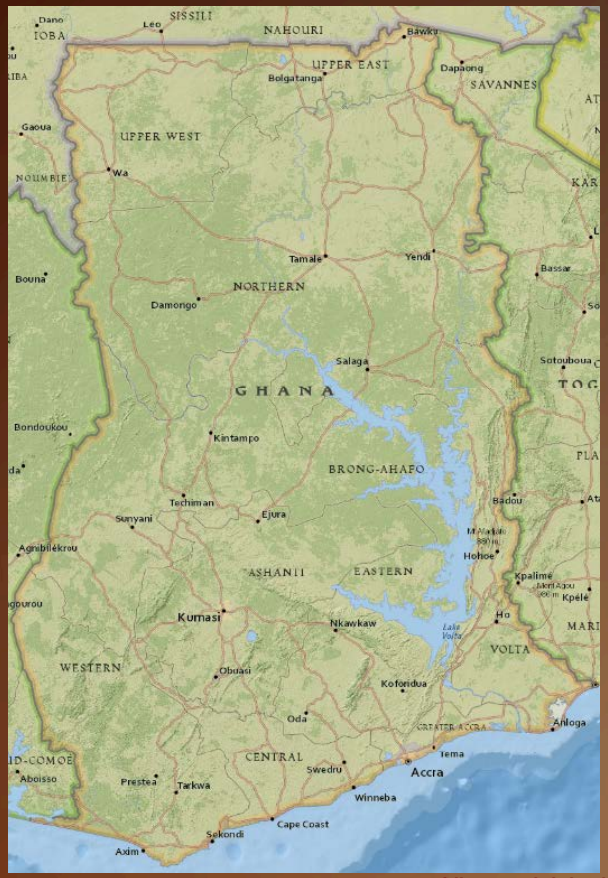
Vector Hazard Report:

Malaria in Ghana

Part 2: Habitat Suitability Models, Bionomics Data and Insecticide Resistance Interpolation for Primary Malaria Vectors of Ghana



Information gathered from products of The Walter Reed Biosystematics Unit (WRBU) and Insecticide Resistance Data provided by the Presidents Malaria Initiative

VectorMap

Systematic Catalogue of the Culicidae

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Know the Vector, know the threat

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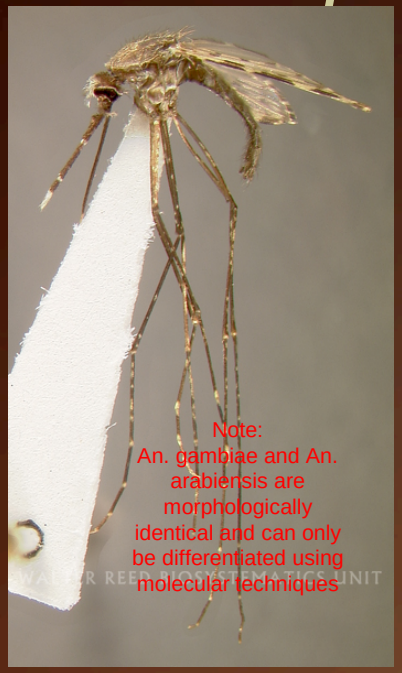
Anopheles (Cel.) gambiae Giles, 1902



Bionomics:
This species occurs in a great variety of types of water; the most striking are the shallow, open sun-lit pools. Females readily enter houses and bite man both indoors and outdoors starting at sunset and peaking just at dawn (Gillies and deMeillon 1968).

Medical Importance:
Primary malaria vector (Gillies and deMeillon 1968).

