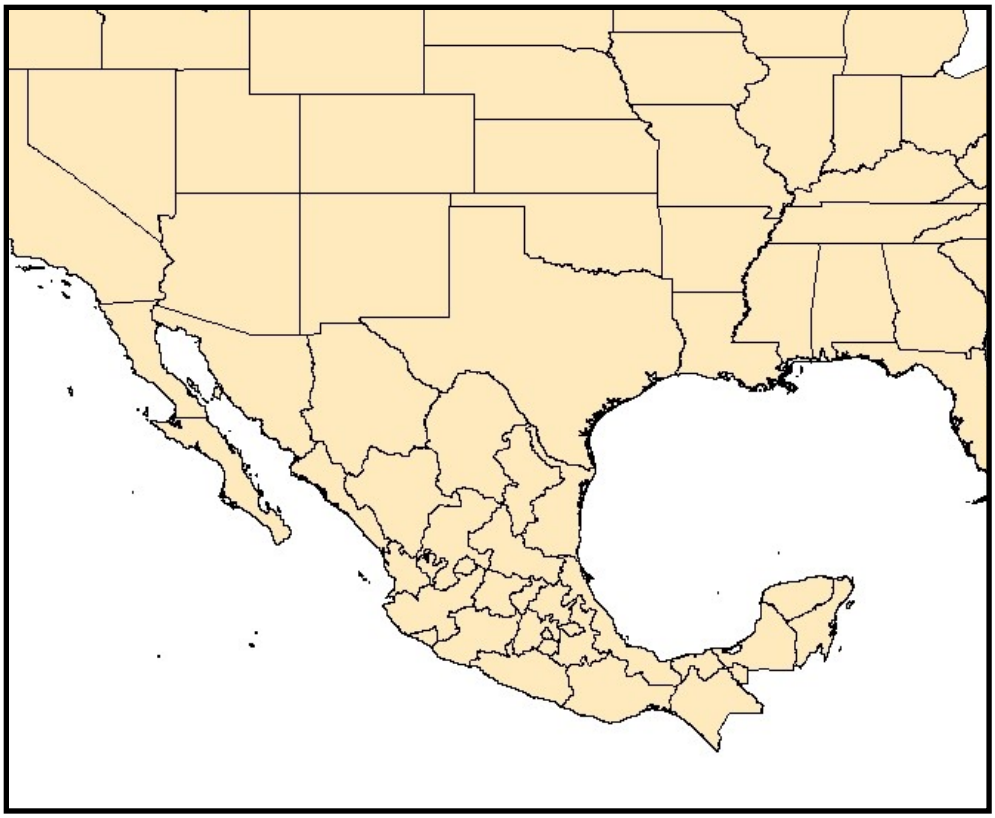
Vector Hazard Report:

Southern U.S./ Northern Mexico

Arthropod-borne disease threats and vector species profiles including bionomics, distribution and identification resources



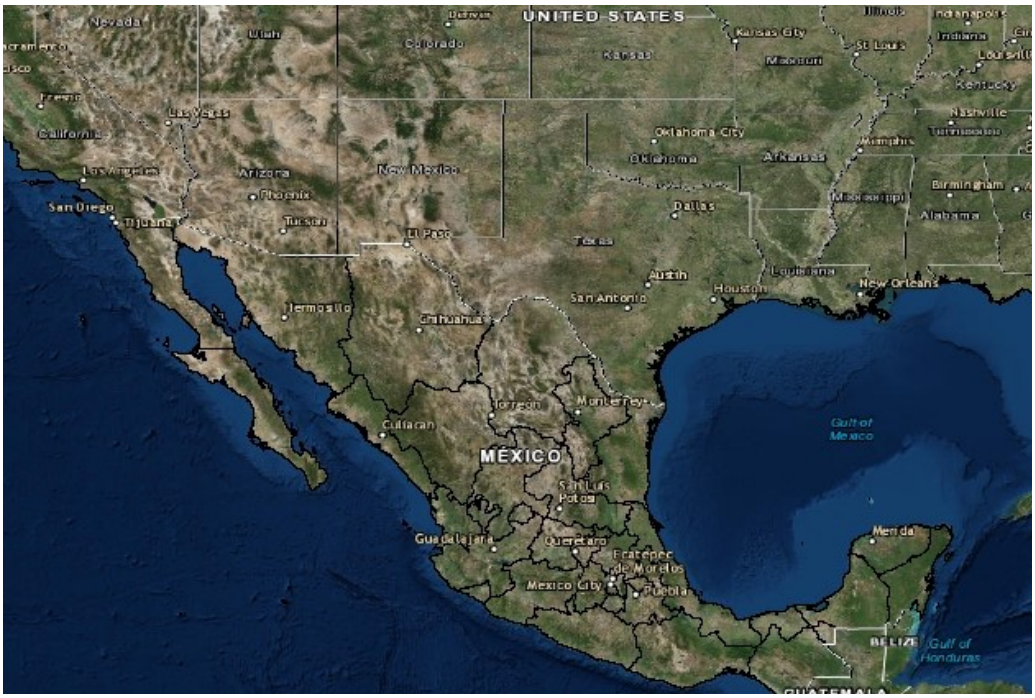
Compiled by David Pecor, 2018

Preface

This product was produced by the Walter Reed Army Institute of Research, Walter Reed Biosystematics Unit (WRAIR-WRBU)

This document provides summarized information on major vectors and vector-borne diseases reported from the Southwest United States and Northern Mexico. Information related to the identification, distribution, medical importance, control and surveillance of vector species are included. For updated information on the current hazards known from this region, please use the near-real time hazard assessment links on page 3. Each page of this document is also hyperlinked via the table of contents to allow easy navigation and access to information most relevant to the reader. View the Vector Hazard Report Quick Guide pages for updated information about current outbreaks and regional climate as well as vector identification resources. Detailed bionomics data for each vector species is available on the vector species ecology profile pages for mosquitoes and ticks.

The target audience for this document are commanders, medical planners, preventive medicine personnel, and particularly medical entomologists.



You Can Request a Vector Hazard Report by contacting the WRBU: NMNH-WRBU@si.edu

Vector Hazard Report Quick Guide

Real-Time Threat Assessment Resources **Visit these websites for regularly updated information about current vector-borne disease threats and regional climate.**
U.S. Dept. of State Travel Alerts
Health.mil Reports
CDC Current Outbreaks List
WHO Outbreak News
HealthMap Outbreaks
VectorMap Current Climate
AccuWeather Current Radar

Additional Resources
WHO Country Profile: Mexico
CDC Travelers Guide: Mexico
Global Mosquito Vectors of Arboviruses of the World

Vector Hazard Report Identification Guide

Vector Identification Resources	
Vector	**Source**
Mosquitoes of the U.S. (Morphology)	Ward, R. D. (2005). Identification and Geographical Distribution of the Mosquitoes of North America, North of Mexico, By RF Darsie Jr. and RA Ward, pp. 416. University Press of Florida, USA, 2005. ISBN0 8130 2784 5. US $75.00.-. Parasitology, 131(4), 580-580.
Mosquito, *Aedes albopictus* (Molecular)	Ruiling, Z., Tongkai, L., Dezhen, M., & Zhong, Z. (2018). Genetic characters of the globally spread tiger mosquito, Aedes albopictus (Diptera, Culicidae): implications from mitochondrial gene COI. Journal of Vector Ecology, 43(1), 89-97.
Mosquitoes (Molecular)	Beebe, N. W. (2018). DNA barcoding mosquitoes: advice for potential prospectors. Parasitology, 1-12.
Mosquito, *Aedes* (Morphology)	Rueda, L. M. (2004). Pictorial keys for the identification of mosquitoes (Diptera: Culicidae) associated with dengue virus transmission. Walter Reed Army Inst Of Research Washington Dc Department Of Entomology.
Mosquitoes (Morphology)	Varnado, W. C., Goddard, J., & Harrison, B. (2012). Identification guide to adult mosquitoes in Mississippi. Mississippi State University Extension Service, Starkville, MS.
Mosquitoes, Anopheles of Central America (Morphology) **Note: Key also available as mobile app**	Wilkerson, R. C., Strickman, D., & Litwak, T. R. (1990). Illustrated key to the female anopheline mosquitoes of Central America and Mexico. Journal of the American Mosquito Control Association, 6(1), 7-34.
Ticks of the U.S. (Morphology)	Bischof, Michael. Interactive Identification Key for the Hard Ticks (Ixodidae) of the Eastern U.S.
Ticks of the U.S. (Morphology)	Keirans, J. E., & Litwak, T. R. (1989). Pictorial key to the adults of hard ticks, family Ixodidae (Ixodida: Ixodoidea), east of the Mississippi River. Journal of Medical Entomology, 26(5), 435-448.
Ticks of the U.S. (Morphology)	Kleinjan, J. E., & Lane, R. S. (2008). Larval keys to the genera of Ixodidae (Acari) and species of Ixodes (Latreille) ticks established in California. The Pan-Pacific entomologist, 84(2), 121.
Fleas (Morphology)	Ewing, H. E., & Fox, I. (1943). The fleas of North America: classification, identification, and geographic distribution of these injurious and disease-spreading insects (No. 500). US Department of Agriculture.

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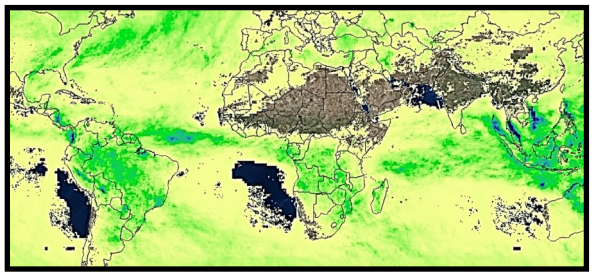
Monthly Climate Maps

Click here to view the maps described below

(Updated monthly, NASA Earth Observations, WorldClim)



Rainfall

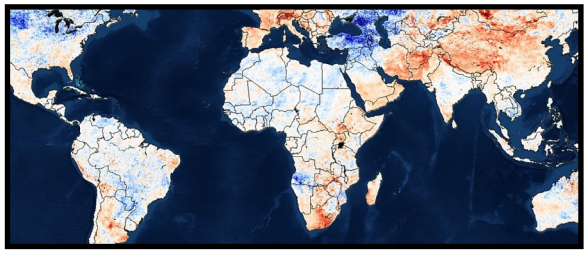
This map displays accumulated rainfall for the past month.

Consistent Above and Below Average Rainfall

This map displays areas with consistently above or below average monthly rainfall based on the previous three months. Above average rainfall may mean increased mosquito breeding habitat in areas with poor drainage. Below average rainfall can lead to increased domestic water storage providing increased mosquito breeding habitat.

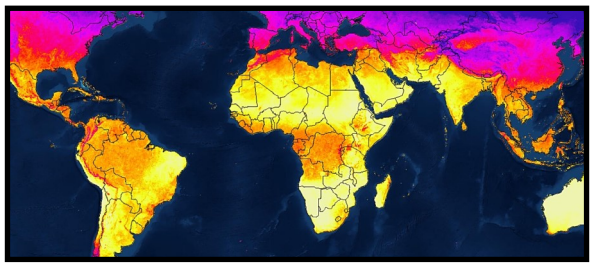
Drought-Breaking Rain

This map displays areas receiving above average rainfall for the previous month with below average rainfall for the previous 12 months. Drought-breaking rain may indicate suitable conditions for vectors and diseases in a stressed environment or population.



Temperature Anomaly

This map displays areas where the earth's temperature was warmer or cooler at the surface during the daytime over the expected average monthly temperatures (averaged over 2001-2010).



Land Surface Temperature

This map displays the temperature of the earths surface during the day-time.

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Malaria

Background

Disease Background: Human malaria is caused by protozoan species in the genus *Plasmodium* that are transmitted by the bite of an infective female Anopheles mosquito. Clinical symptoms of malaria vary with the species. The most serious malaria infection, *Plasmodium falciparum* malaria, can produce life-threatening complications, including renal and hepatic failure, cerebral damage, and coma. Case fatality rates among children and nonimmune adults exceed 10% when not treated. The other human malarias, *vivax*, *malariae* and *ovale*, are not life-threatening except in the very young, the very old, or persons in poor health. Illness is characterized by malaise, fever, shaking chills, headache, and nausea. The frequency of fever, occurring daily, every other day, or every third day, is characteristic of the species. Nonfatal cases of malaria are extremely debilitating. Relapses of improperly treated malaria can occur years after the initial infection in all but falciparum malaria. *Plasmodium malariae* infections may persist for as long as 50 years, with recurrent febrile episodes. Although local transmission of Malaria is quite rare in the United States since the 1950's, a number of imported cases are reported at hospitals annually. Since vectors of *Plasmodium* sp. are still present in the U.S., there remains a risk of vector species feeding on infected humans and spreading the disease.

Transmission Cycle: Female mosquitoes of the genus *Anopheles* are the exclusive vectors of human malaria. *Plasmodium* species undergo a complicated development in the mosquito. When a female *Anopheles* ingests blood containing the sexual stages (gametocytes) of the parasite, male and female gametes unite to form a motile ookinete that penetrates the mosquito's stomach wall and encysts on the outer surface of the midgut. Thousands of sporozoites are eventually released, and some of these migrate to the salivary glands. Infective sporozoites are subsequently injected into a human host when the mosquito takes a blood meal. The time between ingestion of gametocytes and liberation of sporozoites, ranging from 8 to 35 days, is dependent on the temperature and the species of *Plasmodium*. Malaria parasites develop in the mosquito vector most efficiently when ambient air temperatures are between 25° and 30° C. Parasite development is prolonged during cool seasons and at high altitudes, and may exceed the life expectancy of the vector. Once infected, mosquitoes remain infective for life. Vector competence is frequently higher with indigenous strains of malaria. This decreases the likelihood that imported strains from migrants will become established.

Additional Resources:

- CDC Malaria Travel Alert
- Malaria Atlas Project
- Newman, R. D., Parise, M. E., Barber, A. M., & Steketee, R. W. (2004). Malaria-related deaths among US travelers, 1963–2001. Annals of internal medicine, 141(7), 547-555.
- Bannister, B. (2000). Malaria in Mexico. Weekly releases (1997–2007), 4(10), 1649.
- Maldonado, Y. A., Nahlen, B. L., Roberto, R. R., Ginsberg, M., Orellana, E., Mizrahi, M., ... & Campbell, C. C. (1990). Transmission of Plasmodium vivax malaria in San Diego County, California, 1986. The American journal of tropical medicine and hygiene, 42(1), 3-9.

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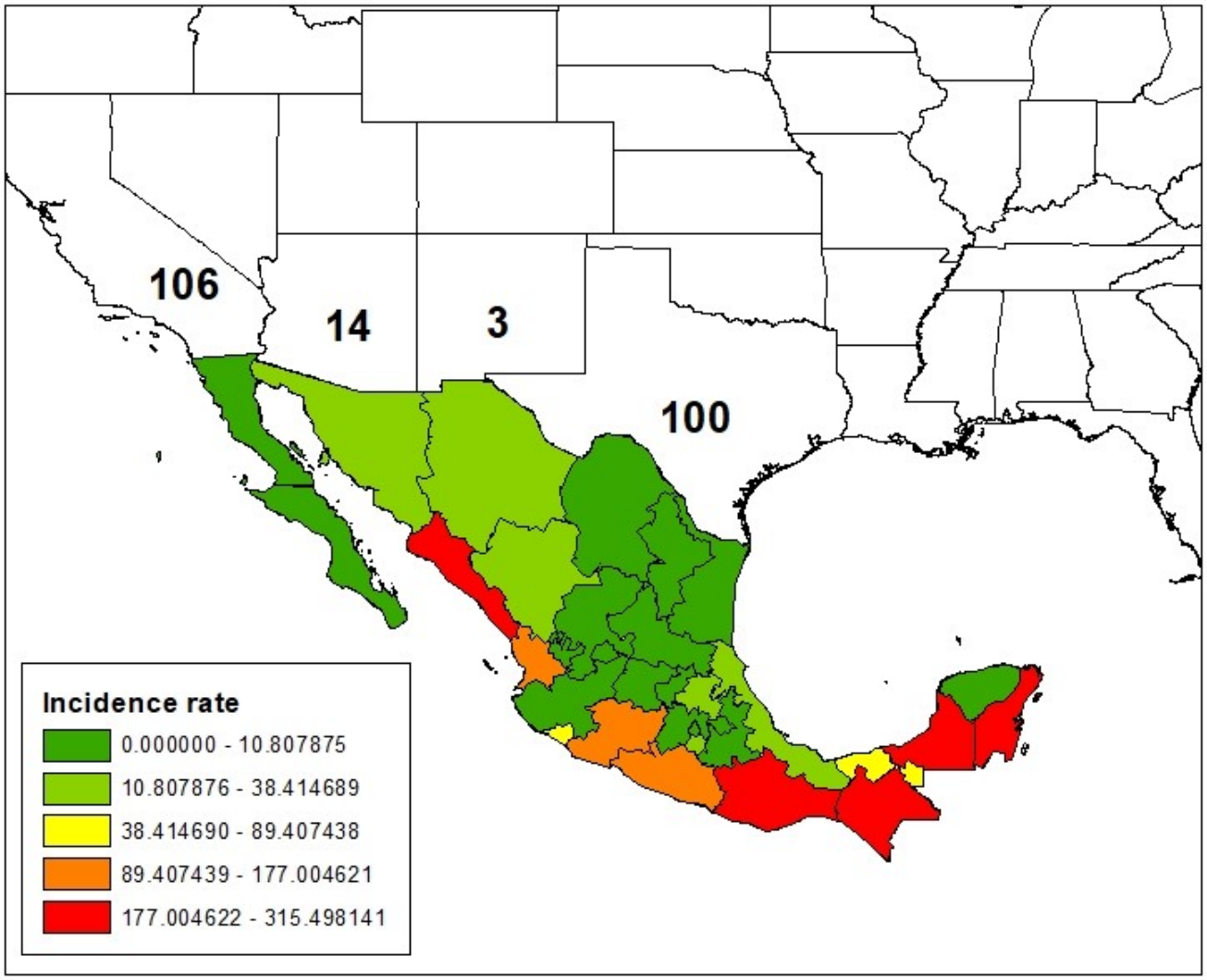
Malaria

Disease Distribution



1. U.S.: Number of imported cases of malaria reported to CDC, 2015
2. Mexico: Incidence rate associated with malaria (per 100 thousand inhabitants).

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Dengue, Chikungunya and Zika Viruses

Disease Background: Dengue fever (Breakbone fever, Dandy fever) is an acute febrile disease characterized by sudden onset, fever for 3 to 5 days, intense headache, and muscle and joint pain. It is commonly called break bone fever because of the severity of pain. There is virtually no mortality in classical dengue. Recovery is complete, but weakness and depression may last several weeks. Dengue is caused by a Flavivirus and includes four distinct serotypes (dengue 1, 2, 3 and 4). Recovery from infection with one serotype provides lifelong immunity from the same serotype but does not protect against other serotypes. Dengue hemorrhagic fever (DHF) and associated dengue shock syndrome (DSS) were first recognized during a 1954 dengue epidemic in Bangkok, Thailand. DHF/DSS have spread throughout Southeast Asia, Indonesia and the southwest Pacific, Latin America and the Caribbean. DHF requires exposure to two serotypes, either sequentially or during a single epidemic involving more than one serotype. DHF is a severe disease that produces high mortality in children. Chikungunya refers to an infection by the Chikungunya virus (CHIKV). The name means "that which bends up" in the native language of southeastern Tanzania, and refers to the symptoms of Chikungunya fever. Chikungunya fever (CHIK) symptoms typically include a sudden high fever and severe joint pain. Headache, back pain, muscle pain, nausea, vomiting, arthritis, rash, and conjunctivitis may also occur. Unlike Dengue, CHIK is currently thought to be nonfatal. Outbreaks of CHIKV historically have occurred in Africa and Asia. In 2007, the virus was found to be spreading in northern Italy and in December 2013 was found in the Caribbean. Zika virus, an arbovirus related to CHIKV and DENV, has recently been reported from Latin America and Southern U.S. Originally described from the Zika forest in Uganda, the virus has since spread to Southeast Asia, the Caribbean, South, Central and North America. Symptoms are mild and include fever, rash, headache, joint pain and conjunctivitis. Zika virus poses a significant threat to women who are pregnant as Zika virus infection is associated with a birth defect called microcephaly.

Transmission Cycle: Dengue, chikungunya and Zika viruses are exclusively associated with *Aedes* mosquitoes in the subgenus *Stegomyia*. *Aedes aegypti* appears to be the primary vector of these viruses although *Ae. albopictus* also plays a significant role in the *transmission* cycle.

Additional Resources:

- CDC Dengue Fever Background
- CDC Chikungunya Background
- CDC Zika Virus Backgroind
- AFPMB Technical Guide No. 47. Aedes Mosquito Vector Control. Office of the Assistant Secretary of Defense (Energy, Installations and Environment). 2016.

