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Malaria and West Nile Virus in the US: a tale from the past to inform the future

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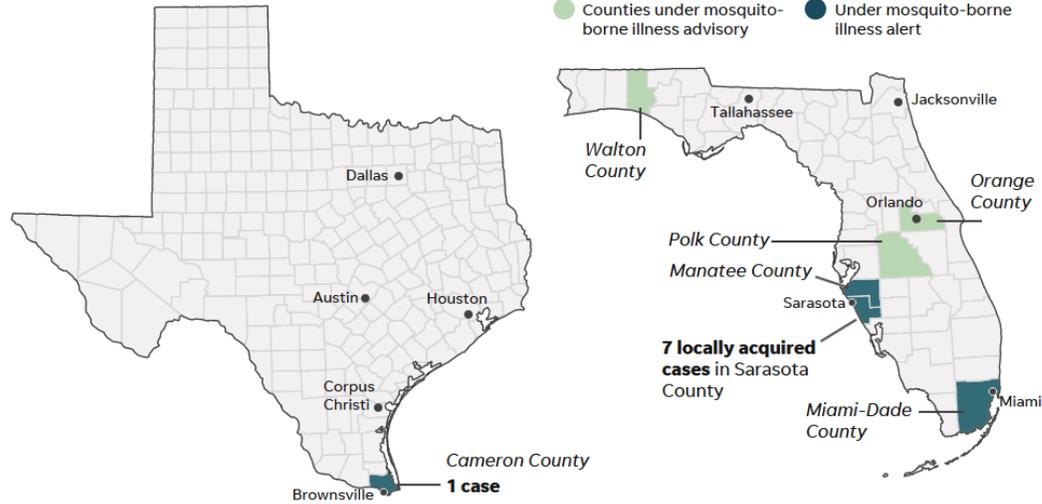
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Malaria cases in Texas and Florida

Each year, Texas experiences about 120 cases of malaria brought on by travel. In 1994, Texas reported its last locally acquired case.

The number of locally acquired malaria infections in Florida this year has risen to seven as of July 18.



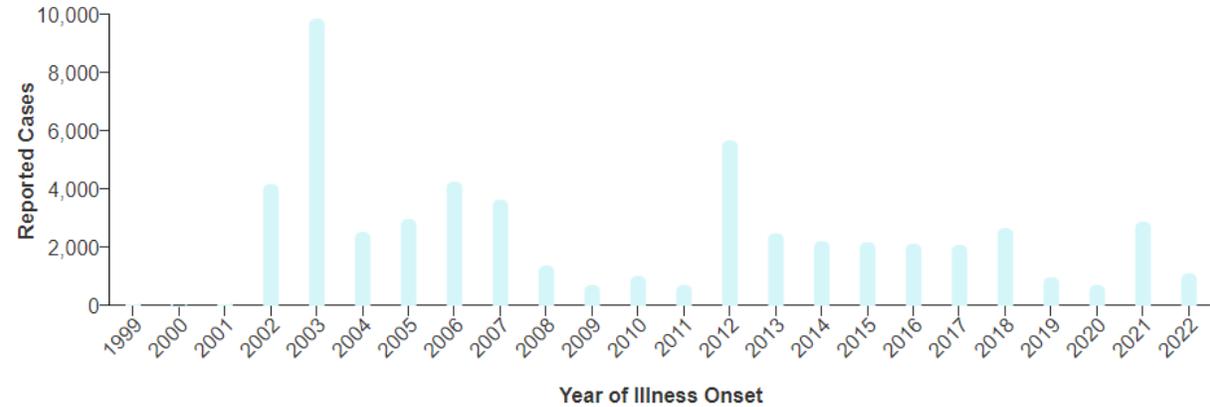
SOURCE Florida Department of Health from July 2-8, GRAPHIC Janet Loehrke/USA TODAY

<https://www.usatoday.com/story/graphics/2023/07/12/malaria-cases-florida-texas-explained/70400044007/>



