Vector Hazard Report:
Malaria Risk in Indonesia

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

[Systematic Catalog of Culicidae](#)
[VectorMap](#)

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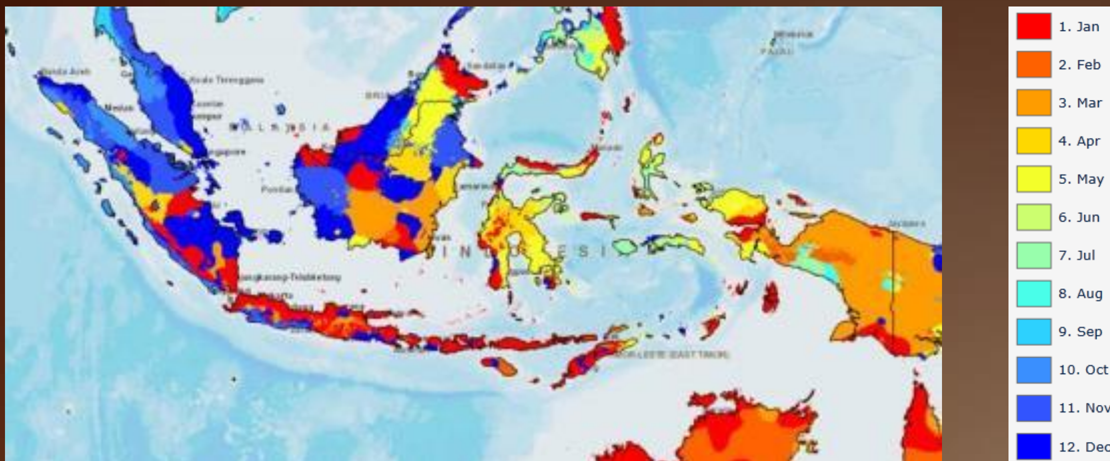
Climate Impacting Malaria Transmission

Climate of Indonesia



Month of maximum precipitation, WorldClim (50 year average)

Month of maximum temperature, WorldClim (50 year average)

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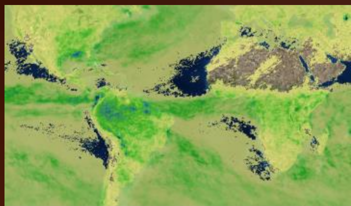
Monthly Climate Maps

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

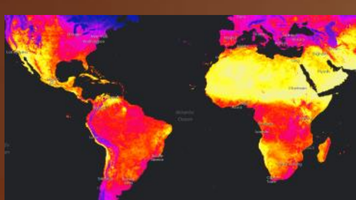
Areas with consistent above average monthly rainfall over the past 3 months may indicate increased mosquito breeding sites which may lead to increased mosquito-borne disease transmission. Areas with consistent below average rainfall may also indicate increased water storage or ponding which can provide 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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Soil Drainage

Soil Drainage (Harmonized World Soil Database 1.1; 0.02 Deg resolution)

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Malaria Risk Maps

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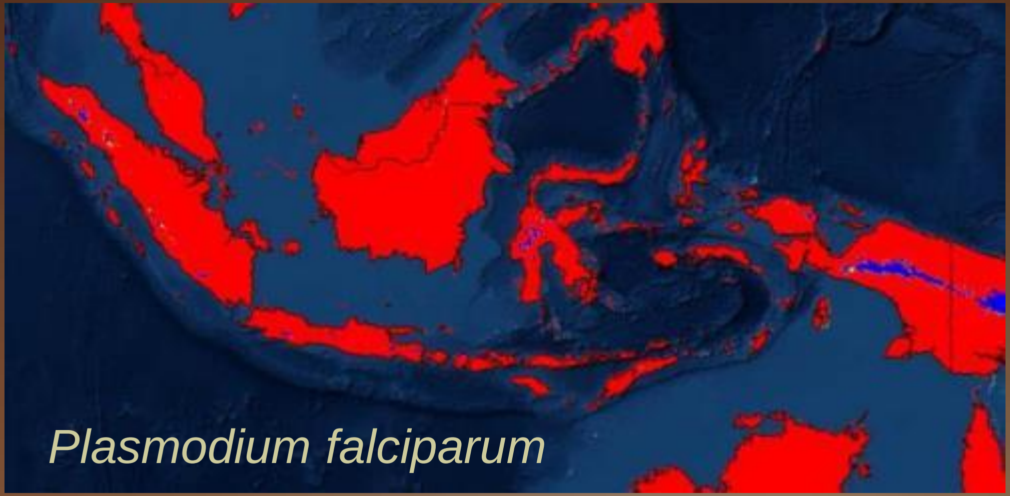
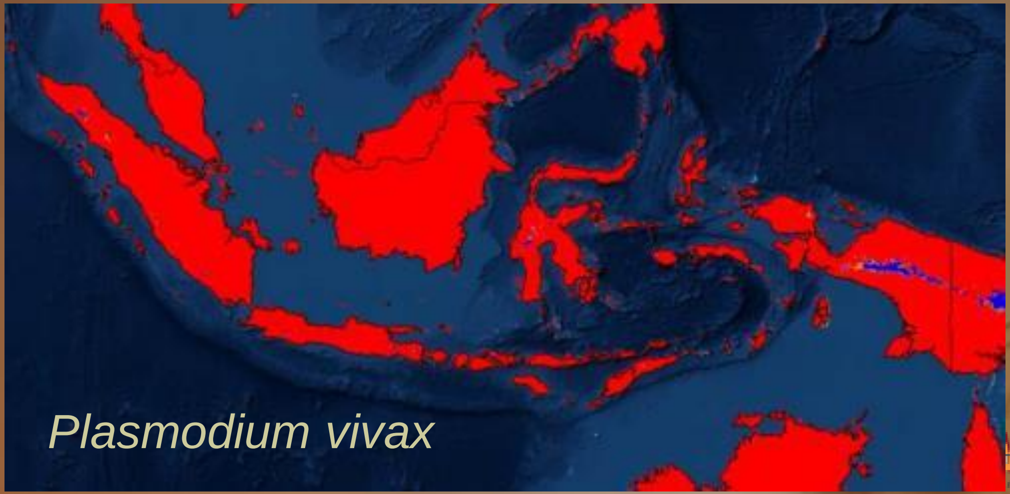
Malaria Risk Maps

The number of infectious days (by month) in which the annual temperature regime could support malaria infection.
Gething et al. 2011

- 1 month. Highly unsuitable for Pf
- 2 months
- 3 months
- 4 months
- 5 months
- 6 months
- 7 months
- 8 months
- 9 months
- 10 months
- 11 months
- 12 months. Highly suitable for Pf





