Vector Hazard Report:
Malaria in Haiti

Part 2: Vector Bionomics and Reference Material

Information gathered from products of
The Walter Reed Biosystematics Unit (WRBU)

VectorMap
Systematic Catalogue of the Culicidae

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Bionomics Dashboards:

Anopheles albimanus Part 1
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Anopheles vestitipennis
Anopheles grabhamii

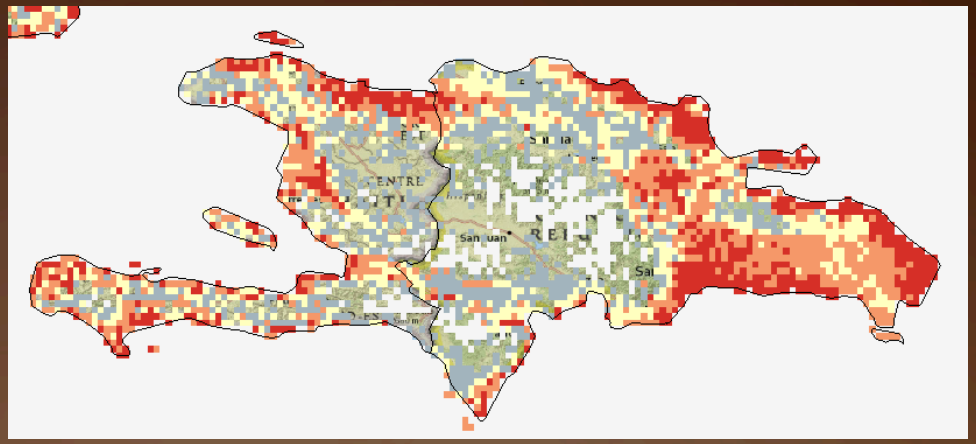
Also:

Keys to the Mosquitoes of Haiti

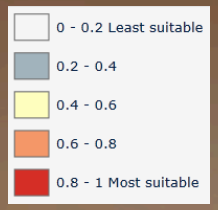
Introduction Literature: Malaria in Cambodia

References

Anopheles (Nys.) albimanus Wiedemann, 1820



Bionomics:
Larvae of *An. albimanus* are found in a wide variety of permanent water habitats. They are salt tolerant. Habitats are usually in full sunlight or partial shade containing abundant floating, emergent vegetation and floating scum and algae. Habitats frequently have muddy bottoms and turbid or polluted water.



Maxent model of *An. albimanus* Nyari, A. 2011

Medical Importance:
In 17 of 20 Caribbean region countries, *An. albimanus* is the primary malaria vector.

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VectorMap Data Summary:
Number of Records: 1499
Number of Localities: 570
Sources: *Preserved Specimens from the Mosquito Information Management Project, Erwin, Terry, 1989; Pecor JE et al. (2002). J Am Mosq Control Assoc. 18,241-276; STRI/EPA funded project (Mosquito Species Diversity and Landscape Change); U.S. Army Research and Development Command and human observations from:* Ibáñez Bernal, S. 1998. Los díptera hematófagos y taxa relacionados de dos áreas protegidas del estado de Yucatán, México (Insecta); Caillouët, K.A. et al. 2008. Characterization of Aquatic Mosquito Habitat, Natural Enemies, and Immature Mosquitoes in the Artibonite Valley, Haiti. J. Vector Ecol., 33(1):191-197; Fernandez, M. et al. 2013. Contribución al conocimiento de la distribución y aspectos biológicos de algunas especies de mosquitos en Haití. Anales de Biología 35: 55-63.

