Vector Hazard Report:
Mosquito-borne Diseases of South East Asia

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

Systematic Catalogue of the Culicidae
VectorMap

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Countries of Interest

WHO Country Profiles:

Bangladesh
Cambodia
China
India
Lao
Malaysia
Myanmar
North Korea
Philippines
Republic of Korea
Taiwan
Thailand
Vietnam

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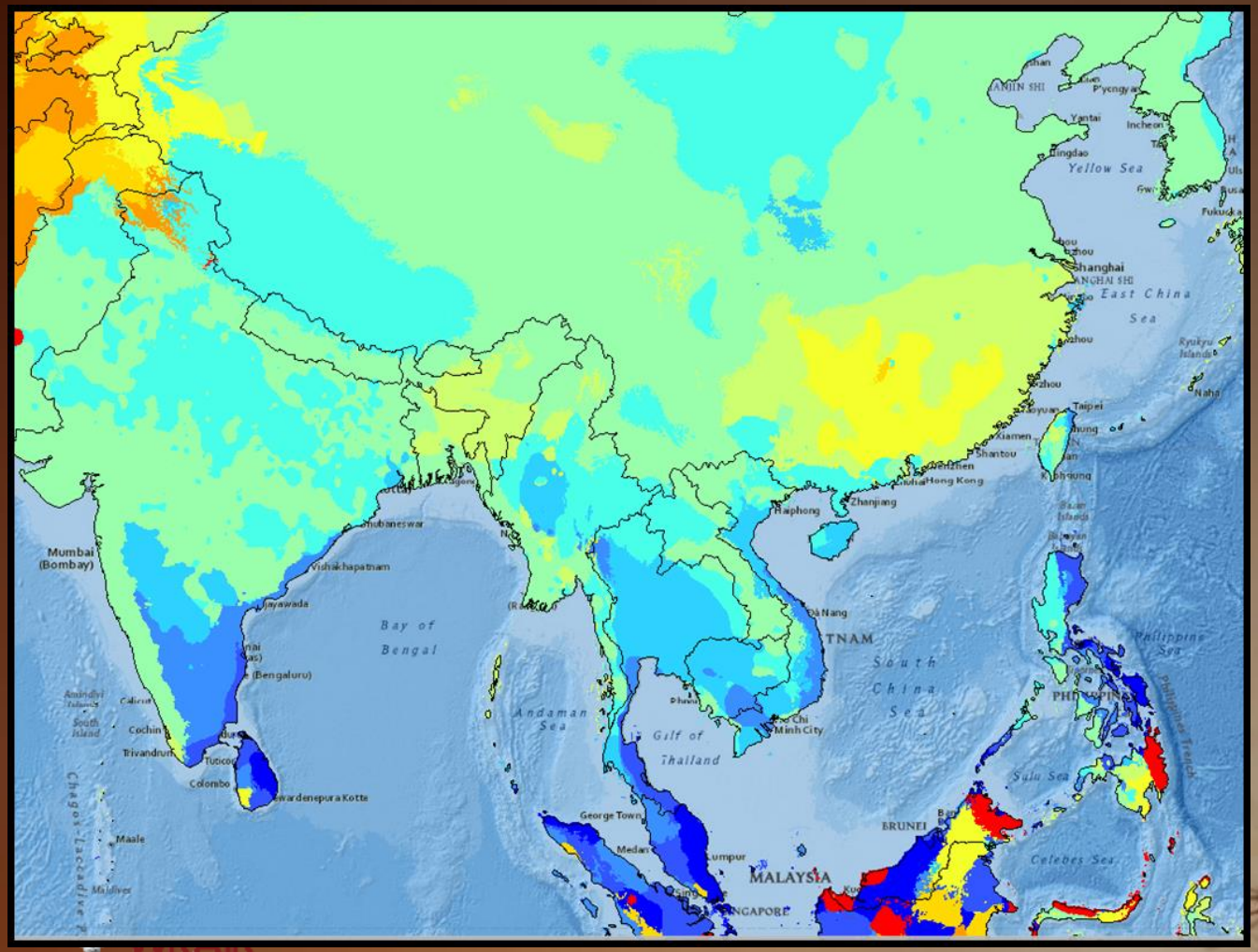
Climate of SE Asia
Month of Maximum Precipitation
-WorldClim



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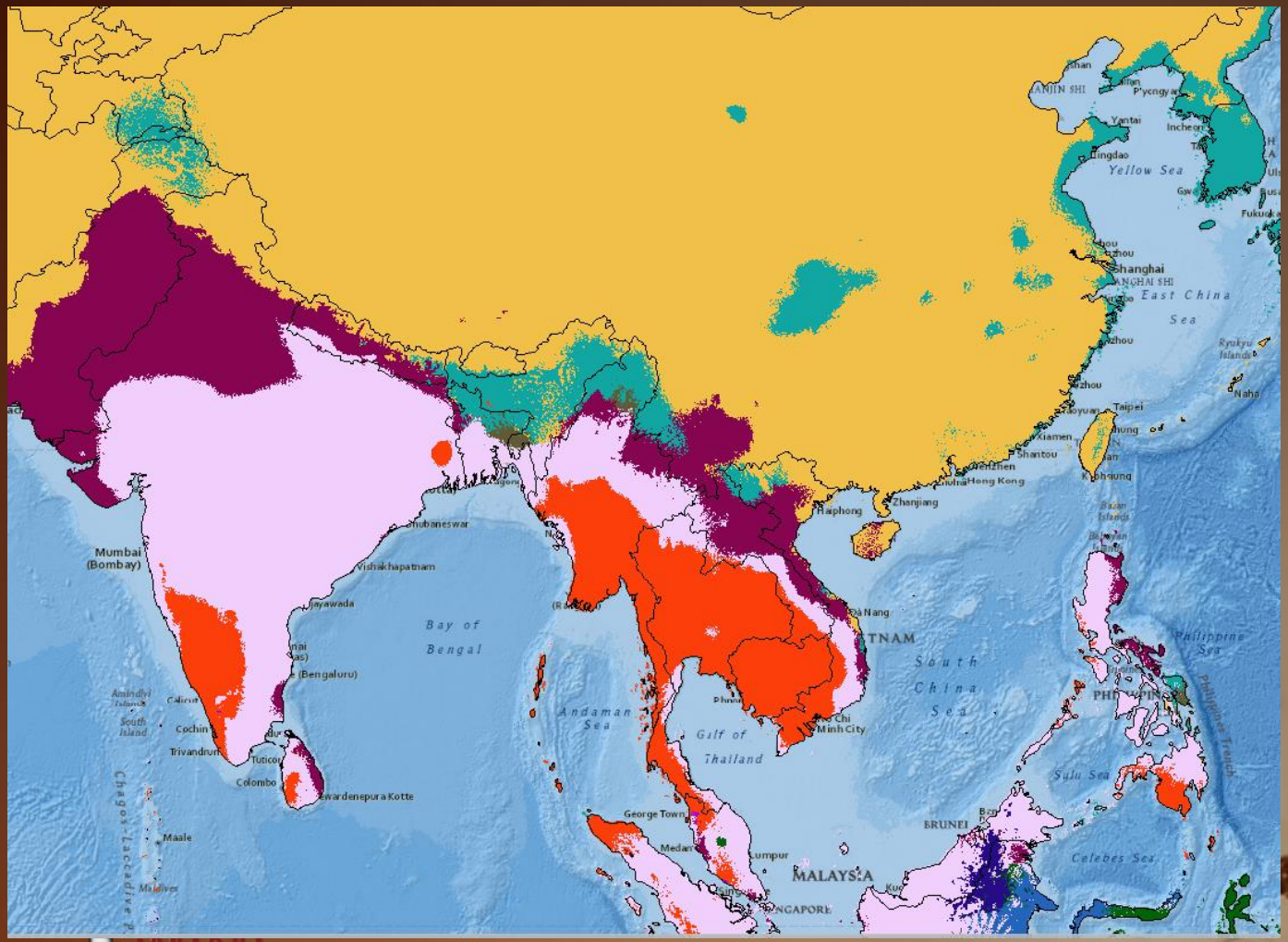
Climate of SE Asia
Month of Maximum Temperature