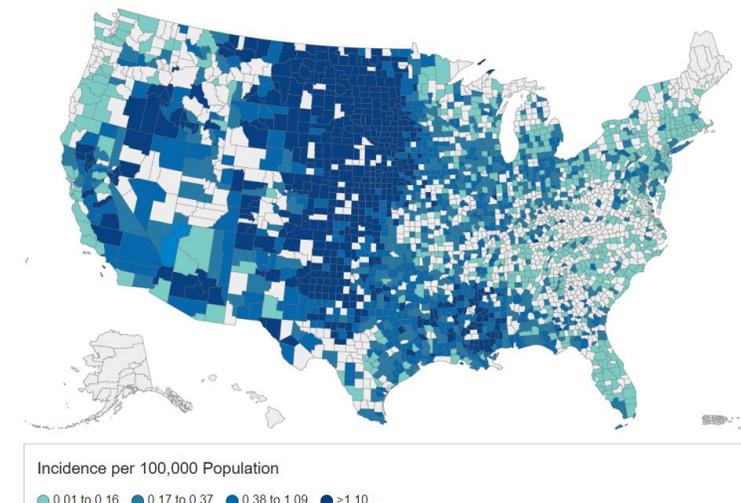
Malaria and West Nile virus: different threat and concern

West Nile virus human disease cases by year of illness onset, 1999-2022



Source: Arbonet

West Nile virus human neuroinvasive disease average annual incidence per 100,000 population by county of residence, 1999-2022*



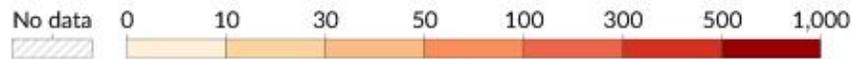
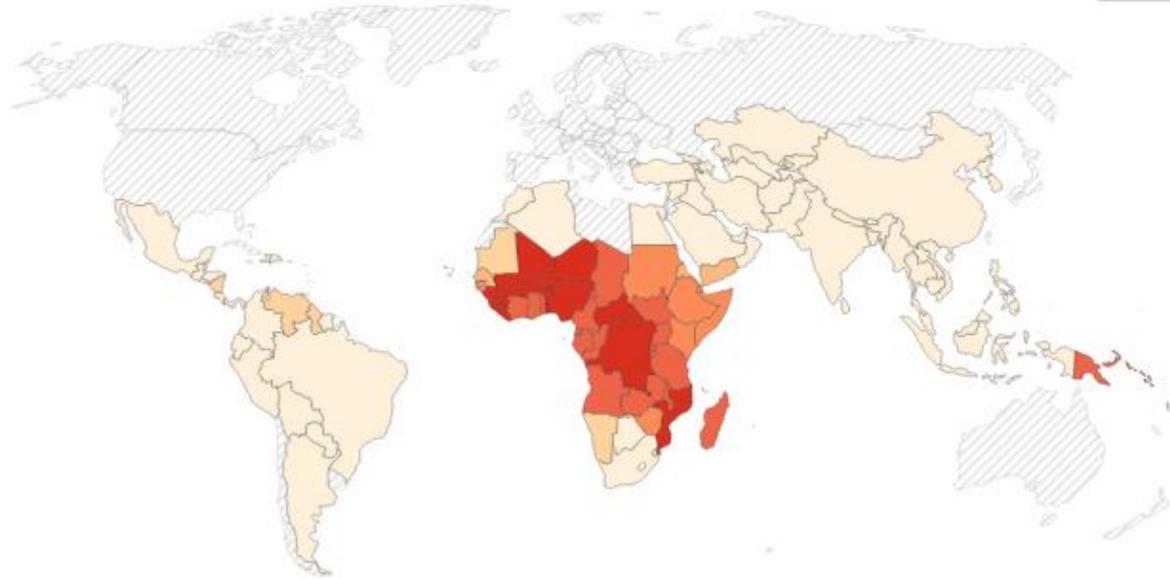
Malaria: no reason to panic

Incidence of malaria, 2020

Incidence of malaria is the number of new cases of malaria in a year per 1,000 population at risk.

Our World in Data

World



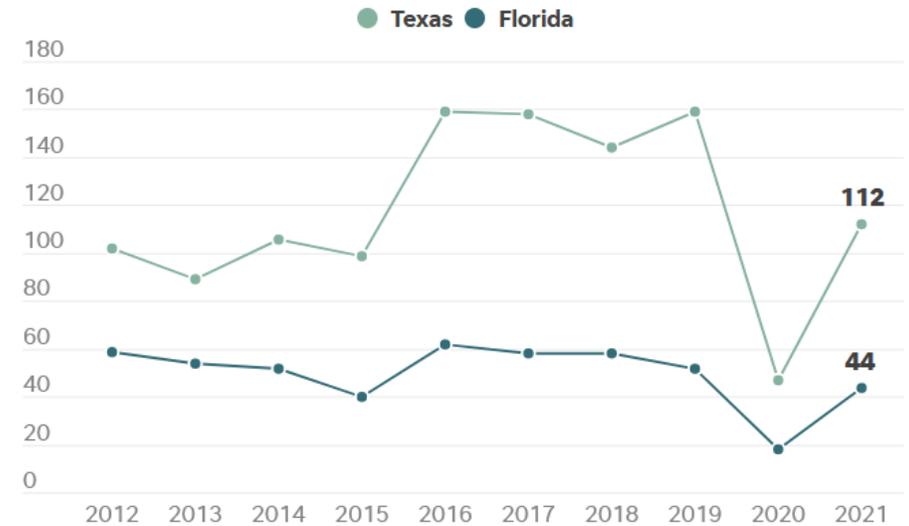
Source: World Health Organization (via World Bank)