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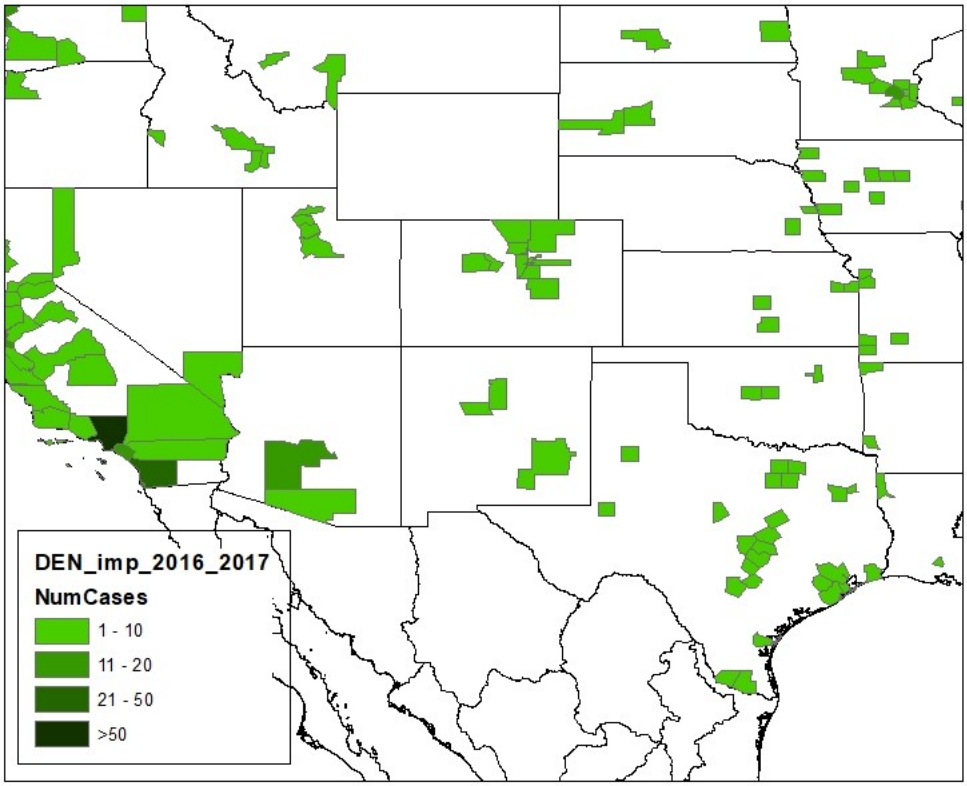
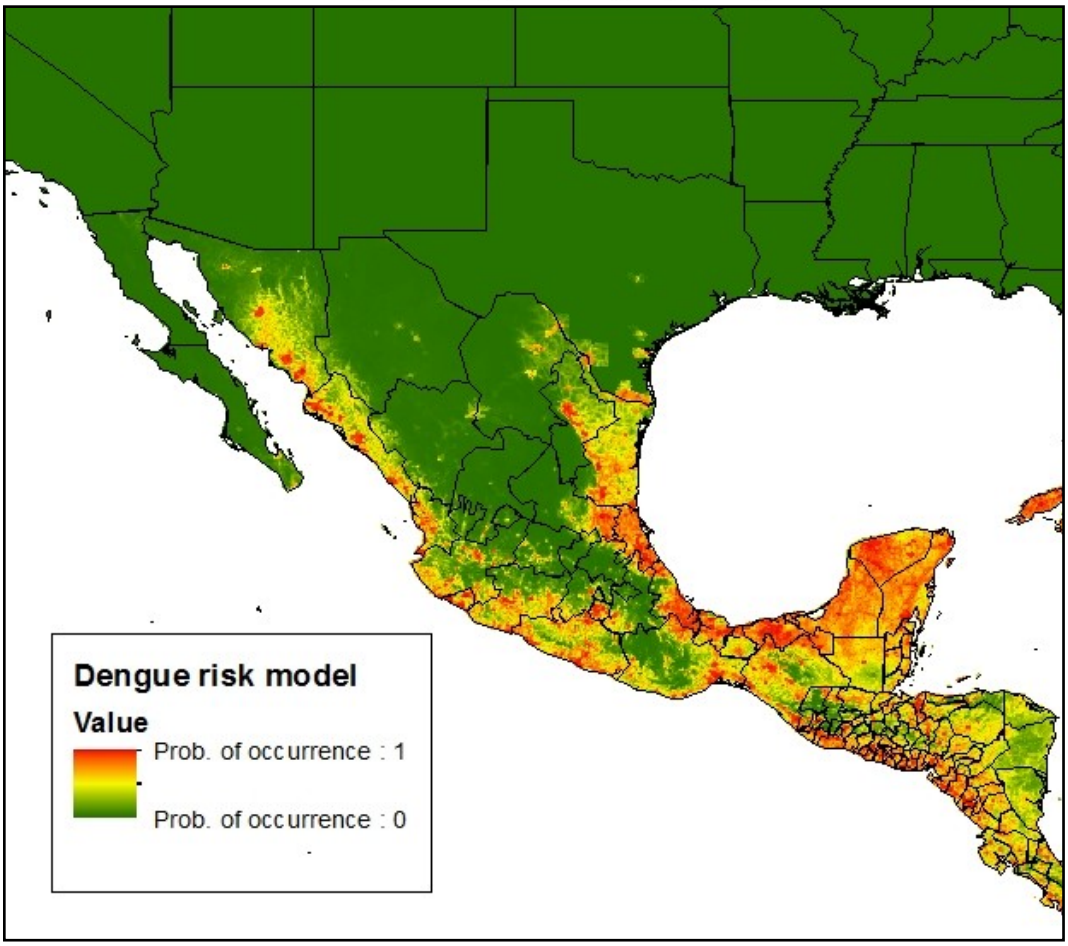
Dengue Virus



Number of imported cases of Dengue virus by U.S. county, CDC, 2016-2017.



Bhatt, S. et al. 2013. The Global Distribution and Burden of Dengue. Nature, 496: 504-507.

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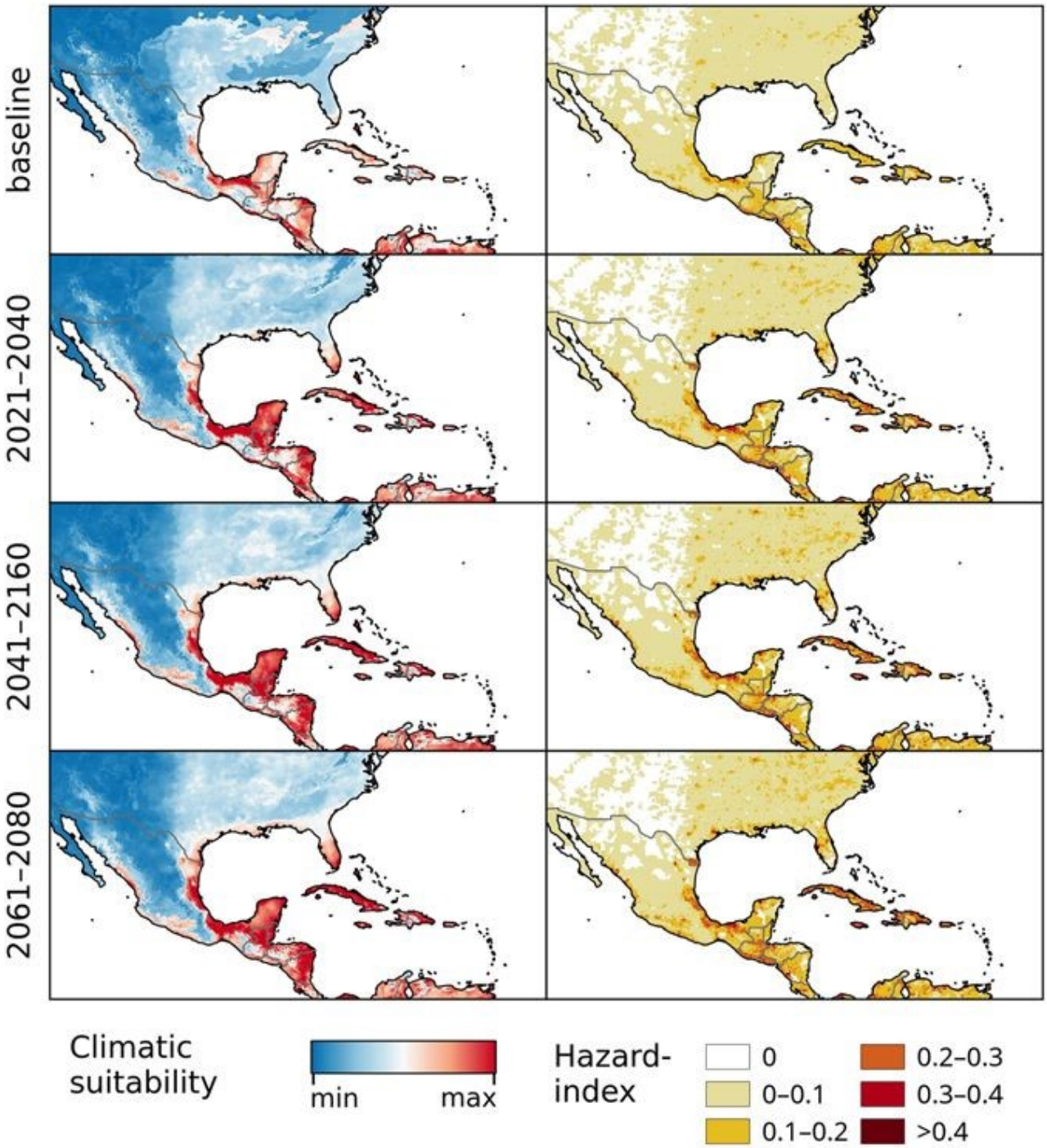
Chikungunya Virus



Chikungunya under the baseline and RCP 8.5 climate change scenarios in North- and Central America. Left: Climatic suitability, right: hazard index. Climate change scenarios represent the mean model output obtained through the 5 GCMs. Climatic suitability output is scaled to the over-all global minimum (0) and maximum (0.623) values observed in any model. Source: Tjaden, N. B., Suk, J. E., Fischer, D., Thomas, S. M., Beierkuhnlein, C., & Semenza, J. C. (2017). Modelling the effects of global climate change on Chikungunya transmission in the 21 st century. Scientific reports, 7(1), 3813.

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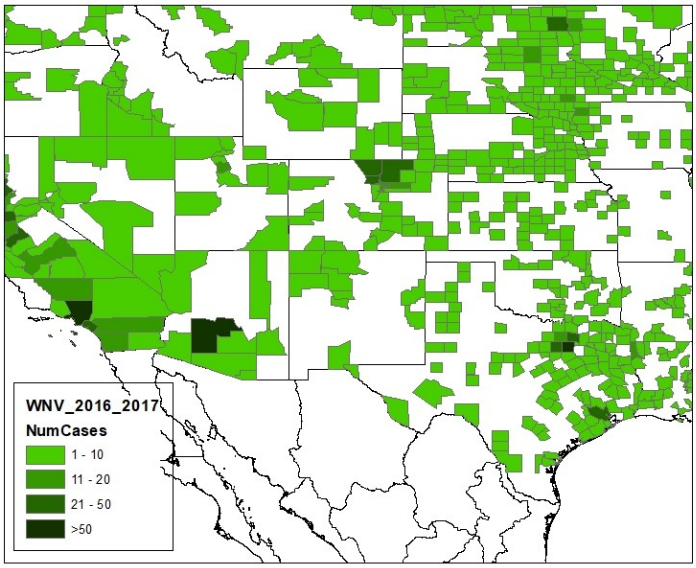
West Nile Virus

Disease Background: West Nile fever is a mosquito-borne illness characterized by fever, headache, muscular pain, and rash. Occasionally, serious complications involve the liver and nervous system. The etiological agent, West Nile virus (WNV), is named after the district of Uganda where the virus was first isolated. It is a Flavivirus closely related to viruses causing Japanese encephalitis and St. Louis encephalitis. Infection with WNV is most often asymptomatic. The incubation period ranges from 1 to 6 days and clinically resembles a mild dengue-like illness.

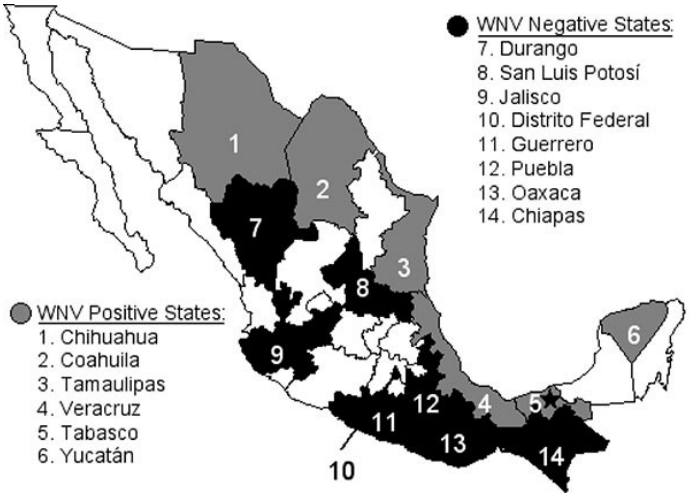
Transmission Cycle: WNV has been isolated from numerous wild birds and mammals. Serological surveys have demonstrated WNV antibodies in wild and domestic bird species, wild mammals such as lemurs, rodents and bats, and domestic animals such as camels, horses, mules, donkeys, goats, cattle, water buffalo, sheep, pigs and dogs. However, birds are considered to be the primary reservoir for WNV and may reintroduce the virus during seasonal migrations. Infections in most mammals fail to produce viremias high enough to infect potential vectors. WNV has been isolated from several species of mosquitoes in nature, and they are recognized as the major vectors, especially *Culex* spp. WNV has also been recovered from bird-feeding ticks and mites. A natural bird-tick zoonotic cycle has been suggested, but the role of ticks in the natural transmission of WNV has not been well defined. Mosquitoes are clearly implicated in the transmission of WNV to humans. WNV replicates quickly in mosquitoes when temperatures exceed 25C. Infected mosquitoes can transmit WNV for life.

Additional Resources:

- CDC West Nile Virus Background
- Lanciotti, R. S., Roehrig, J. T., Deubel, V., Smith, J., Parker, M., Steele, K., ... & Hall, R. A. (1999). Origin of the West Nile virus responsible for an outbreak of encephalitis in the northeastern United States. Science, 286(5448), 2333-2337.



Number of reported cases of West Nile Virus, CDC 2016-2017



Mexican states sampled for antibodies to West Nile virus and Venezuelan equine encephalitis virus in equines. Unshaded states were not sampled. The location of the West Nile virus isolation from a dead Common Raven is shown by a star. Source: Estrada-Franco, J. G., Navarro-Lopez, R., Beasley, D. W., Coffey, L., Carrara, A. S., Da Rosa, A. T., ... & Ramirez, P. P. (2003). West Nile virus in Mexico: Evidence of widespread circulation since July 2002. Emerging Infectious Diseases, 9(12), 1604.

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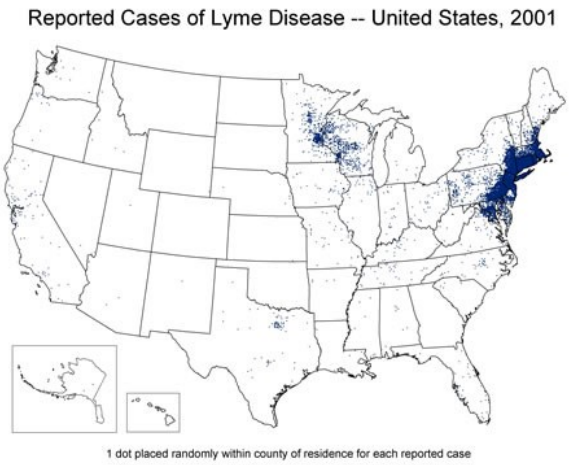
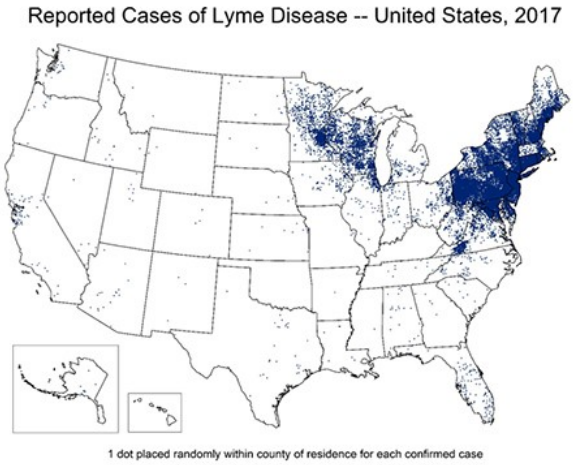
Borrelia Diseases

Lyme Disease

Lyme disease is caused by the bacteria *Borrelia burgdorferi.* Although this disease is rarely fatal, it can be quite debilitating with significant long-term health effects. The primary vector of Lyme disease is *Ixodes scapularis* or more commonly known as the blacklegged or deer tick. Along the West coast the common vector of Lyme disease are *Ixodes pacificus* or Western black-legged tick. The bacteria is transferred to humans via tick saliva as it feeds on blood. These ticks are quite small and are easily overlooked. The CDC reports around 30,000 new cases of Lyme disease per year but estimates that as many as 300,000 cases may be diagnoses annually. Most cases are reported from the upper Mid-West and New England areas, however cases have been reported from California as well as all the U.S. Southern border states. Since the early 2000's there has been a steady increase in the number of Lyme cases in the U.S. Lyme disease in not thought to be widespread in Mexico. For more information see the United States Army Public Health Command FAQ sheet on Lyme disease.

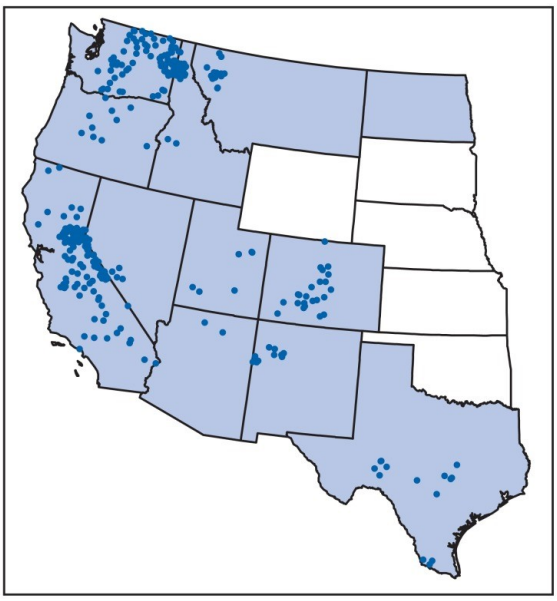




Source: CDC Tickborne Diseases: Lyme Disease

Tickborne Relapsing Fever

Tickborne Relapsing Fever (TBRF) caused by the bacteria *Borrelia hermsii* and *B. turicatae*. TBRF is most common in the arid South West U.S. and most cases occur in the summer when ticks are active. Symptoms are flu-like and initially occur within 7 days of exposure, then repeated febrile illness every 7 days until treated. For more information about RMSF visit the CDC.



Number of reported cases of tickborne relapsing fever — United States, 1990–2011

Source: Centers for Disease Control and Prevention. Tickborne relapsing fever—United States, 1990–2011.

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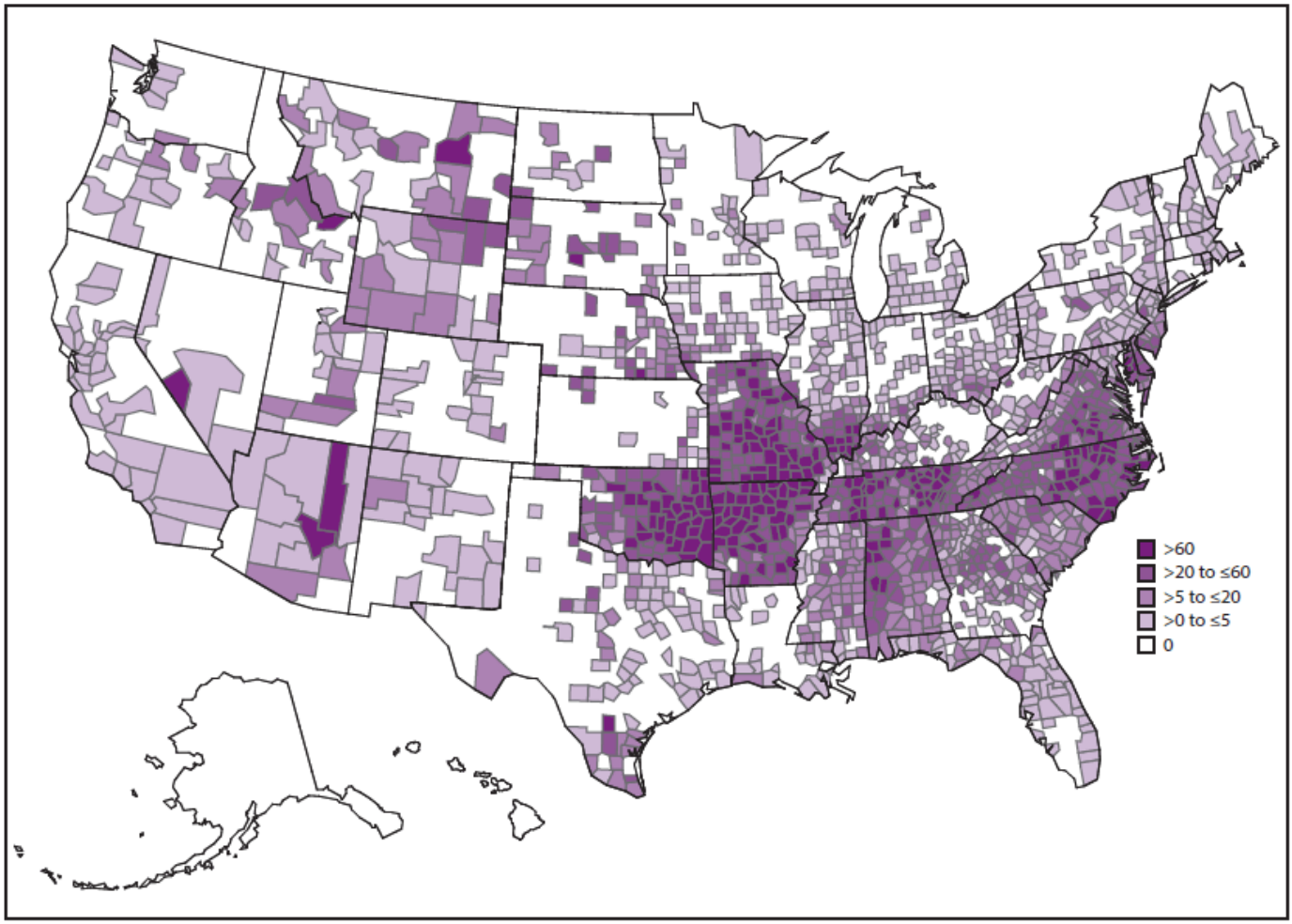
Rickettsia Diseases

Rocky Mountain Spotted Fever

Rocky Mountain Spotted Fever (RMSF) RMSF is caused by the bacteria *Rickettsia rickettsia* and is primarily spread through the bite of an infected *Dermacentor variabilis* (brown dog tick) and *Dermacentor andersoni* (Rocky Mountain wood tick). If left untreated, RMSF can be fatal with a mortality rate of 20-80%. For more information visit the CDC RMSF webpage. See also: Army Public Health Center Fact Sheet: Lyme Disease.

Rickettsiosis

Rickettsia parkeri Rickettsiosis is another Rickettsia bacterial infection. It is transmitted to humans via *Amblyomma maculatum* (Gulf Coast tick) in the southeastern and mid-Atlantic states, as well as parts of southern Arizona. For more information visit the CDC Rickettsia parkeri Rickettsiosis webpage.



Reported incidence rate* of spotted fever rickettsiosis,† by county — United States, 2000–2013. Source: Biggs, H. M. (2016). Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever and other spotted fever group rickettsioses, ehrlichioses, and anaplasmosis—United States. MMWR. Recommendations and Reports, 65.