-WorldClim



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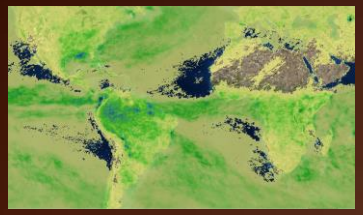
Monthly Climate Maps

Click here to view the maps described below



Rainfall

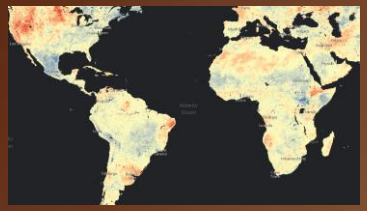
This map shows the accumulated rainfall for the past month. Updated monthly.
-NASA Earth Observations

Consistent Above and Below Average Precipitation

Areas with consistent above average monthly rainfall over the past 3 months may indicate increased mosquito breeding sites which may lead to increased mosquito-borne disease transmission. Areas with consistent below average rainfall may also indicate increased water storage or ponding which can provide additional habitat for mosquito species that lay eggs in human containers, protected micro environments, or long lasting pools. Updated monthly. -NASA Earth Observations.

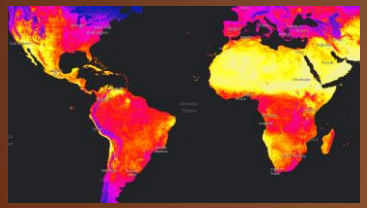
Drought Breaking Rain

Areas receiving above average rainfall for the past month and below average rainfall for the previous 12 months. Drought breaking rain may indicate recent suitable conditions for vectors and diseases in a stressed environment or human population. Updated monthly. -WorldClim, Giovanni online data system NASA GES DISC, Tropical Rainfall Measuring Mission (TRMM).



Temperature anomaly

This map shows where earth's temperatures were warmer or cooler in the daytime for the past month than the average temperatures for the same month from 2001-2010. Updated monthly.
-NASA Earth Observations



Land Surface Temperature

This map shows the temperature of the earth's lands during the daytime. Updated monthly.
-NASA Earth Observations

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Malaria in South East Asia

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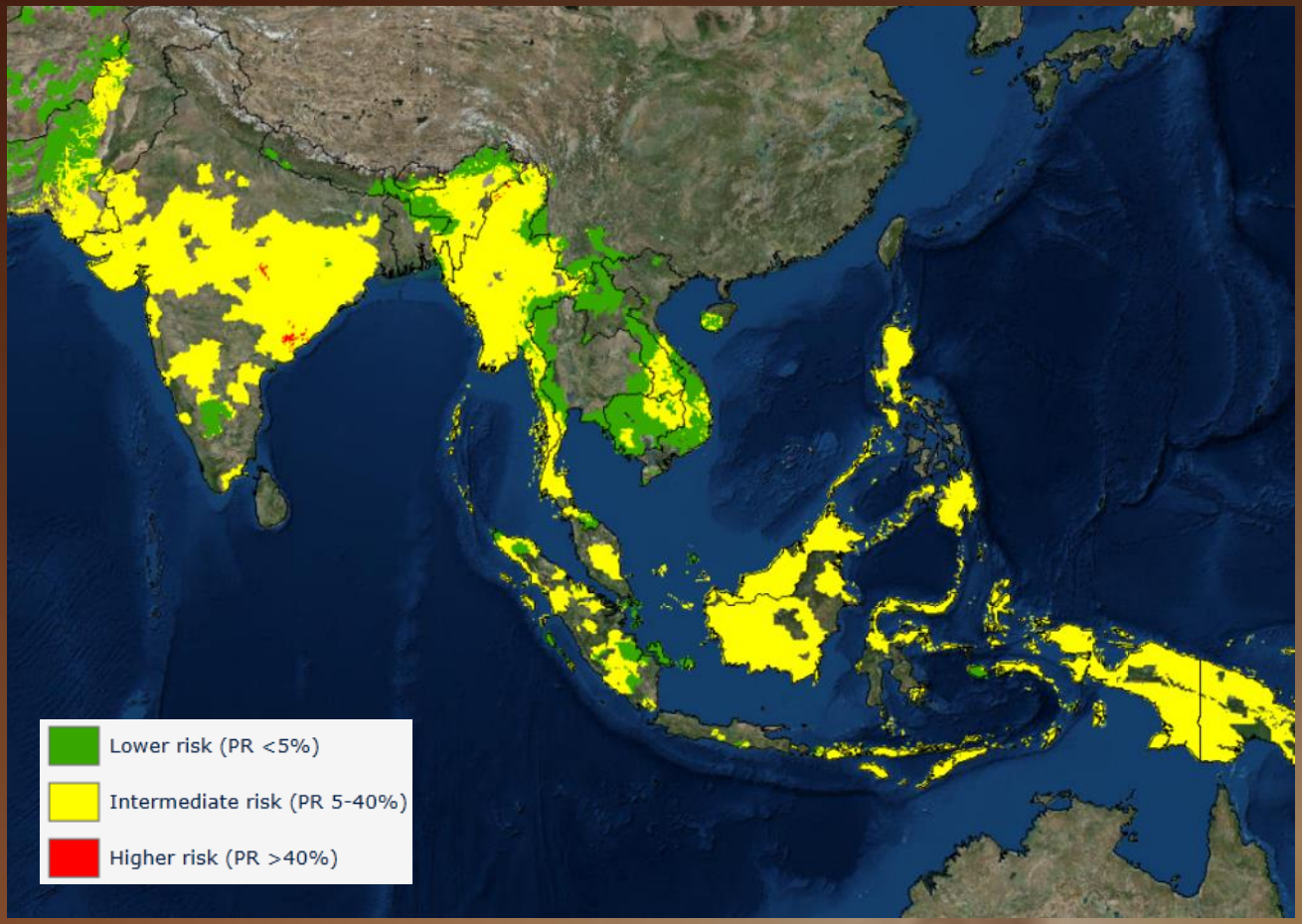
Plasmodium falciparum



Estimated proportion of 2-10 year olds in the general population that are infected with *P. falciparum* at one time averaged over the 12 months of 2010
-Malaria Atlas Project