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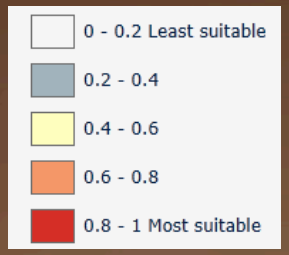
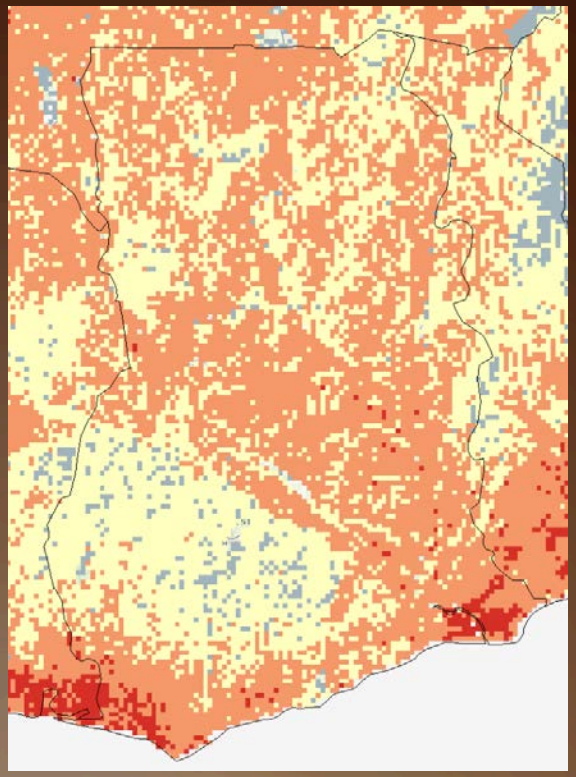
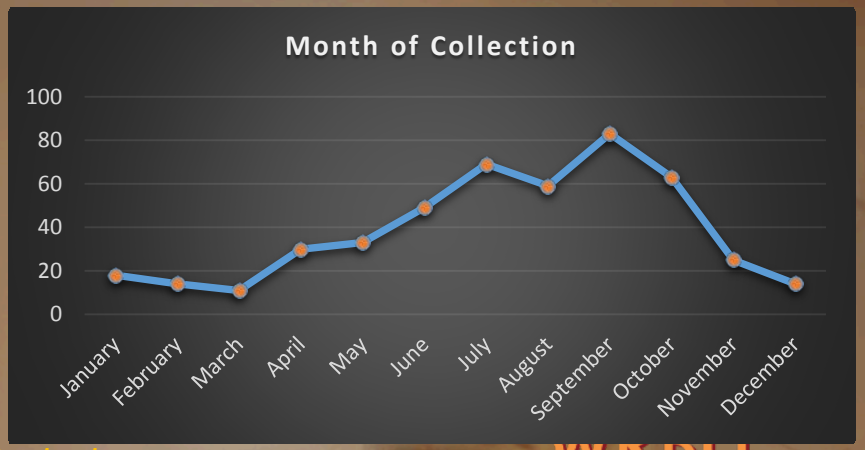




Maxent model
An. gambiae s.l.
Nyari, A. 2011



VectorMap Data Summary:
Number of Records: 685
Number of Localities: 353
See references page for data source citations

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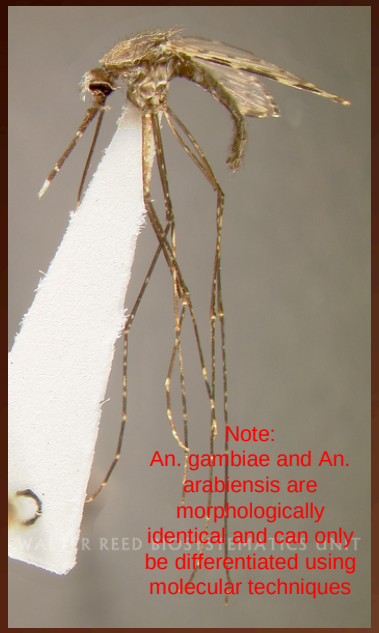
Anopheles (Cel.) arabiensis Patton, 1905



Bionomics:
An. arabiensis larvae are found in relative short duration habitats (3-5 weeks) with high turbidity and lacking in aquatic vegitation or surface film. Chosen breeding sites appear to be associated with cattle, the preferred host. (Gimnig, Ombok, Kamau and Hawley 2001:286)

Medical Importance:
Primary malaria vector (Gillies and deMeillon 1968).

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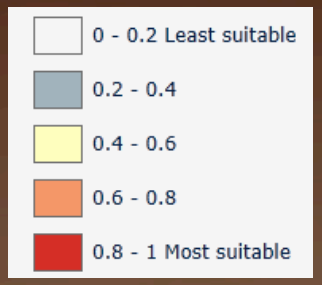
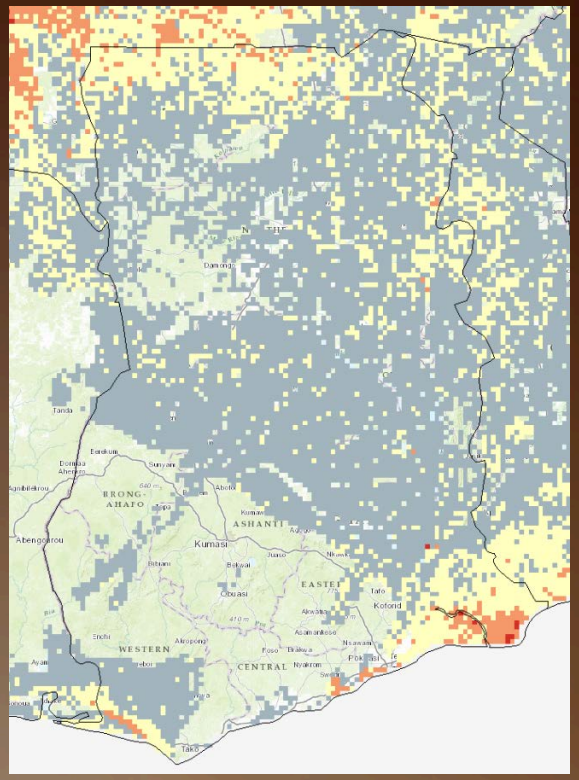
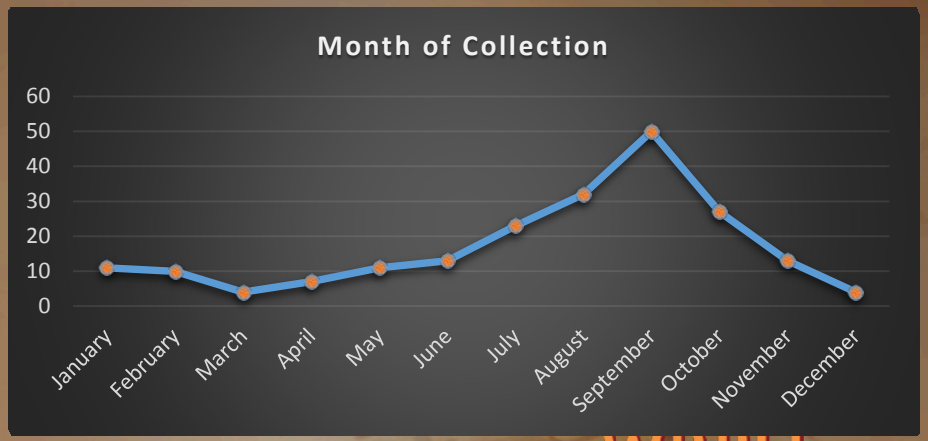