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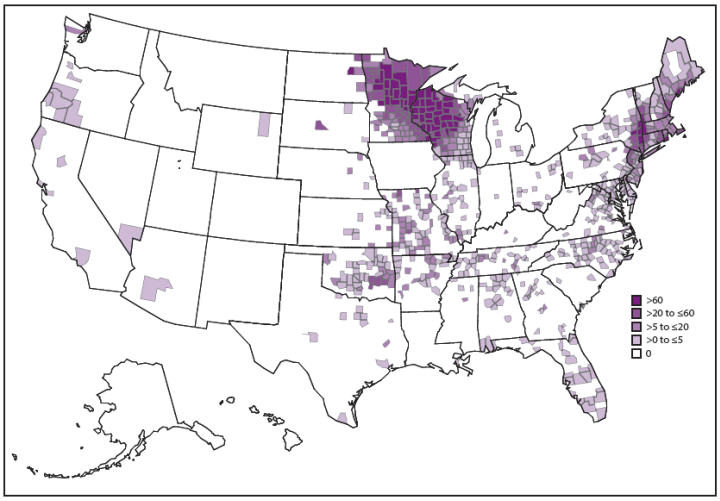
Other Tick-borne Diseases

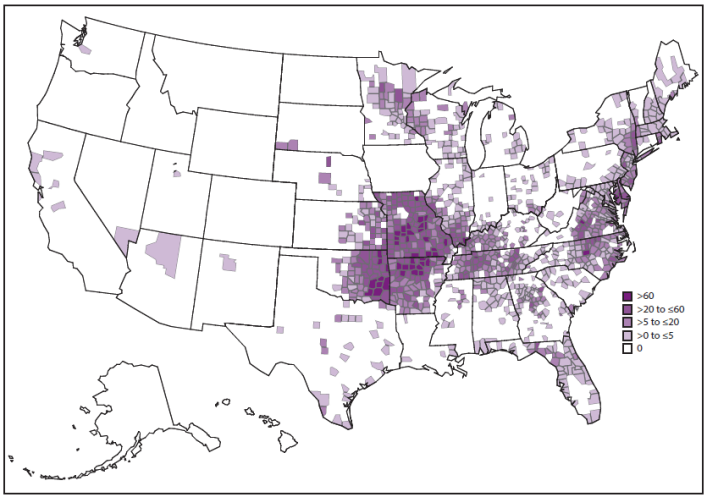
Anaplasmosis, also known as, human granulocytic ehrlichiosis (HGE), is caused by the bacteria *Anaplasma phagocytophilum* . Vectors of anaplasmosis Include *Ixodes scapularis* and *Ixodes pacificus* ticks. The CDC has received most reports of anaplasmosis infection from the Northern mid-West and Northeast. See also: Bakken, J. S., & Dumler, S. (2008). Human granulocytic anaplasmosis. Infectious disease clinics of North America, 22(3), 433-448.

Human Ehrlichiosis is primarily caused by three species of bacteria within the genus *Ehrlichia*, *Ehrlichia chaffeensis*, *Ehrlichia ewingii* and *Ehrlichia muris eauclairensis.* The primary vector of this disease are *Amblyomma americanum* or lone star ticks. Cases of ehrlichiosis are most concentrated in the Southeastern and South-central United States. See also: Dumler, J. S., Madigan, J. E., Pusterla, N., & Bakken, J. S. (2007). Ehrlichioses in humans: epidemiology, clinical presentation, diagnosis, and treatment. Clinical infectious diseases, 45(Supplement_1), S45-S51.

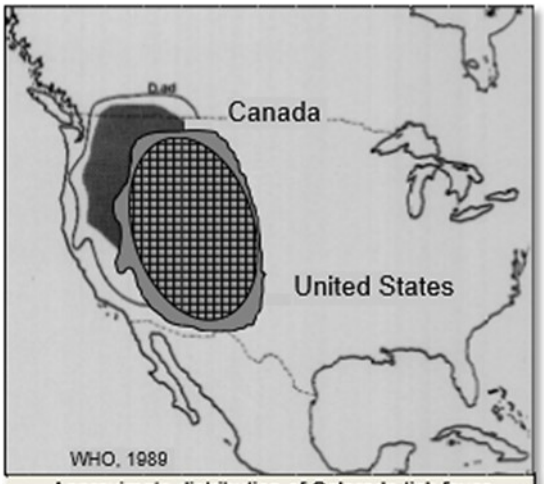
Colorado Tick Fever is caused by Colorado tick fever virus (CTFV) and is transmitted to humans via an infected bite from a *Dermacentor andersoni* (Rocky Mountain Wood tick). CTFV typically occurs at higher elevations. Above 5,000 feet. See also: Brackney MM, Marfin AA, Staples JE, et al. Epidemiology of Colorado tick fever in Montana, Utah, and Wyoming, 1995–2003. Vector Borne Zoonotic Diseases 2010;10:381–385.



Reported incidence rate* of rate* of anaplasmosis, by county 2000–2013. Source: Source: Biggs, H. M. (2016). Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever and other spotted fever group rickettsioses, ehrlichioses, and anaplasmosis—United States. MMWR. Recommendations and Reports, 65.



Reported incidence rate* of Ehrlichia chaffeensis ehrlichiosis, by county — United States, 2000–2013. Source: Source: Biggs, H. M. (2016). Diagnosis and management of tickborne rickettsial diseases: Rocky Mountain spotted fever and other spotted fever group rickettsioses, ehrlichioses, and anaplasmosis—United States. MMWR. Recommendations and Reports, 65.



Approximate distribution of Colorado tick fever (hatched area) and its main vector, *Dermacentor andersoni* (shaded area)

Source: Army Public Health Command Fact Sheet Number 18-058-0317. Colorado Tick Fever

Plague (Pestis, Black Death)

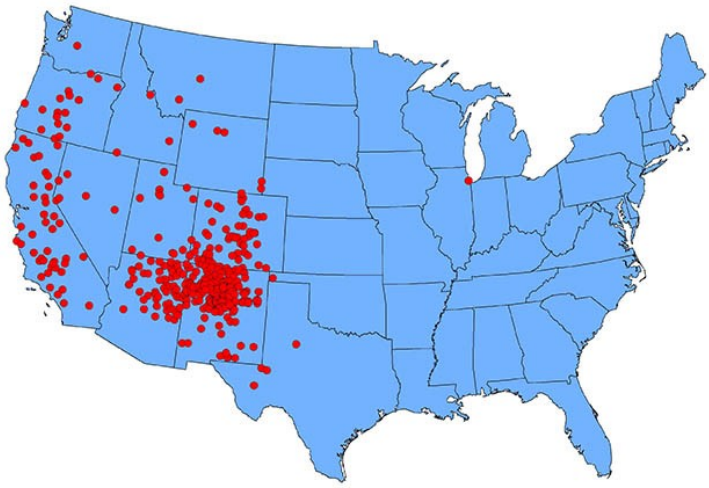
Disease Background: Plague is a zoonotic bacterial disease involving rodents and their fleas, some species of which occasionally transmit the infection to man and other animals. The infectious agent, *Yersinia pestis*, causes fever, chills, myalgia, nausea, sore throat and headache. Bacteria accumulate and swelling develops in the lymph nodes closest to the infected bite. Since most flea bites occur on the lower extremities, the nodes in the inguinal region are involved in 90 percent of cases. The term bubonic plague is derived from the swollen and tender buboes that develop. Plague is most easily treated with antibiotics in the early stages of the disease. However, untreated bubonic plague has a fatality rate of 50%. Infection may progress to septicemic plague with bloodstream dissemination of the bacteria to diverse parts of the body. Secondary involvement of the lungs results in pneumonia. Pneumonic plague is of special medical significance since respiratory aerosols may serve as a source of person-to-person transmission. This can result in devastating epidemics in densely populated areas. Untreated pneumonic or septicemic plague is invariably fatal but responds to early antibiotic therapy. To ensure proper diagnosis, medical personnel should be aware of areas where the disease is enzootic. Plague is often misdiagnosed, especially when travelers or military personnel develop symptoms after returning from an enzootic area.

Transmission Cycle: Plague is a disease of rodents. It is maintained in nature among wild rodents and their fleas. This zoonotic cycle is termed sylvatic, campestral, rural, or wild. Plague and can be very complex, involving many rodent and flea species. Some rodents are highly susceptible to infection, resulting in high mortality. Although large numbers of dead and dying rodents are a good indication of an epizootic of plague, rodent species that are resistant to the effects of infection are more important in maintaining the zoonotic cycle. Most cases in military personnel would probably occur as a result of intrusion into the zoonotic cycle during or following an epizootic of plague in wild rodents. Domestic cats and dogs may carry infected rodent fleas into buildings or tents. Cats may occasionally transmit infection by their bites or scratches, or by aerosol when they have pneumonic plague. However, plague is transmitted to humans primarily by the bite of infected fleas. Fleas often exhibit a host preference, but most species of medical importance readily pass from one host to another. A lack of absolute host specificity increases the potential for infection and transmission of pathogens. Plague may also be acquired by handling tissues of infected animals and infected humans, and by person-to-person transmission of pneumonic plague. Crushed infected fleas and flea feces inoculated into skin abrasions or mucous membranes can also cause infection. Not all flea species are competent vectors. The vector competence of the Oriental rat flea is attributed to enzymes produced by the plague bacilli that cause blood to coagulate in the flea's digestive tract. The flea attempts to clear the blockage in its digestive tract by repeated efforts to feed. In the process, plague bacilli are inoculated into the host.

IV. Additional Resources:

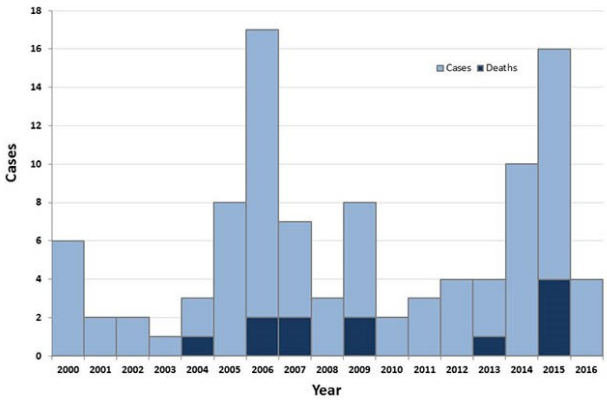
- CDC Plague in the US
- WHO Background Plague

Reported Cases of Human Plague in United States, 1970-2016, CDC.



1 dot placed randomly in most likely county of exposure for each confirmed plague case

Human Plague Cases and Deaths in United States, 2000-2016, CDC.



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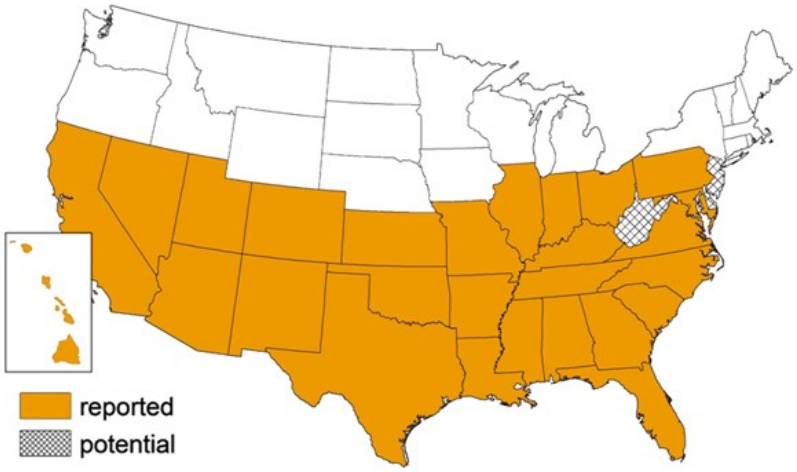
Chagas Disease

Disease Background:

According to the CDC, more than 300,000 people in the U.S. are currently infected with *Trypanosoma cruzi,* the causative agent of Chagas disease and the majority are unaware. Chagas disease, also known as American trypanosomiasis, is acquired through contact with the feces of an infected triatomine bug, also known as "kissing bugs." Chagas disease is endemic throughout South and Central America including Mexico. Of the estimated 300,000 people in the U.S. currently infected with Chagas, most are thought to have emigrated from countries where the disease is endemic and localized transmission in the U.S. is thought to be rare.



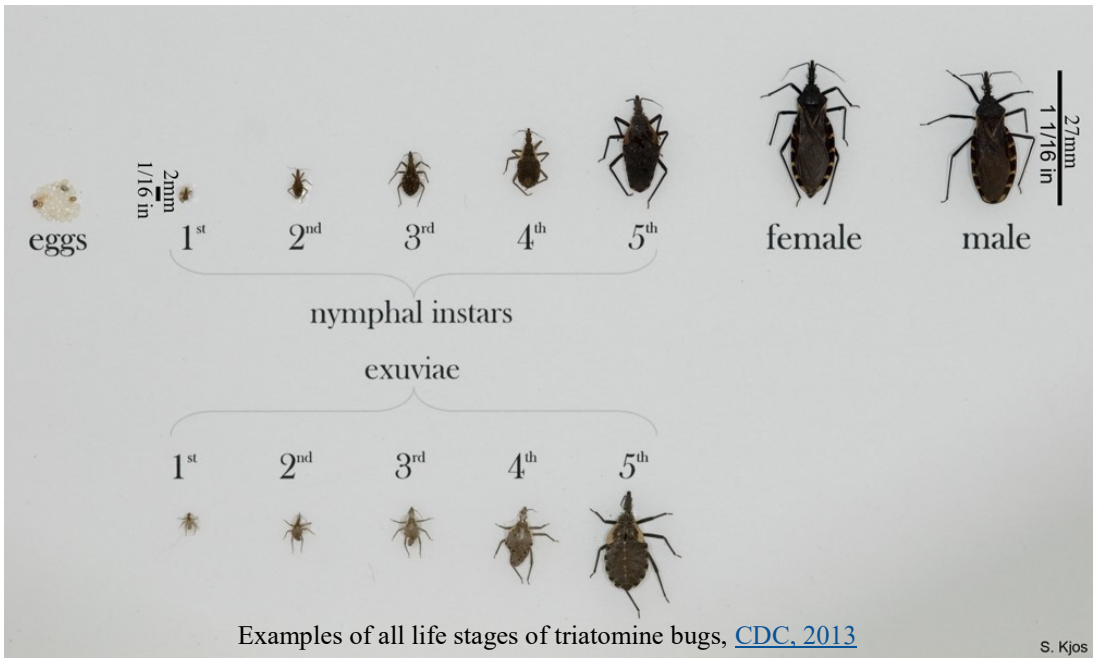
U.S. Distribution of Triatomine species, CDC, 2013.

Transmission Cycle:

Triatomine bugs can be found in a variety of habitats around human habitation including, under porches or cement, In rock, wood, brush piles, or on the underside of bark, in rodent nests or animal burrows. Other common habitats are outdoor dog houses or kennels, chicken coops or other domestic animal enclosures. Triatomine bugs are nocturnal and feed on the blood of mammals, birds, and reptiles.

IV. Additional Resources:

- CDC Chagas Disease Epidemiology & Risk Factors
- CDC Triatomine Bug FAQs
- WHO Chagas disease (American trypanosomiasis)
- Bennett C, Straily A, Haselow D, et al. Chagas Disease Surveillance Activities — Seven States, 2017. MMWR Morb Mortal Wkly Rep 2018;67:738–741.
- Klotz, S. A., Dorn, P. L., Klotz, J. H., Pinnas, J. L., Weirauch, C., Kurtz, J. R., & Schmidt, J. (2009). Feeding behavior of triatomines from the southwestern United States: an update on potential risk for transmission of Chagas disease. *Acta tropica*, *111*(2), 114-118.



Examples of all life stages of triatomine bugs, CDC, 2013

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Aedes (*Stg.*) *aegypti* (Linnaeus, 1762)

Bionomics:

Primarily found in close association with humans, *Aedes aegypti* will use any and all natural and artificial containers as larval breeding sites. Away from urban areas the species tends to favor pools in river beds, tree stumps, tree holes and natural containers.

Medical Importance:

Ae. aegypti is considered a primary vector of dengue fever, chikungunya and Zika viruses.

WRBU Catalog

Dengue Vector Bionomics (Ritchie, S. 2014)

VectorBase: *Ae. aegypti*

Aedes aegypti Female, Photo credit J. Stoffer WRBU

Aedes aegypti scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes aegypti hind tarsomere, Female, Photo credit J. Stoffer WRBU

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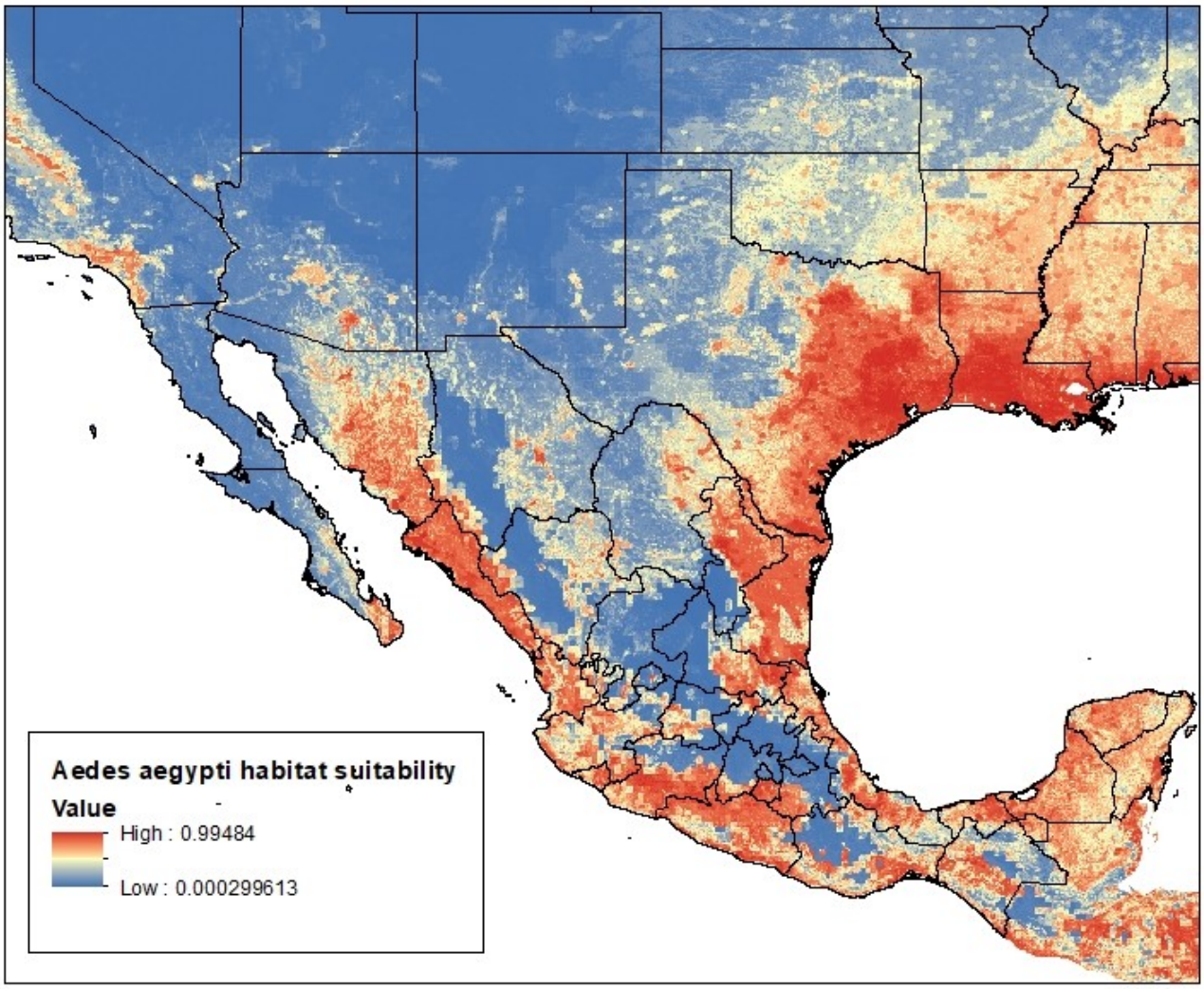
Aedes (*Stg*.) *aegypti* (Linnaeus, 1762)



Boosted regression tree model of habitat suitability for *Ae. aegypti*, Global.
Kraemer et al. 2016.

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Aedes (*Stg.*) *albopictus* (Skuse, 1895)

Bionomics:

Aedes albopictus larvae are found in natural containers, including tree holes, bamboo stumps, coconut shells, rock holes, palm fronds, and leaf axils. They are also found in all varieties of artificial containers and will breed indoors. Females readily bite humans.

Medical Importance:

Aedes albopictus is a proven vector of dengue and yellow fever in the wild. Under laboratory conditions: bird malarias, Eastern and Western equine encephalitis, La Crosse encephalitis, West Nile, chikungunya and Japanese encephalitis viruses.

WRBU Catalog

Vector Bionomics (Ritchie, S. 2014)

VectorBase: *Ae. albopictus*

Aedes albopictus Female, Photo credit J. Stoffer WRBU

Aedes albopictus scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes albopictus hind tarsomere, Female, Photo credit J. Stoffer WRBU

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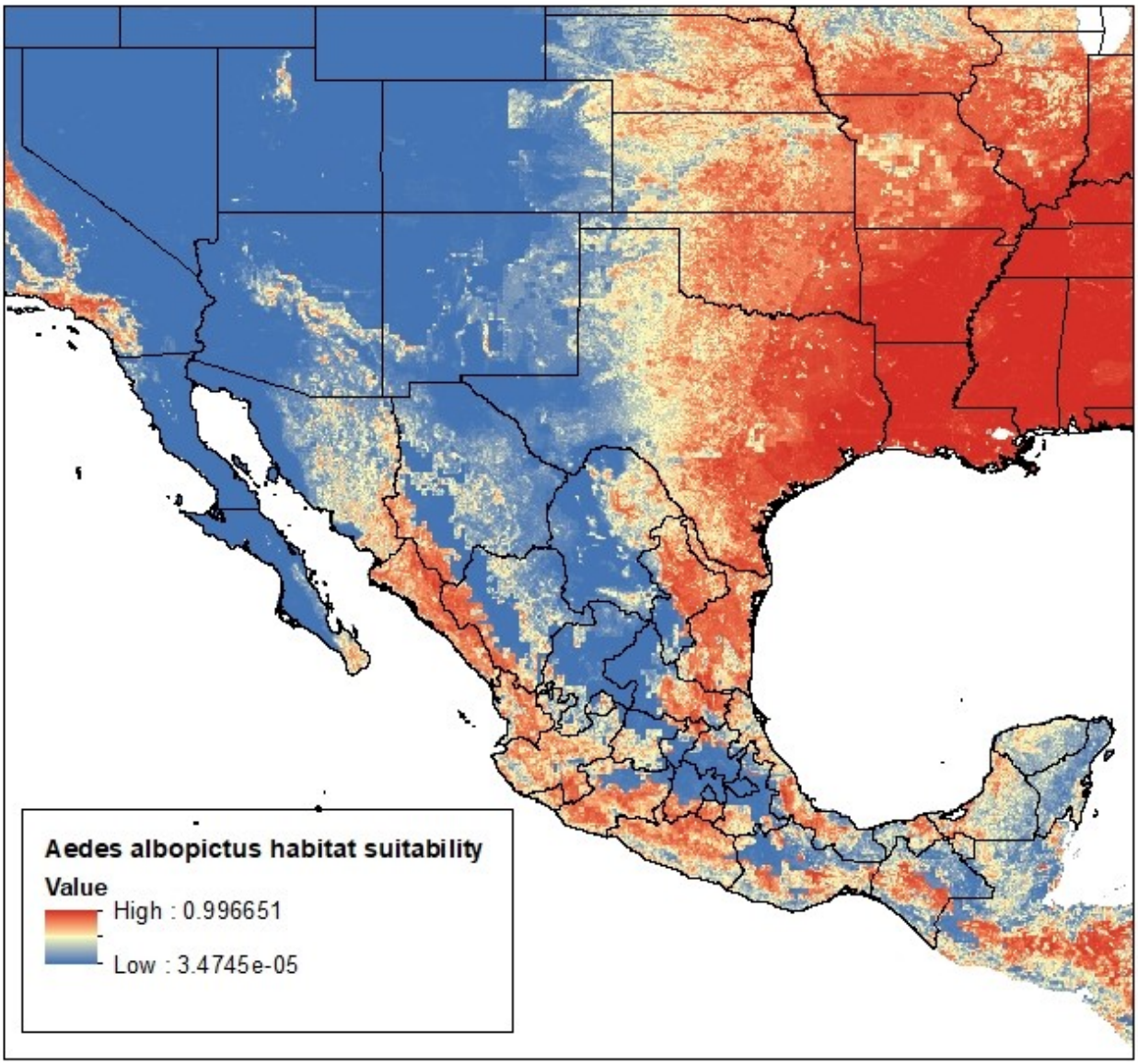
Aedes (*Stg.*) *albopictus* (Skuse, 1895)



Boosted regression tree model of habitat suitability for *Ae. albopictus*, Global.
Kraemer et al. 2016.

