Vector Hazard Report Forecast: U.S./ Mexico Border
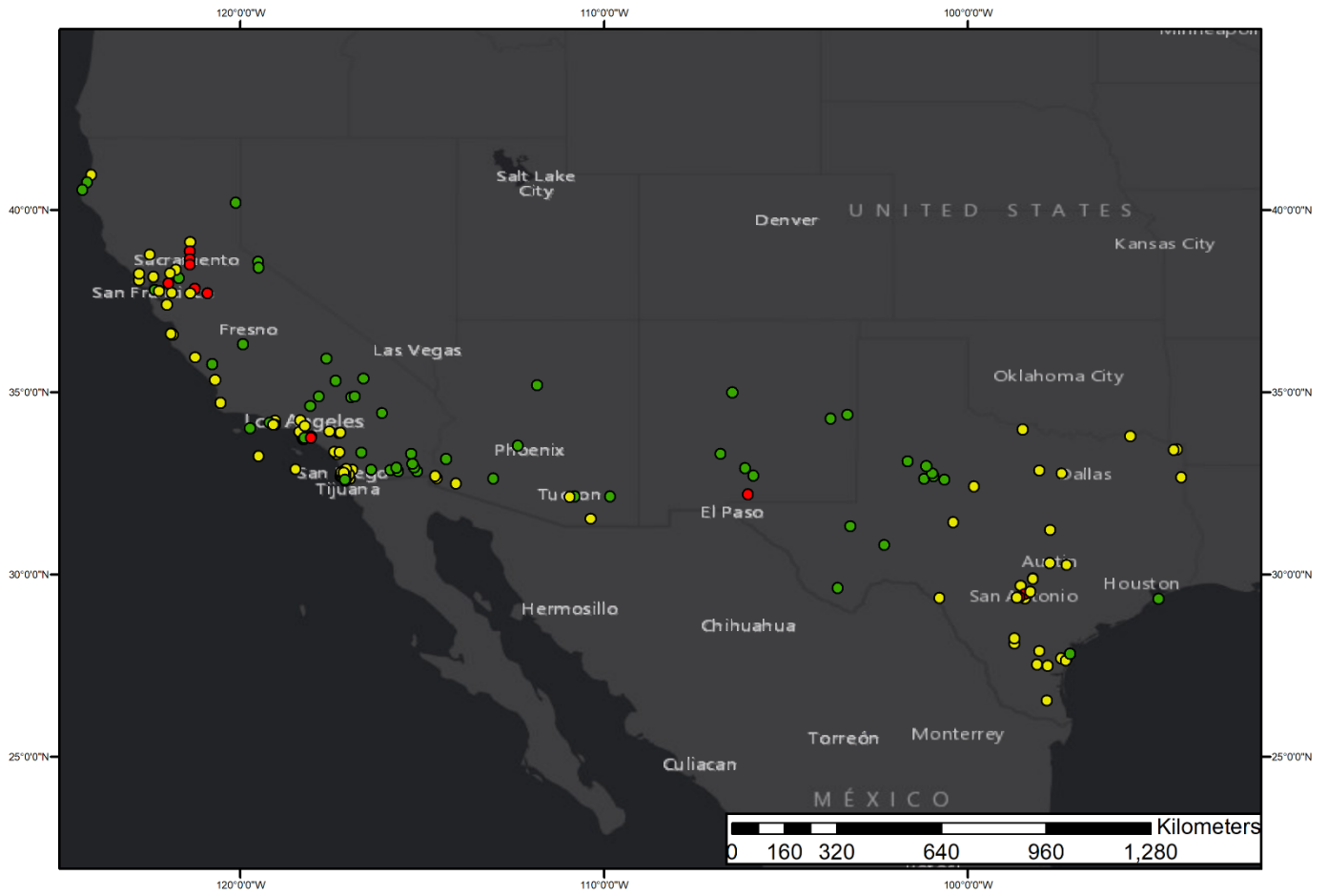
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Forecast Dates: 5 to 15 November 2019