Maxent model *An. arabiensis* s.l.
Nyari, A. 2011



VectorMap Data Summary:
Number of Records: 258
Number of Localities: 138
See references page for data source citations

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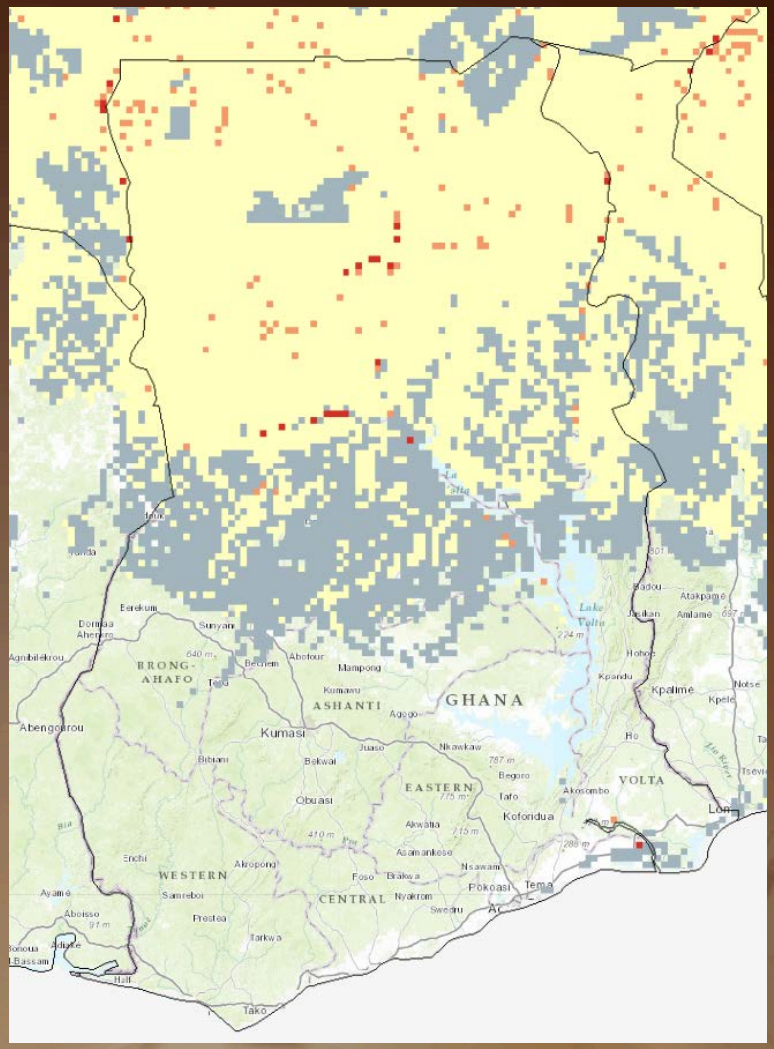
Anopheles (Cel.) wellcomei Theobald, 1904



Maxent model *An. wellcomei* Dornak, L., 2011

Bionomics:
Larvae are found in swamps with vertical and horizontal vegetation, streams with grassy margins, rice fields and vegetation along large rivers even in areas of high forest. Females will enter houses to bite but are mainly zoophilic. Biting activity begins at dusk and peaks at about 2300, after which it gradually decreases (Gillies and deMeillon 1968).