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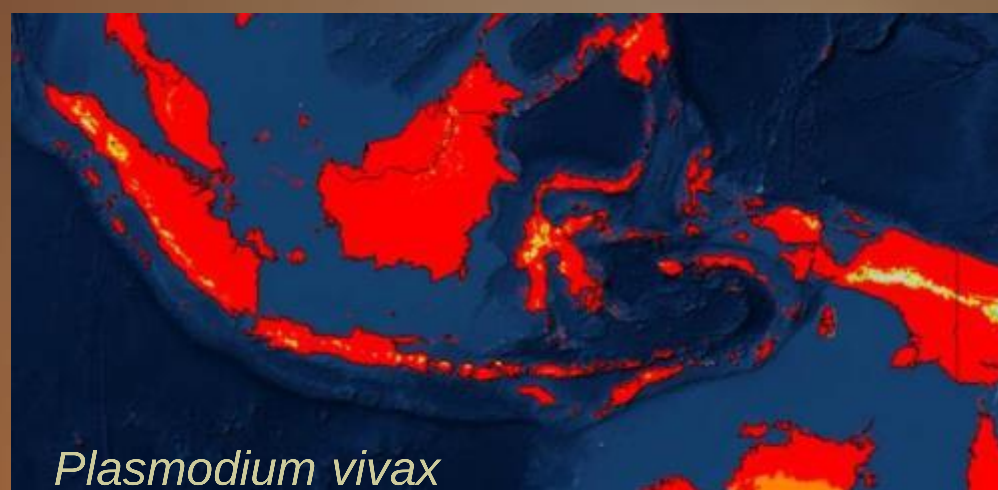
Malaria Risk Maps

The normalized Z(T) index of temperature suitability that incorporates the duration and degree of suitability across an average year
Gething et al. 2011



- Not suitable
- Low suitability
- Low to intermediate suitability
- Intermediate to high suitability
- High suitability

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Malaria Risk Maps

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

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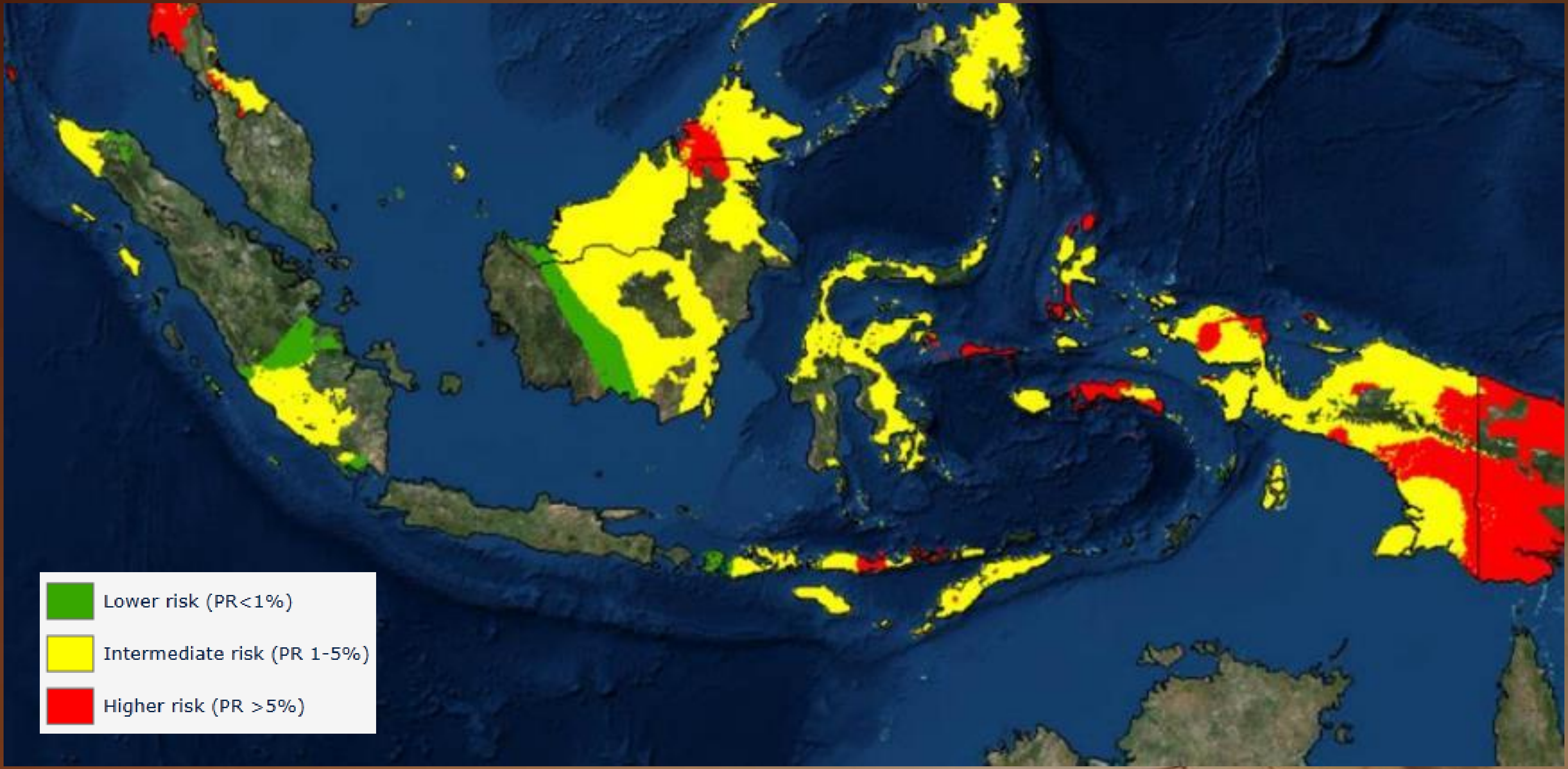
Malaria Risk Maps

Stratified estimate 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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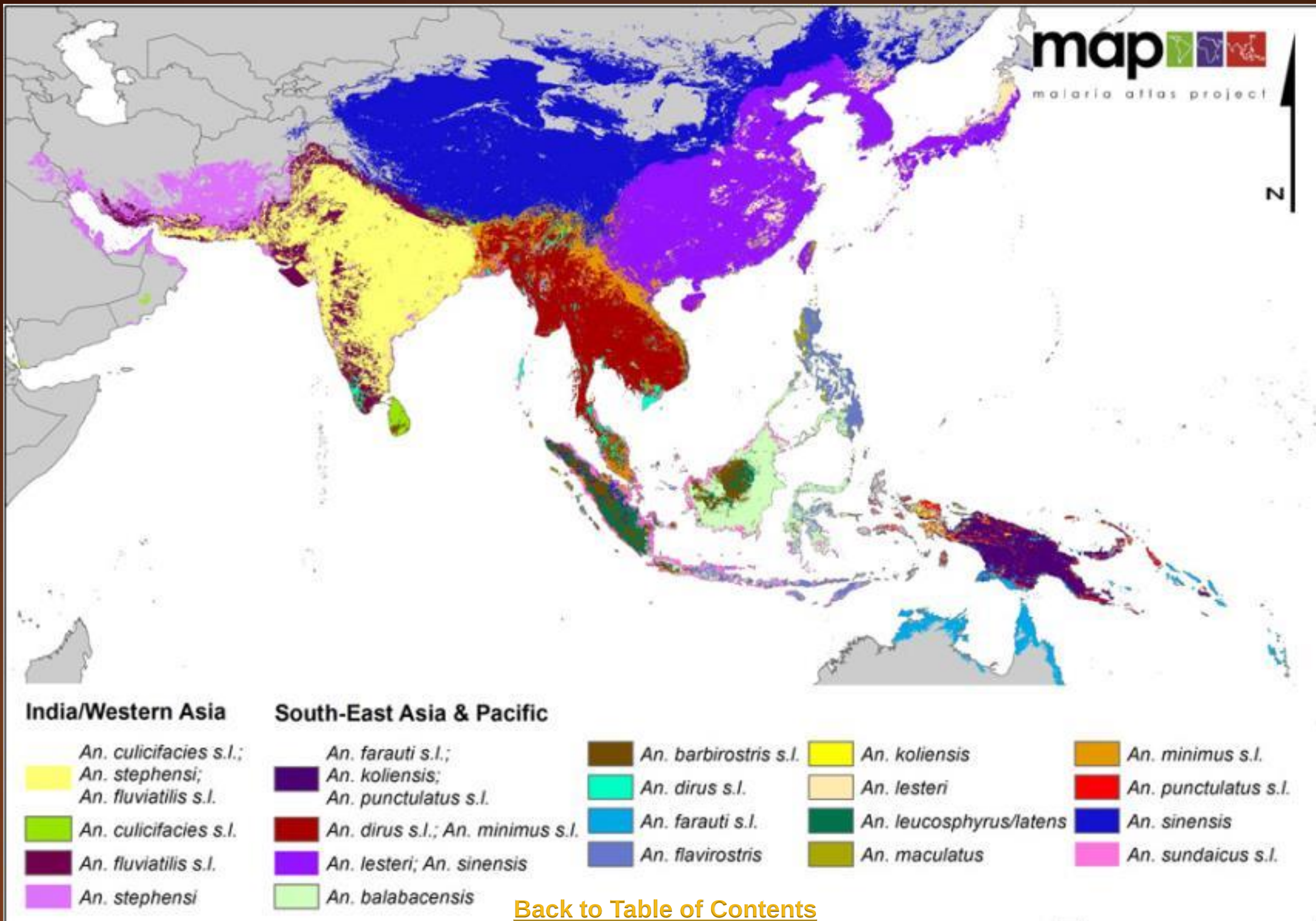
Dominant Malaria Vectors

