ABSTRACT

TITLE: Climate effects, West Nile virus vector development, and transmission risk

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Climate variables have been shown to govern mosquito abundance and potential for arboviral transmission. Although daily weather and seasonal to inter-annual climatic variability influence pathogen vector biology, this information is not readily employed in vector-borne disease programs. The reasons for this disconnect between climatic information and vector management are: (1) accurate relationships between climate and infectious disease are most likely dependent upon local scale parameters that have not been related to regional climate data and (2) interaction among climatologists, entomologists, public health and vector control professionals has not been integrated to the level where information can be developed, validated, and readily incorporated into mosquito management plans. In this study we have gathered the expertise of climatologists, entomologists, social science/risk analysis experts and public health/vector control professionals. We will develop a system for predicting and monitoring risk of human feeding by mosquito vectors and West Nile virus (WNV) transmission that will be readily usable by public health professionals for decision-making. This system will provide a mechanism for early warning of WNV risk as well as serve as a model for other existing and future vector-borne risks including category B select agents. These vector-borne disease risks include Rift Valley fever, Japanese Encephalitis and Ross River virus. Competent mosquito vectors for each of these diseases are already present in the United States. In order to develop, refine and validate the system we will focus our efforts on New York State with the intent to make the system adaptable to any region. We hypothesize that a few key climate factors influence and drive WNV transmission dynamics, and these key factors can be modeled to accurately predict the risk of WNV transmission to people.

Before we gain an understanding of the ways in which climate factors influence vector abundance, we will quantify the relationship between climate and mosquito development/abundance using locally relevant mosquito strains. While a few field studies examining larval development rates have been conducted in the Western US in habitats particular to that region, most knowledge about larval development rates is based on laboratory experiments that may not be applicable to field conditions or local vector strains. Simultaneously, we will explore pedagogical issues with end users to determine the types of information needed for decision-making, and the optimal format (including level of complexity, logical and visual design) and means of delivery that would be most useful to technical staff and decision makers. On the basis of this research, and with the objective of optimizing utility for local and regional public health units, we will develop a decision support and risk communication program to serve as the user interface with the climate-forecasting model.

The specific aims of this proposed study are to (1) determine the date of spring emergence and generational development rates for epidemiologically important mosquito vector species in New York State, (2) develop a climate-based model incorporating

mosquito development, population abundance, and virus replication/amplification rates for WNV based on the proportion of infected vectors, and building from these, (3) develop a decision support system that can be effectively utilized by public health and vector control professionals.

We have gathered a multidisciplinary team to collaborate on this effort that includes a climatologist (DeGaetano), vector biologists (Harrington, Anderson), public health and vector-control professionals at the state and county level (Petit, Backenson, Gall, Ninivaggi, Campbell), and a social science-risk analyst (Levitan). Collectively, this interdisciplinary team is well suited to further examine the relationship between climate variability and human risk for vector-borne diseases.