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Aedes (*Och.*) *atropalpus* (Coquillett, 1902)

Bionomics:

Larvae of *Aedes atropalpus* may be found throughout the summer in overflow pools in rock holes along mountain streams and occasionally in rain-filled rock holes well removed from the stream. The females of *Ae. atropalpus* are rather aggressive biters and are frequently found near rocky streams.

Medical Importance:

Aedes atropalpus is a known vector of La Crosse and West Nile viruses.

WRBU Catalog

Aedes atropalpus Female, Photo credit J. Stoffer WRBU

Aedes atropalpus scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes atropalpus hind leg, Female, Photo credit J. Stoffer WRBU

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Aedes (*Och.*) *dorsalis* (Meigen, 1830)

Bionomics:

Aedes dorsalis larvae occur in a variety of habitats including both brackish and fresh water. They are often found in large numbers in tidal marshes along the Pacific coast and in saline pools along the margins of Great Salt Lake in Utah. The species also occurs in fresh-water marshes and in overflow from artesian wells and irrigation ditches. The species is an important pest of humans and animals in Utah, California, and often in other localities in western North America.

Medical Importance:

Western equine encephalitis virus (WEE) has been isolated from wild-caught *Aedes dorsalis* in the San Joaquin Valley, California and in Colorado. California encephalitis virus has been isolated from wild-caught *Ae. dorsalis* from Kern County, California. *Ae. dorsalis* is also considered a vector of West Nile Virus.

WRBU Catalog

Aedes dorsalis Female, Photo credit J. Stoffer WRBU

Aedes dorsalis scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes dorsalis head, lateral, Female, Photo credit J. Stoffer WRBU

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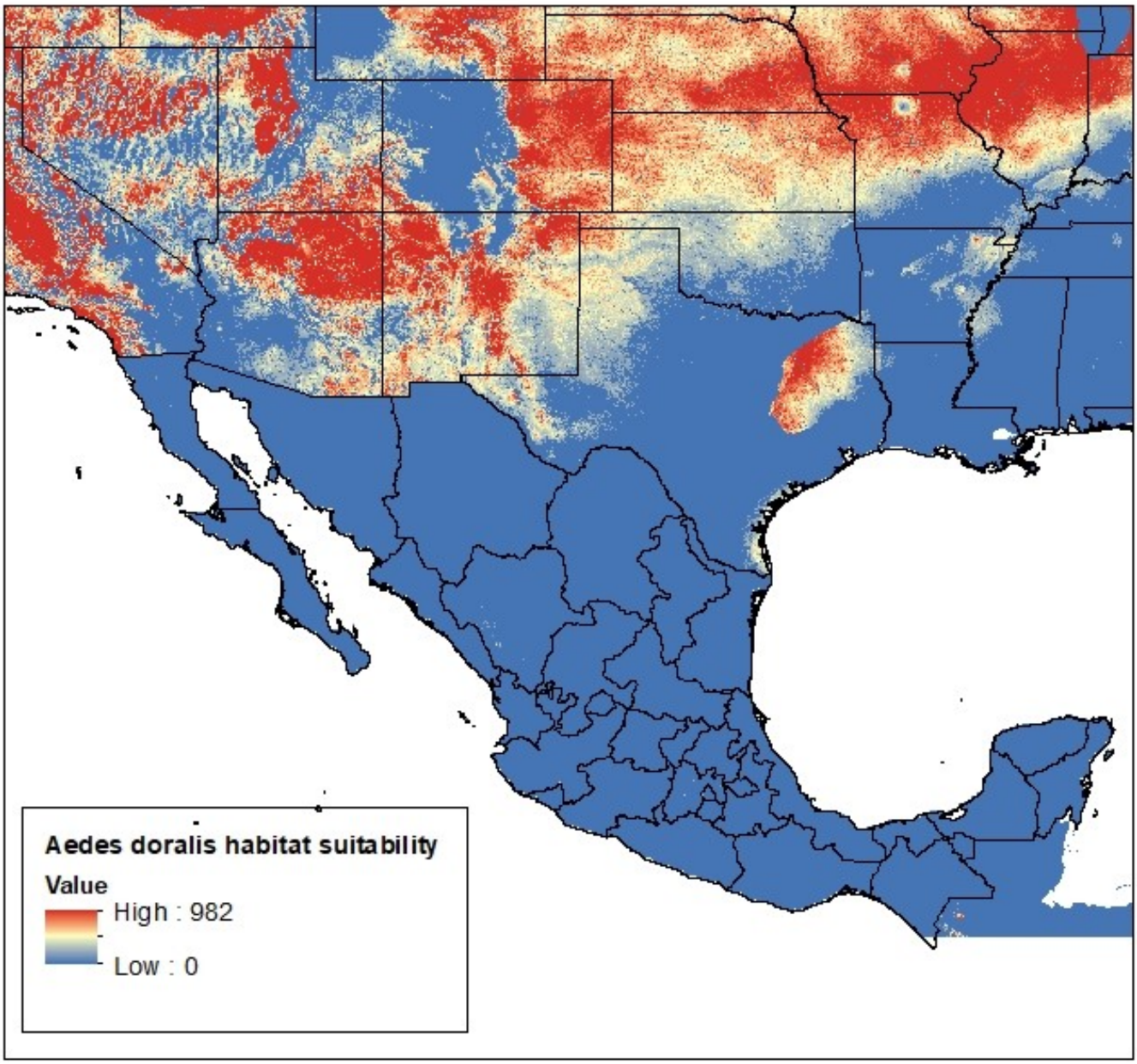
Aedes (*Och.*) *dorsalis* (Meigen, 1830)



Maximum entropy habitat suitability model for *Aedes dorsalis* (Nyari, 2011)

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Aedes (*Och.*) *melanimon* Dyar, 1924

Bionomics:

Very little is known of the biology of *Aedes melanimon. Some specimens have been collected* along the edge of a small cold clear mountain stream. The adults are described as being abundant in the surrounding tall grass.

Medical Importance:

Aedes melanimon is considered a vector of Western equine encephalitis virus (WEE) and West Nile Virus (WNV).

WRBU Catalog

Aedes melanimon Female, Photo credit J. Stoffer WRBU

Aedes melanimon scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes melanimon head, lateral, Female, Photo credit J. Stoffer WRBU

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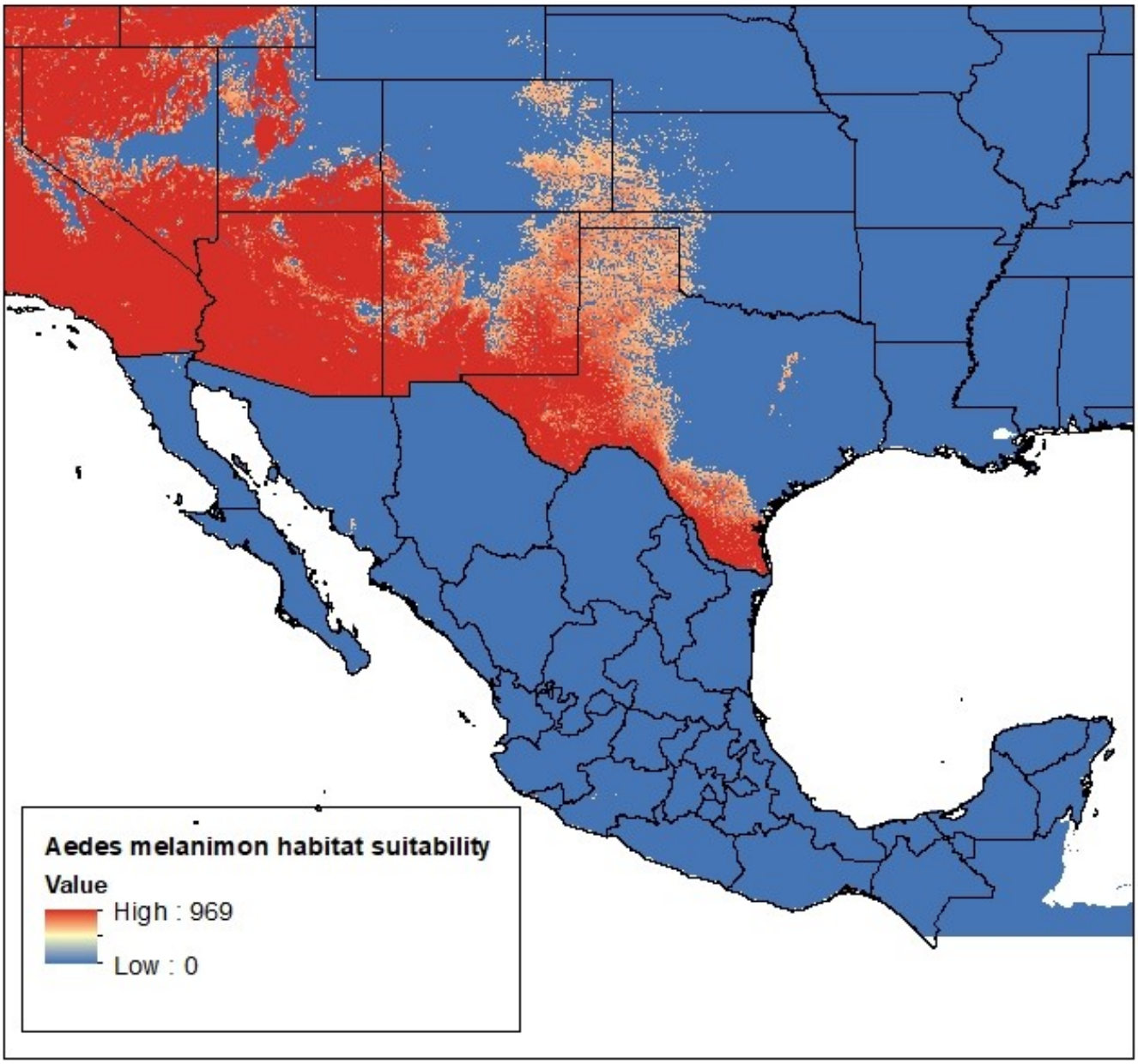
Aedes (*Och.*) *melanimon* Dyar, 1924



Maximum entropy habitat suitability model for *Aedes melanimon* (Nyari, 2011)

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Aedes (*Pro.*) *triseriatus* (Say & Thomas, 1823)

Bionomics:

Aedes triseriatus larvae are found primarily in tree holes and occasionally in artificial containers and rock holes.

Medical Importance:

Aedes triseriatus is a proven vector of the LaCrosse strain of California encephalitis. Under laboratory conditions an efficient vector of yellow fever, eastern equine, Venezuelan and Western equine encephalo-myelitis.

WRBU Catalog

Aedes triseriatus Female, Photo credit J. Stoffer WRBU

Aedes triseriatus scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes triseriatus head, lateral, Female, Photo credit J. Stoffer WRBU

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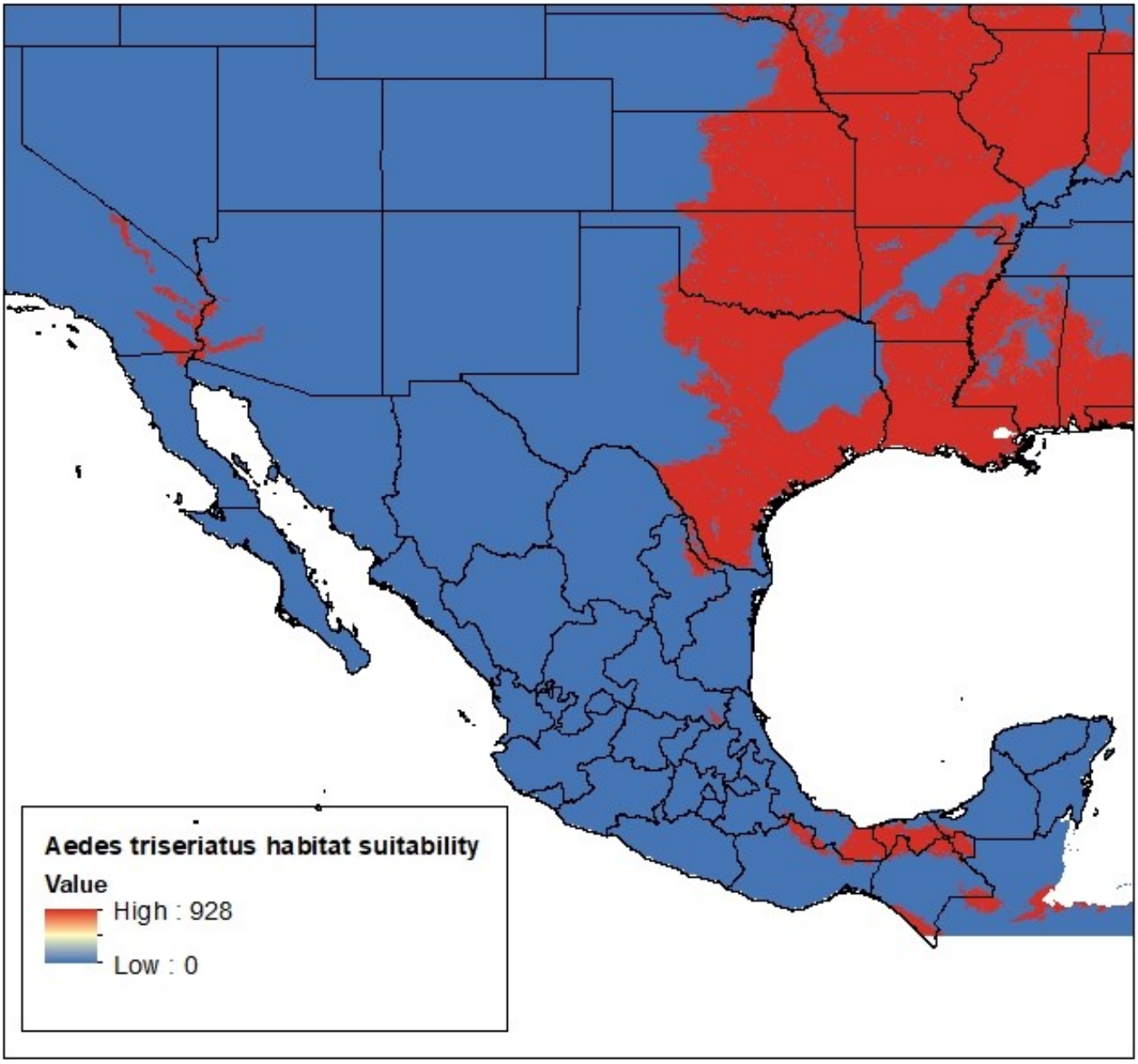
Aedes (*Pro*.) *triseriatus* (Say & Thomas, 1823)



Maximum entropy habitat suitability model for *Aedes triseriatus* (Nyari, 2011)

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Aedes (*Adm.*) *vexans* (Meigen, 1830)

Bionomics:

Immatures of *Aedes vexans* are found in unshaded fresh water flood pools in secondary scrub, but have also been collected in ditches, swamps and rice fields. Habitats usually have little aquatic vegetation or algae. Females are night biters and readily feed on man and cattle. It is important to note that this species is very likely part of a larger species complex with several cryptic taxa making up the group. Identifications based on morphology alone may only be possible to *Ae. vexans* group.

Medical Importance:

Aedes vexans is capable of transmitting West Nile Virus.

WRBU Catalog

Aedes vexans Female, Photo credit J. Stoffer WRBU

Aedes vexans scutum dorsal view Female, Photo credit J. Stoffer WRBU

Aedes vexans head lateral, Female, Photo credit J. Stoffer WRBU

Aedes vexans hind tarsomere, Female, Photo credit J. Stoffer WRBU

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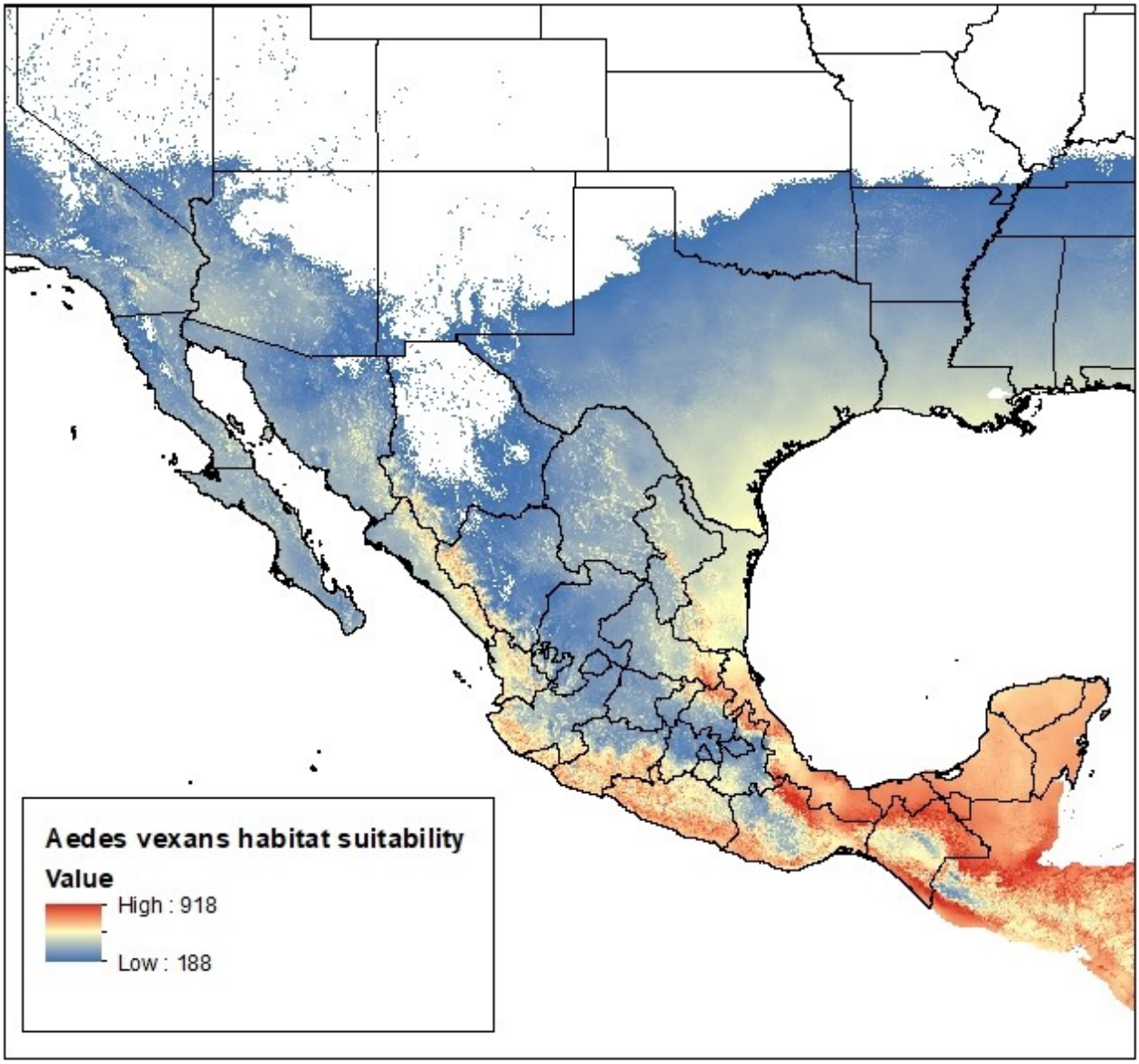
Aedes (*Adm.*) *vexans* (Meigen, 1830)



Maximum entropy habitat suitability model for *Aedes vexans* (Nyari, 2011)

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Anopheles (*Ano.*) *freeborni* Aitken, 1939

Bionomics:

Anopheles freeborni larvae are found in clear seepage water, in roadside pools, in rice fields, and in other similar habitats. Pools that are sunlit, at least part of the day, seem to be preferred, although larvae are occasionally found in rather densely shaded pools. Heavy production of larvae often occurs in matted algal growths in water along the margins of rice fields. The females enter houses readily and feed on humans. They are more active at dusk and during the night but occasionally do attack man during the daylight hours in dense shade or on cloudy days.

Medical Importance:

An. freeborni is the principal vector of malaria in the arid and semiarid western United States.