-Sinka, et al. 2012

For a high resolution view of this map visit the [Malaria Atlas Project]



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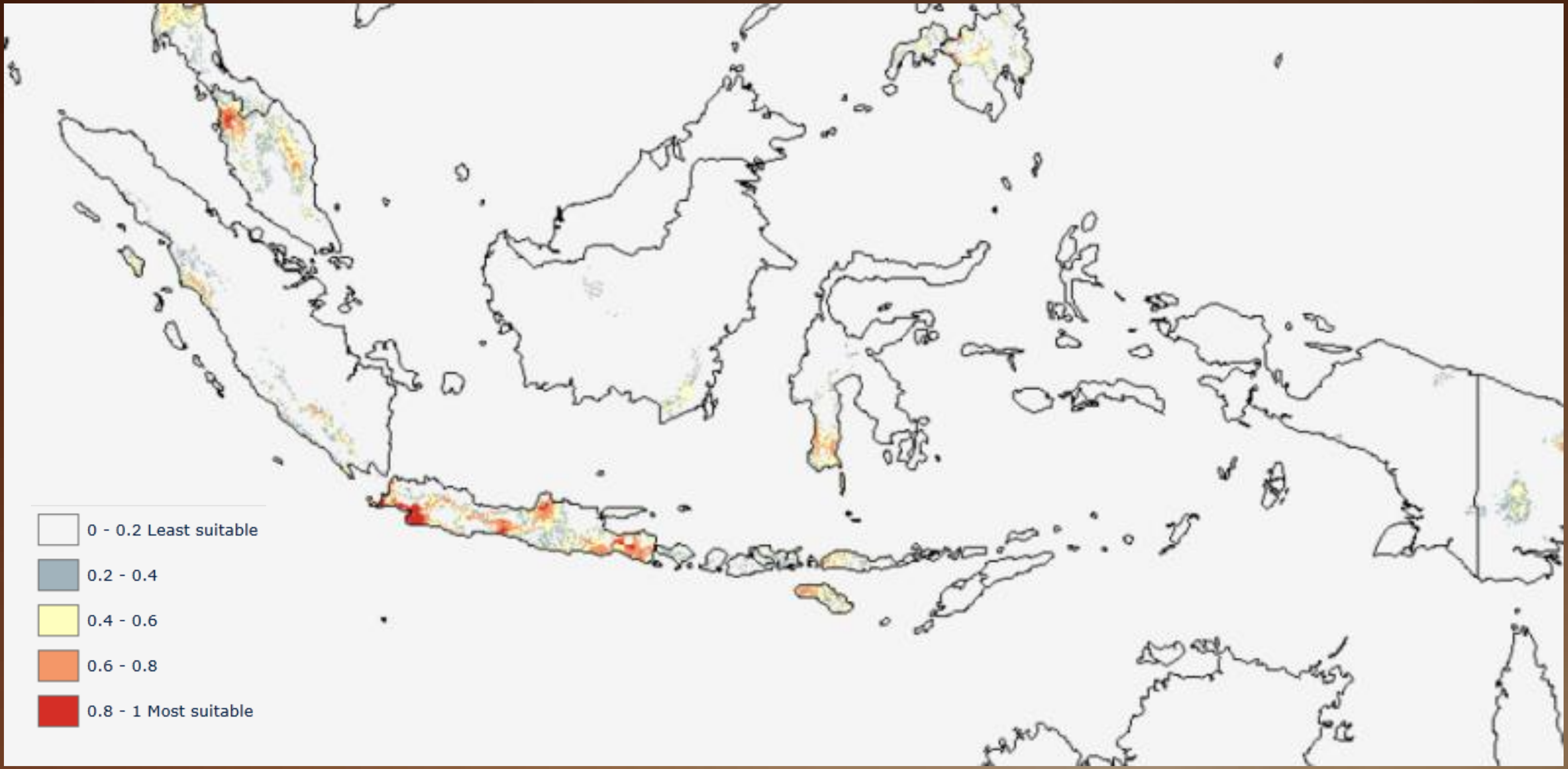
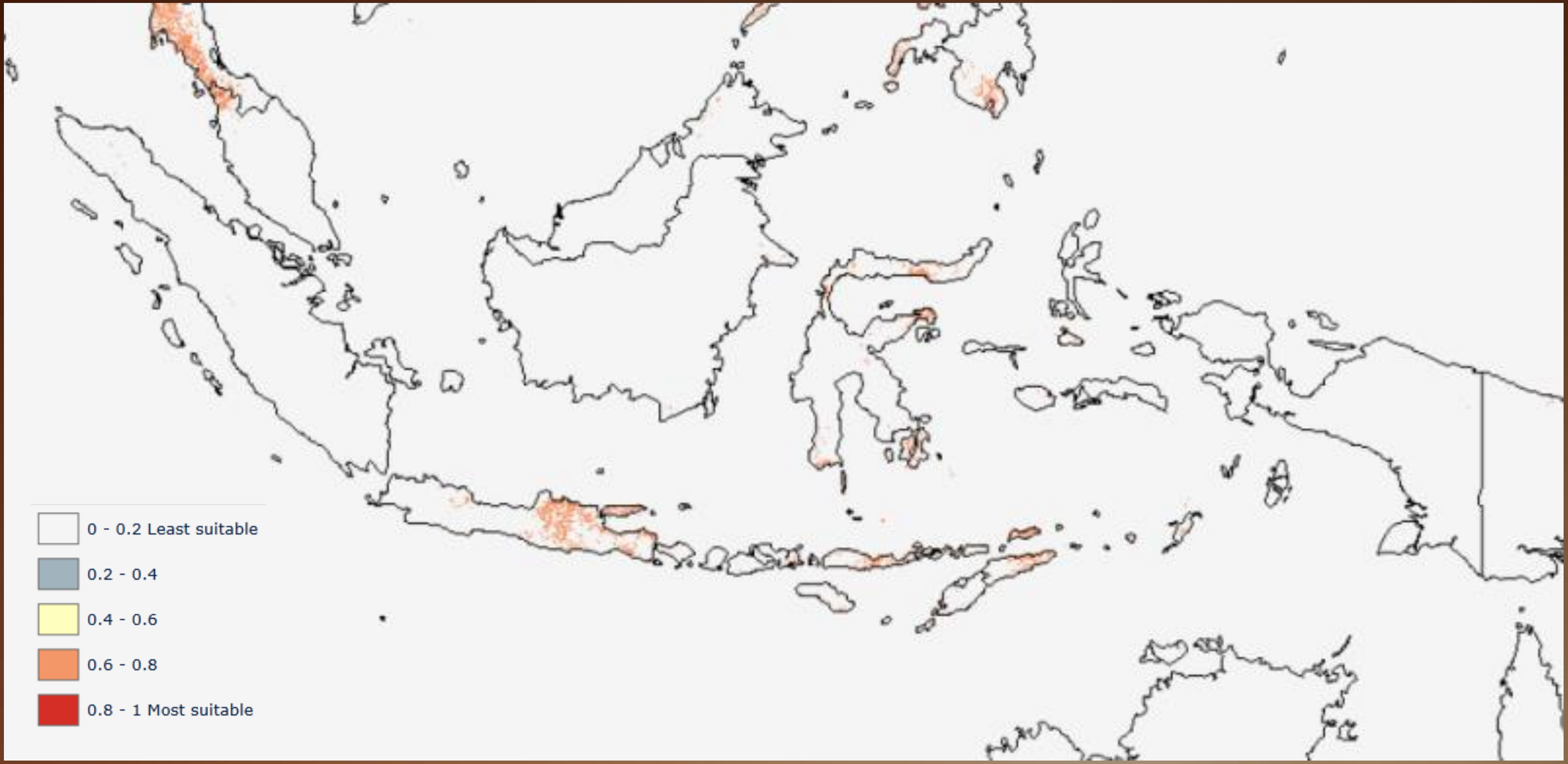
Primary Malaria Vectors: Habitat Suitability Models