OurWorldInData.org/malaria • CC BY

Malaria cannot be transferred through sexual activity and is not contagious like the common cold or the flu.

Past cases of malaria in Texas and Florida

Number of reported cases of malaria by year, 2012-2021



- While significant progress has been made, malaria still persists as a public health concern in Africa and, to a lesser extent, in Asia and LAC.
- *P. falciparum* and *P. vivax* malaria are prevalent (*P.f* more serious)
- Introductions of *Plasmodium* sp. To the US via travelers are common.

Malaria vectors: expanding and more aggressive?

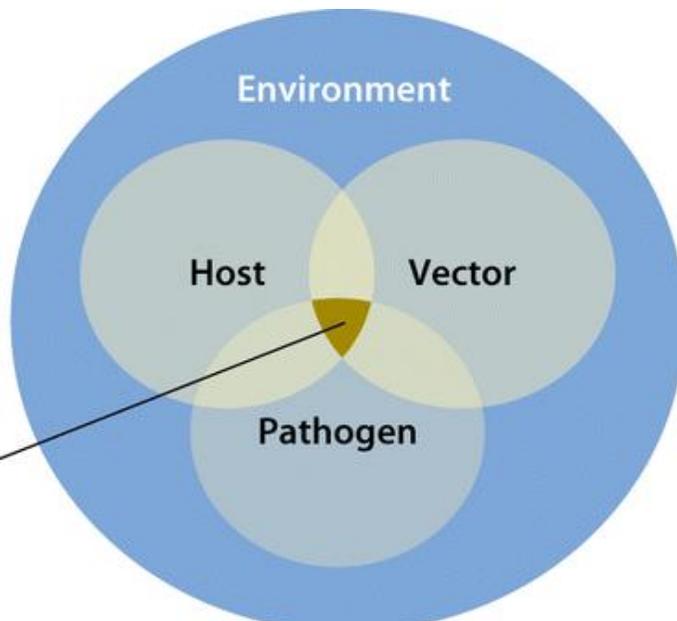


Image: Reisen, 2010. *Ann. Rev. Entomol.*



Mosquito collection, Emory University Field Station on Ichuaway Plantation, Baker County, Georgia, ca. 1938-1945. Photograph by United States Public Health Services Office of Malaria Control in War Areas,

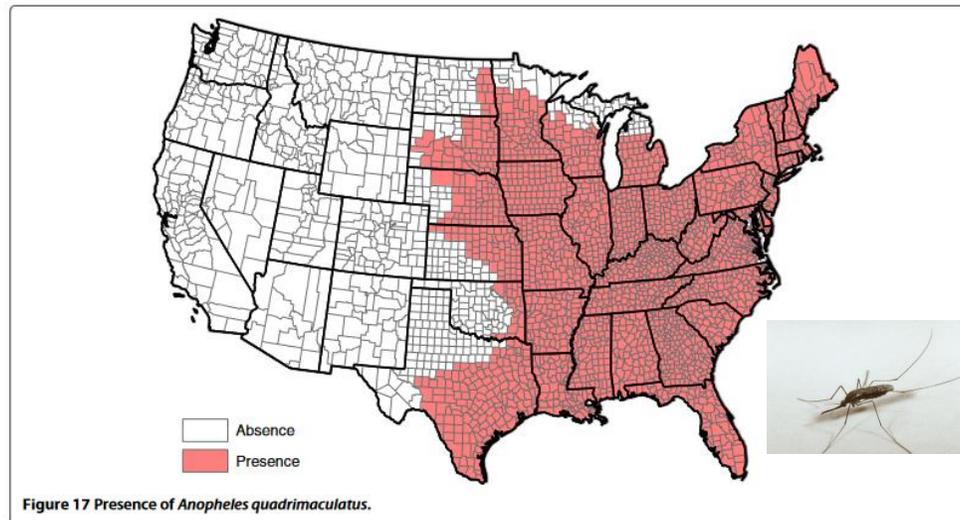


Figure 17 Presence of *Anopheles quadrimaculatus*.