WRBU Catalog

Anopheles freeborni Female, Photo credit J. Stoffer WRBU

Anopheles freeborni scutum dorsal view Female, Photo credit J. Stoffer WRBU

Anopheles freeborni head lateral, Female, Photo credit J. Stoffer WRBU

Anopheles freeborni wing, lateral, Female, Photo credit J. Stoffer WRBU

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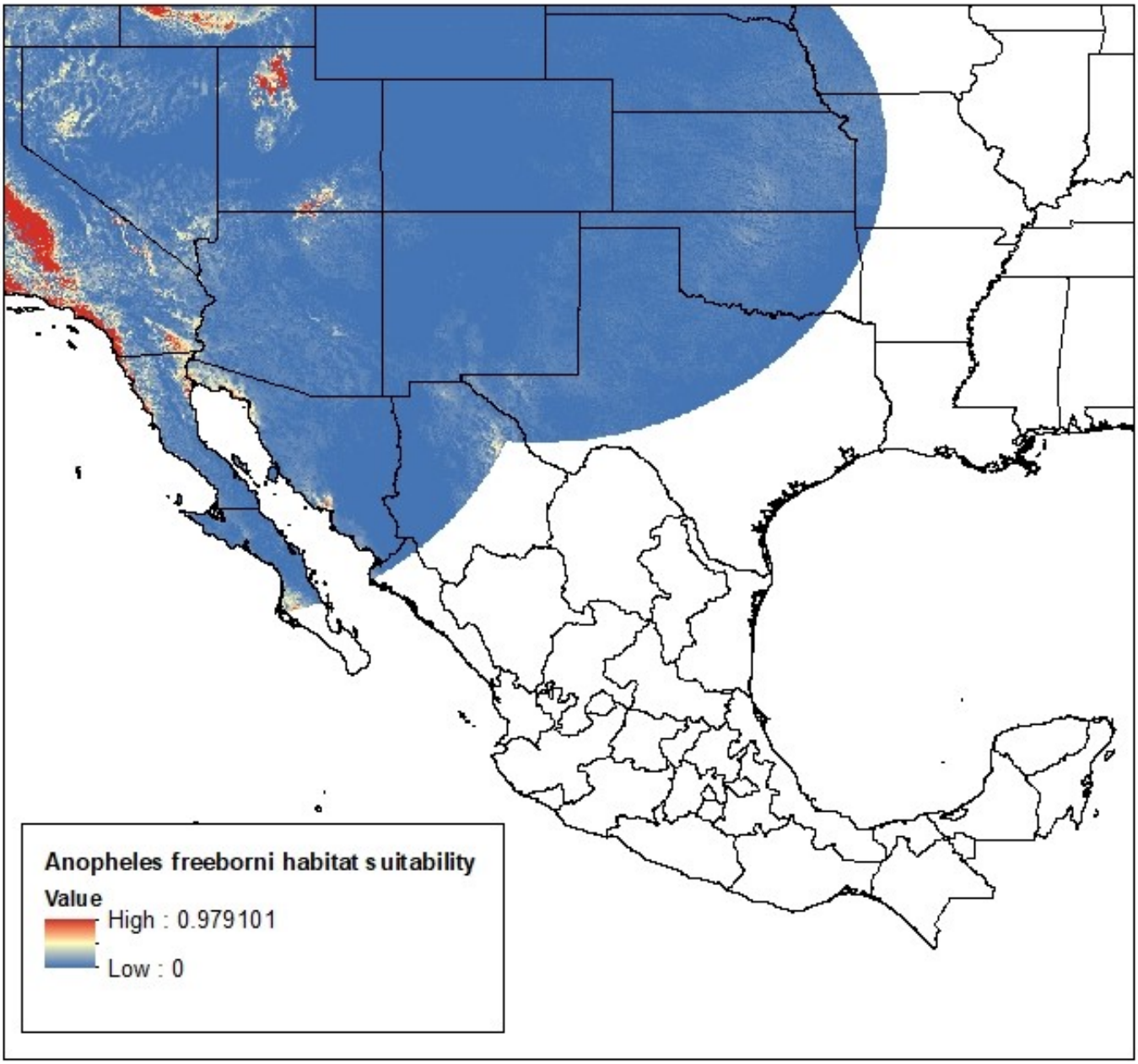
Anopheles (*Ano*.) *freeborni* Aitken, 1939



Maximum entropy habitat suitability model for *Anopheles freeborni* (Nyari, 2011)

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Anopheles (*Ano.*) *pseudopunctipennis* Theobald, 1901

Bionomics:

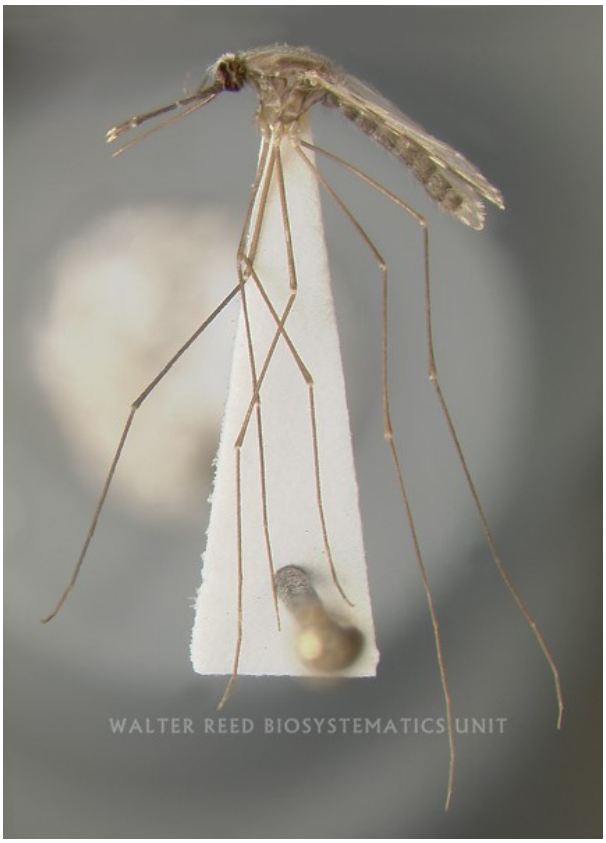
Anopheles psuedopunctipennis larvae are found in sunny habitats including stream pools and margins. Larvae are commonly found in valleys and typically occupy stagnant stream pools with rocky bottoms and 10 cm or less of water. Larvae appear to be highly associated with mats of green or filamentous algae. Females feed at night and will enter houses to take a blood meal.

Medical Importance:

An. psuedopunctipennis is the principal vector of malaria in the United States.

WRBU Catalog

Manguin, S., Roberts, D. R., Peyton, E. L., Rejmankova, E., & Pecor, J. (1996). Characterization of Anopheles pseudopunctipennis larval habitats. Uniformed Services University of The Health Sciences Bethesda MD Department of Preventive Medicine And Biometrics.



Anopheles pseudopunctipennis Female, Photo credit J. Stoffer WRBU

Anopheles pseudopunctipennis scutum dorsal view Female, Photo credit J. Stoffer WRBU

Anopheles pseudopunctipennis head lateral, Female, Photo credit J. Stoffer WRBU

Anopheles pseudopunctipennis wing, lateral, Female, Photo credit J. Stoffer WRBU

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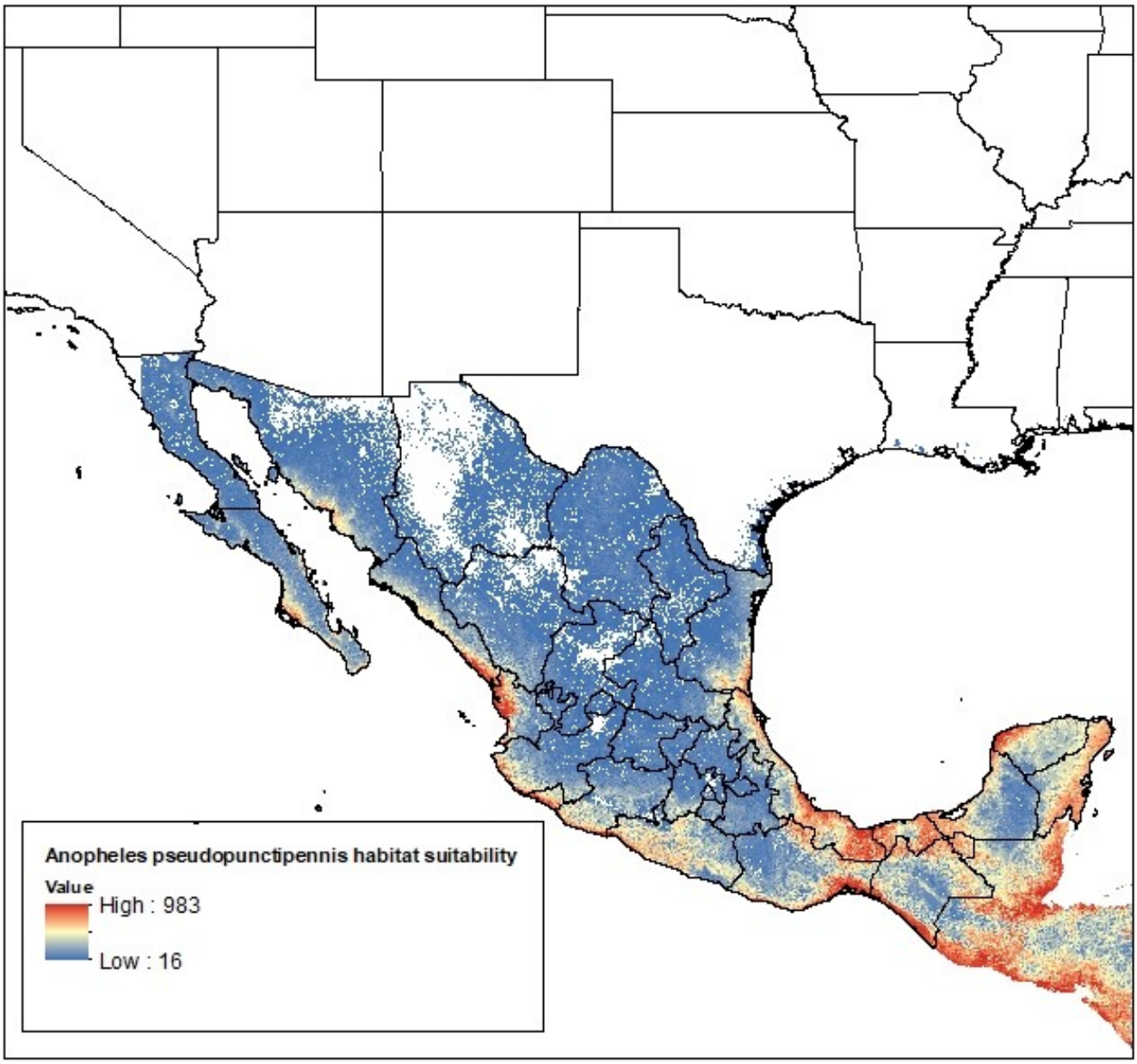
Anopheles (*Ano*.) *pseudopunctipennis* Theobald, 1901



Maximum entropy habitat suitability model for *Anopheles pseudopunctipennis* (Nyari, 2011)

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Anopheles (*Ano.*) *punctipennis* Say, 1823

Bionomics:

Larvae of *Anopheles punctipennis* are found in a large variety of aquatic habitats, including ponds, temporary pools, springs, borrow pits, roadside puddles, wheel ruts in muddy roads, hog wallows, eddies along the margins of flowing streams, and in rain-water barrels and other artificial containers. The species seems to prefer cool, clear water, particularly in hill streams. The females feed mostly after dusk but will attack man during the daytime in dense woodlands or in their daylight resting places. This mosquito is generally regarded as an outdoor species and seldom enters dwellings in large numbers to feed.

Medical Importance:

Anopheles punctipennis is considered an important vector of human malaria.

WRBU Catalog

Anopheles punctipennis Female, Photo credit J. Stoffer WRBU

Anopheles punctipennis scutum dorsal view
Female, Photo credit J. Stoffer WRBU

Anopheles punctipennis head lateral, Female, Photo credit J. Stoffer WRBU

Anopheles punctipennis wing, lateral, Female, Photo credit J. Stoffer WRBU

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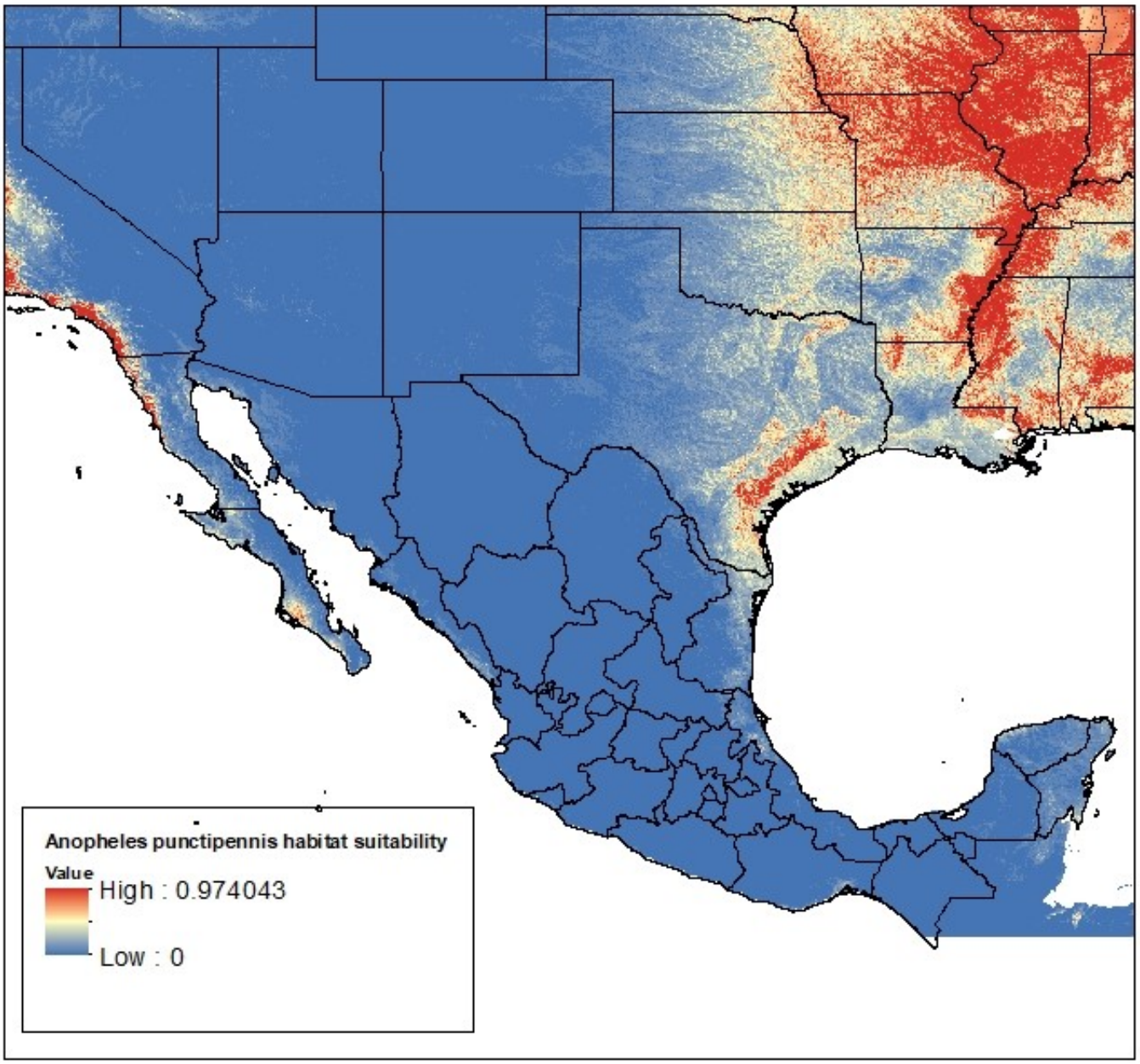
Anopheles (*Ano*.) *punctipennis* Say, 1823



Maximum entropy habitat suitability model for *Anopheles punctipennis* (Nyari, 2011)

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Anopheles (*Ano.*) *quadrimaculatus* Say & Thomas 1824

Bionomics:

Larvae of *Anopheles quadrimaculatus* are found in permanent fresh water habitats which contain floating and/or emergent vegetation. Females readily bite man, domestic and wild animals, and are most active just after dusk.

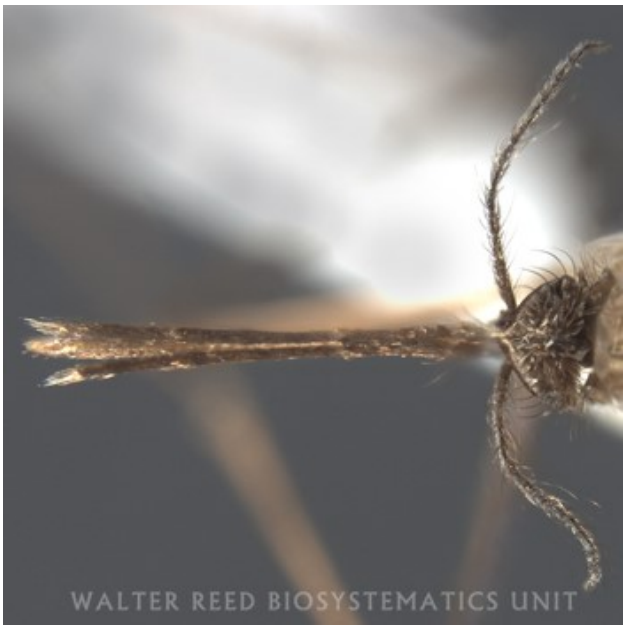
Medical Importance:

Anopheles quadrimaculatus is an excellent vector of human malaria. NOTE: Recent DNA analysis of this species indicates at least four sibling species are present under this name.

WRBU Catalog

Anopheles quadrimaculatus Female, Photo credit J. Stoffer WRBU

Anopheles quadrimaculatus scutum dorsal view Female, Photo credit J. Stoffer WRBU



Anopheles quadrimaculatus head dorsal, Female, Photo credit J. Stoffer WRBU

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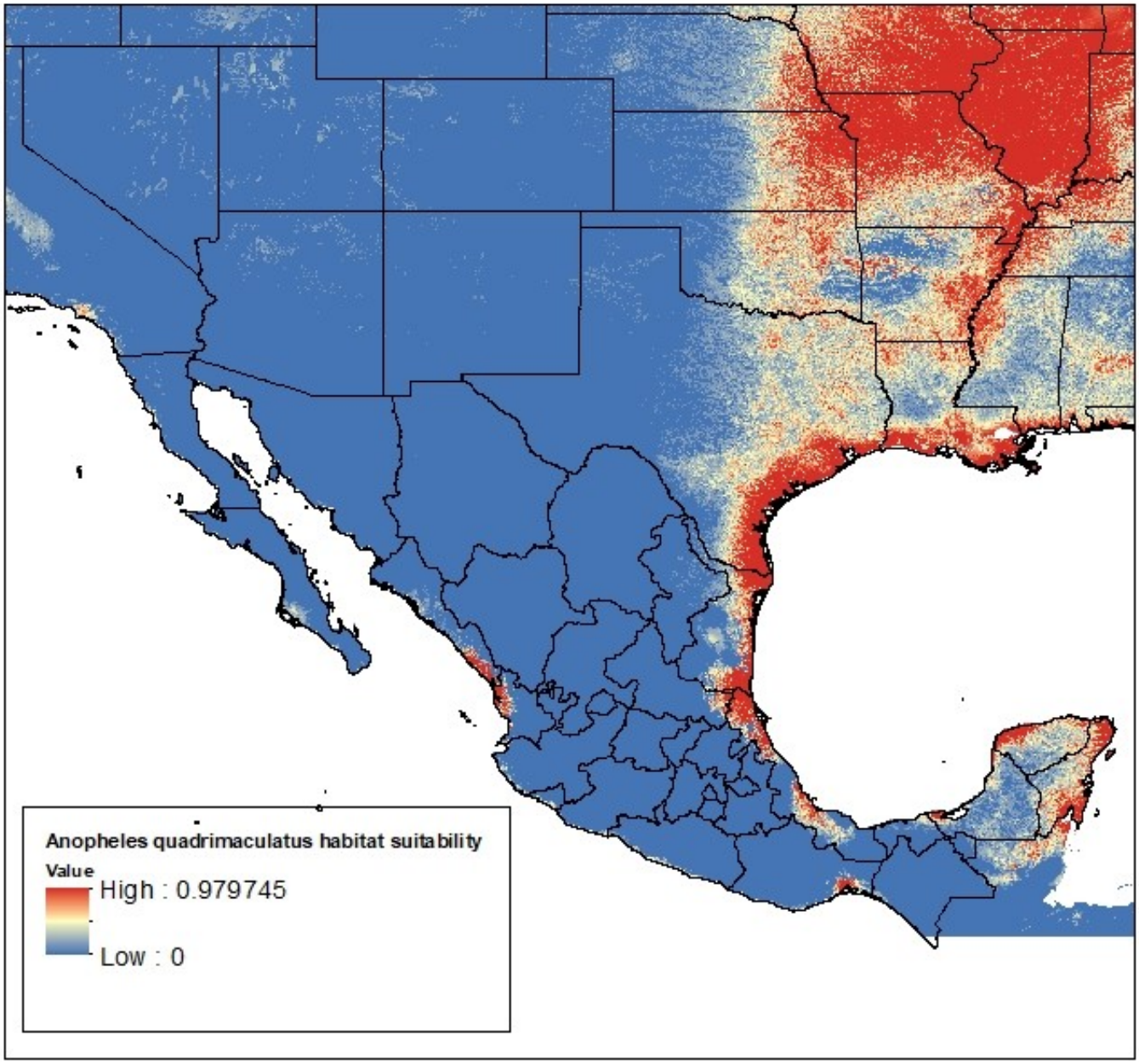
Anopheles (*Ano*.) *quadrimaculatus* Say & Thomas 1824



Maximum entropy habitat suitability model for *Anopheles quadrimaculatus* (Nyari, 2011)

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Coquillettidia (*Coq.*) *perturbans* (Walker, 1856)

Bionomics:

Female *Coquillettidia perturbans* lay their eggs on the surface of water in areas of heavy emergent vegetation. After hatching, the small larvae attach themselves with the modified siphon to the roots or submerged stems of plants where they remain throughout development. The pupa also attaches itself to plants by means of the modified respiratory trumpets and remains there until the adult is ready to emerge. The females bite principally at night, apparently being most active during the early part of the night. They occasionally attack man during daylight hours in shady places when their haunts are invaded.

Medical Importance:

Coquillettidia perturbans is considered a vector of Eastern equine encephalitis.

WRBU Catalog

Coquillettidia perturbans Female, Photo credit J. Stoffer WRBU

Coquillettidia perturbans scutum dorsal view Female, Photo credit J. Stoffer WRBU

Coquillettidia perturbans head dorsal, Female, Photo credit J. Stoffer WRBU

Coquillettidia perturbans hind leg, Female, Photo credit J. Stoffer WRBU

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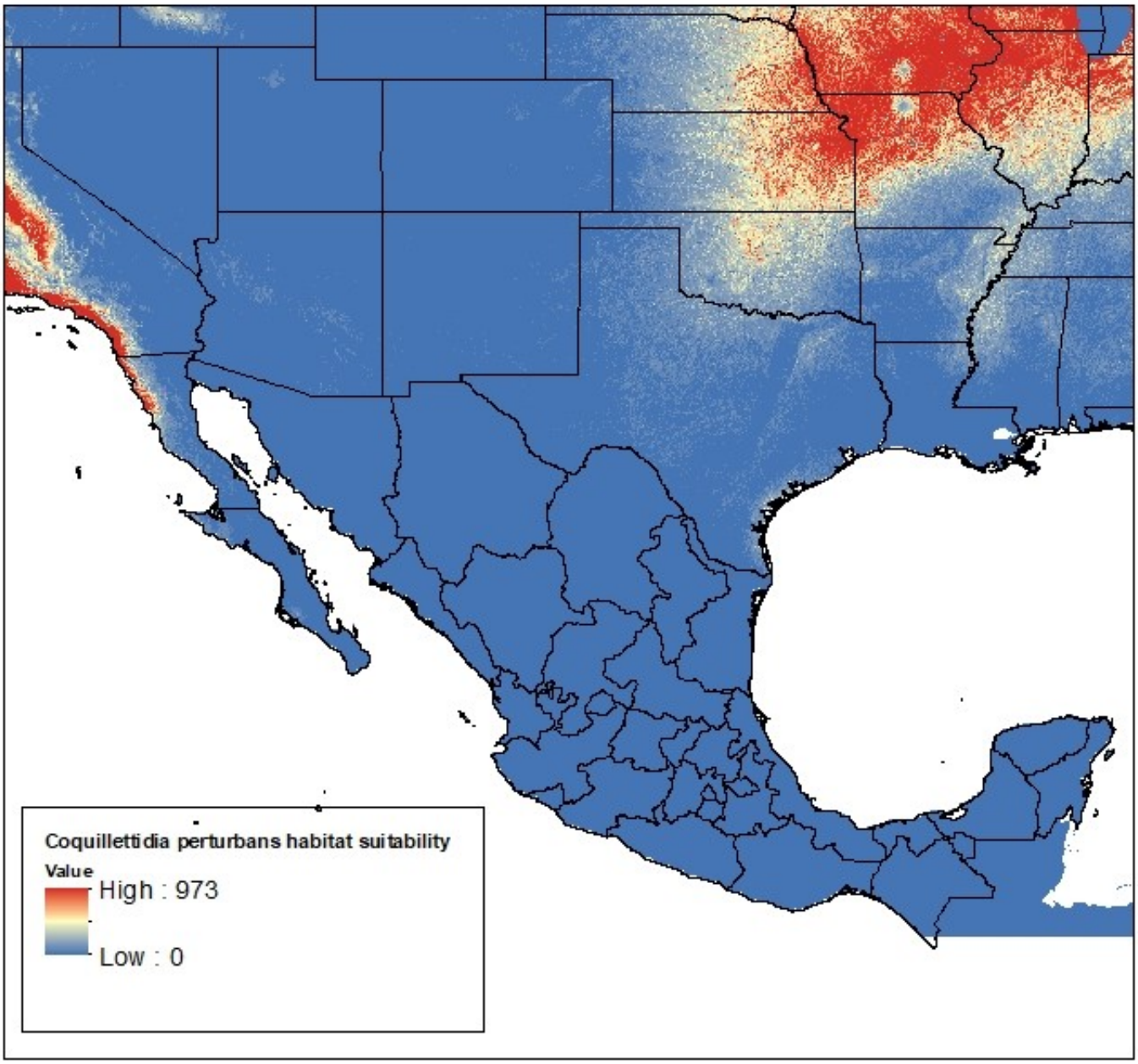
Coquillettidia (*Coq.*) *perturbans* (Walker, 1856)



Maximum entropy habitat suitability model for *Coquillettidia perturbans*
(Dornak, 2011)

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Culex (*Cux*.) *nigripalpus* Theobald, 1901

Bionomics:

Larvae of *Culex nigripalpus* are found in ditches, grassy pools, and marshes of a semi-permanent or permanent nature. They are occasionally found in water in wheel ruts, leaf axils of plants, and artificial containers. *Cx. nigripalpus* is a common man-biting species and is also attracted to CDC traps and animal baited (donkey, chicken) traps.