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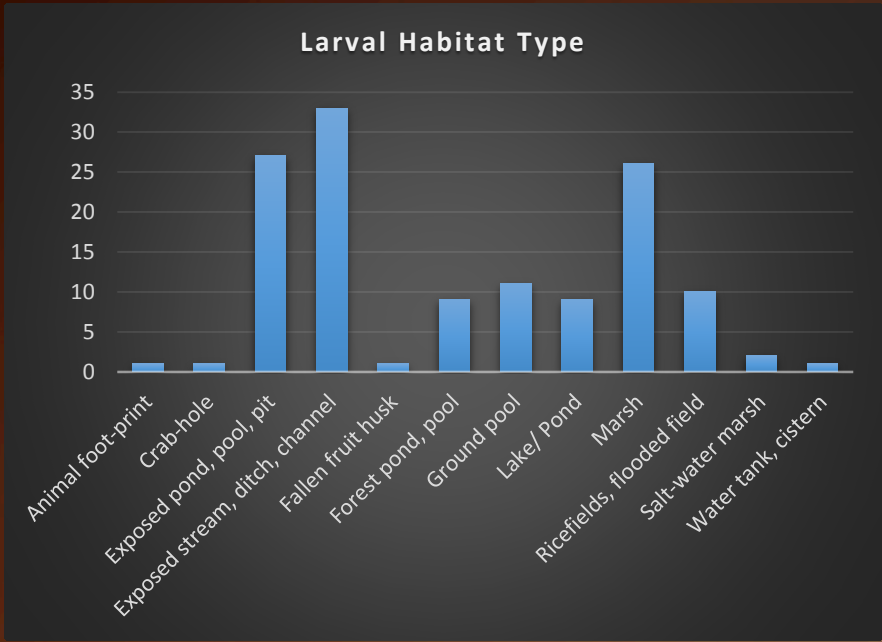
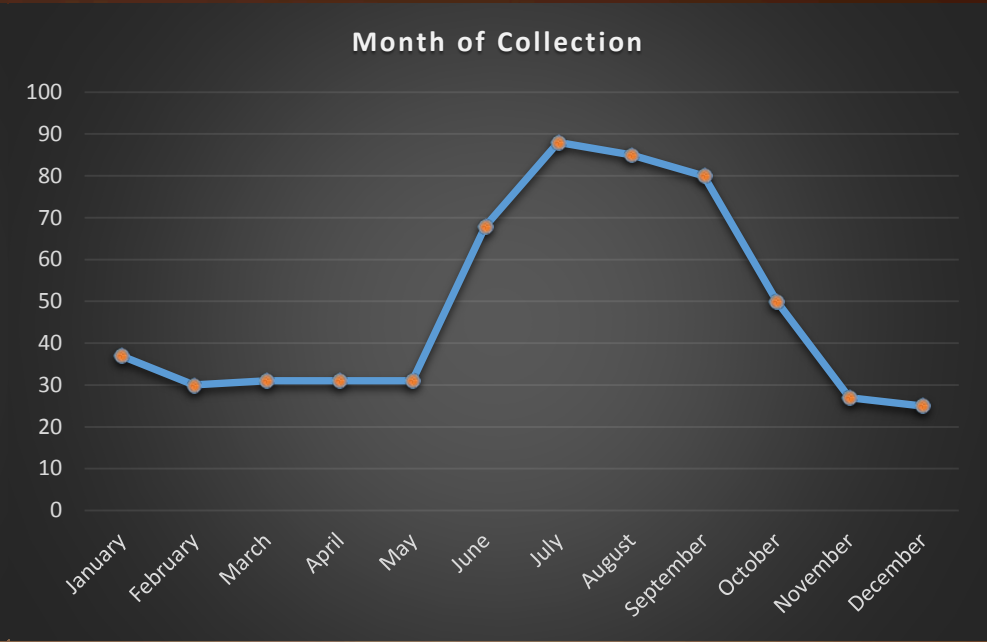
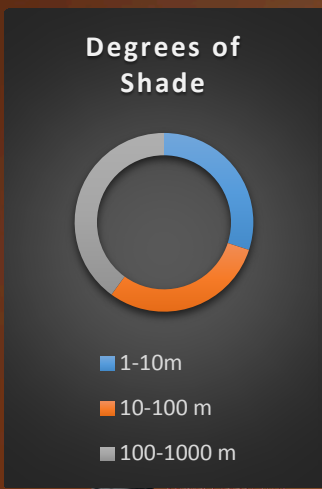
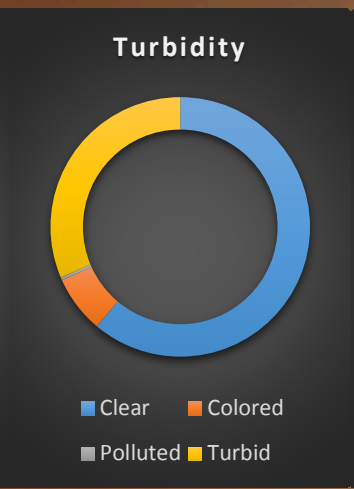
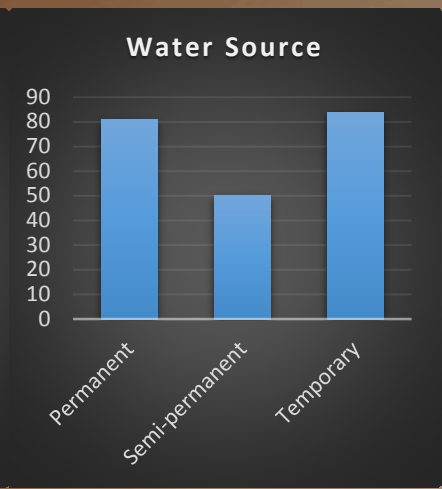
Bionomics: *Anopheles (Nys.) albimanus*