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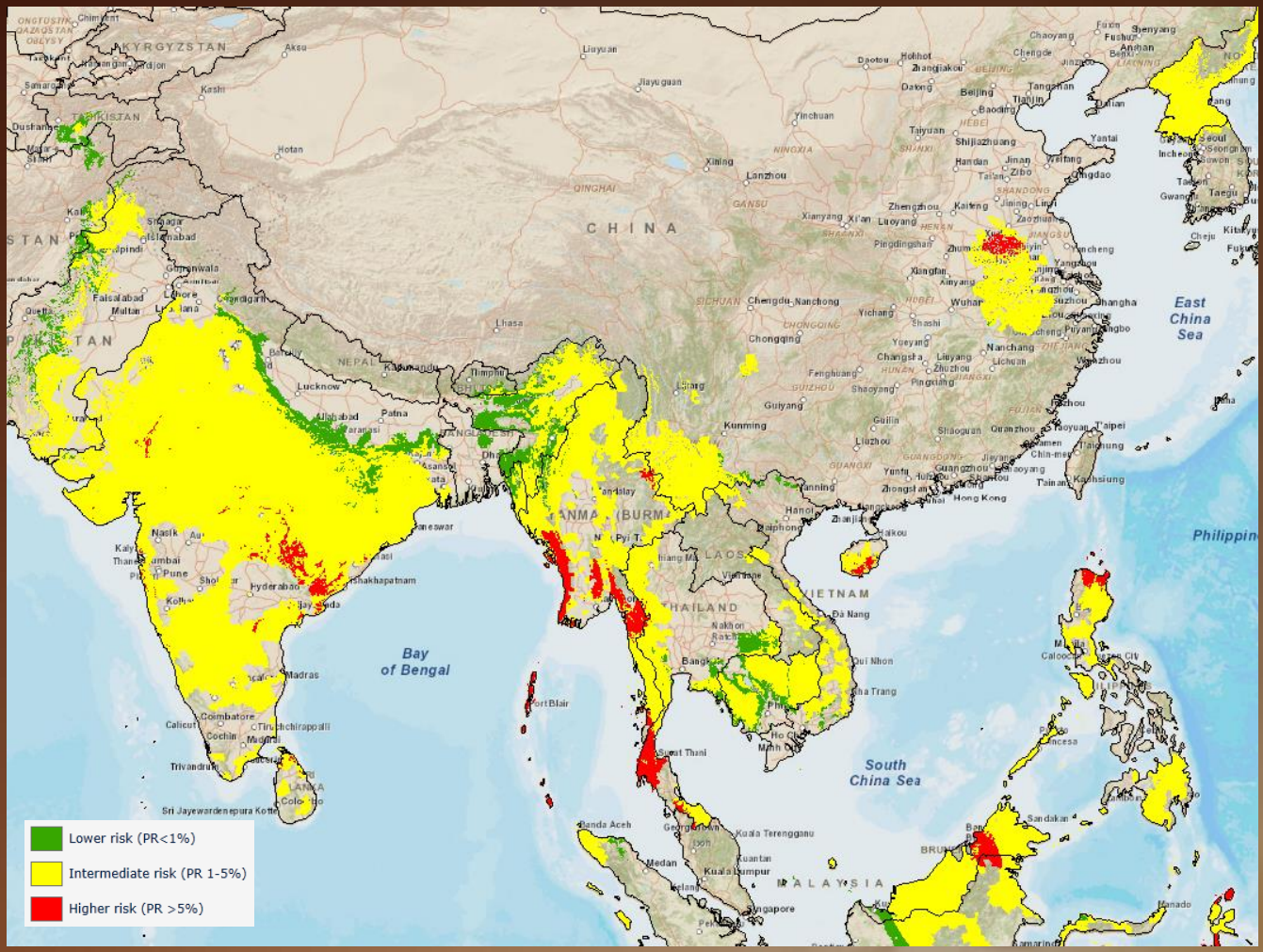
Plasmodium vivax



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

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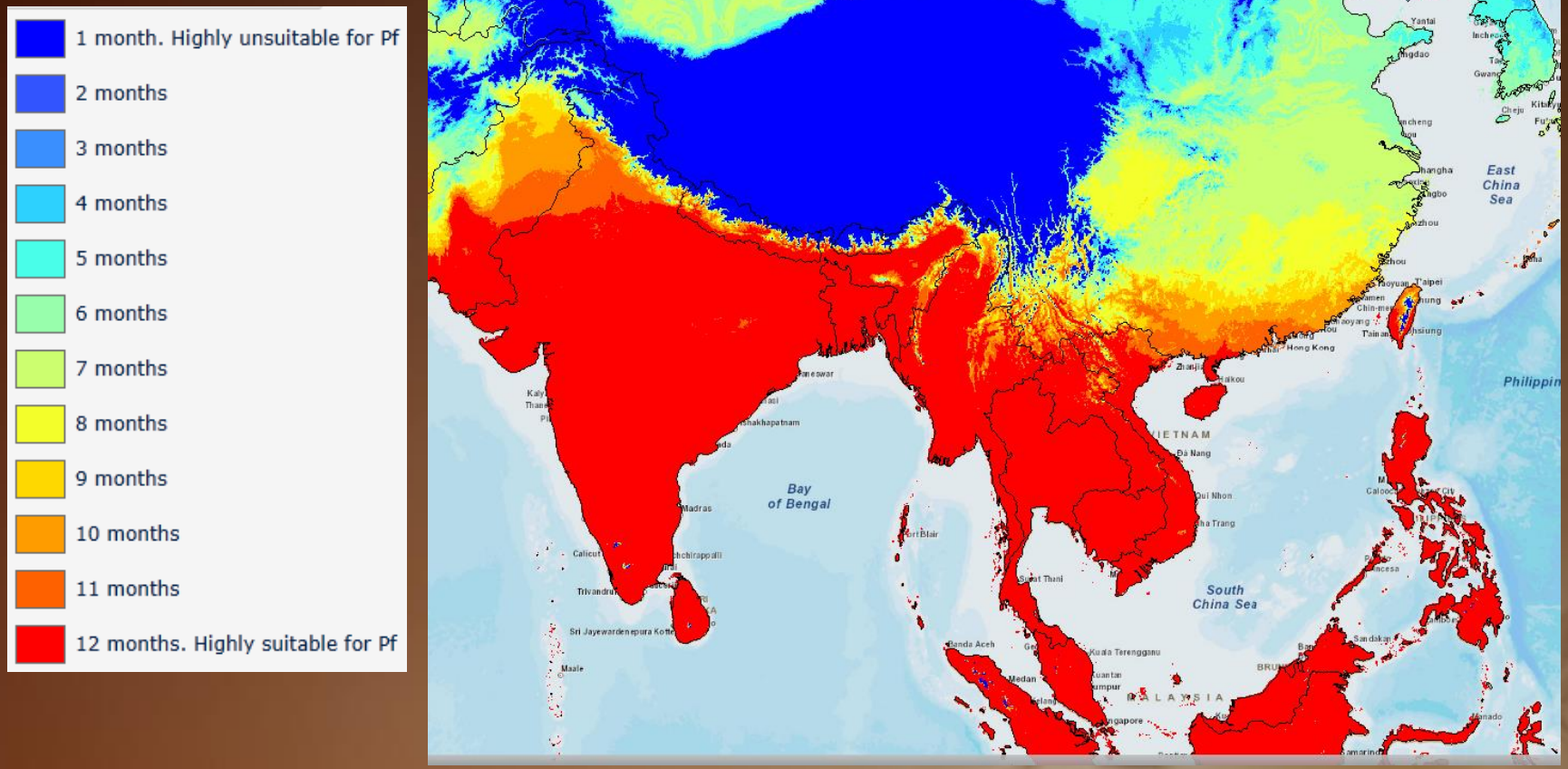
Temperature Suitability



Number of months per year where mean temperatures can support infectious mosquito populations.
-Gething, et al. 2011.