Wang et al. *Parasites & Vectors* 2014, 7:264

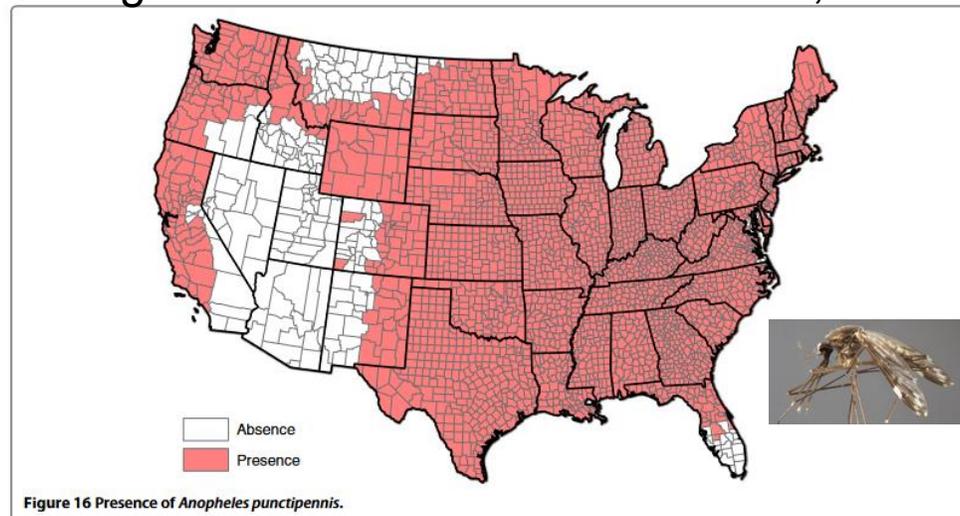
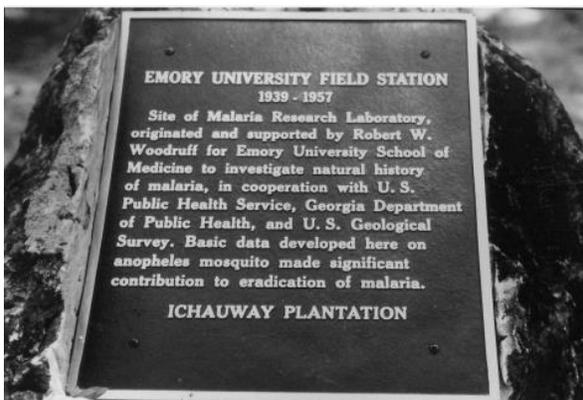
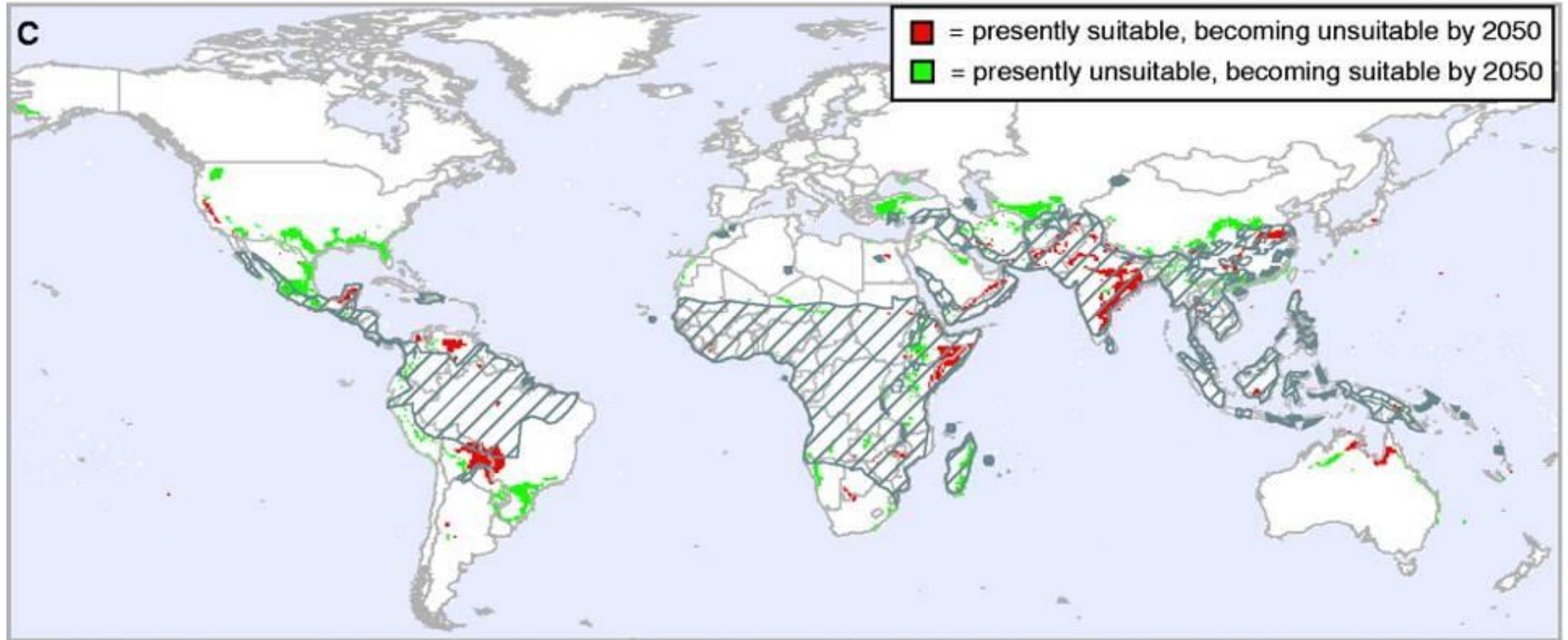