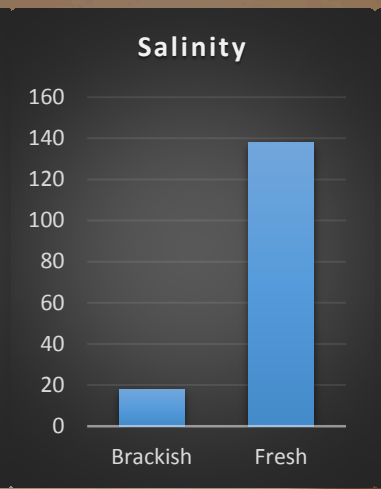


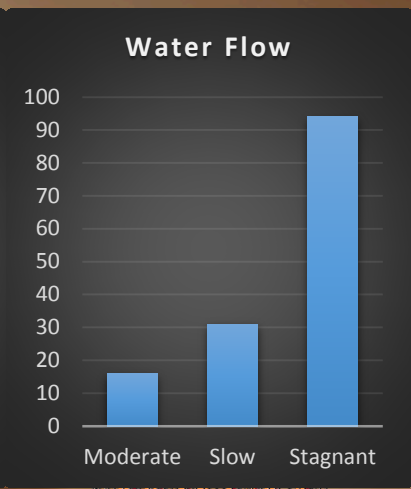












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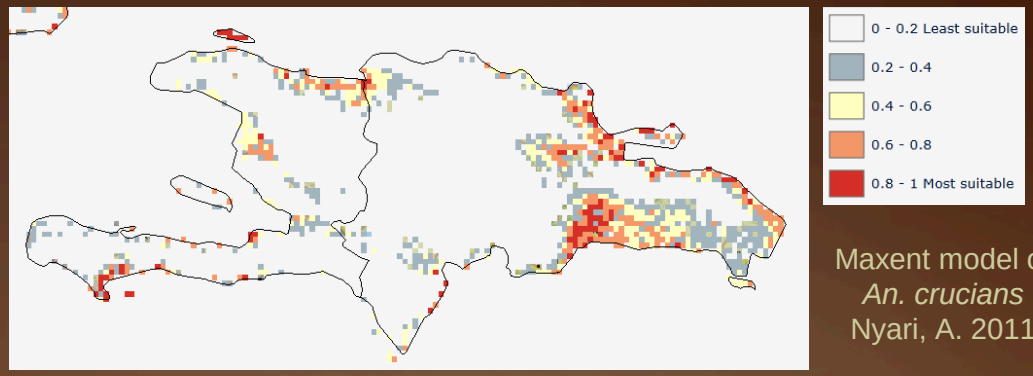
Anopheles (Ano.) crucians Wiedemann, 1828

Bionomics:
The larvae of *An. crucians* are found in semi-permanent and permanent pools, pond, lakes and swamps. Acidic water with emergent and floating vegetation is preferred. Females are outdoor night biters but will bite during the cloudy day and in the shade. Both sexes are attracted to lights.

Medical Importance:
An. crucians has been found to be naturally infected with malaria. Infection rates of 3.28% have been observed. This species may serve as an important malaria vector.