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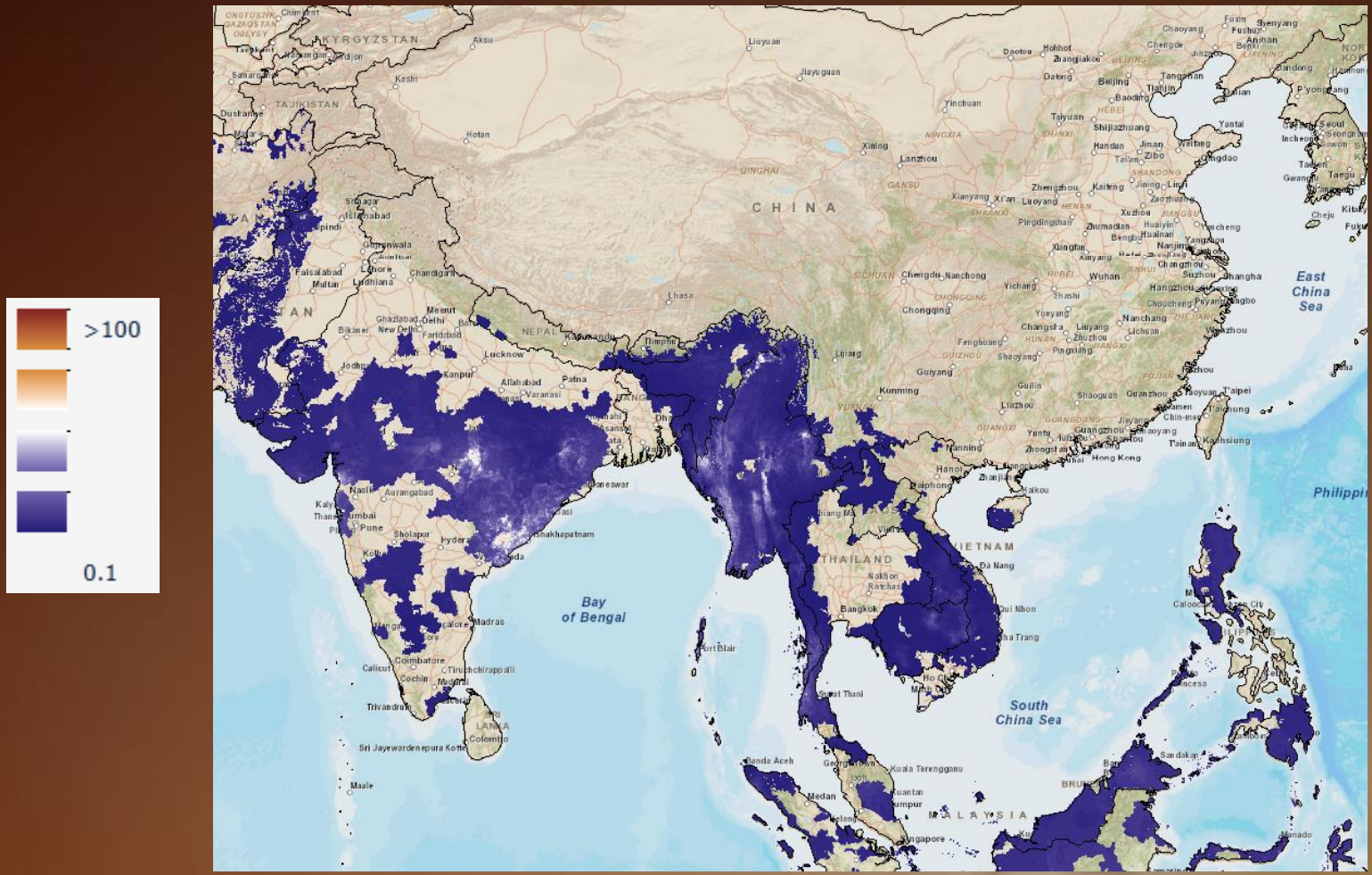
Entomological Inoculation Rate



Malaria (*Plasmodium falciparum*)
Entomological Inoculation Rate, 2010. Number of expected bites from infected mosquitoes per person, per year. Gething et al. 2011

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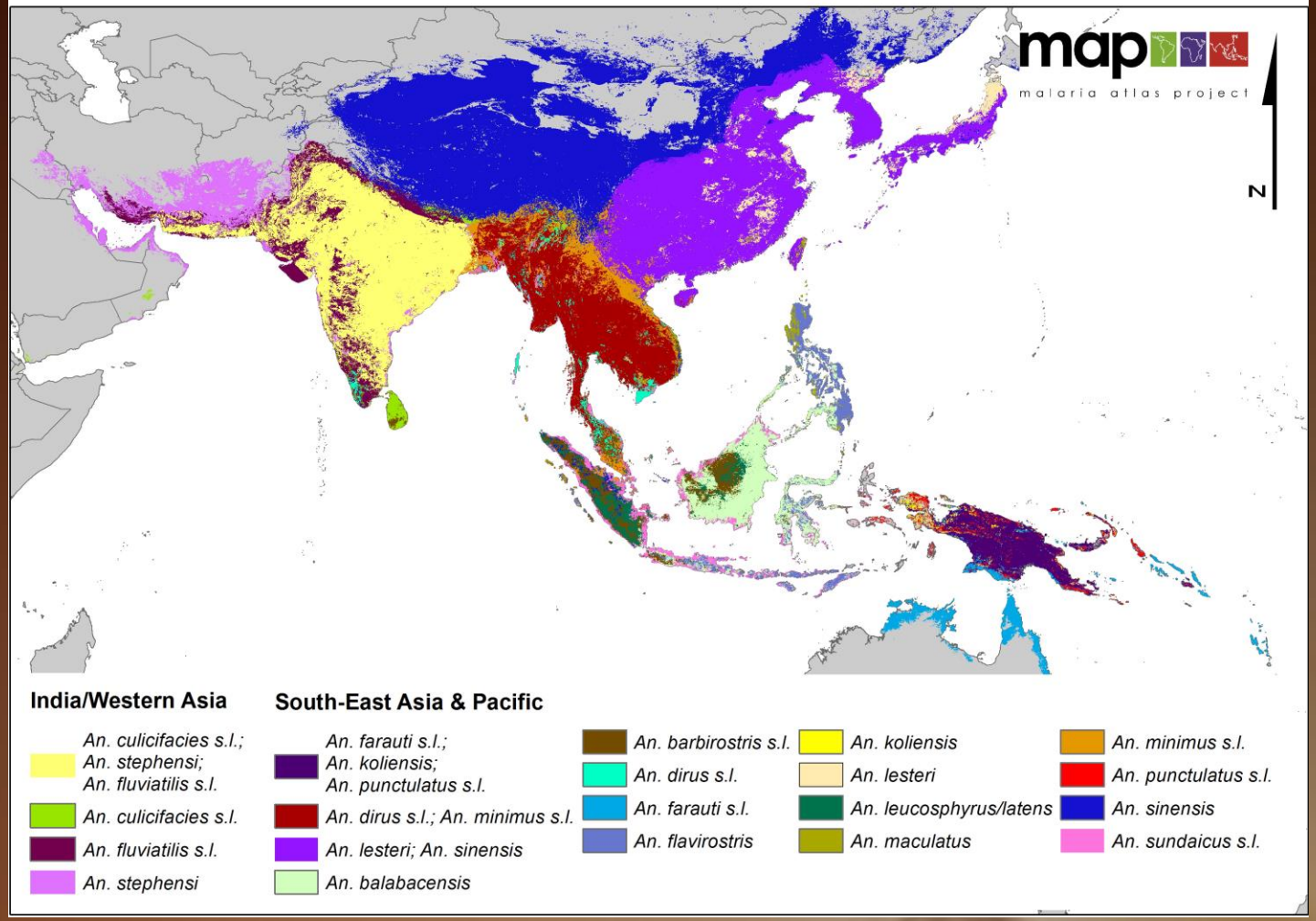
Dominant malaria vector species in Asia



Dominant Malaria Vectors, Malaria Atlas Project. Sinka, et al. 2012
For a high resolution view of this map click here.

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Malaria Vector Habitat Suitability Models