Habitat Suitability Model: *Anopheles aconitus*



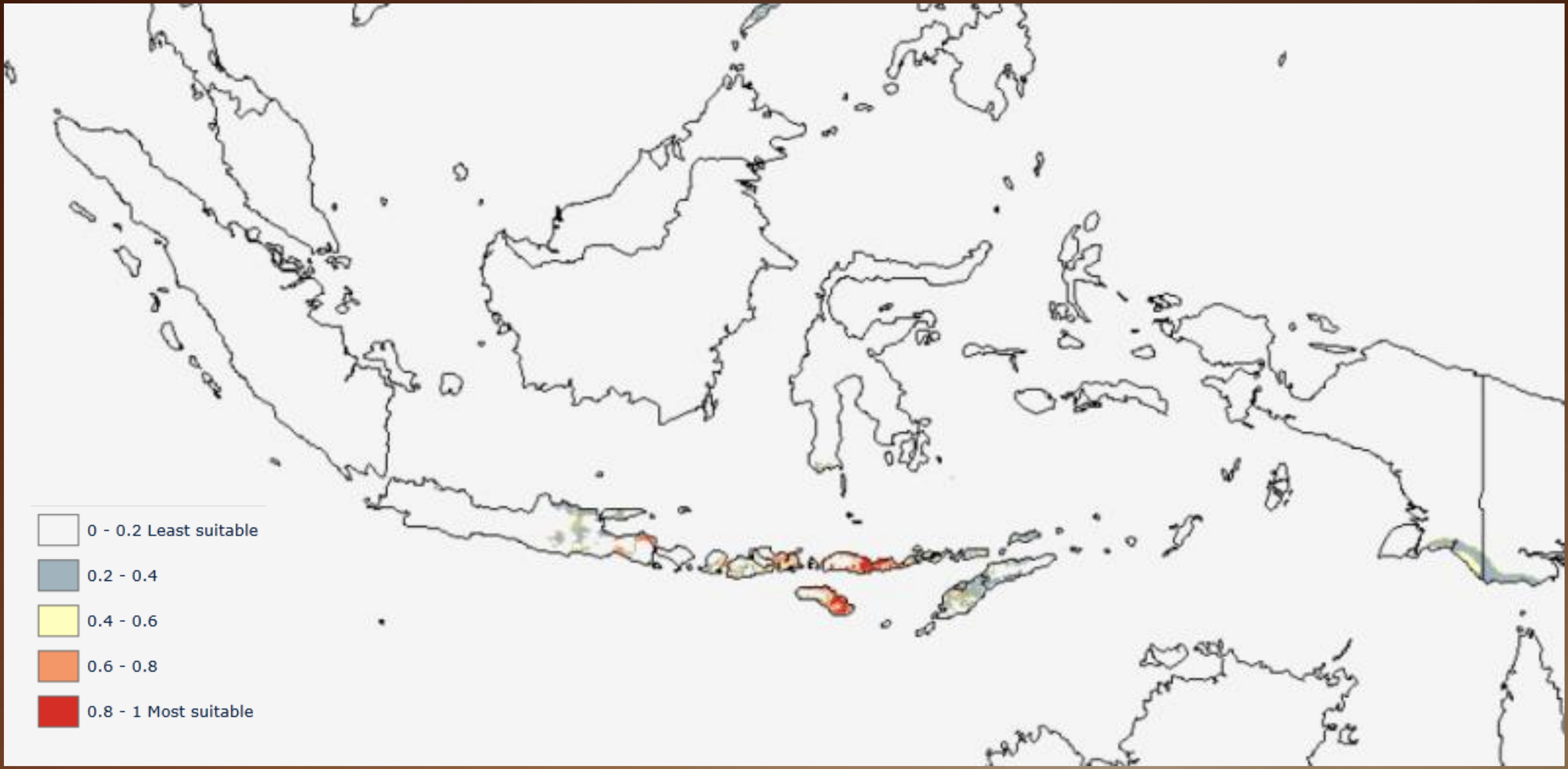
Maxent model of *An. acontius*, Nyari, A. 2011