Maxent model of *An. crucians*
Nyari, A. 2011

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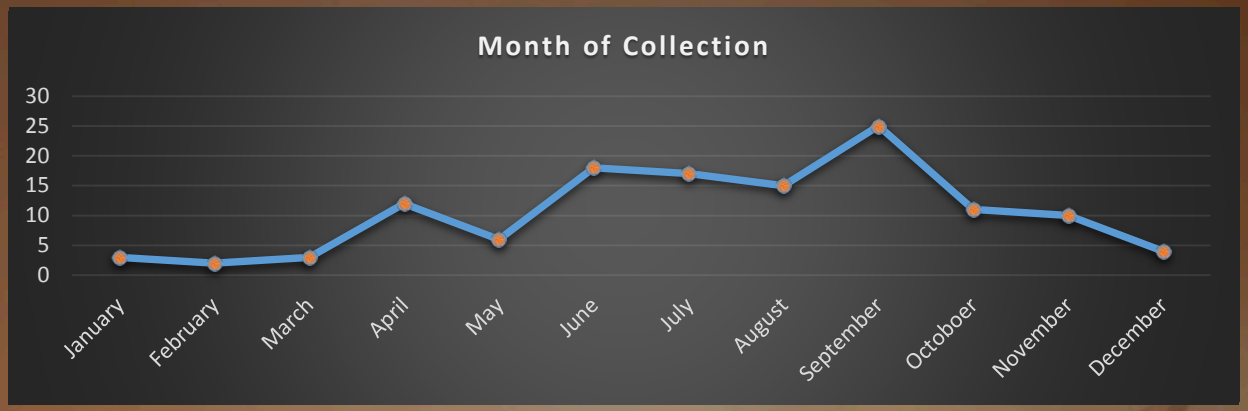

VectorMap Data Summary:
Number of Records: 516
Number of Localities: 86
Sources: Preserved Specimens from the USNM collection; Mosquito Information Management Project, Erwin, Terry, 1989; Pecor, J.E. et al. (2002). J Am Mosq Control Assoc. 18,241-276 and human observations from: USACHPPM-W Entomology Lab reports; Ibáñez Bernal, S. 1998. Los díptera hematófagos y taxa relacionados de dos áreas protegidas del estado de Yucatán, México (Insecta).

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Anopheles (Ano.) vestitipennis Dyar and Knab, 1906

Bionomics:

Larvae have been found in rice fields, swamps, and ditches in clear, fresh and stagnant water usually with grass, rice, reeds or cattails (Belkin, Heinemann & Page, 1970).

Medical Importance:

An. vestitipennis is a suspected vector of malaria (Loyola E.G. et al. 1991).

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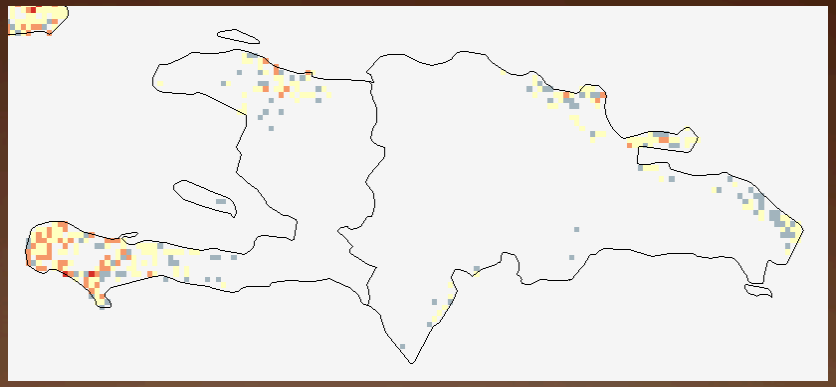
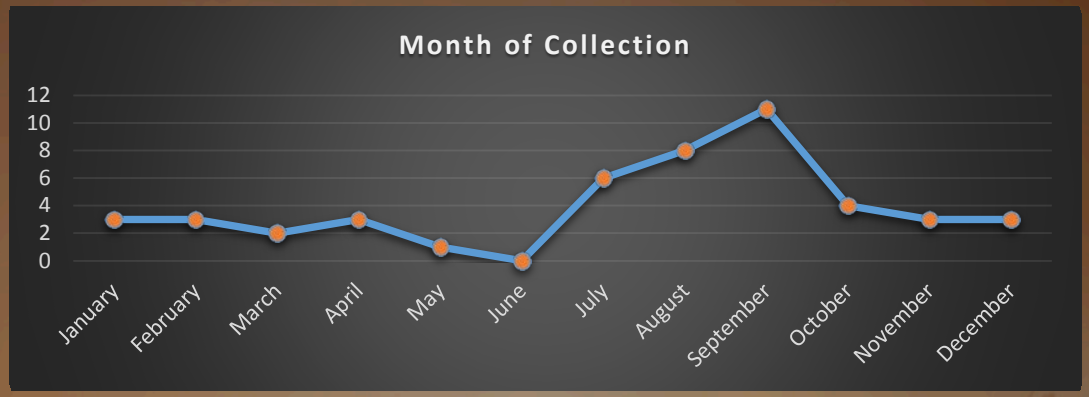