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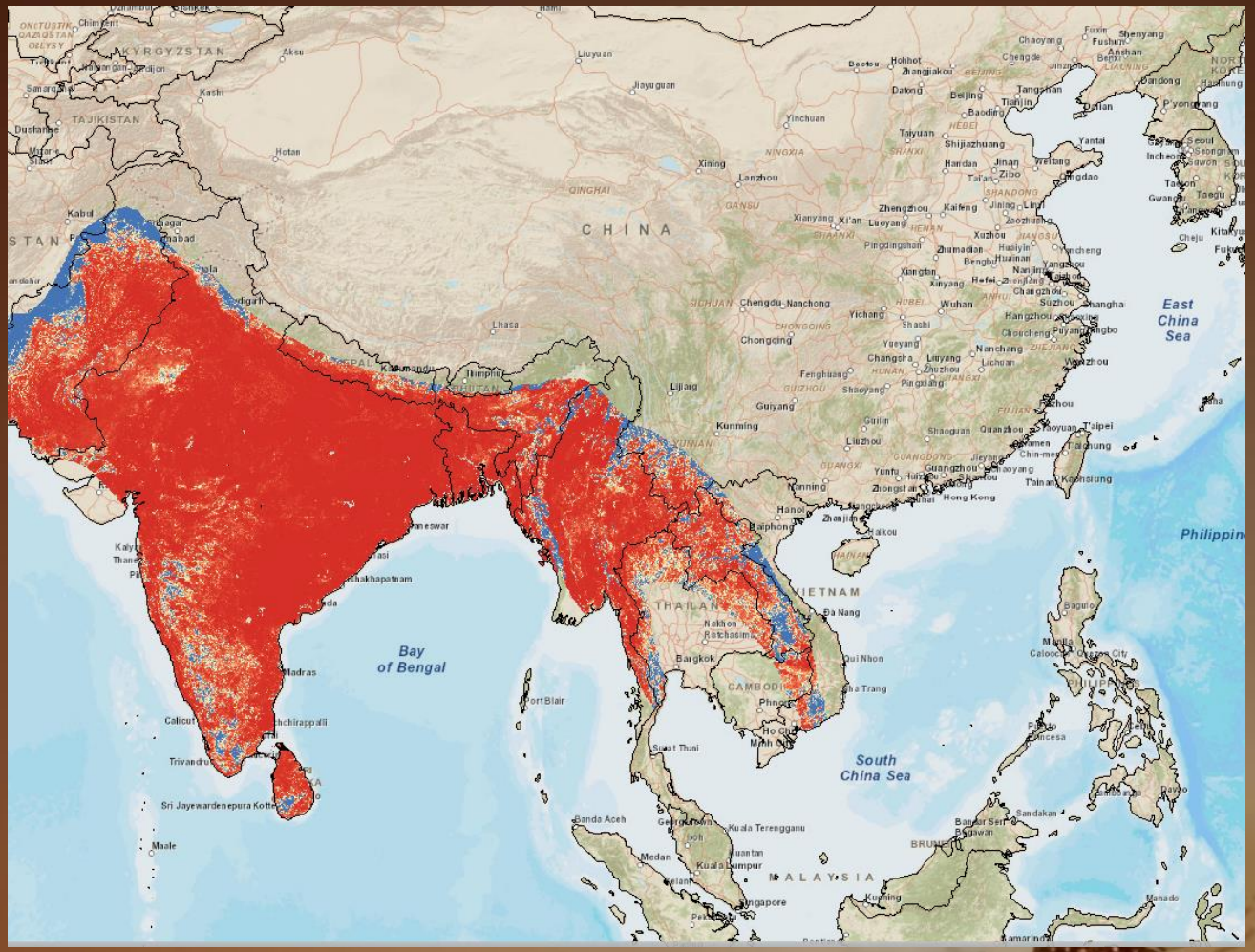
Anopheles culicifacies

(Habitat suitability modeled using Maxent)



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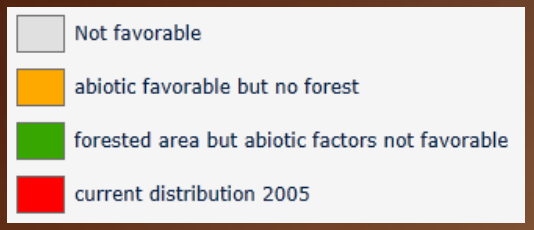
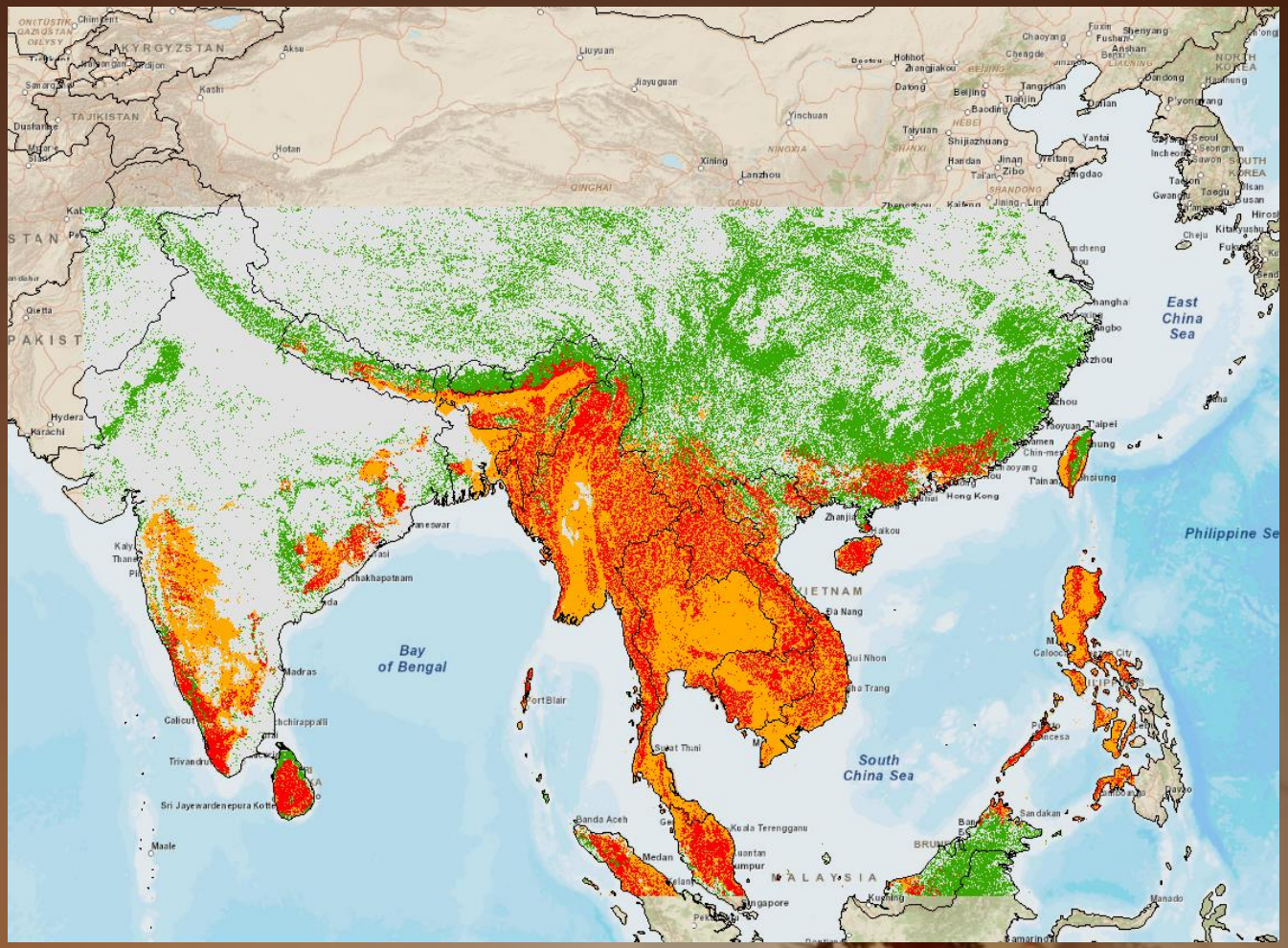
Anopheles dirus Complex

(Predicted Distribution: Obsomer, V. et al. 2012)





