existing mosquito ditches, creating ponds and pannes and more natural channel features to restore the marsh.

Wertheim project area

Historic grid ditching has fundamentally altered the vegetation and habitat of Long Island marshes. Almost all of the salt marshes in the County were ditched in the 1930's. Better water management in salt marshes can reduce or eliminate the need for chemical control of adult mosquitoes. Ancillary benefits include improved marsh functioning, maintenance and enhancement of biodiversity and a return to a more natural appearance. In addition, fish habitats will be improved, allowing fish to enter breeding areas and consume mosquito larvae.

OMWM is widely believed to be the most effective, economical and environmentally beneficial means of control for salt marsh mosquitoes. Extensive OMWM programs have been conducted in nearby states such as Connecticut, New Jersey, Maryland and Delaware. These states report great success in both controlling mosquitoes and restoring habitat.

Wertheim National Wildlife Refuge OMWM Project

Suffolk County is implementing a long term, comprehensive demonstration project of several methods of OMWM with government and not-for-profit partners. The United States Fish and Wildlife Service (USFWS) is a partner in the project and has allowed a portion of the Wertheim National Wildlife Refuge (WNWR) in Shirley, New York to be used for this purpose. WNWR is a 2,550-acre site located on the south shore of Long Island on the Carmans River. It is considered an environmentally critical location due to rare species and migratory birds.

Tidal wetland

The project is situated in four distinct areas totaling 165 acres of the refuge. Two of the areas will undergo OMWM alteration while the remaining two will be observed as control points. Extensive monitoring pre and post project for physical, chemical, and biological parameters is ongoing in each study site.

Two primary goals of the project are to restore the natural functions of the system and decrease pesticide usage for mosquito control by reducing breeding sites, and promote larval control by naturally occurring fish.

In 2005, with permission from DEC, the 40 northern acres of Wertheim were successfully restored. A new tidal channel was constructed, many ditches were plugged, and numerous ponds were constructed. The Wertheim work will be completed on an additional 40-acres in the winter of 2005 to 2006.

Monitoring and Modeling

As part of the extensive field effort for the program, a comprehensive array of monitoring techniques was and are being utilized to evaluate pesticide fate and transport. These included direct monitoring of air, refrigerated deposition pans, and samples of water column, sediment, and biota. Using experimental analytical techniques, results were measured to the part per trillion range. This is as low as the state-of-the-art will permit, and approximately 100 times lower than conventional lab results. Studies were conducted during spray events in 2004 to obtain verification and calibration data for the dispersion model that will be used in the project's risk assessment. Testing was done using the adulticide Scourge®, with the active ingredient resmethrin.

Truck-mounted spraying was tested on September 22, 2004, at Cathedral Pines County Park, with ambient air and deposition samples collected.

The model selected to simulate truck-mounted adulticide applications was the Industrial Source Complex Short-Term (ISCST3) USEPA approved air dispersion model (Version 02035). This model was used to provide both ground level air concentrations and particle deposition estimates.

A review of the model versus actual data suggests that the model is slightly conservative, giving higher than average readings, and appears to work well at most downwind distances.

Two limited field tests were also conducted to obtain data on aerial adulticide applications. These were conducted in the Mastic-Shirley area on August 18 and 25, 2004, during actual adulticide applications. The adulticide applications were in response to high mosquito populations and observed West Nile Virus in collected species samples.

The modeling for aerial applications uses a two-step approach. The Agricultural Dispersion (Ag-DISP) aerial pesticide dispersion model, developed by the US Department of Agriculture, Forest Service, was used to develop the initial displacement caused by the turbulent effects of the helicopter speed and prop wash. These values were then used as input for the ISCST3 model to predict air concentrations and particle deposition estimates similar to the ground-based modeling approach discussed earlier.

As in the ground-based scenario, the model yielded conservative results. The conclusion is that this modeling approach will be appropriate in predicting conservative air concentrations and deposition values for both aerial and ground-based adulticide applications for the risk assessment. This will allow the determination of anticipated target and off-target impacts during a specific spray event, as well as determining worst-case impacts based on changing spray parameters and meteorological conditions.

Additional Work

- Comparison of Wertheim West and Seatuck salt marshes to determine vegetative patterns over several hundred years and the environmental influences on these patterns. Results show system-wide changes in plant communities at both marshes, during the past century. Parallel-grid ditching seems the most logical explanation for the changes at Wertheim, while upland development and in-marsh alterations had a more significant impact on marsh change than ditching did alone at Seatuck.
- Comparison of invertebrate species in salt marshes with varying larvicide histories. Although this was a limited sampling effort, the data collected implies that long-term persistent use of modern larvacides appears to have no impact on these signature invertebrates.
- Catch basin mosquito breeding survey. Areas with older, less well-maintained catch basins may deserve greater monitoring by SCVC, as they may serve as breeding site for potential disease vectors.
- 21 tidal and freshwater wetlands were selected from the north and south shores of Suffolk County for study as "Primary Study Areas" (PSAs). These wetlands were chosen because of their exceptional environmental quality or for their value as archetypes for other site within the County. Each PSA was also important to the County's vector control program as a known mosquito breeding area, a site managed by the Division of Vector Control, or a control site for the purposes of the project. General descriptions of reach marsh were created from public records, aerial photography and maps, and any specific reports published concerning the areas. These descriptions were then augmented by rigorous field observations, made according to an approved plan of study.

The County also conducted Demonstration Projects to evaluate whether or not certain products are effective in repelling mosquitoes. Products tested include garlic oil, Mosquito Solution®, and Mosquito Magnets®.