Habitat Suitability Model: *Anopheles baimaii*



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

Habitat Suitability Model: *Anopheles culicifacies*



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

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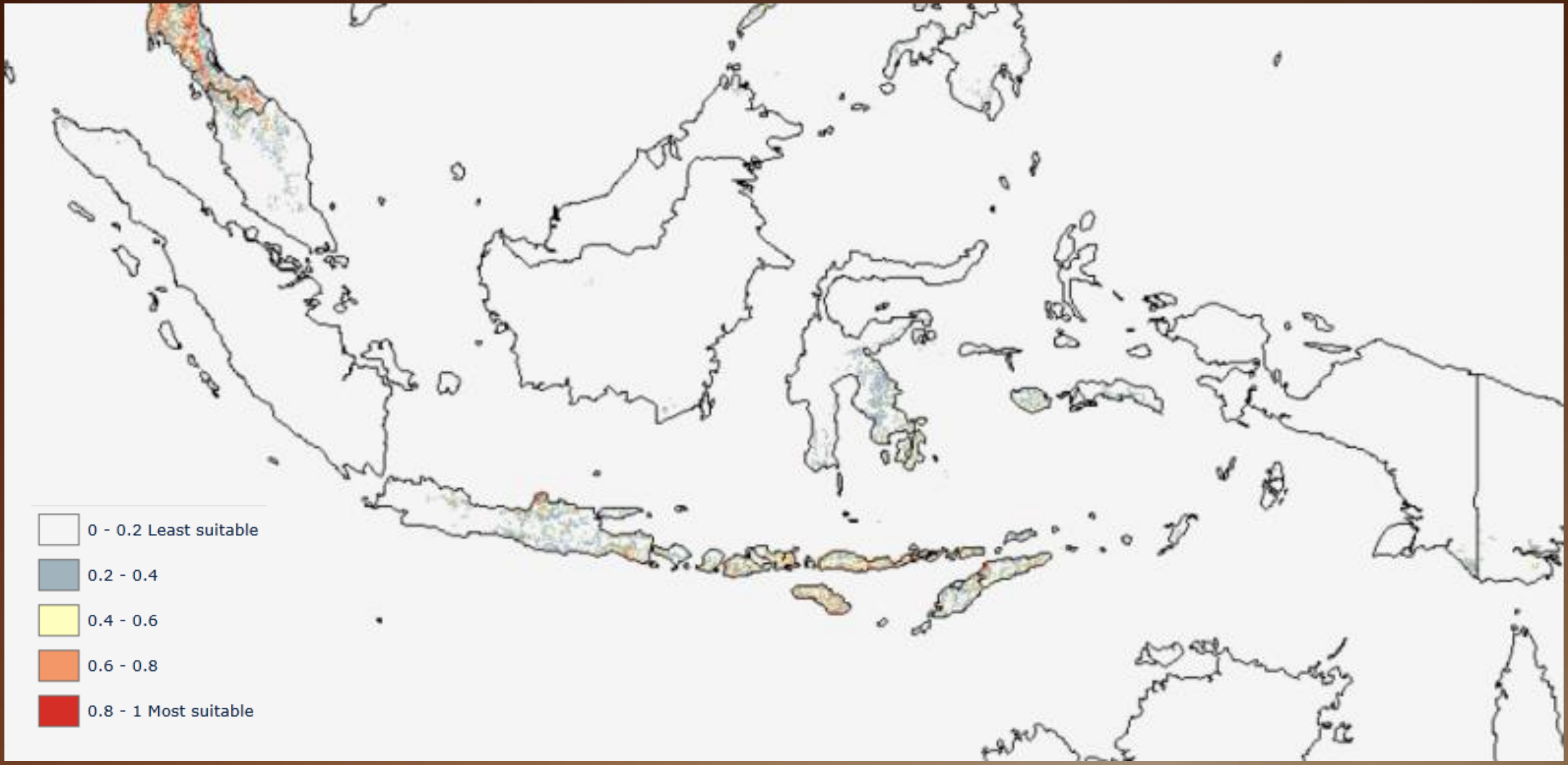
Habitat Suitability Model: *Anopheles dirus s.l.*



Maxent model of *An. dirus* s.l., Nyari, A. 2011

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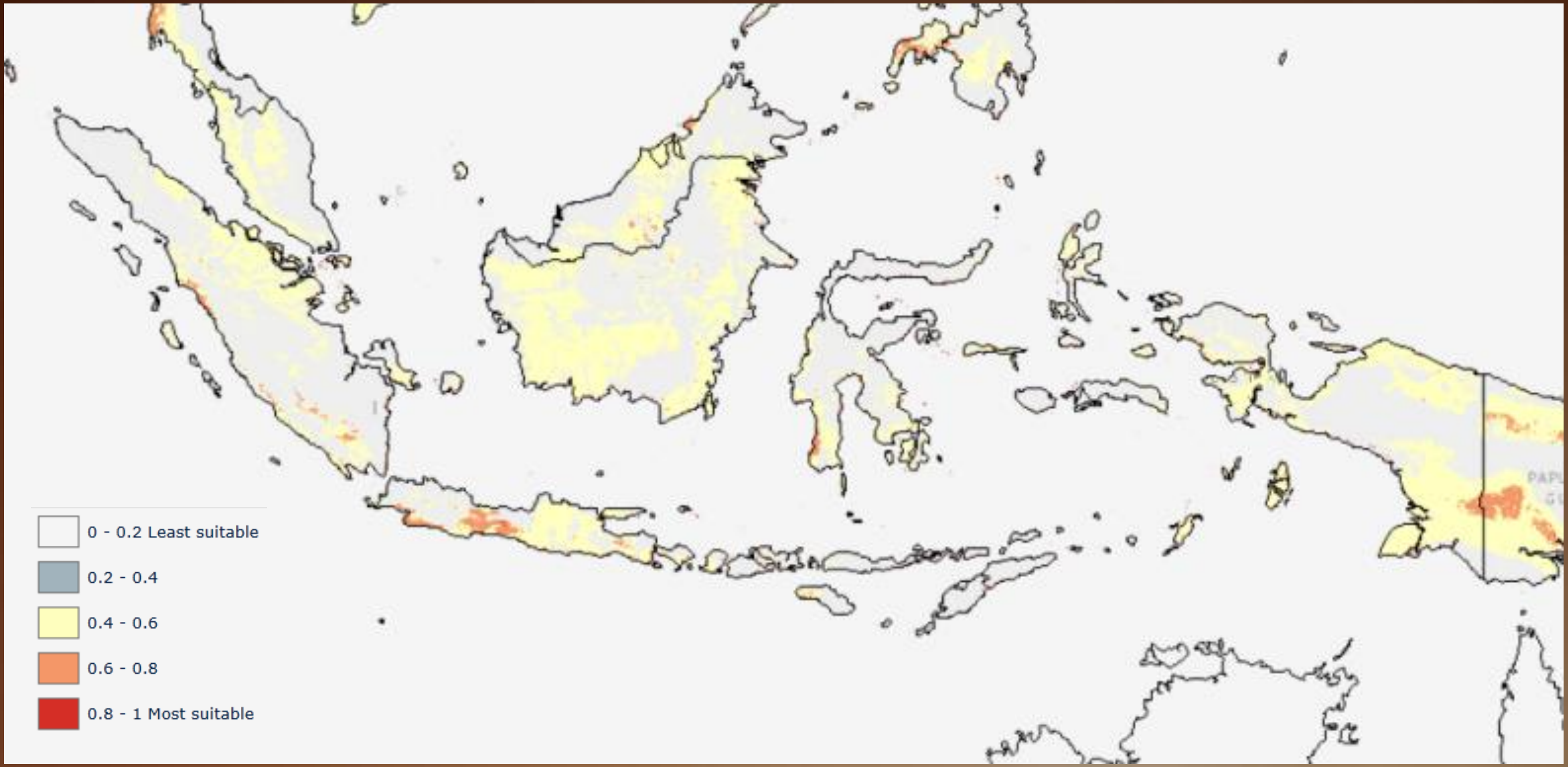
Habitat Suitability Model: *Anopheles flavirostris*



Maxent model of *An. flavirostris*, Dornak, L. 2011

Habitat Suitability Model: *Anopheles maculatus*

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

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Habitat Suitability Model: *Anopheles minimus*

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

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Habitat Suitability Model: *Anopheles subpictus*