Forecast Background: We have conducted an analysis using mosquito activity temperature thresholds, forecasted maximum daily temperatures, vector species habitat suitability models and locations of CONUS U.S. military installations to answer the question: "is mosquito vector activity likely here?" Our analysis includes three habitat suitability models for West Nile virus mosquito vector species reported from North America (*Culex tarsalis*, *Cx. quinquefasciatus* and *Cx. pipiens*) in addition to Zika, chikungunya and dengue fever virus vectors (*Aedes aegypti* and *Ae. albopictus*). The overall risk score for each installation is based on habitat suitability for all five vectors, temperature suitability during the forecast dates and installation-level mosquito surveillance data compiled from September to October, 2019. This three-tier system is summarized in **Figure 1**. Habitat suitability models for *Culex* sp. were developed using surveillance data from VectorMap and a maximum-entropy modeling approach. Habitat suitability for *Aedes* sp. were derived from the average yearly habitat suitability models of Kraemer *et al*. 2015. We have also included surveillance data collected on some installations provided by Army Public Health Command-Central from September to October, 2019. Forecasted mean maximum temperature data for each installation was obtained from the Climate Prediction Center, NOAA, U.S. National Weather Service. For this analysis, we have conservatively set the temperature suitability for all vectors between 13 - 38° C meaning if maximum temperatures fall within this range, mosquito activity is possible (Rueda, 1990). For more information about this analysis please view Foley & Pecor, 2016; Foley & Pecor, 2018. It is our goal to provide situational awareness and guidance on timing and locations of vector surveillance activities. Please note that our projections are based on habitat suitability predictions, and daily maximum temperature forecasts. Vigilant vector surveillance is necessary to confirm mosquito activity.

Results: Our latest forecast indicates that all installations in California, Arizona, New Mexico and Texas are expected to experience maximum daily temperatures supporting mosquito activity in early November. Vector surveillance is highly recommended for 9 facilities where habitat suitability models predict a high probability of encountering multiple vector species and/ or recent surveillance has detected vector species (**Figure 2**). However, our analysis indicates that surveillance is also recommended for an additional 83 facilities across Arizona, California, New Mexico and Texas. It is important to note that vectors of dengue, chikungunya, Zika and yellow fever viruses (*Ae. aegypti* and *Ae. albopictus*), vectors of West Nile virus (*Culex tarsalis*, *Cx. quinquefasciatus* and *Cx. pipiens*) and vectors of malaria (*Anopheles freeborni* and *An*. *quadrimaculatus*) will remain active throughout early November. We continue to recommend that surveillance activity be conducted when maximum daily temperatures fall within 13C/55F to 38C/100F. To view maps of vector-borne disease incidence data for 2019 by US county visit ArboNET Disease Maps CDC.

Figure 1:

Map of U.S. military facilities within states bordering Mexico. Colors indicate predicted risk designation, (i.e. Green, low risk and Red, high risk).

Overall Risk Score	Interpretation
0 to 2	Our analysis indicates a low probablity of any vector species occurance, Surveillance not reccomended
3 to 5	Our analysis indicates a high probablity of multiple vector species occurance and temperature suitabilty but no surveillance data is available; Surveillance reccomended
6 to 10	Our analysis indicates a high probablity of multiple vector species activity and/ or recent surveillance has detected 1 or more of the species; Surveillance highly reccomended

Three-tier system based on the number of vector species predicted to occur at each installation, forecasted temperature suitability and recent mosquito surveillance.

Figure 2:

Facility Name	State
Fort Sam Houston	Texas
Lackland AFB	Texas
Naval Operational Support Center Sacramento	California
McClellan AFB	California
Los Alamitos Reserve Center and Air Station	California
Seal Beach Naval Weapons Station	California
Defense Distribution Region West Sharpe Site	California
Naval Weapons Station Seal Beach (Concord Detachment)	California
Fort Bliss	New Mexico

Facilities Designated 'High Risk' for mosquito activity based on habitat and temperature suitability as well as recent surveillance results.

References:

Foley, D. H., & Pecor, D. B. (2018). An Excel Spreadsheet Tool for Exploring the Seasonality of Aedes Vector Hazard for User-Specified Administrative Regions of Brazil. US Army Medical Department Journal, Jan-Jun. 22-29.

Foley, D. H., & Pecor, D. B. (2016). A location-specific spreadsheet for estimating Zika risk and timing for Zika vector surveillance, using US military facilities as an example. BioRxiv, 088823

Kraemer, M. U., Sinka, M. E., Duda, K. A., Mylne, A. Q., Shearer, F. M., Barker, C. M., ... & Hendrickx, G. (2015). The global distribution of the arbovirus vectors Aedes aegypti and Ae. albopictus. elife, 4, e08347.

Rueda, L. M., Patel, K. J., Axtell, R. C., & Stinner, R. E. (1990). Temperature-dependent development and survival rates of Culex quinquefasciatus and Aedes aegypti (Diptera: Culicidae). Journal of medical entomology, 27(5), 892-898.