Medical Importance:
Possible malaria vector (Gillies and deMeillon 1968).

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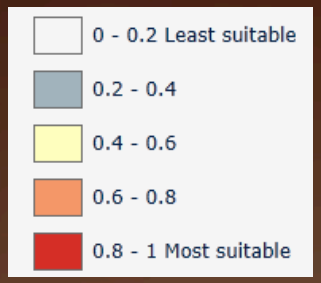
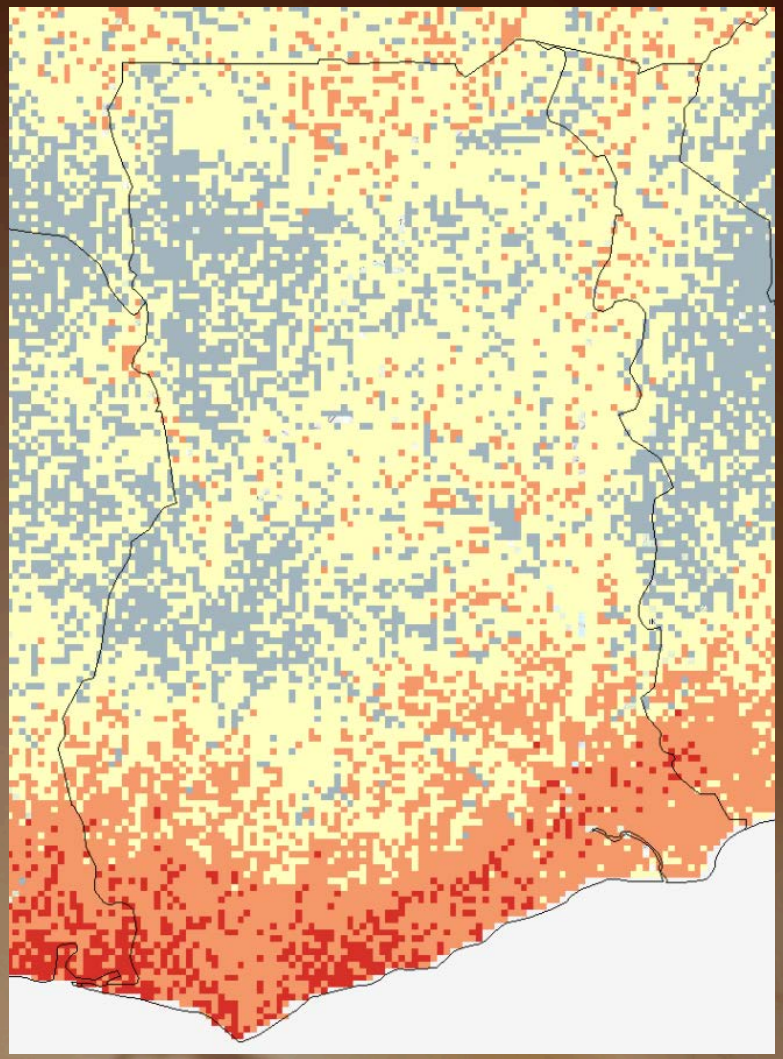
Anopheles (Cel.) funestus Giles, 1900





Maxent model *An. funestus* Dornak, L., 2011

Bionomics:
In most parts of its range, *An. funestus* breeds characteristically in bodies of clear water that are either large and more or less permanent, e.g. swamps (near edges if deep), weedy sides of streams, rivers, furrows or ditches, protected portions of lake shore, ponds, etc., especially when weedy, or water such as seepages, which are fed from underground permanent sources (Evans 1938). A. funestus is one of the most anthropophilic mosquitoes known. The great bulk of feeding takes place inside houses after 2200 up to dawn (Gillies and deMeillon 1968).

Medical Importance:
Vector of malaria and bancroftian filariasis (Gillies and deMeillon 1968).