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

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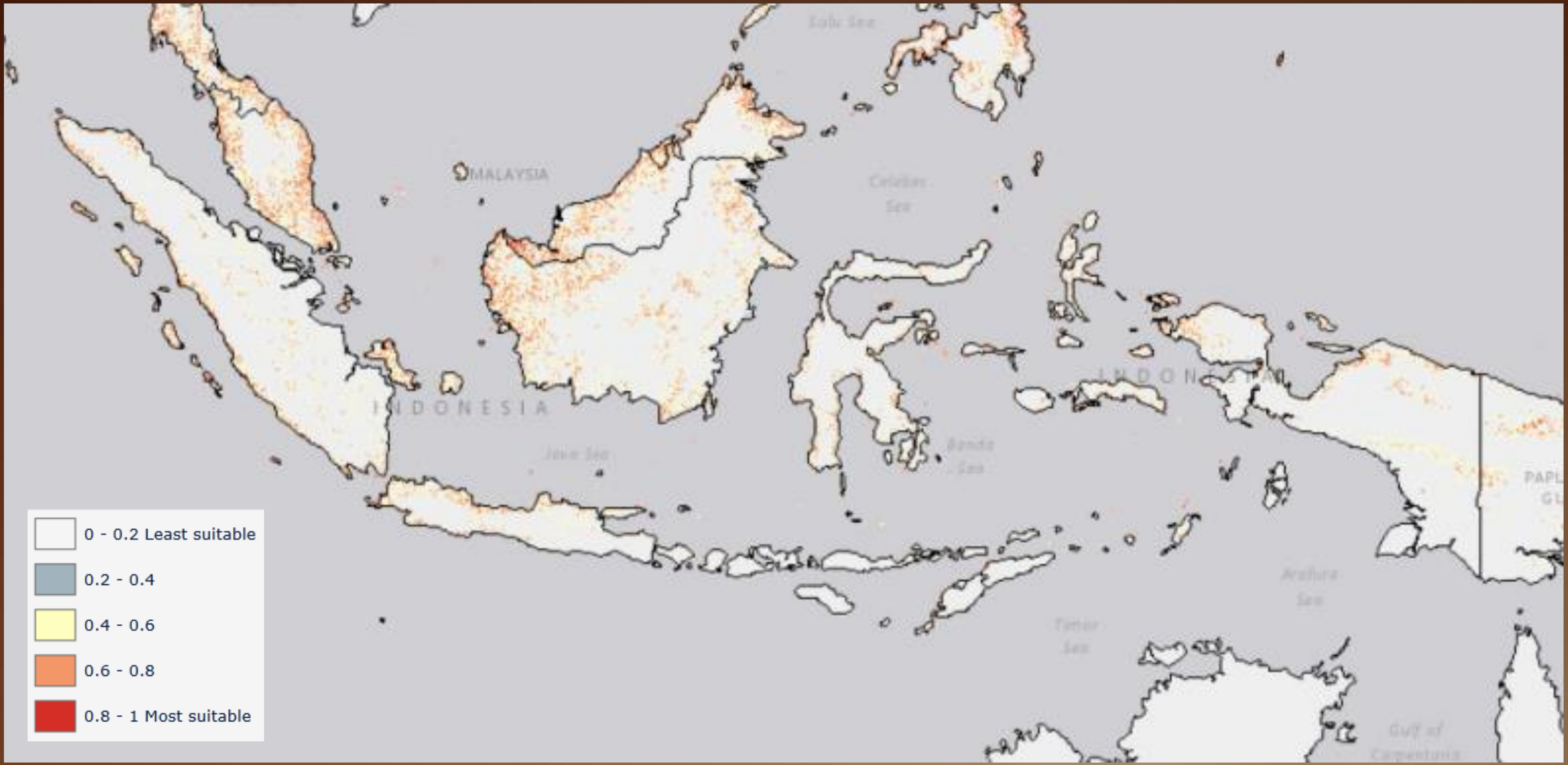
Habitat Suitability Model: *Anopheles sundaicus*



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

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Secondary Malaria Vectors: Habitat Suitability Models