Medical Importance:

Culex nigripalpus is considered a vector of Eastern equine encephalitis (EEE), St. Louis encephalitis (SLE) and West Nile Virus WNV.

WRBU Catalog

Culex nigripalpus Female, Photo credit J. Stoffer WRBU

Culex nigripalpus scutum dorsal view Female, Photo credit J. Stoffer WRBU

Culex nigripalpus head lateral, Female, Photo credit J. Stoffer WRBU

Culex nigripalpus abdomen, dorsal, Female, Photo credit J. Stoffer WRBU

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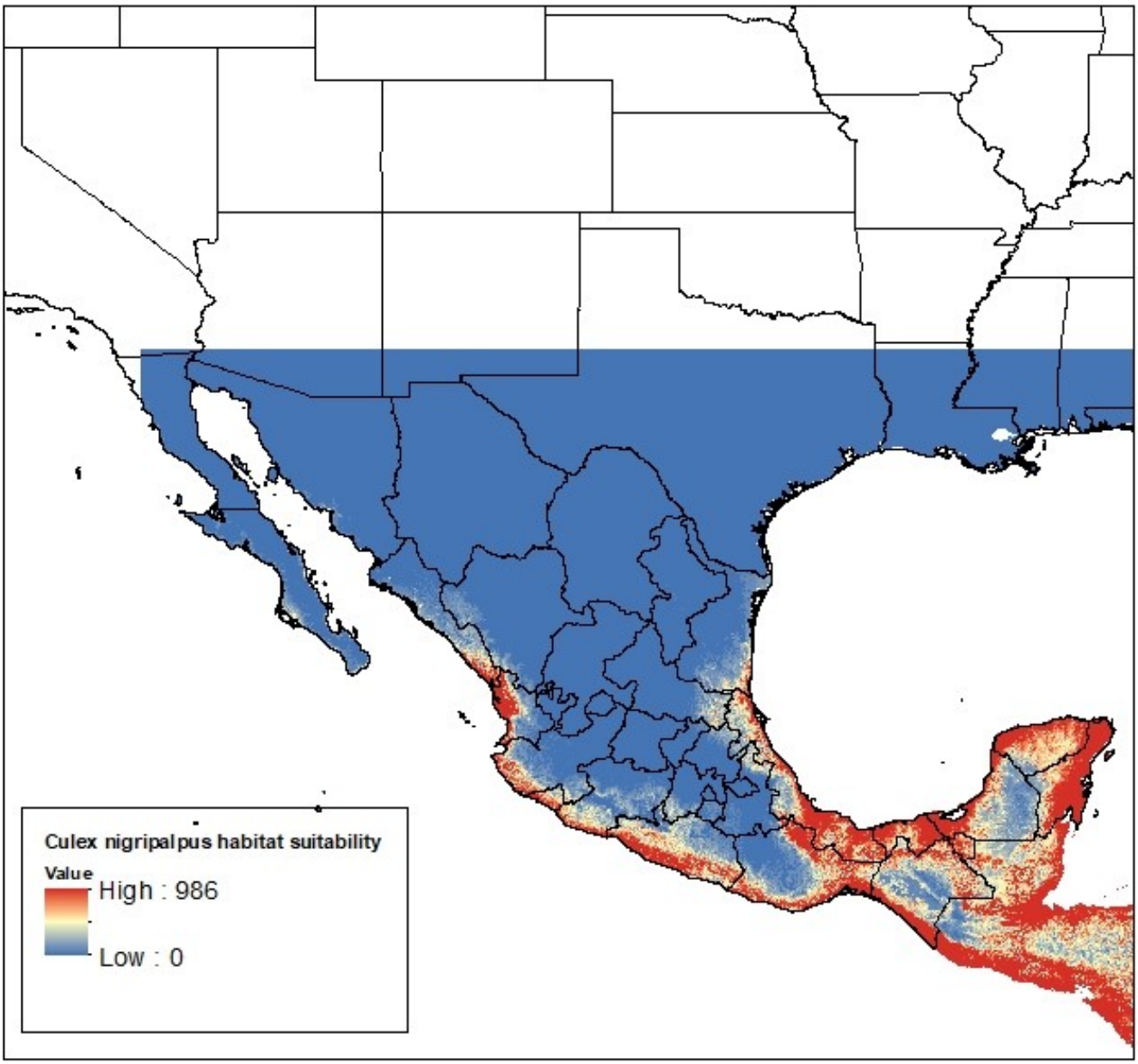
Culex (*Cux*.) *nigripalpus* Theobald, 1901



Maximum entropy habitat suitability model for *Culex nigripalpus*
(Dornak, 2011)

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Culex (*Cux.*) *quinquefasciatus* Say, 1823

Bionomics:

Larvae of *Culex quinquefasciatus* can be found in bodies of water containing a high degree of organic pollution. Open drains and domestic water storage containers are often utilized by this species and are often found in and around urban environments.

Medical Importance:

Culex quinquefasciatus is a known vector of West Nile Virus (WNV).

WRBU Catalog

Bhattacharya, S., Basu, P., & Sajal Bhattacharya, C. (2016). The southern house mosquito, *Culex quinquefasciatus*: profile of a smart vector. J Entomol Zool Stud, 4(2), 73-81.

Culex quinquefasciatus Female, Photo credit J. Stoffer WRBU

Culex quinquefasciatus thorax, lateral view Female, Photo credit J. Stoffer WRBU

Culex quinquefasciatus head dorsal, Female, Photo credit J. Stoffer WRBU

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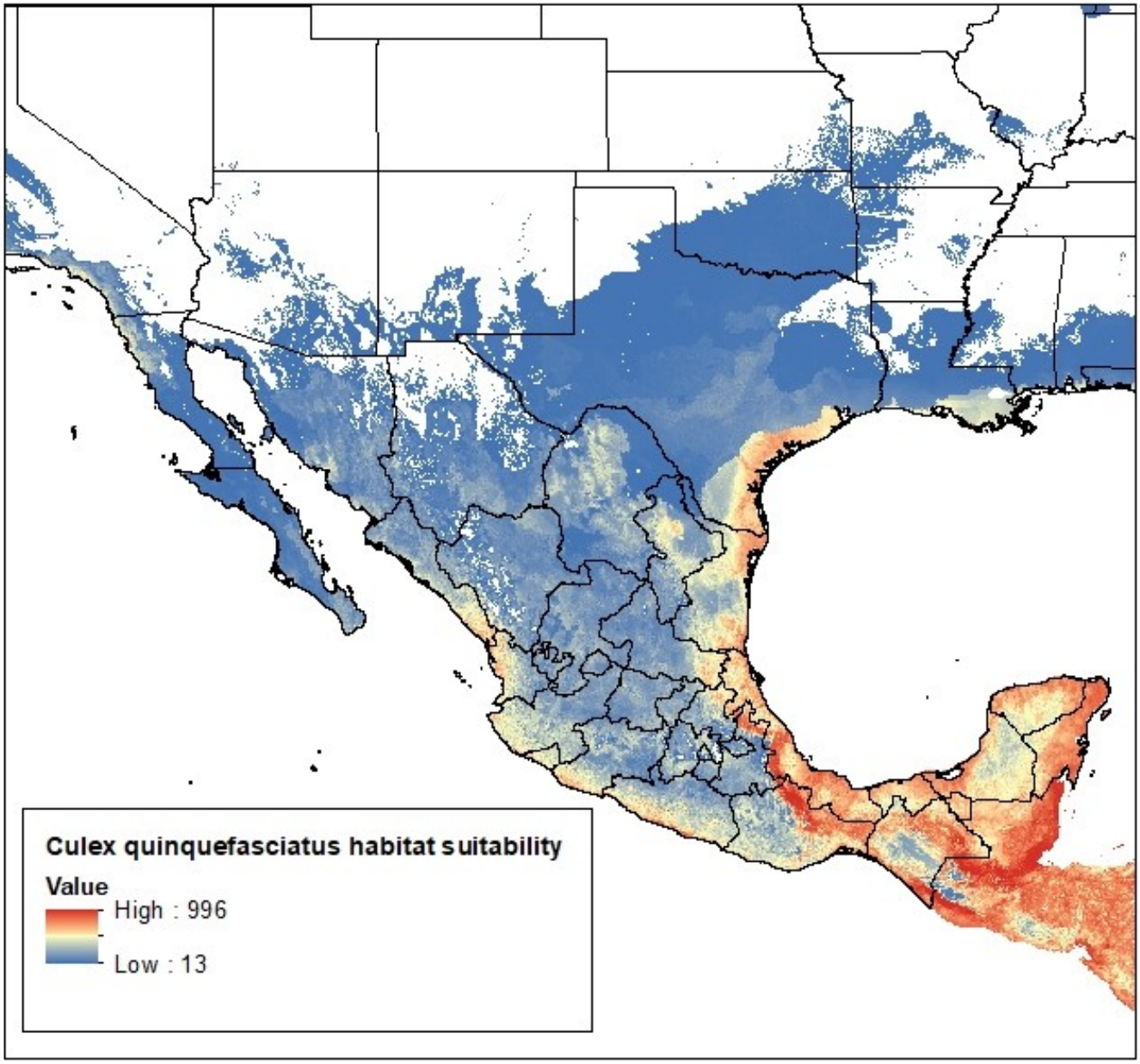
Culex (*Cux*.) *quinquefasciatus* Say, 1823



Maximum entropy habitat suitability model for *Culex quinquefasciatus* (Dornak, 2011)

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Culex (*Cux*.) *restuans* Theobald, 1901

Bionomics:

Culex restuans larvae are found in a wide variety of aquatic habitats, such as ditches, pools in streams, woodland pools, and artificial containers. The females are regarded as troublesome biters by some observers.

Medical Importance:

Cx. restuans is considered a vector of St. Louis encephalitis and West Nile Virus.

WRBU Catalog

Culex restuans Female, Photo credit J. Stoffer WRBU

Culex restuans thorax lateral view Female, Photo credit J. Stoffer WRBU

Culex restuans head lateral, Female, Photo credit J. Stoffer WRBU

Culex restuans hind leg, Female, Photo credit J. Stoffer WRBU

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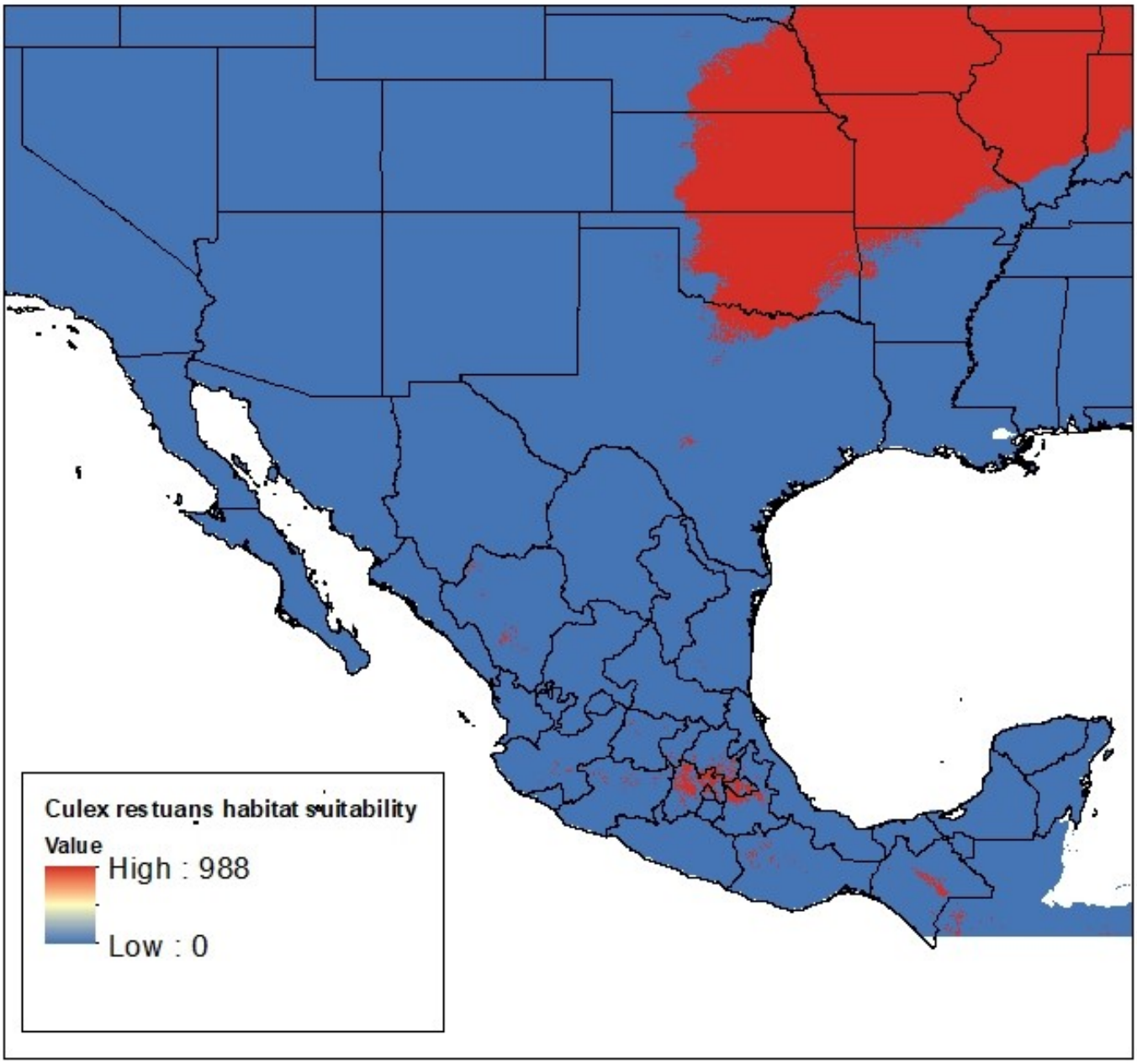
Culex (*Cux*.) *restuans* Theobald, 1901



Maximum entropy habitat suitability model for *Culex restuans*
(Dornak, 2011)

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Culex (*Cux.*) *tarsalis* Coquillett, 1896

Bionomics:

The larvae of *Culex tarsalis* are found in clear or foul water in a variety of habitats including ditches, irrigation systems, ground pools, marshes, pools in stream beds, rain barrels, hoofprints, and ornamental pools. Foul water in corrals and around slaughter yards appear to be favorite larval habitats in many localities. *Cx. tarsalis* are biters, attacking at dusk and after dark, and readily entering dwellings for blood meals. Domestic and wild birds seem to be the preferred hosts. and man, cows, and horses are generally incidental hosts.

Medical Importance:

Culex tarsalis is believed to be the chief vector of Western equine encephalitis virus under natural conditions. The virus has been isolated from wild-caught *Cx. tarsalis* on several occasions in areas in which the disease was both epidemic and epizootic. The viruses of both St. Louis and California encephalitis have been isolated from this mosquito. It also a proven vector of West Nile Virus.

Culex tarsalis Female, Photo credit J. Stoffer WRBU

WRBU Catalog

Culex tarsalis abdomen, dorsal, Female, Photo credit J. Stoffer WRBU

Culex tarsalis scutum dorsal view Female, Photo credit J. Stoffer WRBU

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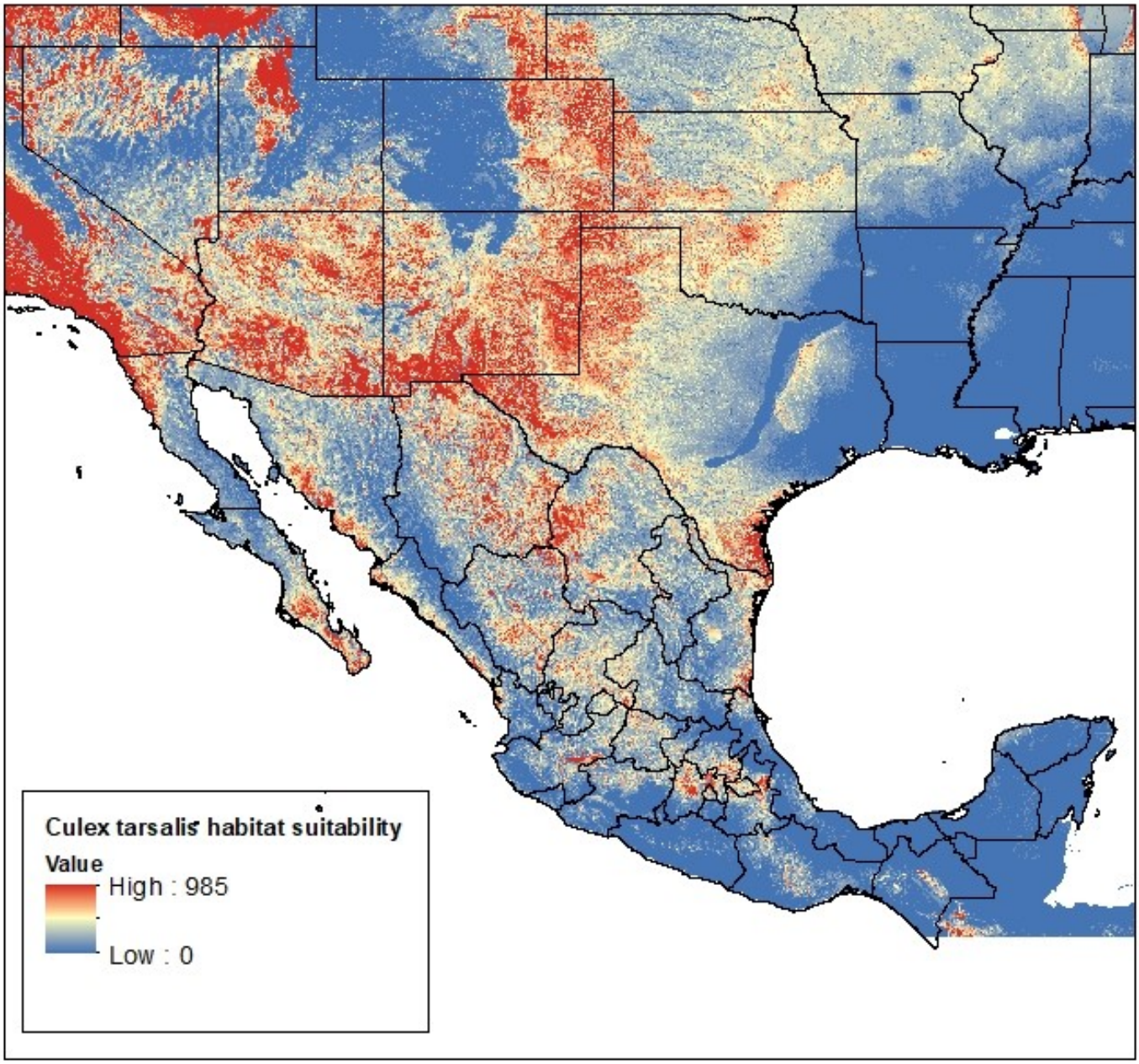
Culex (*Cux*.) *tarsalis* Coquillett, 1896



Maximum entropy habitat suitability model for *Culex tarsalis*
(Dornak, 2011)

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Culiseta (*Cus.*) *inornata* (Williston, 1893)

Bionomics:

The larvae of *Culiseta inornata* are found in ground pools, ditches, and occasionally in artificial water containers, often heavily polluted. They occur in brackish water in the coastal marshes in California.