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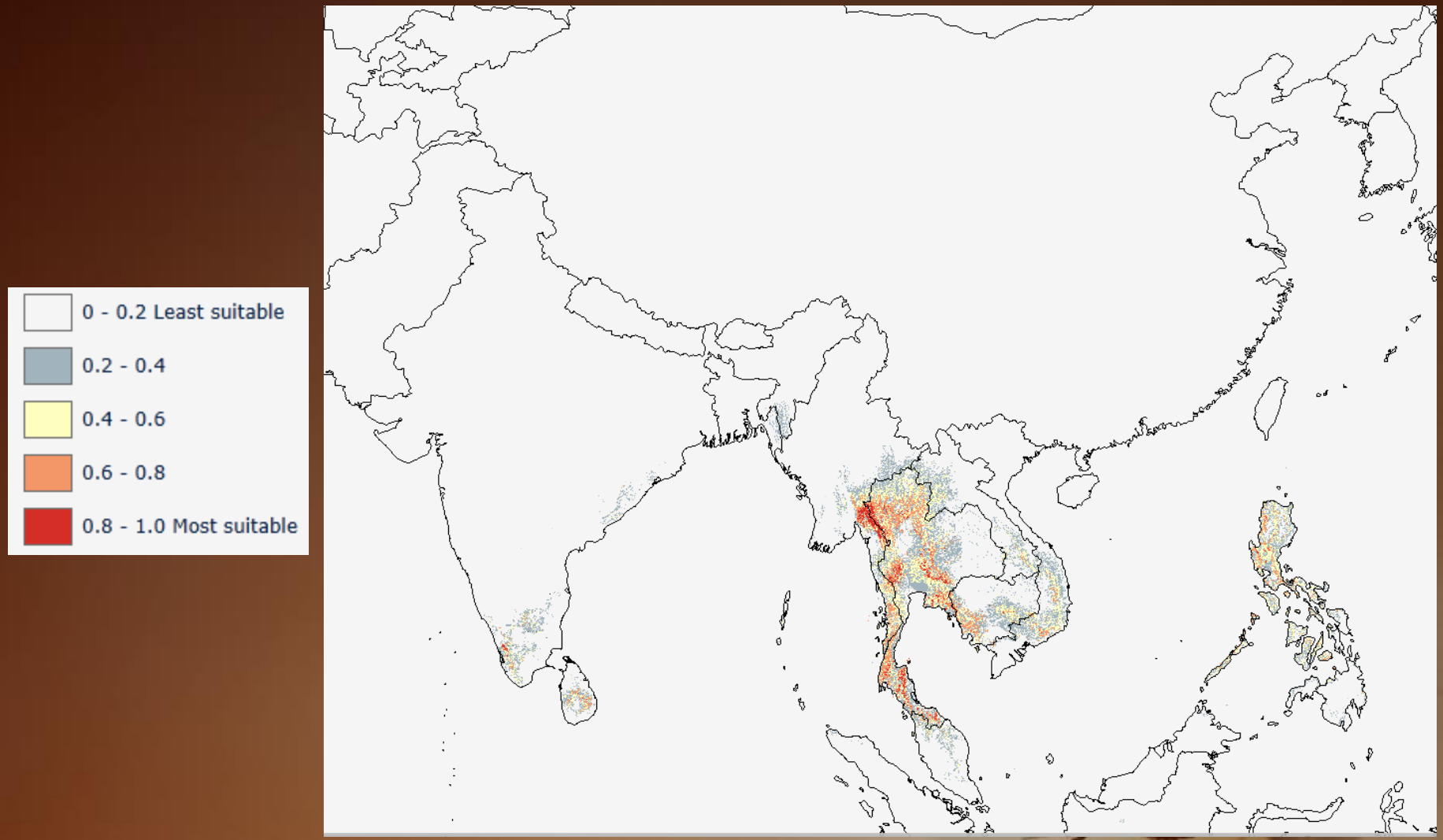
Anopheles dirus

(Habitat suitability modeled using Maxent)



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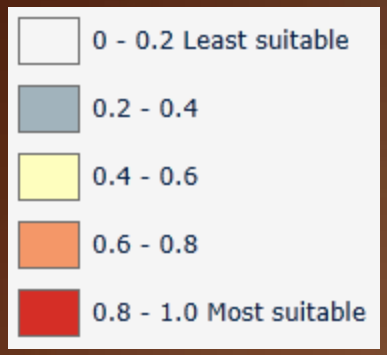
Anopheles maculatus

(Habitat suitability modeled using Maxent)



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Anopheles minimus

(Habitat suitability modeled using Maxent)

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Malaria Vector Bionomics and Medical Importance

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Anopheles (Cel.) culicifacies Giles, 1901

Bionomics:

Larvae are found in fresh water irrigation ditches, rain pools, pools in riverbeds, freshly dug pits or holes and wells. Females avoid oviposition site with emergent vegetation. Larvae found between 35 and 960m. in Thailand; in Vietnam only over 914 and in Pakistan usually between 1524 - 1829 but also up to 2286m (Harrison 1980).

Medical Importance:

Primary malaria vector (Harrison 1980).

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Anopheles (Cel.) dirus s.s.
Peyton and Harrison, 1979

Bionomics:
Immatures abundant in rainy season and found in several small, shallow shady temporary ground pools, animal footprints, puddles on foot paths, pools in dry stream beds, springs, streams, ground pools, wheel ruts, rock pools, bamboo stumps, and depressions in hollow logs (Sallum et al. 2005b).

Medical Importance:
Primary vector of human Plasmodium parasites in forested and hilly-forested areas throughout its distribution range (Sallum et al. 2005b).

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Anopheles (Cel.) maculatus Theobald, 1901

Bionomics:
Larvae found in hilly areas in seepage springs and small streams with some sunlight. Found frequently in recently cleared areas with disturbed soil. Adults primarily zoophilic (Reid 1968).

Medical Importance:
Primary malaria vector and a vector of W. bancrofti (Reid 1968).

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Anopheles (Cel.) minimus Theobald, 1901

Bionomics:
Larvae found in small- to moderate-sized streams of clear, cool unpolluted water with partial shade and grassy margins. Other larval habitats include rock pools, sand pools next to streams, seepage pools and springs, stream pools and fallow rice fields with seepage. Females anthropophilic and endophagus (Harrison 1980).

Medical Importance:
Primary malaria vector (Harrison 1980).

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Anopheles (Cel.) punctulatus Donitz, 1901

Bionomics:

Larvae are found in sunny road ruts and other temporary pools such as depressions and footprints in native trails, margins of streams and sloughs. Habitats are usually free of vegetation but may have marginal herbaceous growth and dense algae. Females readily bite man indoors during the early morning hours (Belkin 1962).

Medical Importance:

Primary malaria vector and vector of human periodic filariasis (Belkin 1962).

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Anopheles (Cel.) stephensi Liston, 1901

Bionomics:
In urban areas the larvae are found in a wide variety of artificial containers, cisterns, wells, tubs and fountains. In the wild they are found in stream pools, stream margins, seepages, irrigation channels and springs. Females avidly bite man (Puri in Boyd 1949).

Medical Importance:
Primary malaria vector (Christophers 1933).

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Dengue and chikungunya viruses in South East Asia