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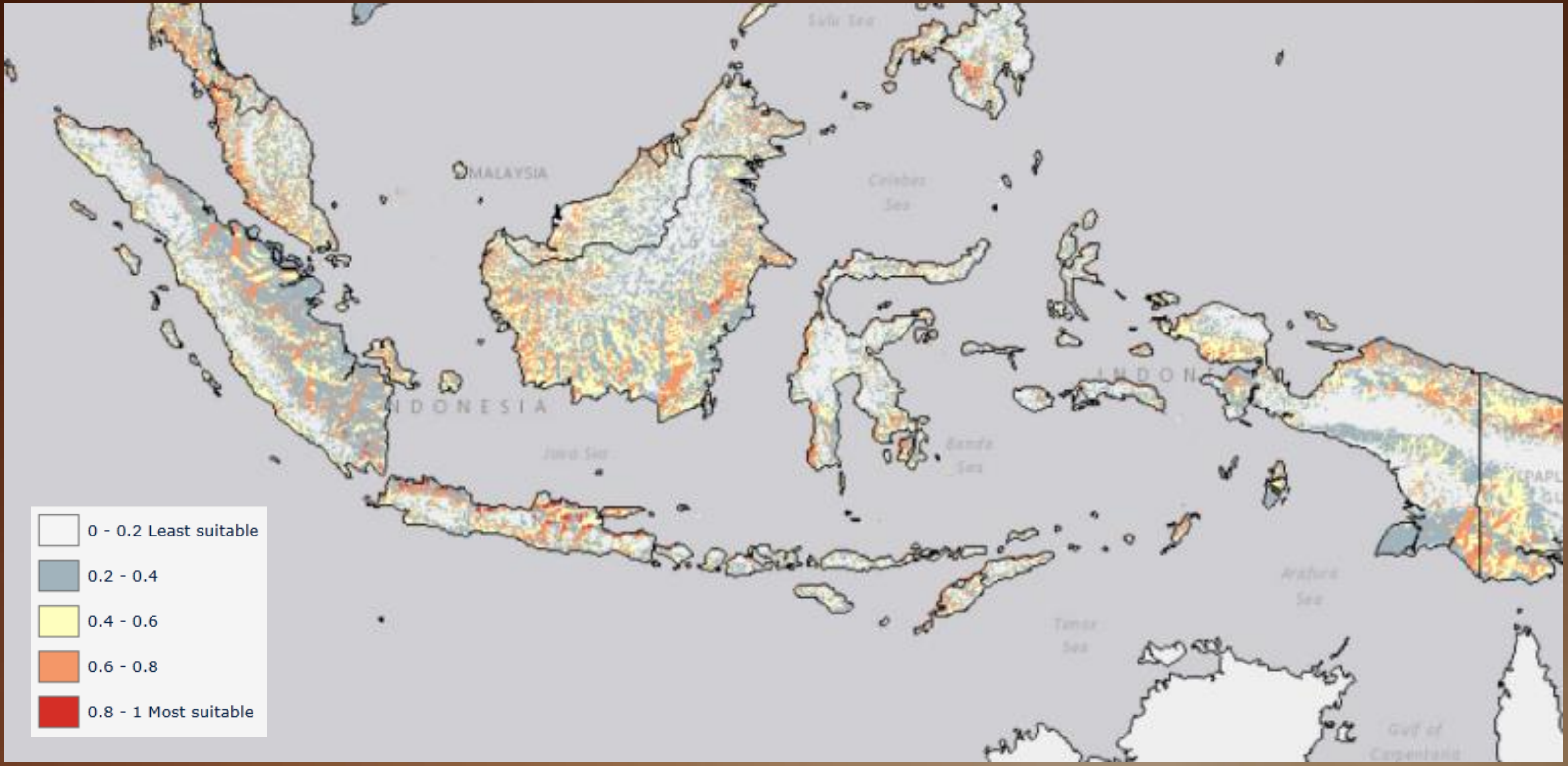
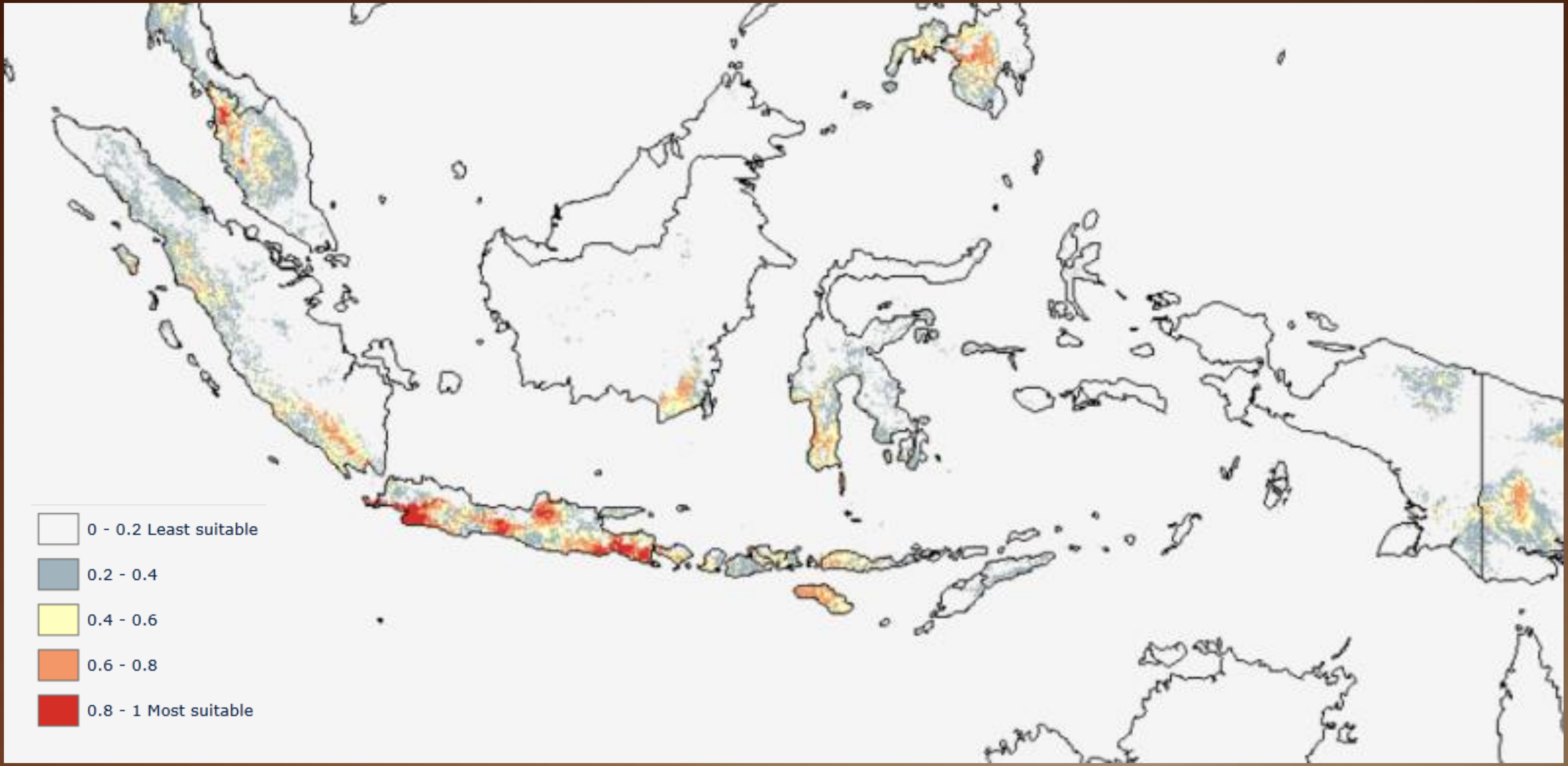
Habitat Suitability Model: *Anopheles karwari*



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

Habitat Suitability Model: *Anopheles annularis*



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

Primary Malaria Vectors: Bionomics and Medical Importance

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Anopheles (Cel.) aconitus Doenitz, 1902

Bionomics:

Larvae found primarily in flooded rice fields, grassy ponds and stream margins. Also found in Nippa palm swamps, stream pools, fresh water swamps, rock pools, seepage pools, and ditches. In Thailand, aconitus is found at elevations of 1 - 700m. In Indonesia, Java it is found up to 853m (Harrison 1980).

Medical Importance:

An. aconitus is a primary malaria vector (Harrison 1980).

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Anopheles (Cel.) baimaii Sallum & Peyton, 2005

Bionomics:

Larval habitats of An. baimaii are usually temporary and well shaded, including small rocky pools, bamboo stumps, slit trenches, roadside puddles, cattle and domestic elephant prints, and stream pockets. This species is also reported from domestic wells, earthen pots, ceramic jars and cement tanks (Sallum, et al. 2005a,b).

Medical Importance:

An baimaii has been reported as an important vector of human malaria parasites (Sallum, et al. 2005a,b).

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Anopheles (Cel.) culicifacies Giles, 1901

Bionomics:

An. culicifacies larvae are found in fresh water irrigation ditches, rain pools, pools in riverbeds, freshly dug pits or holes and wells. Females avoid oviposition sites with emergent vegetation.

Medical Importance:

An. culicifacies is considered a primary malaria vector (Harrison 1980).

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Anopheles (Cel.) dirus Peyton & Harrison, 1979

Bionomics:

Immatures are abundant in rainy seasons 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:

An. dirus is considered a 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.) flavirostris *(Ludlow, 1914)*

Bionomics:

Larvae are found in shaded and unshaded stream margins especially around roots, ground pools an shallow wells. Puri and Boyd 1949; Mendoza and Abinoja 1952. Females feed on both man and cattle and readily enter houses to bite (Puri in Boyd 1949).

Medical Importance:

An. flavirostris is considered a primary malaria vector (Puri in Boyd 1949).

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Anopheles (Cel.) maculatus Theobald, 1901

Bionomics:
Larvae found in hilly areas in seepage springs and small streams with some sunlight. This species is frequently found in recently cleared areas with disturbed soil. The adults are primarily zoophilic (Reid 1968).

Medical Importance:
An. maculatus is considered a primary malaria vector and a vector of W. bancrofti (Reid 1968).

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Anopheles (Cel.) minimus Theobald, 1901

Bionomics:

Larvae are 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:

An. minimus is considered a primary malaria vector (Harrison 1980).

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Anopheles (Cel.) subpictus Grassi, 1899

Bionomics:
Larvae are typically found in muddy pools often near houses and in barrow pits, buffalo wallows and artificial containers (Puri in Boyd 1949, Reid 1968).

Medical Importance:
An. subpictus is considered a primary malaria in the Celebes but of minor importance elsewhere (Reid 1968).

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Anopheles (Cel.) sundaicus (Rodenwaldt, 1925)

Bionomics:
Primarily a coastal species, An. sundaicus larvae are found in sunlit brackish pools with algae. Adults bite primarily cattle but readily bite man indoors and out (Reid 1968).

Medical Importance:
An. sundaicus is considered a primary malaria vector (Reid 1968).