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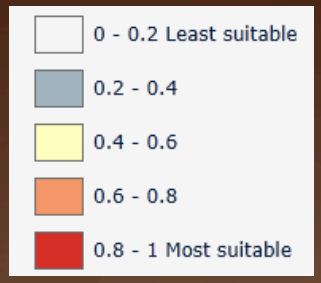
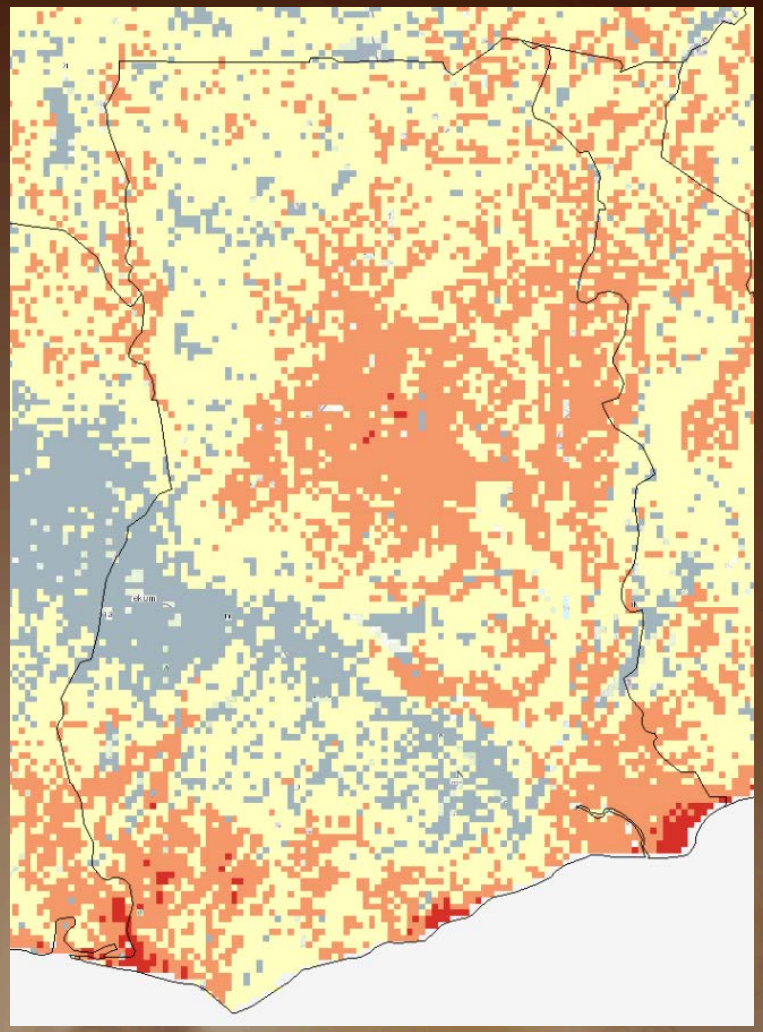
Anopheles (Cel.) nili (Theobald, 1904)





Maxent model *An. nili* Nyari, A., 2011

Bionomics:
Principally a stream breeder, larvae being found in vegetation or in dense shade along the edges of streams and large rivers. Symes (1931a) found that out of 163 collections of larvae of this species in Kenya, 139 were taken from streams. Variable in behaviour in both feeding and resting habits. In Liberia, Barber et al. (1932), Sierra Leone, Gordon et al. (1932)) Upper Volta, Hamon, Choumara et al. (1959), Dahomey, Hamon, Rickenbach and Robert (1956)) Nigeria, Service (1963a), Cameroun, Hamon and Mouchet (1961), Chad, Lacan (1958), and in parts of the Sudan, Lewis (1956a), it is an anthropophilic species biting man readily indoors and outdoors and frequently resting indoors by day. It has also been recorded as quite common in houses in the West Nile district of Uganda, Kafuko et al. (1962). (Gilies and deMeillon 1968:85)

Medical Importance:
An important malaria vector in many parts of West Africa. Wherever man-biting occurs infected specimens are found. (Gilies and deMeillon 1968:85)