Maxent model of *An. vestitipennis*
Nyari, A. 2011



VectorMap Data Summary:

Number of Records: 165
Number of Localities: 33
Sources: Preserved Specimens from the USNM collection; Mosquito Information Management Project, Erwin, Terry, 1989; Pecor, J.E. et al. (2002). J Am Mosq Control Assoc. 18,241-276 and human observations from: USACHPPM-W Entomology Lab reports; Ibáñez Bernal, S. 1998. Los díptera hematófagos y taxa relacionados de dos áreas protegidas del estado de Yucatán, México (Insecta).

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Anopheles (Ano.) grabhamii Theobald 1901

Bionomics:
An. grabhamii larvae have been found in slow moving stream margins, stream pools, flooded fields, ditches, and large man-made containers. The water is typicaly fresh and clear with or without vegetation. Larvae are known to tolerate brackish water (Simmons and Aitken (1942) and Belkin et al. (1970))

Medical Importance:
This species is considered a malaria vector. Adult *An. grabhamii* mosquitoes have been found infected with *P. falciparum* Carley (1931) and Earle (1936).

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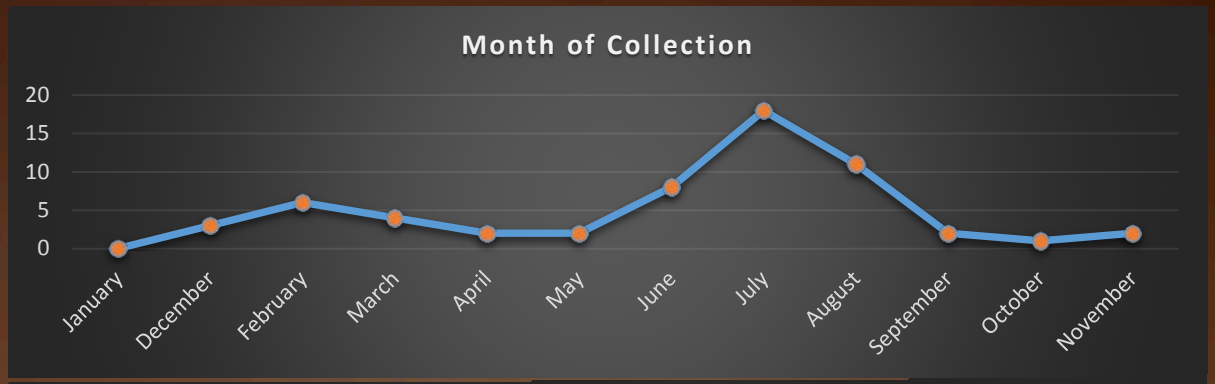
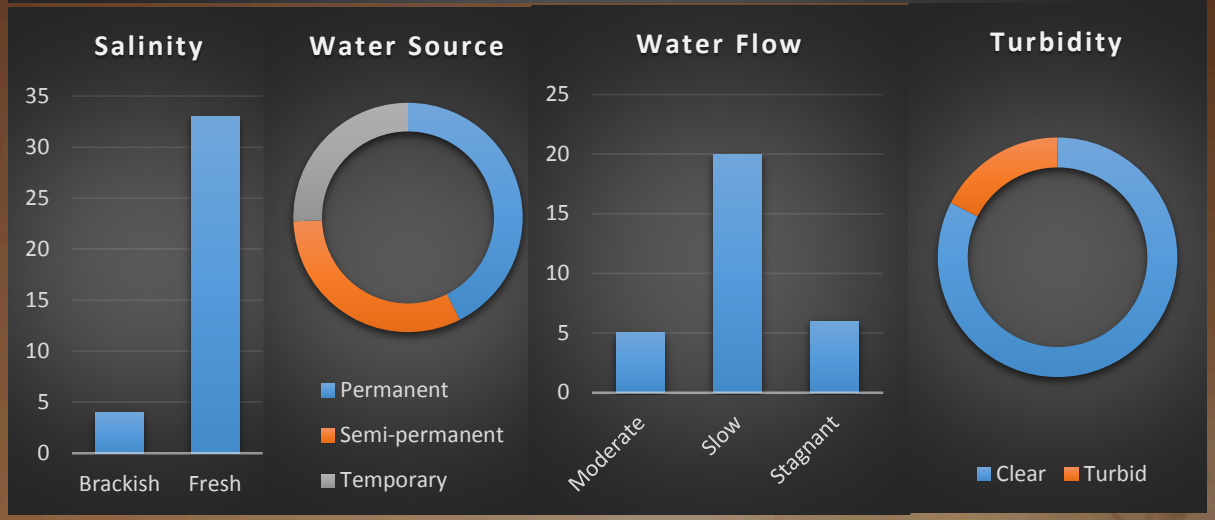
VectorMap Data Summary:
Number of Records: 136
Number of Localities: 58
Sources: Preserved Specimens from the Mosquito Information Management Project, Erwin, Terry, 1989