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Secondary Malaria Vectors: Bionomics and Medical Importance

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Anopheles (Cel.) karwari (James, 1902)

Bionomics:

Larvae of this species are found in seepages and small streams in hilly areas in the open and under light shade. Adults are primarily zoophilic (Reid 1968).

Medical Importance:

An. karwari is considered a secondary malaria vector (Reid 1968).

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Anopheles (Cel.) annularis Van der Wulp 1884

Bionomics:
Larvae of this species are found in clear, still water with abundant vegetation. Habitats include ponds, swamps, rice fields. Adults are primarily zoophilic (Reid 1968).

Medical Importance:
An. annularis is considered a secondary vector of malaria (Reid 1968).

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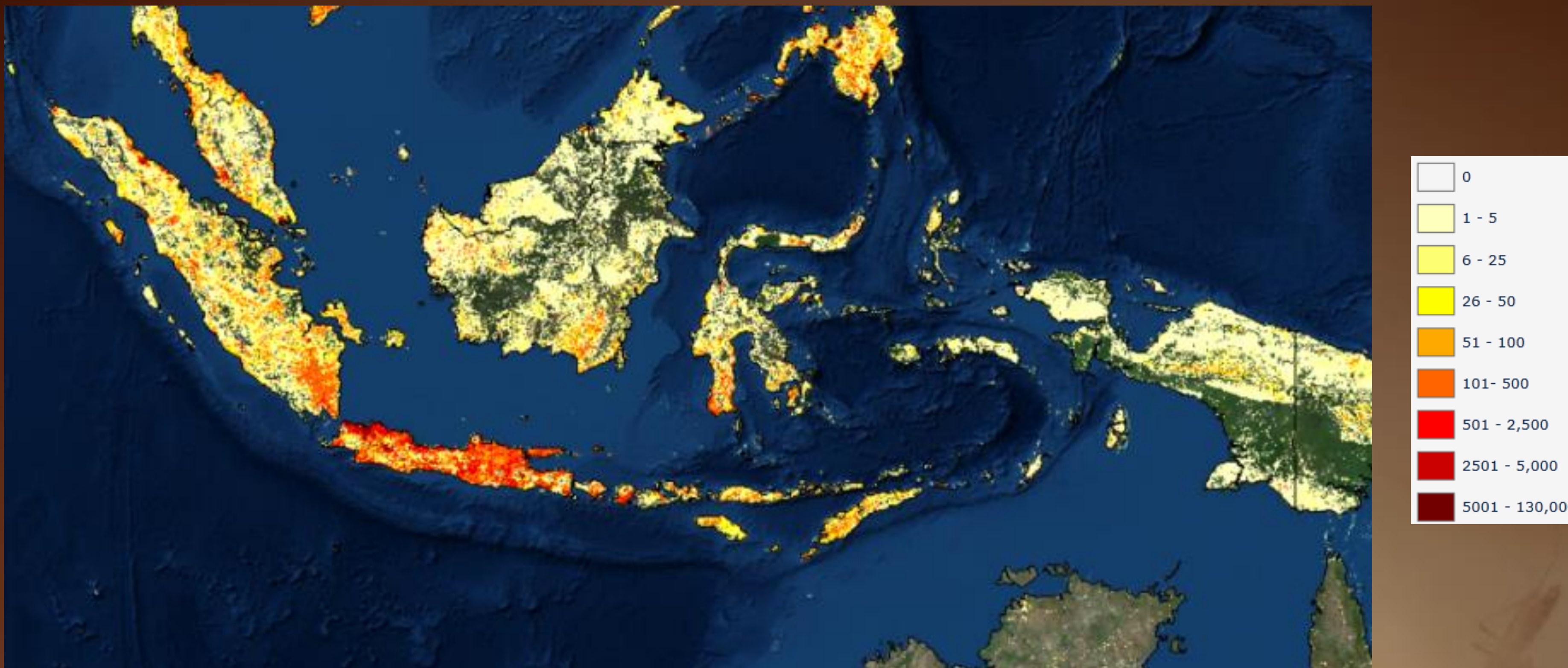
Human Density

People per sq. mile, LandScan 2011



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References

Maxent model of predicted range for *Anopheles aconitis Nyari, A. 2011*

Maxent model of predicted range for *Anopheles baimaii* Nyari, A. 2011

Maxent model of predicted range for *Anopheles culicifacies* Nyari, A. 2011

Maxent model of predicted range for *Anopheles dirus s.l.* Nyari, A. 2011

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Maxent model of predicted range for *Anopheles karwari* Nyari, A. 2011

Maxent model of predicted range for *Anopheles annularis* Nyari, A. 2011

- Gething, Peter W. et al. A new world malaria map: Plasmodium falciparum endemicity in 2010. Malaria Journal 2011, 10:378.
- 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/

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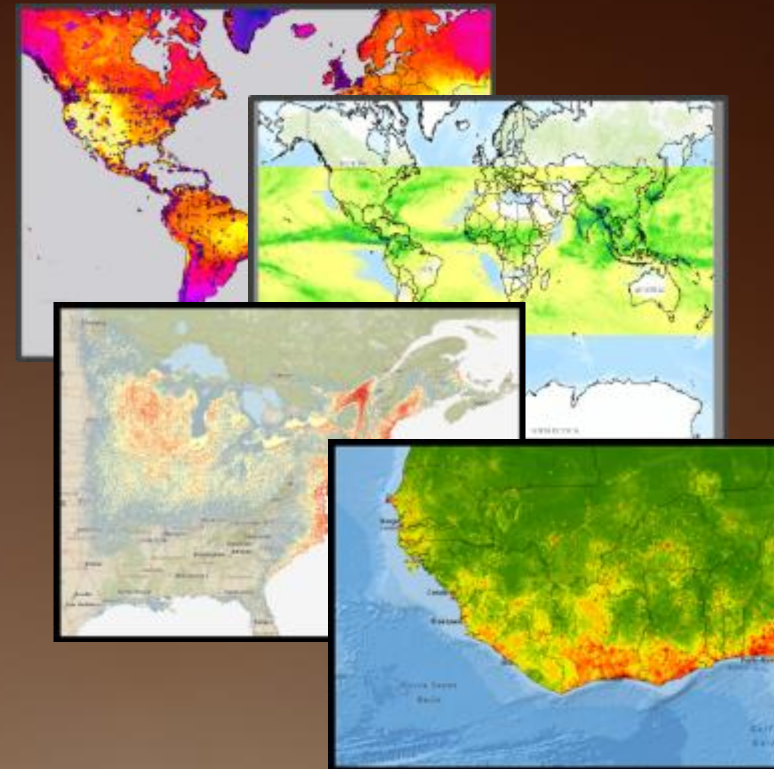
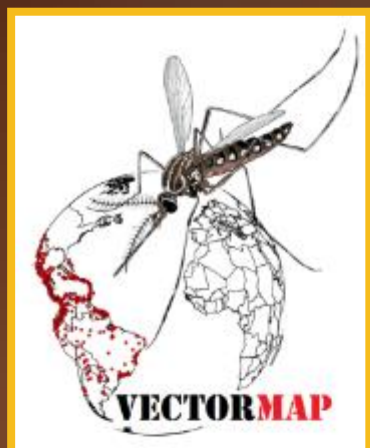
The Walter Reed Biosystematics Unit is part of the Walter Reed Army Institute of Research and is based at the Smithsonian Institution Museum Support Center. To access taxonomic keys, the Systematic Catalog of Culicidae or to learn more about WRBU visit www.wrbu.org.





VectorMap 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.

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