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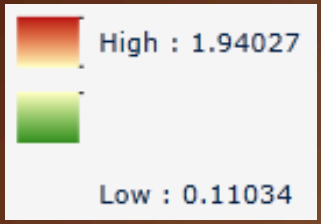
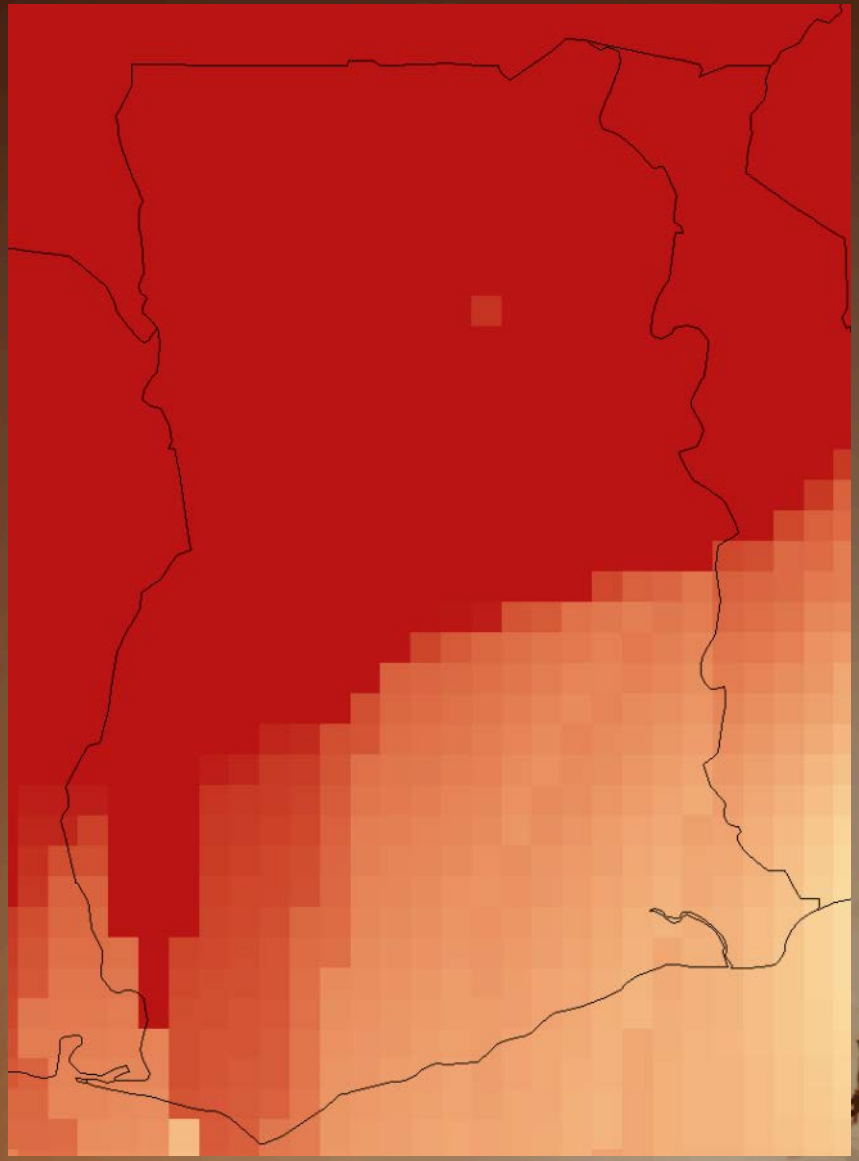
Insecticide Resistance of Malaria Vectors: Carbamates

Empirical Bayesian-Kriging Analysis using PMI data





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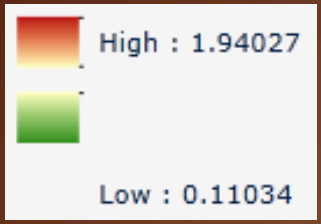
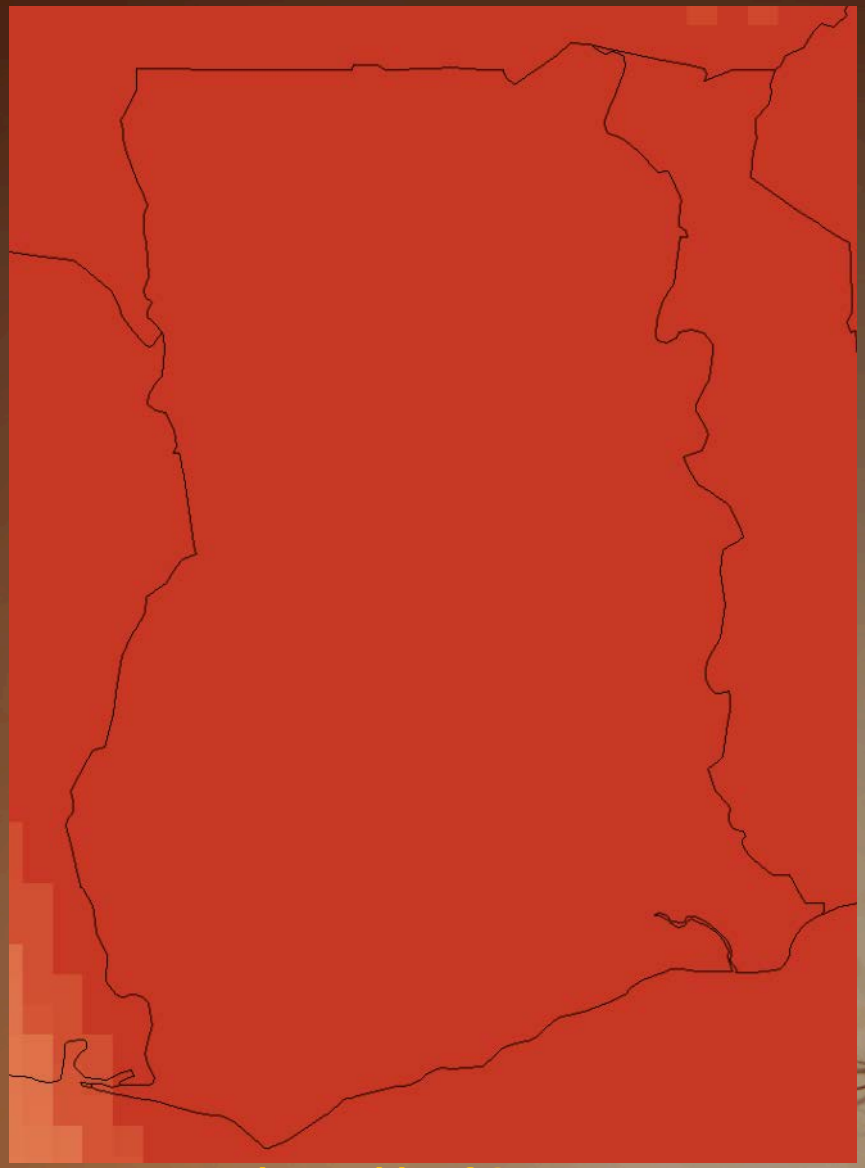
Insecticide Resistance of Malaria Vectors: Organochlorines