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Keys to the Mosquitoes of Haiti

Haiti
Identification Keys
Species List for Medically Important Mosquitoes of Central and South America
Species List of Mosquitoes Reported from Zambia
WRBU Keys to the Medically Important Mosquitoes of Central and South America
Rueda, Leopoldo. 2004. Pictorial keys for the identification of mosquitoes (Diptera: Culicidae) associated with Dengue Virus Transmission. Zootaxa 589: 1–60.
Belkin, John et al. 1970. The Culicidae of Jamaica. Contrib. American Entomological Institution: 6(1). (Keys begin on page 13)
Russell, Paul F. et al. 1943. Keys to the Anopheline Mosquitoes of the World. The American Entomological Society The Academy of Natural Sciences. Prepared for The Preventive Medicine Division, Office of The Surgeon General, U. S. Army
Komp, W.H.W. 1942. The Anopheline Mosquitoes of the Caribbean Region. Federal Security Agency, U.S. Public Health Service. National Institute of Health Bulletin No. 179

Introduction Literature: Malaria in Haiti

Topic	Author	Year	Title	Journal	Summary
Biosurveillance	Marquetti-Fernández, María del Carmen	2013	Contribution to knowledge of distribution of mosquitoes and some biological aspects of mosquitoes in Haiti	Anales de Biología 35: 55-63, 2013	Following the earthquake in 2010, rapid entomological assessment of 35 districts in Haiti were carried out, focusing on larval habitat. Results are described and include all mosquito species found
Biosurveillance	Hobbs, Jesse	1986	The Biting And Resting Behavior Of Anopheles albimanus In Northern Haiti	J. Amr. Mosq. Control Assoc. Vor. 2, No. 2	A one year study of the biting and resting behavior of An. albimanus in 4 rural villages in Northern Haiti and discussion on how findings relate to malaria infection rates.
Biosurveillance	Eisele, Thomas P.	2006	Prevalence of Plasmodium falciparum Infection in Rainy Season, Artibonite Valley, Haiti, 2006	Emerging Infectious Diseases 13(10)	A population-based survey to estimate the prevalence of Plasmodium falciparum infection among persons older than 1 month in the Artibonite Valley of Haiti during the high malaria transmission season in 2006
Biosurveillance	Caillouet, Kevin A.	2008	Characterization of aquatic mosquito habitat, natural enemies, and immature mosquitoes in the Artibonite Valley, Haiti	Journal of Vector Ecology, 33(1):191-197	Descriptions of water body types that support mosquito breeding, of particular interest to the authors is the relationship beween An. albimanus population levels and presence of aquatic predators.
Biosurveillance	Mason, John	1968	The Development of the Haiti Malaria Erradication Programme	The World Health Organization, WHO/MAL/68.665	A review of a past attempt at malaria erradication including background info, development of the program and a summary of the studies preliminary findings
Biosurveillance	Taylar, Robert	1966	The Ecology of Anopheles albimanus in Haiti	Mosquito News 26(3)	A baseline survey of An. albimanus breeding sites, population density and biting behavior conducted in 1963-64
Evaluation of interventions	Keating, Joseph	2008	A Description of Malaria-Related Knowledge, Perceptions, and Practices in the Artibonite Valley of Haiti: Implications for Malaria Control	Am. J. Trop. Med. Hyg., 78(2), 2008, pp. 262–269	Knowledge, perceptions, and practices related to malaria were obtained from household representatives using a standardized questionnaire. Results suggest malaria control in Haiti should focus on enhanced surveillance and case management, with expanded information campaigns about malaria prevention and treatment options.
Evaluation of interventions	Clinton Health Access Initiative	2013	The feasibility of malaria elimination on the island of Hispaniola, with a focus on Haiti. An assessment conducted January–June 2013	N/A	Feasibility assessment conducted to inform the governments of Haiti and the Dominican Republic (DR) with the goal of malaria elimination by 2020
Evaluation of interventions	Schliessmann, D. J.	1973	Drainage and Larviciding for Control of a Malaria Focus in Haiti	Mosquito News 33(3)	A description of a historical malaria ellimination plan that includes IRS, MDA and source reduction
Evaluation of interventions	Roberts, Leslie	2010	Elimination Meets Reality in Hispaniola	Science 328(5980) 850-851	A discussion on malaria elimination efforts in the past
Evaluation of interventions	Anon, ?	2010	Surveillance Snapshot: Malaria Among Deployers to Haiti, U.S. Armed Forces, 13 January-30June 2010	MSMR 17(8): 11	Basic overview of U.S. military deployment to Haiti following the earthquake of 2010.
General Background	AFPMB	1994	Disease Vector Ecology Profile: Haiti	Defense Pest Management Information Analysis Center	General background on VBD risk in Haiti including risk maps for malaria and other mosquito-borne diseases.
General Background	CHIPPM	?	A Soldier's Guide to Staying Healthy in Hispaniola: Haiti and the Dominican Republic	U.S. Army Center for Health Promotion and Preventive Medicine: SHG 015-0304	This document is designed for distribution to deployed personel to reduce the risk of disease and other non-combat related injuries