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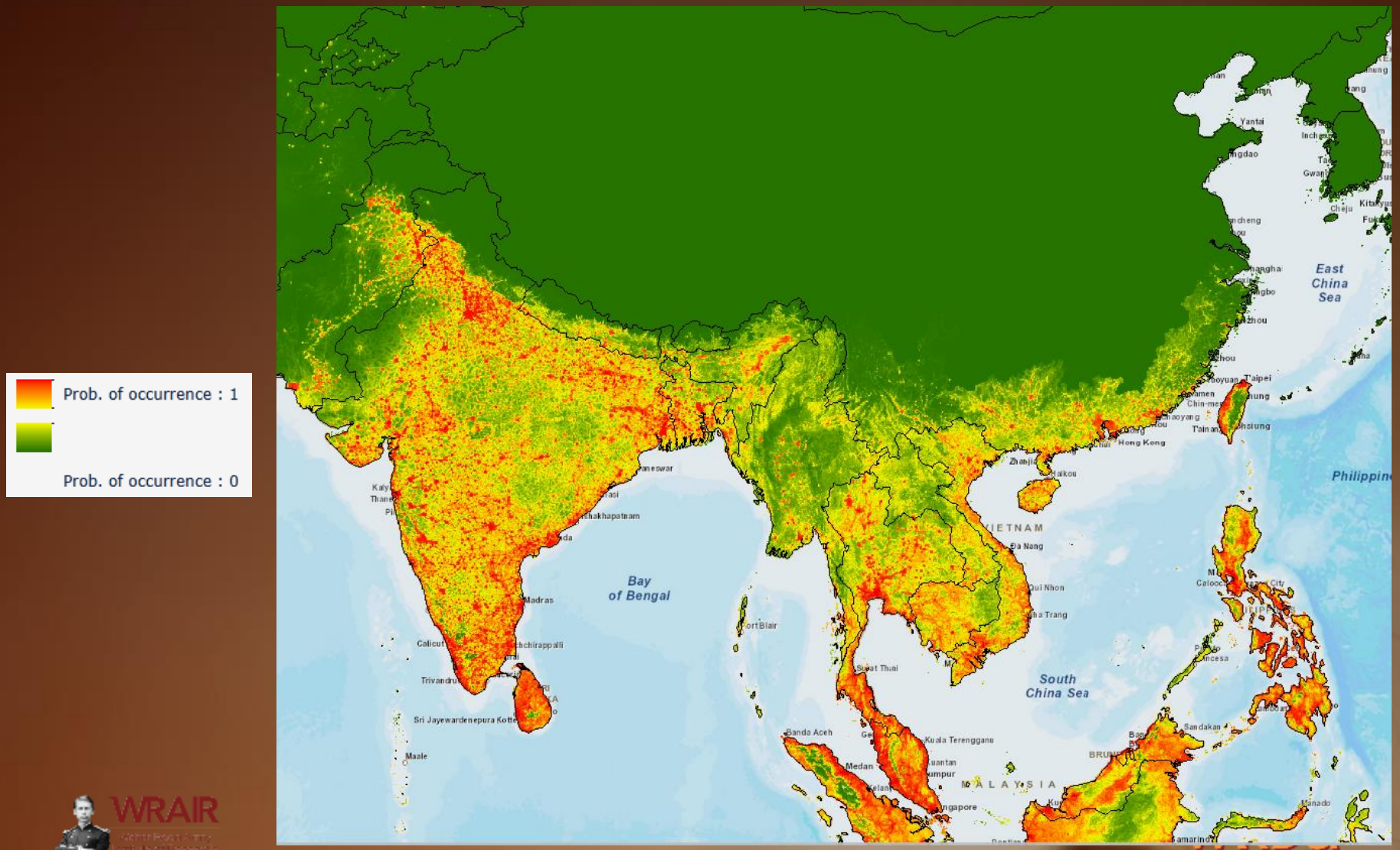
Dengue Virus Prediction Model

Bhatt, S. et al. 2013



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Countries reporting CHIKV cases to CDC as of March 2015

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Dengue and Chikungunya Virus Vector Habitat Suitability Models

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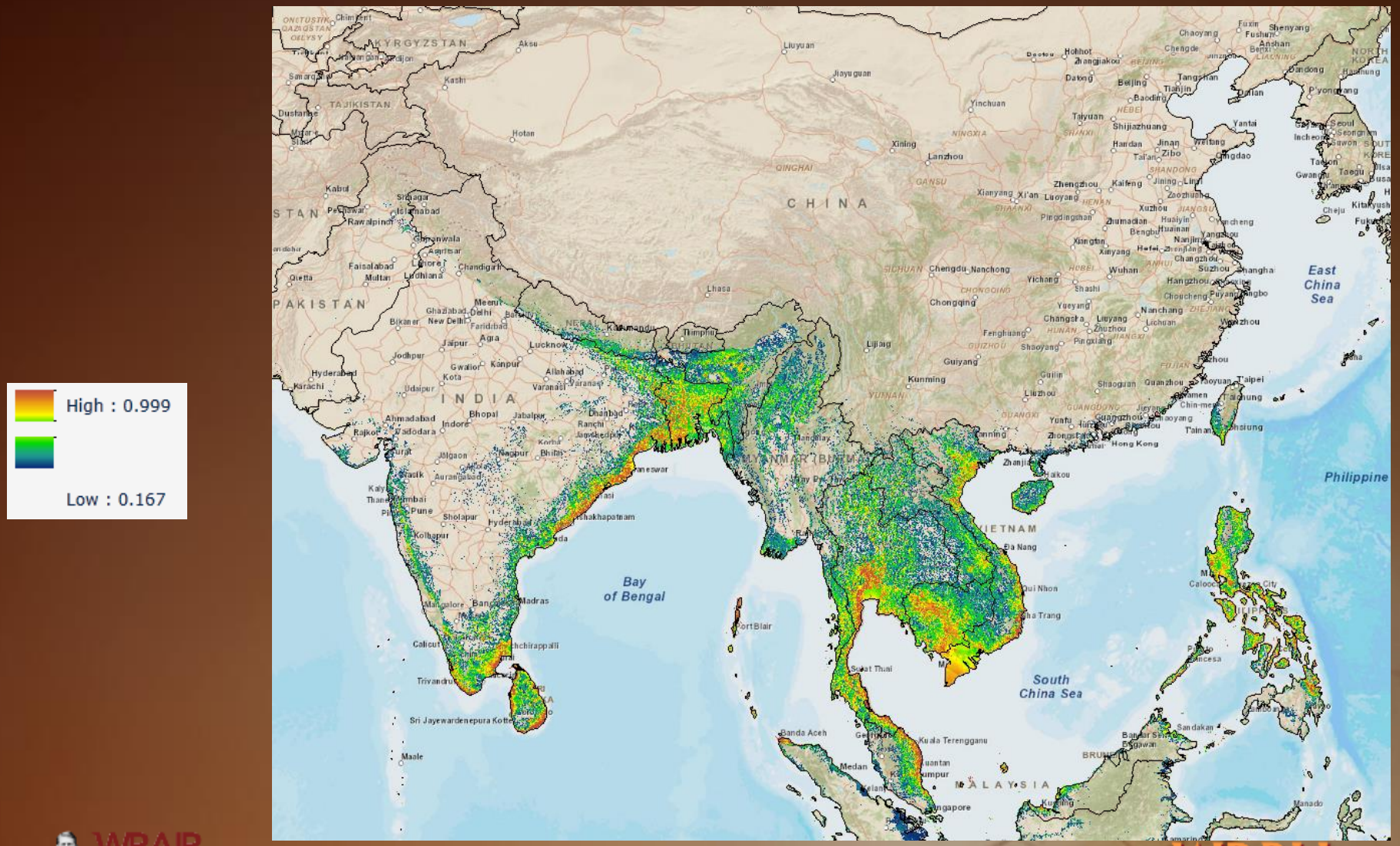
Aedes aegypti

(Habitat suitability modeled using Maxent)