Empirical Bayesian-Kriging Analysis using PMI data





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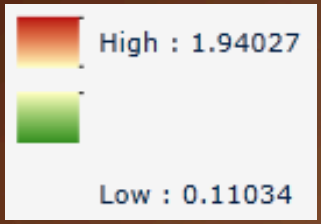
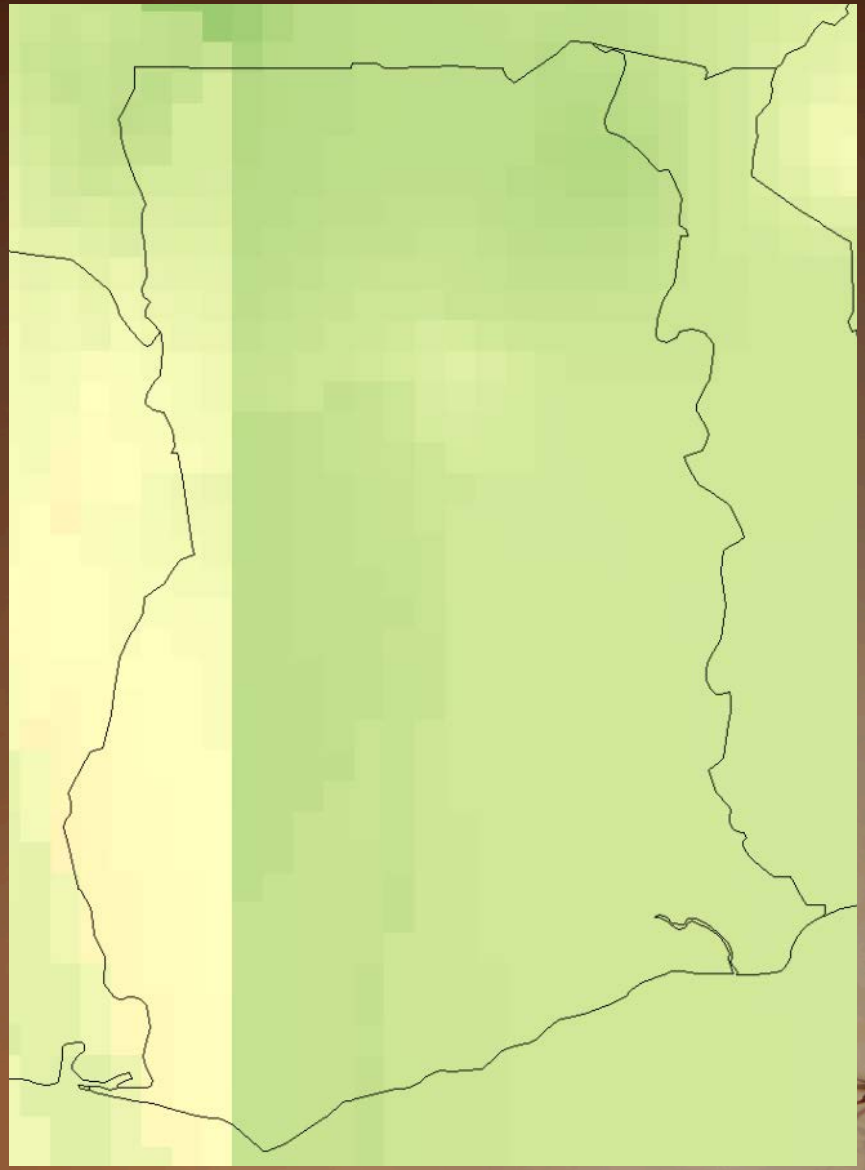
Insecticide Resistance of Malaria Vectors: Organophosphates