Medical Importance:

Culiseta inornata is considered a vector of Western equine encephalitis and West Nile Virus

WRBU Catalog

Culiseta inornata Female, Photo credit J. Stoffer WRBU

Culiseta inornata thorax lateral view Female, Photo credit J. Stoffer WRBU

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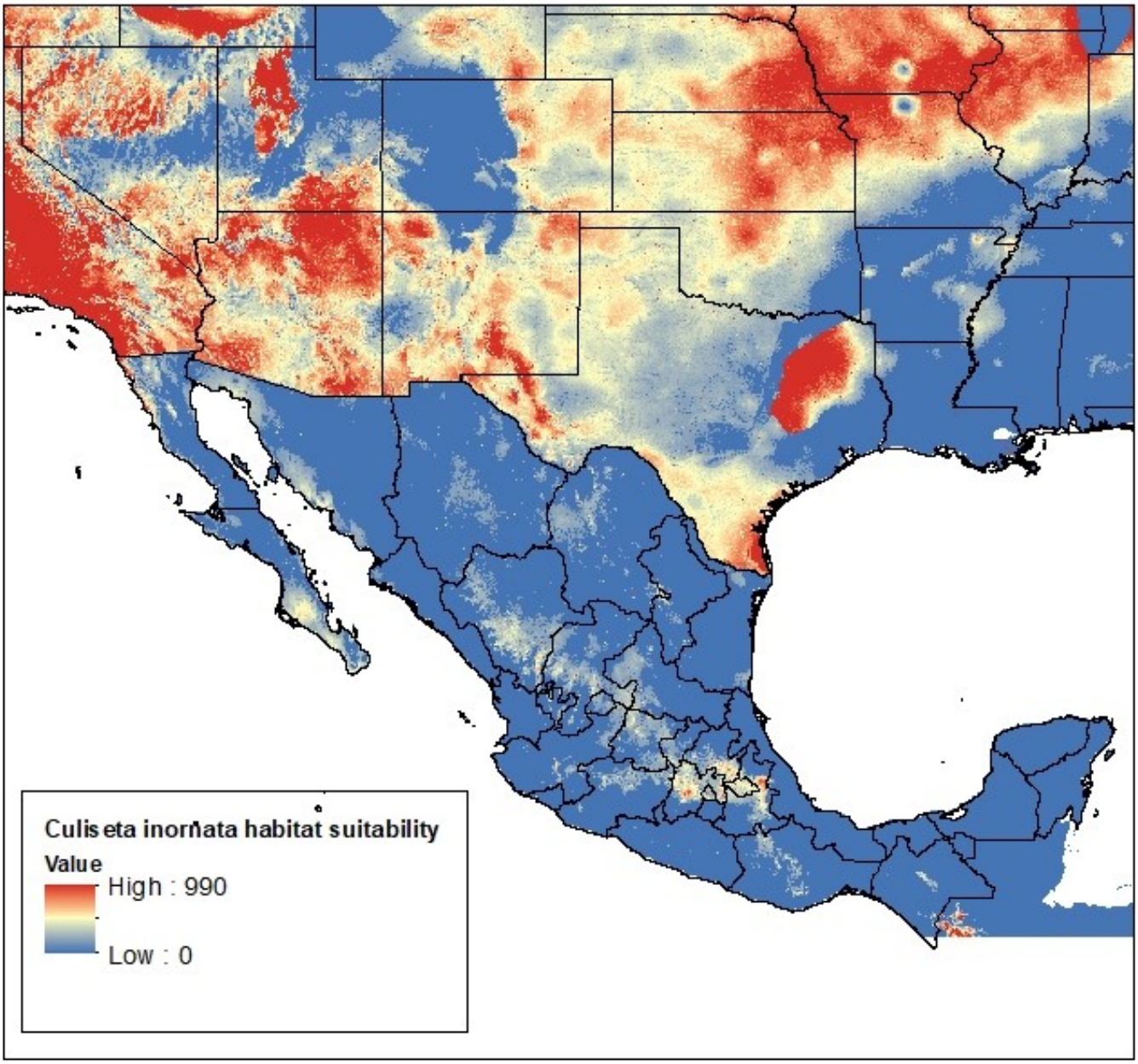
Culiseta (*Cus*.) *inornata* (Williston, 1893)



Maximum entropy habitat suitability model for *Culiseta inornata*
(Dornak, 2011)

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Amblyomma americanum (Linnaeus) (Lone Star Tick)

Medical Importance:

Known vector of tularemia and *Ehrlichia chaffensis*. Suspected vector of Rocky Mountain spotted fever (RMSF), found naturally infected with *Rickettsia parkeri* and *Ehrlichia ewingii*. This species has also recently tested positive for lone star tick nodavirus (LSTN-1).

Hosts:

Extremely aggressive and nonspecific in its feeding habits; all three motile life stages will feed on a wide variety of mammals, including humans and ground-feeding birds.

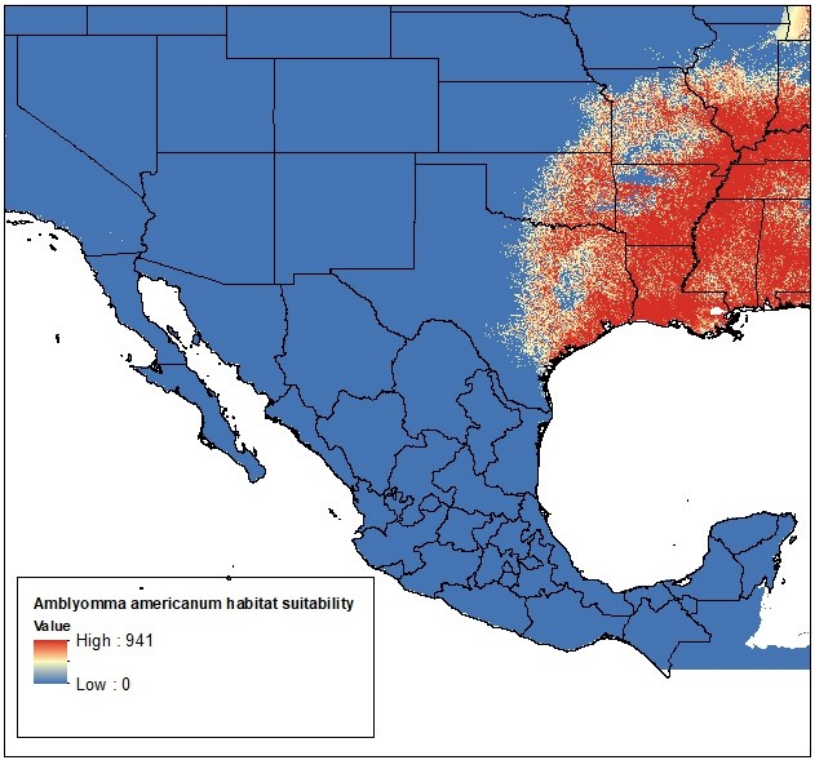
Additional Resources:

- Tokarz, R., Sameroff, S., Tagliafierro, T., Jain, K., Williams, S. H., Cucura, D. M., ... & Diuk-Wasser, M. (2018). Identification of Novel Viruses in *Amblyomma americanum*, *Dermacentor variabilis*, and *Ixodes scapularis* Ticks. mSphere, 3(2), e00614-17.
- Tokarz, R., Sameroff, S., Leon, M. S., Jain, K., & Lipkin, W. I. (2014). Genome characterization of Long Island tick rhabdovirus, a new virus identified in Amblyomma americanum ticks. Virology journal, 11(1), 26.
- Kim, D., Jaworski, D. C., Cheng, C., Nair, A. D., Ganta, R. R., Herndon, N., ... & Park, Y. (2018). The transcriptome of the lone star tick, *Amblyomma americanum*, reveals molecular changes in response to infection with the pathogen, *Ehrlichia chaffeensis*. Journal of Asia-Pacific Entomology.

Adult Female
Dorsal View

Adult Male
Dorsal View

Images courtesy of U.S. Army Public Health Center



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Amblyomma cajennense (Fabricius)

Medical Importance:

Amblyomma cajennense is a proven vector if *rickettsia rickettsii*, the bacterium which causes Rocky Mountain spotted fever (RMSF).

Hosts:

Feeds exclusively on vertebrate hosts, seeking a blood-meal from a different host for each life stage. Humans, dogs and horses are common hosts for this species but it has been observed feeding on domestic and wild pigs as well.

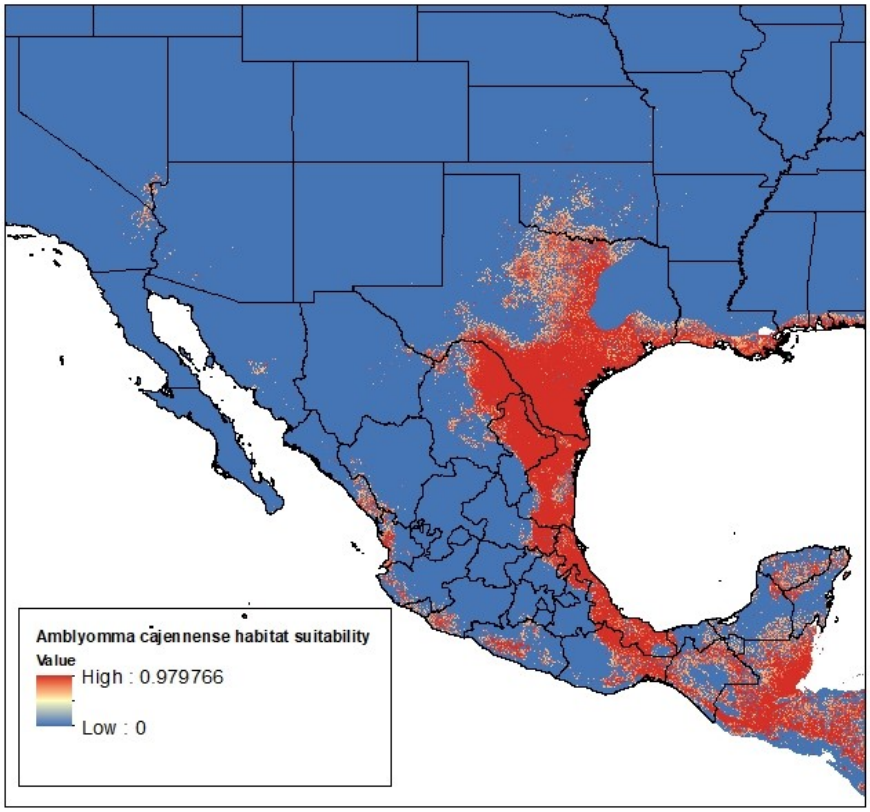
Additional Resources:

- *Amblyomma cajennense* Cayenne tick Fact Sheet, Animal Diversity Web
- Merrill, M. M., Boughton, R. K., Lord, C. C., Sayler, K. A., Wight, B., Anderson, W. M., & Wisely, S. M. (2018). Wild pigs as sentinels for hard ticks: A case study from south-central Florida. International Journal for Parasitology: Parasites and Wildlife, 7(2), 161-170.

Adult Female
Dorsal View

Adult Male
Dorsal View

Images courtesy of Tick Encounter Resource Center, 2018



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Amblyomma maculatum Koch (Gulf Coast Tick)

Medical Importance:

Known vector of American boutonneuse fever (infection with *R. parkeri*); and is considered a significant nuisance tick due to its painful bites.

Hosts:

Adults feed on large animals, including deer, cattle, sheep, and humans; larvae and nymphs on small mammals and ground-feeding birds, such as rabbits, fox, meadow larks, and bob-white quail.

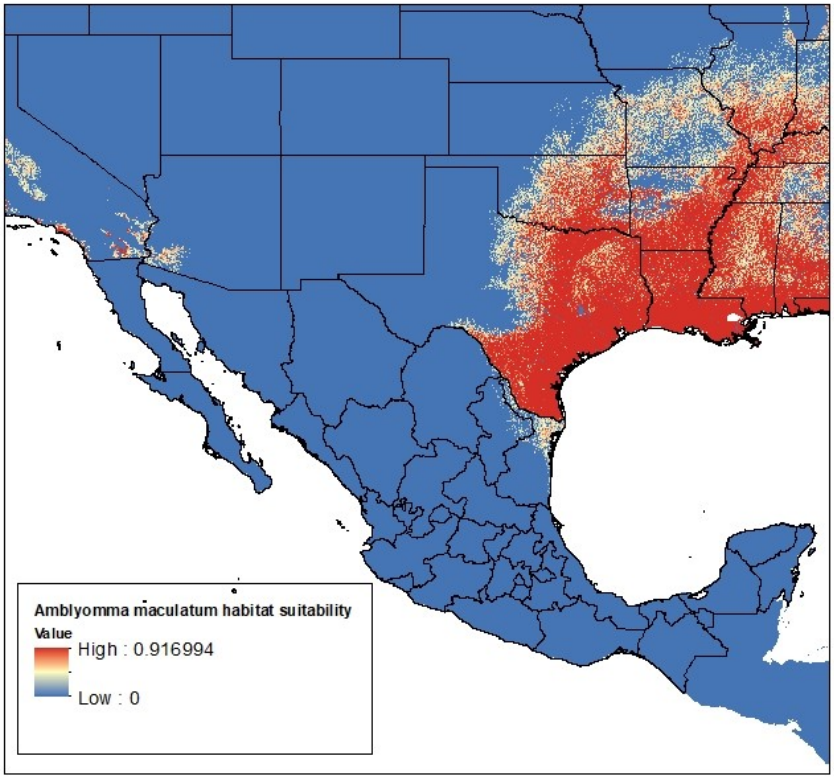
Adult Female
Dorsal View

Adult Male
Dorsal View

Images courtesy of U.S. Army Public Health Center

Additional Resources:

- Saito, T. B., Bechelli, J., Smalley, C., Karim, S., & Walker, D. H. (2018). Vector tick transmission model of spotted fever rickettsiosis. *The American journal of pathology.*
- Lee, J. K., Stokes, J. V., Moraru, G. M., Harper, A. B., Smith, C. L., Wills, R. W., & Varela-Stokes, A. S. (2018). Transmission of *Amblyomma maculatum*-Associated Rickettsia spp. During Cofeeding on Cattle. Vector-Borne and Zoonotic Diseases, 18(10), 511-518.



Dermacentor andersoni Stiles (Rocky Mountain Wood Tick)

Medical Importance:

Dermacentor andersoni is a primary vector of Rocky Mountain Spotted Fever in the Rocky Mountain states and also known to transmit the causative agents of Colorado tick fever and tularemia; produces cases of tick paralysis in the U.S. and Canada each year.

Hosts:

Immatures prefer many species of small mammals, such as chipmunks and ground squirrels, whereas adults feed mostly on cattle, sheep, deer, humans, and other large mammals including dogs.

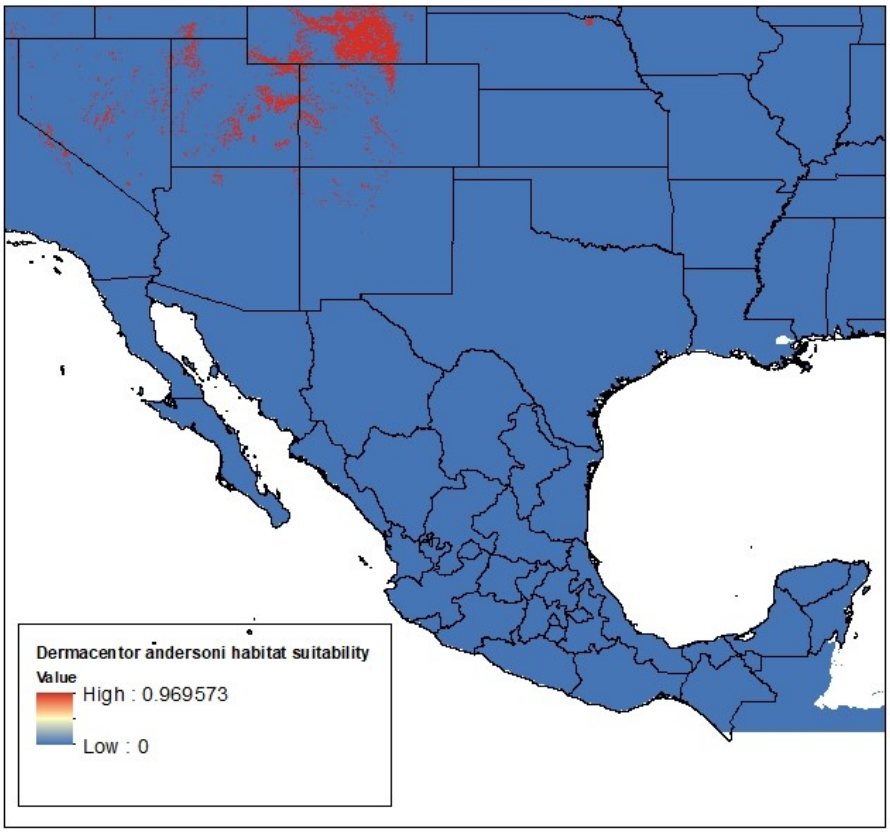
Additional Resources:

- Alhassan, A., Liu, H., McGill, J., Cerezo, A., Jakkula, L. U., Nair, A. D., ... & Narra, H. P. (2018). *Rickettsia rickettsii* whole cell antigens offer protection against Rocky Mountain spotted fever in the canine host. Infection and Immunity, IAI-00628.

Adult Female
Dorsal View

Adult Male
Dorsal View

Images courtesy of Tick Encounter Resource Center, 2018



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Dermacentor variabilis (Say)
(American Dog Tick)

Medical Importance:

One of the most medically important ticks in the U.S., Dermacentor variabilis is a primary vector of Rocky Mountain Spotted Fever and also transmits tularemia and causes tick paralysis.

Hosts:

Immatures feed primarily on small mammals, particularly rodents; adults prefer the domestic dog but will readily bite humans opportunistically.

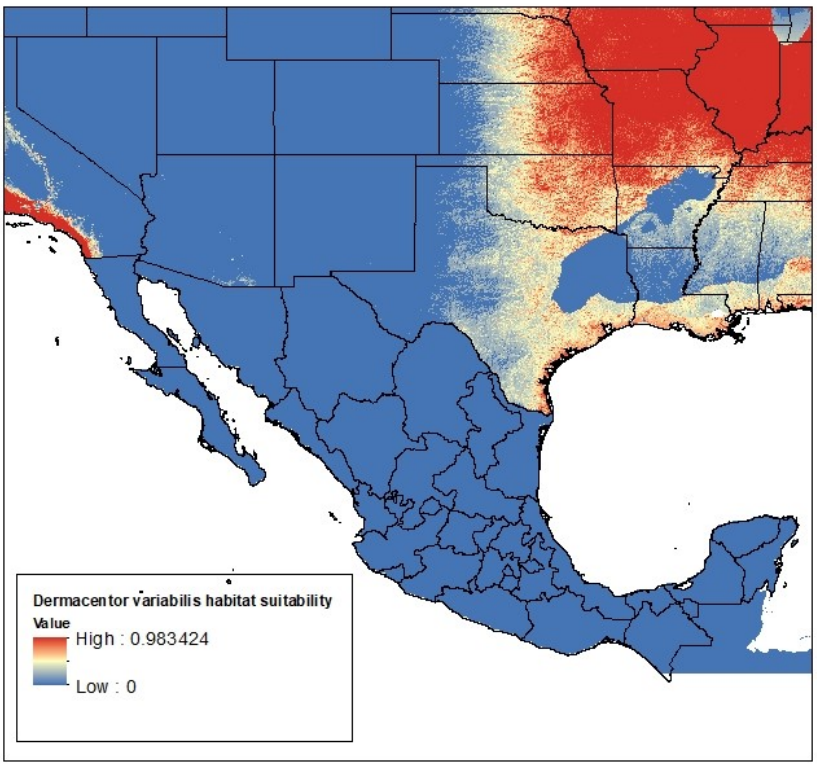
Adult Female
Dorsal View

Adult female
Ventral View

Images courtesy of U.S. Army Public Health Center

Additional Resources:

- Alhassan, A., Liu, H., McGill, J., Cerezo, A., Jakkula, L. U., Nair, A. D., & Narra, H. P. (2018). *Rickettsia rickettsii* whole cell antigens offer protection against Rocky Mountain spotted fever in the canine host. Infection and Immunity, IAI-00628.
- Tokarz, R., Sameroff, S., Tagliafierro, T., Jain, K., Williams, S. H., Cucura, D. M., ... & Diuk-Wasser, M. (2018). Identification of Novel Viruses in *Amblyomma americanum*, *Dermacentor variabilis*, and *Ixodes scapularis* Ticks. mSphere, 3(2), e00614-17.



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Haemaphysalis longicornis Neumann (Asian Long horned Tick)

Images courtesy of Entomology Today, James Occi, 2017

Medical Importance:

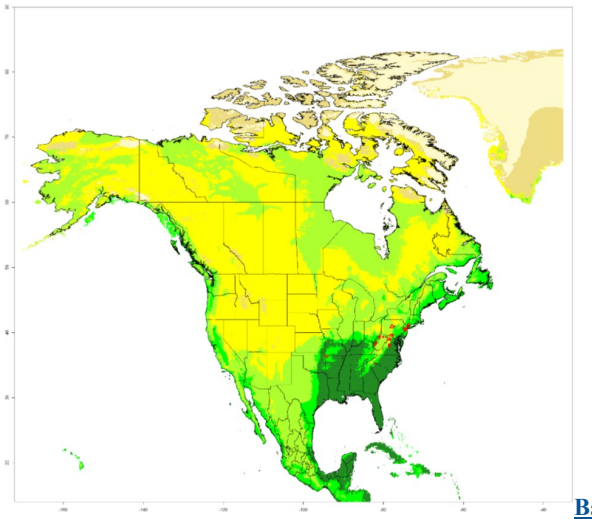
Haemaphysalis longicornis is a known vector of *Rickettsia japonica* (Oriental spotted fever), bunyavirus, *Anaplasma*, *Ehrlichia*, and *Borrelia* spp. It's vector capacity in North America has yet to be fully realized.

Hosts:

Across its native range, *Haemaphysalis longicornis* feeds on cattle, deer, sheep and horses. Humans who are in close proximity to domesticated livestock can also become hosts opportunistically as well. Although a bloodmeal is required for egg production, parthenogenic populations exist which do not require males for reproduction. It is important to note however, vector capacity in parthenogenic populations may differ from the sexual populations.

Additional Resources:

- Haddow, A. D. (2018). The consequences of medically important invasive arthropods: The long horned tick, *Haemaphysalis longicornis*. Clinical Infectious Diseases.
- Mihara, R., Umemiya-Shirafuji, R., Abe, Y., Matsuo, T., Horiuchi, N., Kawano, S., ... & Suzuki, H. (2018). The development of oocytes in the ovary of a parthenogenetic tick, *Haemaphysalis longicornis*. Parasitology international, 67(4), 465-471.



Habitat suitability of areas across North America for Haemaphysalis longicornis. Source: Magori, K. (2018). Preliminary prediction of the potential distribution and consequences of *Haemaphysalis longicornis* (Ixodida: Ixodidae) in the United States and North America, using a simple rule-based climate envelope model. bioRxiv, 389940.

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Ixodes pacificus Cooley and Kohls (Western Blacklegged Tick)

Adult Female
Dorsal View

Hosts:

Immature *Ixodes pacificus* feed on numerous species of small mammals, birds, and lizards; in certain areas of California, predominance of feeding on lizards; adults feed primarily on Columbian black-tailed deer.

Medical Importance:

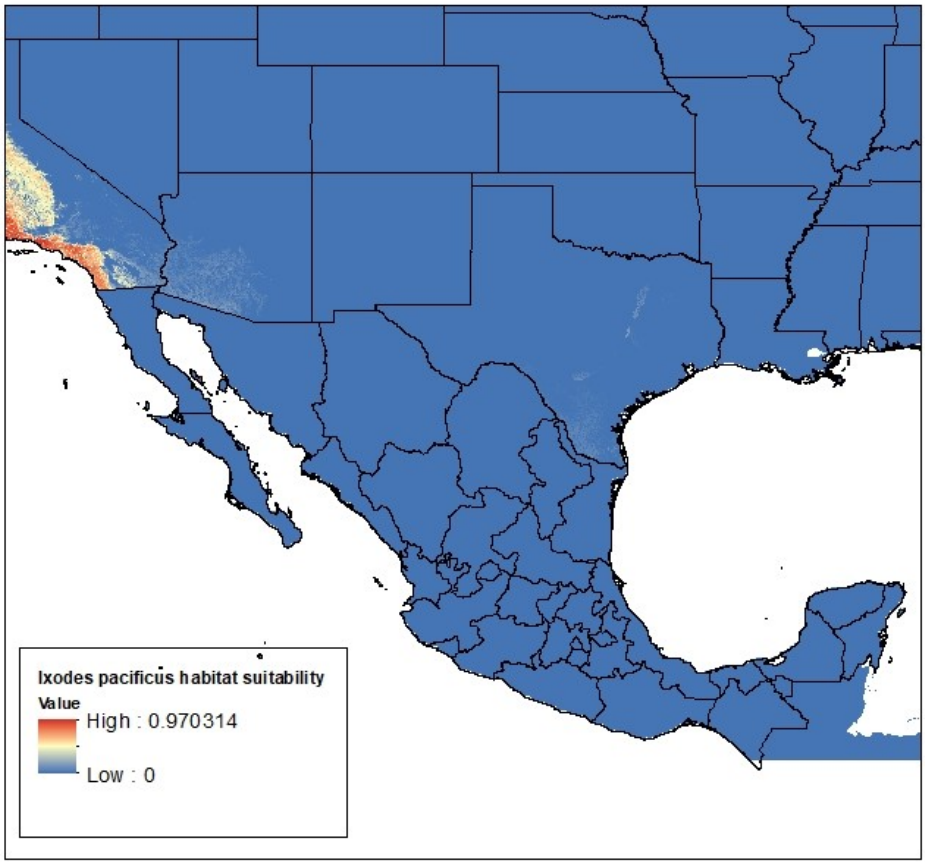
Known to be a vector of Lyme borreliosis spirochetes; most, if not all, cases of Lyme borreliosis occurring in California are transmitted by this tick; transmits agent of human granulocytic anaplasmosis; there are reports of Type I (IgE-mediated) hypersensitivity reactions in humans as a result of bites by this species.