References

Maxent model of *Cx. nigripalpis* Dornak, L. 2011

Maxent model of *Ae. scapularis* Dornak, L. 2011

Maxent model of *Ae. aegypti* Nyari, A. 2011

Maxent model of *An. vestitipennis* Nyari, A. 2011

Maxent model of *An. crucians* Nyari, A. 2011

Maxent model of *An. albimanus* Nyari, A. 2011

- People/1 Sq Km. This Product Was Made Utilizing The Landscan (2011)™ High Resolution Global Population Data Set Copyrighted By UT-Battelle, LLC, Operator Of Oak Ridge National Laboratory Under Contract No. DE-AC05-00OR22725 With The United States Department Of Energy. The United States Government Has Certain Rights In This Data Set. Neither Ut-Battelle, Llc Nor The United States Department Of Energy, Nor Any Of Their Employees, Makes Any Warranty, Express Or Implied, Or Assumes Any Legal Liability Or Responsibility For The Accuracy, Completeness, Or Usefulness Of The Data Set. Available At Http://Www.Ornl.Gov/Sci/Landscan/
- Predicted Probability of Occurrence of Yellow Fever Virus. Spatial Ecology and Epidemiology Research Group, University of Oxford, Dept. of Zoology. Models for vectors and vector-borne diseases. Advances in Parasitology 62, 1 – 35. 2006.
- Estimated Proportion of the General Population that are Infected with *P. vivax* at any one time, averaged over the 12 months of 2010. Malaria Atlas Project
- Bhatt, S. et al. 2013. The Global Distribution and Burden of Dengue. Natrure, 496: 504-507.
- Loyola EG, Arredondo-Jimenez JI, Rodriguez MH, Bown DN, Vaca-Marin MA. Anopheles vestitipenis, the probable vector of Plasmodium vivax in the Lacandon forest of Chiapas, Mexico. Trans R Soc Trop Med Hyg 1991; 85: 171-174
- Samson, D.M. et al. 2015. New Baseline Environmental Assessment of Mosquito Ecology in Northern Haiti During Increased Urbanization. Journal of Vector Ecology 40: 46-58

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VECTORMAP

VectorMap is only as good as the data you provide. If you have collection records, models or pathogen testing results please contact the VectorMap team to learn how to contribute data at mosquitomap@si.edu.

Vector Photos Provided by Judith Stoffer, Walter Reed Biosystematics Unit

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