Empirical Bayesian-Kriging Analysis using PMI data





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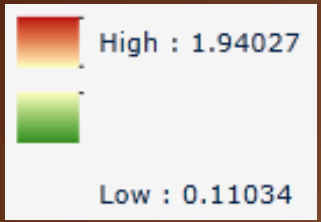
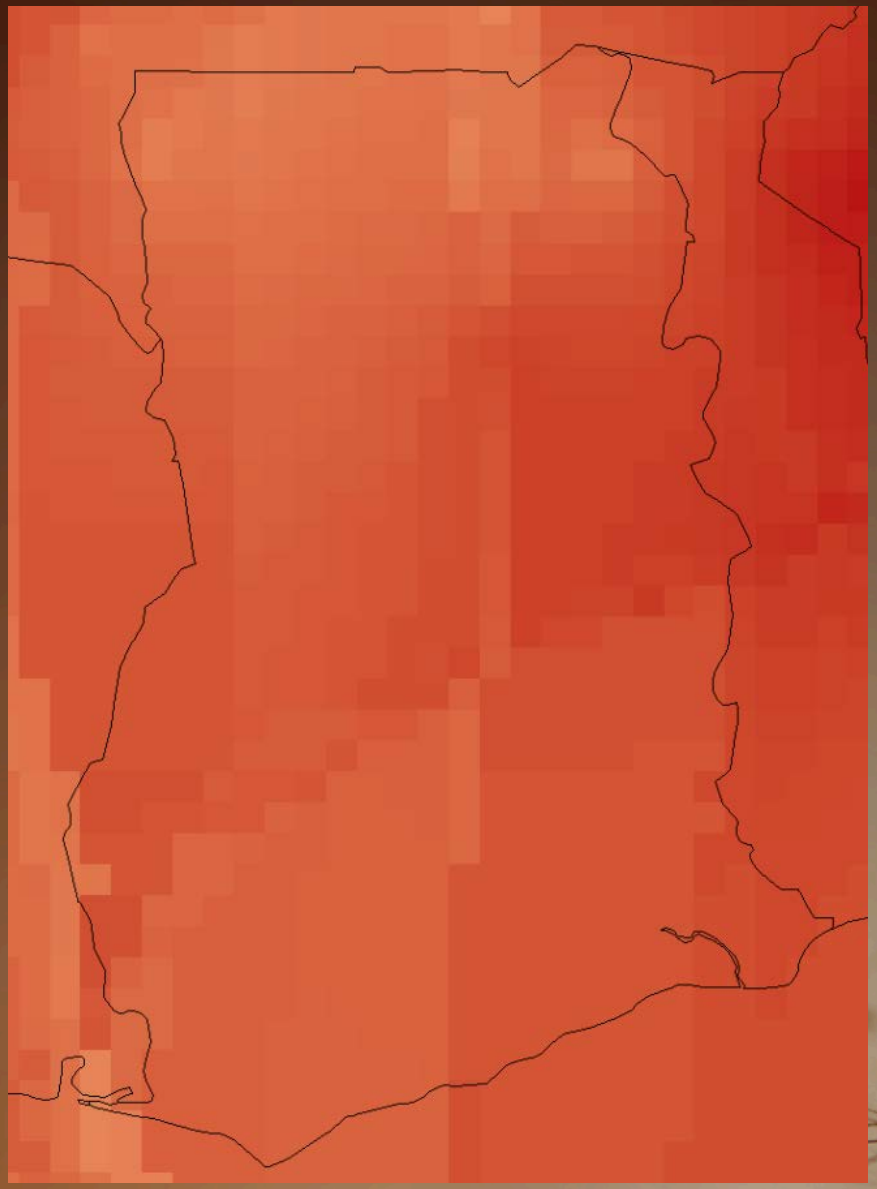
Insecticide Resistance of Malaria Vectors: Pyrethroids

Empirical Bayesian-Kriging Analysis using PMI data





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References

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Maxent model *An. arabiensis* Nyari, A. 2011

Maxent model *An. wellcomei* Dornak, L., 2011

Maxent model *An. funestus* Dornak, L., 2011

Maxent model *An. nili* Nyari, A., 2011

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- Human Observations from Coetzee, M., Craig, M. & L.E. Sueur, D. 2000. Mapping the Distribution of Members of the Anopheles gambiae Complex in Africa and Adjacent Islands. Parasitology Today 16: 74-77; Sang R., et al. (2010). Rift Valley Fever Virus Epidemic in Kenya, 2006/2007: The Entomologic Investigations. Am. J. Trop. Med. Hyg. 83:28–37; NAMRU-3/ VBRP ID Team; NAMRU-3: Alia Zayed, PhD, Mahmoud Saleh, PhD & Reham Tag El-Din, MSC; Ebenezer, A. et al. 2013. Species composition of the Anopheles gambiae complex across eco-vegetational zones in Bayelsa State, Niger Delta region, Nigeria
- Insecticide Resistance: Empirical Bayseian Kriging with ArcMap 10.3 of (0) susceptible, (1) moderate, (2) highly resistant for combined malaria vectors from PMI surveillance data using WHO assays (2006-2014)

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The Walter Reed Biosystematics Unit is part of the Walter Reed Army Institute of Research and is based at the Smithsonian Institution Museum Support Center. To access taxonomic keys, the Systematic Catalog of Culicidae or to learn more about WRBU visit www.wrbu.org.

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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