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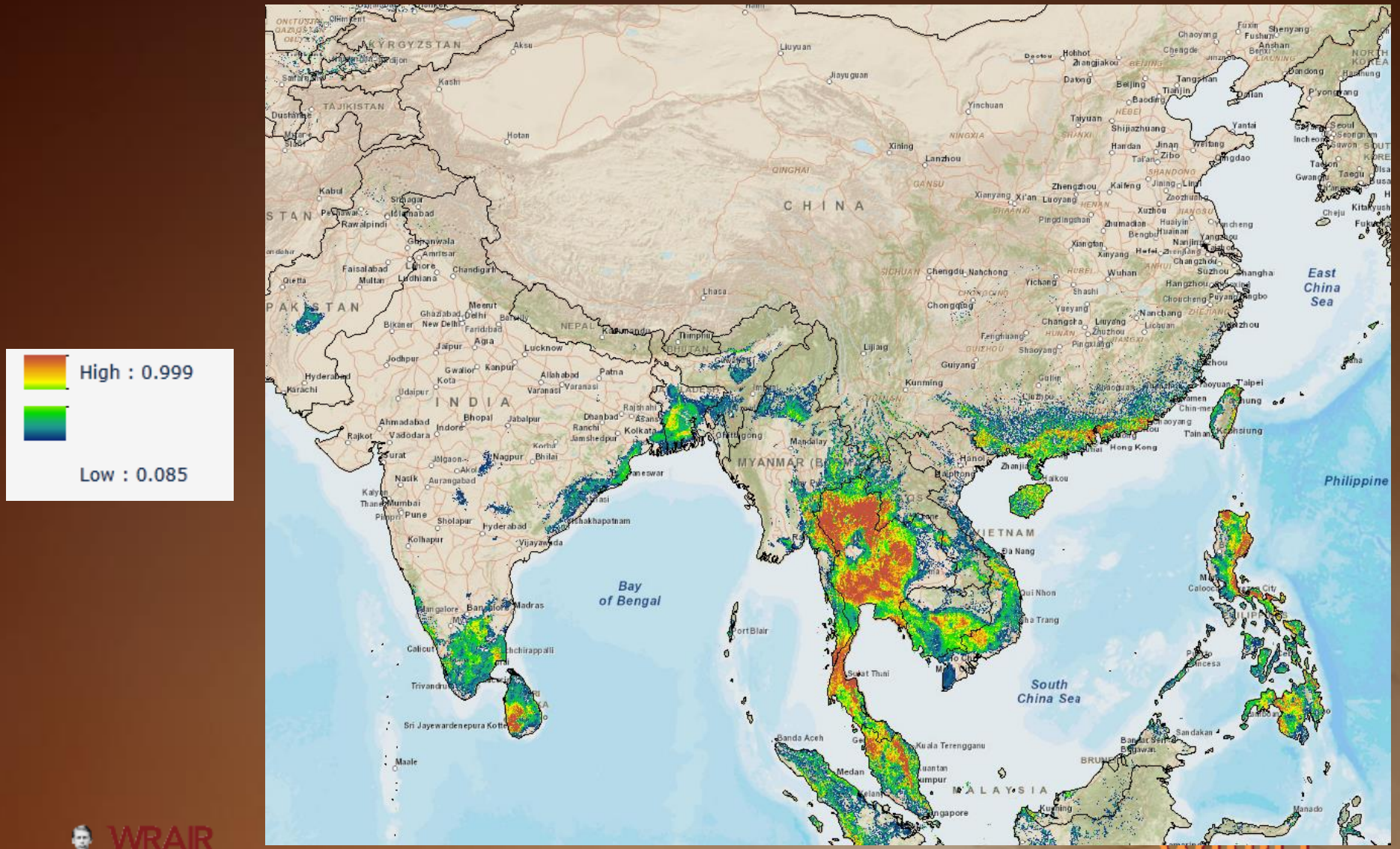
Aedes albopictus

(Habitat suitability modeled using Maxent)



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Dengue and Chikungunya Virus Vector Bionomics and Medical Importance

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Primary Vectors of CHIKV

Aedes (Stg.) aegypti (Linnaeus, 1762)

“Yellow Fever Mosquito”

Bionomics:

In association with man, *Ae. aegypti* will use any and all natural and artificial containers. Away from urban areas the species tends to favor pools in river beds, tree stumps, tree holes and natural containers. Females are primarily day biters and readily enter buildings to feed. They have also been taken in lesser numbers at night (Christophers 1960).

Medical Importance:

This species is a primary vector of dengue, chikungunya virus and yellow fever (Christophers 1960).

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Primary Vectors of CHIKV

Aedes (Stg.) albopictus (Skuse, 1894)

“Asian Tiger Mosquito”

Bionomics:

Also known as the “Asian Tiger Mosquito”, the immatures are found in natural containers, including treeholes, bamboo stumps, coconut shells, rockholes, palm fronds, and leaf axils. They are also found in all varieties of artificial containers and will breed indoors. The females readily bite man (Huang 1972).

Medical Importance:

This species is a known vector of dengue and yellow fever in the wild. Under laboratory conditions it has also been shown to vector bird malarias, Eastern and Western equine encephalitis, West Nile, chikungunya and Japanese encephalitis viruses (Huang,1972).

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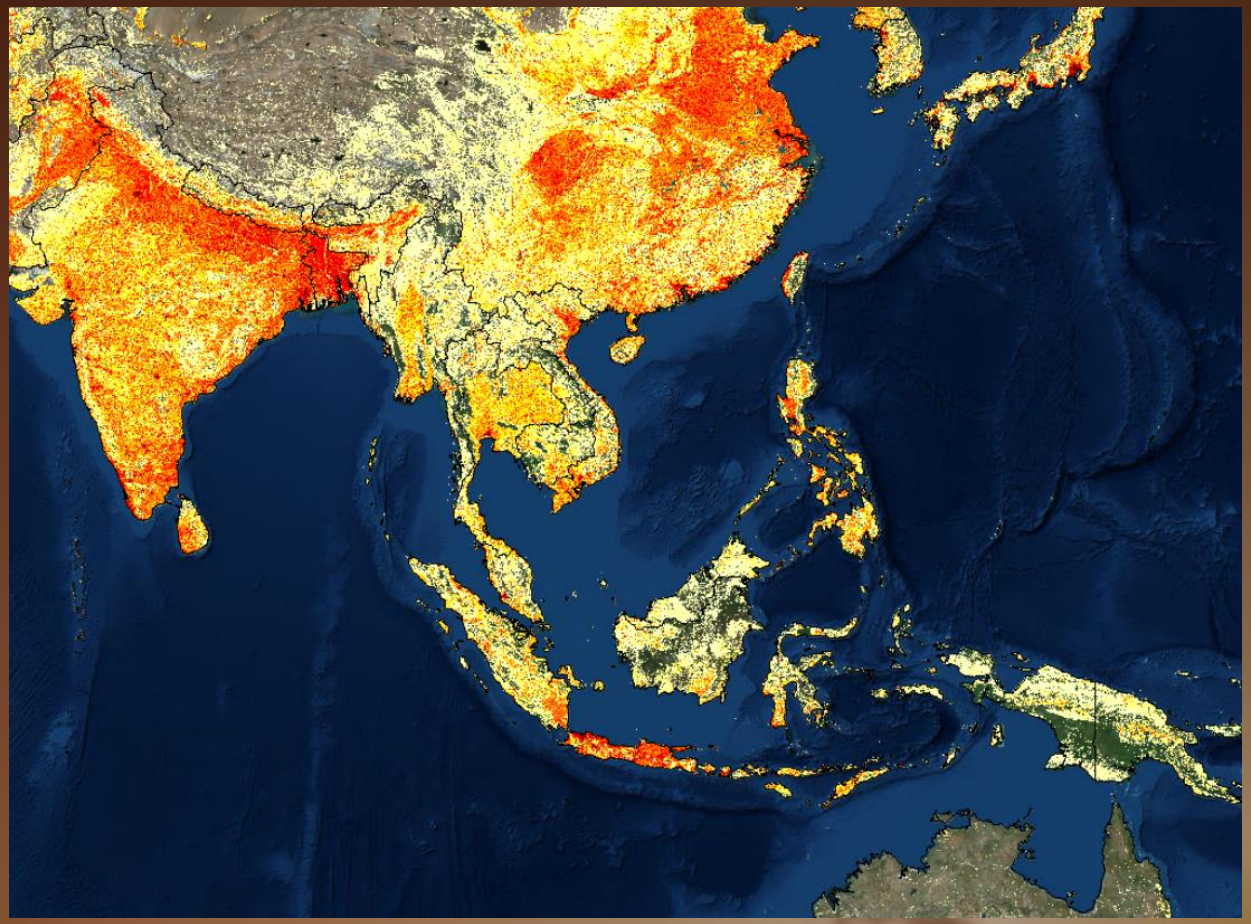
Human Density

LandScan 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

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References

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Obsomer, V. et al. 2012. Predicted Distribution of major malaria vectors belonging to the An. dirus complex in Asia. Ecological Niche and Environmental Influences. PLoS One 7(11): E: 50475

Sinka, Marianne E. et al. 2012. A global map of dominant malaria vectors. Parasites & Vectors 2012, 5:69.

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

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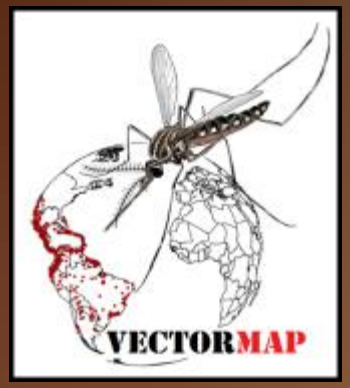
Know the vector, know the threat

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 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 Courtesy of Judith Stoffer, Walter Reed Biosystematics Unit

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