Additional Resources:

- Burgdorfer, W., Lane, R. S., Barbour, A. G., Gresbrink, R. A., & Anderson, J. R. (1985). The western black-legged tick, *Ixodes pacificus*: a vector of *Borrelia burgdorferi*. The American journal of tropical medicine and hygiene, 34(5), 925-930.
- Dennis, D. T., Nekomoto, T. S., Victor, J. C., Paul, W. S., & Piesman, J. (1998). Reported distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the United States. Journal of medical entomology, 35(5), 629-638.

Adult Male
Dorsal View

Images courtesy of Tick Encounter Resource Center, 2018



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Ixodes scapularis Say

(Blacklegged or Deer Tick)

Medical Importance:

Ixodes scapularis is the primary vector of the causative agent of Lyme borreliosis, especially in the northeastern and upper midwestern areas of the U.S. It is also a vector of the protozoan *Babesia microti*, vector of the agent of human granulocytic anaplasmosis.

Hosts:

Immatures feed on lizards, small mammals, and birds; adults prefer deer but will bite people; in Mexico, additional host records from dogs, cattle and jaguars.

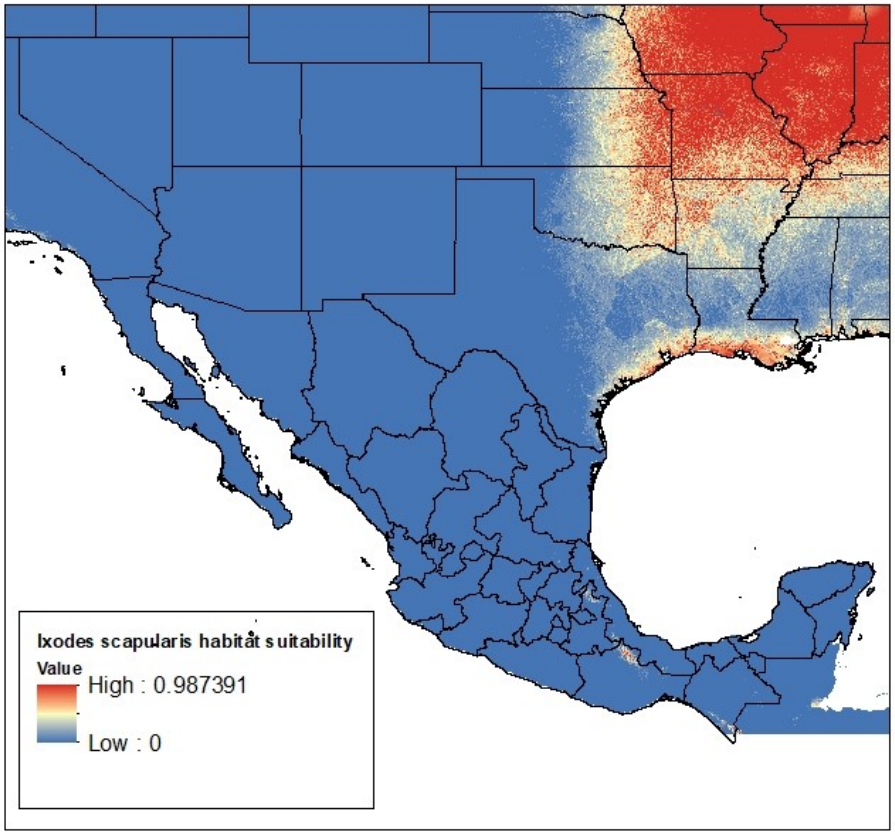
Additional Resources:

- Eisen, L., Rose, D., Prose, R., Breuner, N. E., Dolan, M. C., Thompson, K., & Connally, N. (2017). Bioassays to evaluate non-contact spatial repellency, contact irritancy, and acute toxicity of permethrin-treated clothing against nymphal *Ixodes scapularis* ticks. Ticks and tick-borne diseases, 8(6), 837-849

Adult Female
Dorsal View

Adult Female
Ventral View

Images courtesy of U.S. Army Public Health Center



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Rhipicephalus sanguineus (Latreille)

(Brown Dog Tick)

Adult Female
Dorsal View

Medical Importance:

Rhipicephalus sanguineus is a proven vector of *Rickettsia rickettsii* (Rocky Mountain spotted fever).

Hosts:

The most common host is domestic dogs but this species will bite humans opportunistically. It is considered one of the most widely distributed ticks in the world. It is found in urban, suburban and rural habitats generally associated with humans due to their host preference of dogs. Adult *Rhipicephalus* sp. are passive in their host-questing activity (rarely moving more than 2 m).

Additional Resources:

- Alhassan, A., Liu, H., McGill, J., Cerezo, A., Jakkula, L. U., Nair, A. D., ... & Narra, H. P. (2018). *Rickettsia rickettsii* whole cell antigens offer protection against Rocky Mountain spotted fever in the canine host. Infection and Immunity, IAI-00628.
- Gasmi, S., Bouchard, C., Ogden, N. H., Adam-Poupart, A., Pelcat, Y., Rees, E. E., ... & Thivierge, K. (2018). Evidence for increasing densities and geographic ranges of tick species of public health significance other than *Ixodes scapularis* in Québec, Canada. PloS one, 13(8), e0201924.

Adult Female
Ventral View

Images courtesy of J. Stoffer, WRBU

U.S. Distribution of *Rhipicephalus sanguineus*, CDC, 2018

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Xenopsylla cheopis (Rothschild, 1903)

Bionomics:

Xenopsylla cheopis Female, Photo credit J. Stoffer WRBU

Xenopsylla cheopis occurs primarily where commensal rodents are found, particularly *Rattus norvegicus*. Adult fleas feed exclusively on blood and utilize blood protein for egg production. After feeding on a rodent, the female flea lays several (2 to 15) eggs. Several hundred eggs may be laid during the entire life span. Oviposition most often occurs on the hairs of the host, although the eggs drop off and hatch in the nest or its environment. In locally humid environments, such as rodent burrows, eggs may hatch in as little as 2 days. Larvae live in the nest and feed on dried blood, dander, and a variety of organic material; they grow rapidly when temperature exceeds 25°C and the relative humidity is greater than 70%. The larval stages can be completed in as little as 14 days (at 30 to 32°C), or as long as 200 days when temperatures drop below 15°C or when nutrition is inadequate. Mature larvae pupate in cocoons, loosely attached to nesting material. Adult emergence from pupae may occur in as little as 7 days or as long as a year and is stimulated by carbon dioxide or host activity near the cocoon. Adult fleas normally await the approach of a host rather than actively search for one. They feed on humans when people and rodents live close together, but humans are not a preferred host. The life span of adult *X. cheopis* is relatively short compared to that of other fleas species.

NOTE: if rat populations decline suddenly due to disease or rat control programs, fleas readily switch to feeding on humans.

Medical Importance:

X. cheopis is considered a primary vector of Plague and Murine Typhus.

Ctenocephalides felis (Bouché, 1835)

Bionomics:

Also known as the cat flea, *Ctenocephalides felis* is commonly associated with domesticated and feral cats and dogs. This flea can readily enter homes via pets and will readily feed on humans once inside. *Ctenocephalides felis* generally spends its entire life cycle on its host with females producing between 2,000 to 8,000 eggs in a lifetime.

Medical Importance:

Ctenocephalides felis is a vector of Bartonella. This species is also a proven vector of Rickettsia typhi and Rickettsia felis. Some cat fleas have tested positive for *Borrelia burgdorferi*, however this species vector capacity has not been fully studied.

Additional Resources for fleas of the US:

Billeter, S. A., & Metzger, M. E. (2016). Limited evidence for *Rickettsia felis* as a cause of zoonotic flea-borne rickettsiosis in southern California. Journal of medical entomology, 54(1), 4-7.

Ewing, H. E., & Fox, I. (1943). The fleas of North America: classification, identification, and geographic distribution of these injurious and disease-spreading insects (No. 500). US Department of Agriculture.

Teltow, G. J., Fournier, P. V., & Rawlings, J. A. (1991). Isolation of *Borrelia burgdorferi* from arthropods collected in Texas. The American journal of tropical medicine and hygiene, 44(5), 469-474.

Video: Cat Flea Under Electron Microscope

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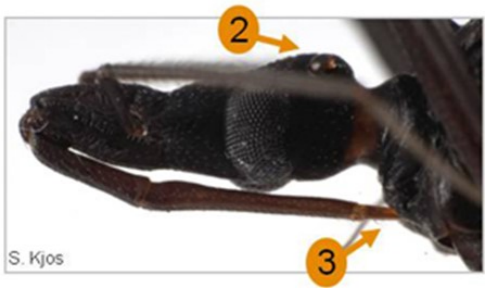
Triatoma gerstaeckeri

Key characteristics:

1. Yellow markings extending horizontally on abdominal segments
2. Head long, flattened on top
3. Mouthparts relatively hairless with longer hairs at tip
4. Pronotum uniformly black
5. Tip of scutellum long, narrow
6. Legs slender, long

Estimated U.S. Distribution



Triatoma incrassate

Key characteristics:

1. Abdomen entirely yellow underneath with distinct yellow margin around edge on top
2. Head elevated above eyes in lateral view
3. Mouthparts with short hairs, longer hairs on terminal segment
4. Pronotum uniformly dark
5. Tip of scutellum short, broad

Estimated U.S. Distribution

Maps and images courtesy of the Centers for Disease Control and Prevention, Global Health, Division of Parasitic Diseases. Page last reviewed 2013.

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Triatoma indictiva

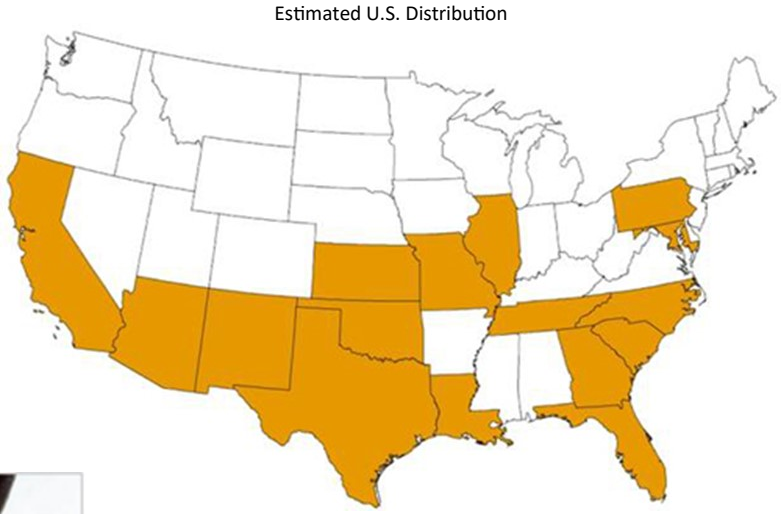
Key characteristics:

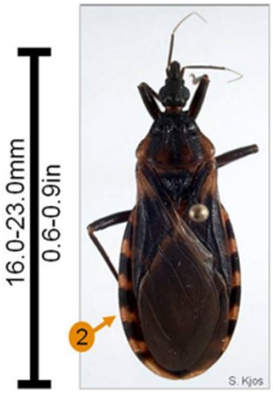
1. Reddish-orange markings extending horizontally on abdominal segments confined to ~1/5 of each segment
2. Pronotum uniformly black
3. Wings without prominent, light-colored markings

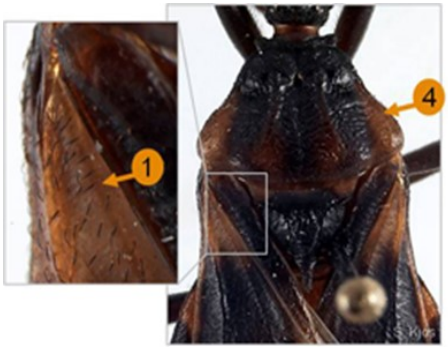
Triatoma lecticularia

Key characteristics:

1. Dark hairs covering entire body
2. Orange-yellow markings extending horizontally on abdominal segments
3. Mouthparts with hairs on all segments, denser on terminal segments
4. Pronotum with orange-yellow lateral markings
5. Legs covered with hair







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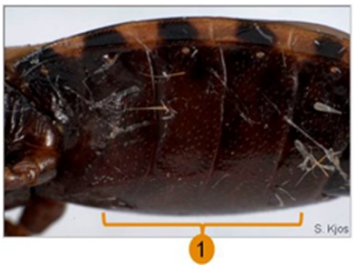
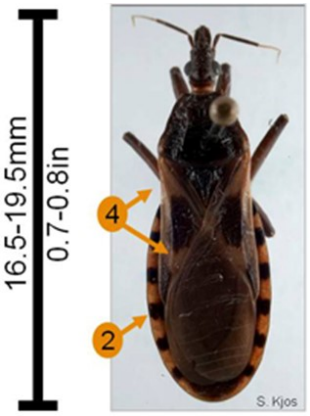
Triatoma neotomae

Key characteristics:

1. Body shiny, abdomen longitudinally flattened underneath
2. Black, irregularly-shaped band on each abdominal segment surrounded by yellow markings
3. Mouthparts with hairs on all segments, denser at junction of terminal 2 segments forming a brush like structure
4. Wings with distinct orange to pale yellow markings on basal half
5. Legs short, stout



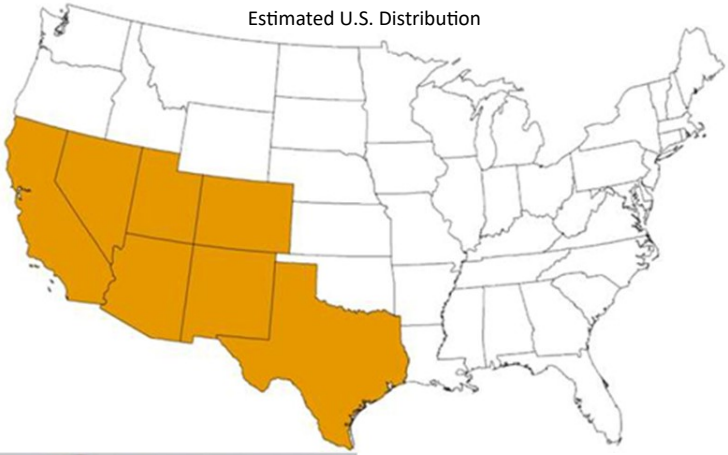


Triatoma protracta

Key characteristics:

There are 3 subspecies known (protracta, navajoensis, woodi) have been reported from the U.S. They are polymorphic in appearance. *T. protracta woodi* is featured in the images here.

1. Overall dark brown to black
2. Mouthparts with short hairs; becoming longer at tip
3. Pronotum uniformly light brown to black
4. Tip of scutellum short, broad
5. Legs short, stout



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Triatoma recurva

Key characteristics:

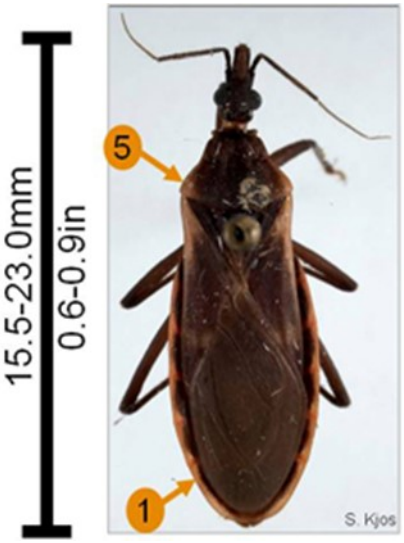
1. Yellow-orange margin around outer edge of abdomen; abdomen wide often strongly curved up at edges
2. Mouthparts relatively hairless with longer hairs at tip
3. Pronotum uniformly dark colored
4. Tip of scutellum long, narrow
5. Wings uniformly dark colored
6. Legs long, slender

Triatoma rubida

Key characteristics:

There are 3 subspecies known (protracta, navajoensis, woodi) have been reported from the U.S. They are polymorphic in appearance. *T. protracta woodi* is featured in the images here.

1. Overall dark brown to black
2. Mouthparts with short hairs; becoming longer at tip
3. Pronotum uniformly light brown to black
4. Tip of scutellum short, broad
5. Legs short, stout



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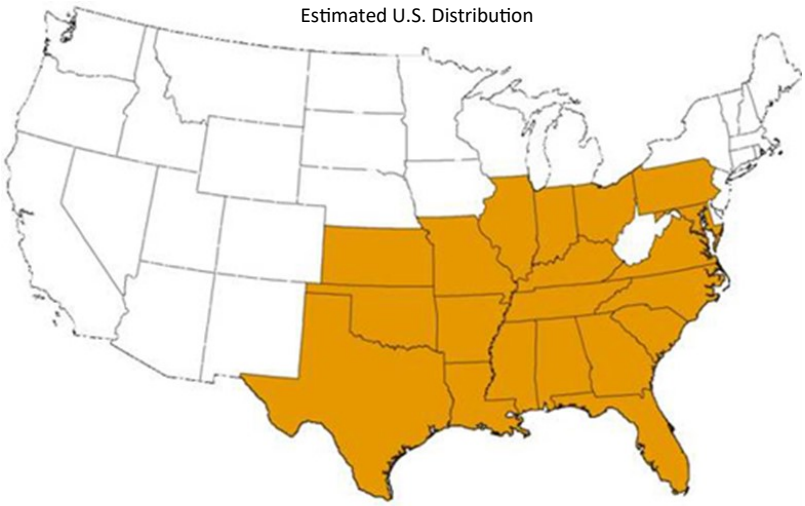
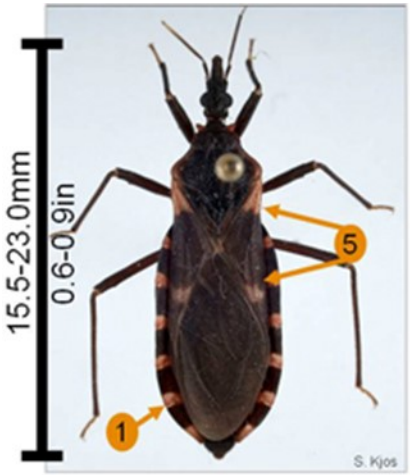
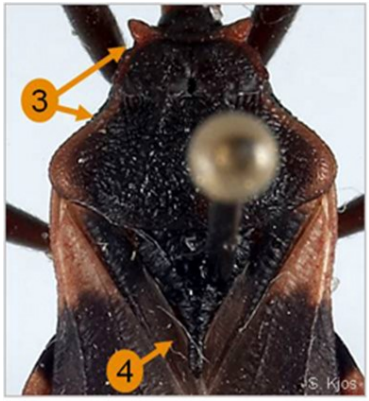
Triatoma sanguisuga



Key characteristics:

1. Orange-red to yellowish horizontal markings covering of abdominal segment
2. Mouthparts relatively hairless
3. Pronotum black with orange-red to yellowish side and top margins
4. Tip of scutellum long, narrow
5. Distinctive orange-red to yellowish markings on wings





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U.S. Civilian Vector Control Contacts

Texas

Harris County Public Health Mosquito Control Division
3330 Old Spanish Trail, Bldg. D
Houston, TX 77021
Phone: (713) 440-4800
Fax: (713) 440-4795

Cameron County
Department of Health & Human Services
1390 W. Expressway 83
San Benito, Texas. 78586
Phone: (956) 247-3625

Hidalgo Co. Health Department
Environmental Health Division
1304 S 25th Ave.
Edinburg, Tx 78539
Phone: (956) 383-0111
Fax: (956) 383-7351
E-mail: *environmental@hchd.org*

Zapata County Department Environmental and Animal Control Office
2505 N. US Hwy 83
Zapata, TX 78076
Phone: 956.765.6201
Fax: 956.765.6186

Webb County: City of Laredo Health Department Vector Control
2600 Cedar Ave., P.O. Box 2337, Laredo, TX 78044
Fax. (956) 726-2632
Phone: 956-795-4904

Maverick County: City of Eagle Pass Animal Services
100 S. Monroe
Eagle Pass, Texas 78852
Phone: 830-773-1111
Fax: 830-773-9170

Val Verde County: City of Del Rio Vector Control
203 Ave. P
Del Rio, TX 78840
Phone: 830-774-7250

El Paso County: City of El Paso Vector Control
300 N. Campbell
El Paso, Texas 79901
Phone: 915-212-0134

New Mexico

Lea County Vector Control
1019 East Bender Boulevard
Hobbs, NM 88240
Phone: 575-391-2983

New Mexico

Eddy County Vector Control Department
Johnny Munoz
410 E Derrick Road
Carlsbad, NM 88220
Phone: 575-885-4835 (Carlsbad) AND 575-746-9540 (Artesia)

Dona Ana County Vector Control
845 N Motel Blvd
Las Cruces, New Mexico 88007
Phone: 575-526-8150
Fax: 575-525-5951

Arizona

Cochise County Vector Control Program
1415 Melody Lane
Bldg. A
Bisbee, AZ 85603
Phone: 520-586-8200

Santa Cruz County Mosquito Information
2150 N. Congress Drive
Nogales, AZ 85621
Phone: 520-375-7900
Fax: 520-375-7904

Pima County Vector (Mosquito and Cockroach) Control
3950 S. Country Club Road
Ste. 100
Tucson, Arizona 85714
Phone: 520-724-7908
Fax: 520-724-9597

Yuma County Vector Control (Mosquito Control and Prevention)
2200 West 28th Street
Suite 222
Yuma, Arizona 85634
Phone: 928-317-4584
Fax: 928-317-4583

California

Imperial County Environmental Health: Bee – Mosquitoes
797 Main Street
Suite B
El Centro, CA 92243
Phone: 442-265-1888
Fax: 442-265-1903

San Diego County Vector Control Program
5570 Overland Avenue
Suite 102
San Diego, CA 92123
Phone: 858-694-2888
Fax: 858-571-4268
Email: vector@sdcounty.ca.gov