Figure 16 Presence of *Anopheles punctipennis*.



The Global Spread of Malaria in a Future, Warmer World

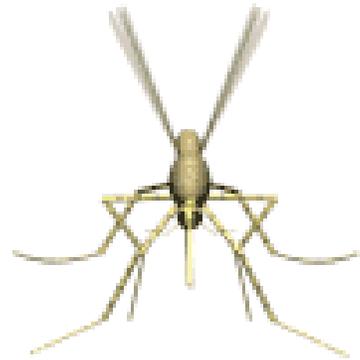
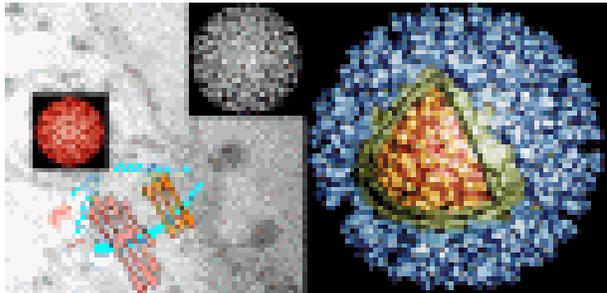
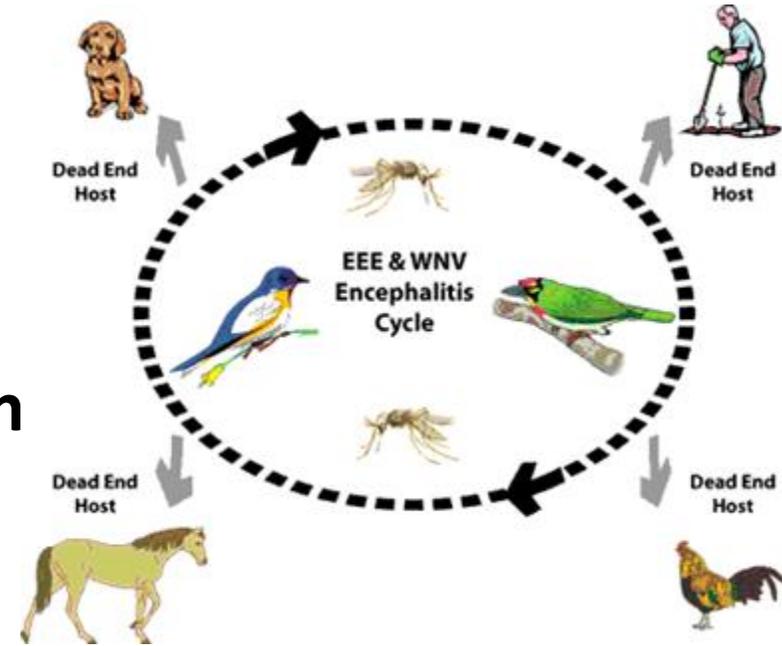


The increases in travel and human-vector contacts may make some areas (in the US) more favorable for the occurrence of sporadic locally-acquired cases.

Vector-borne zoonosis: when humans and wildlife collide

- ◆ Vector survival
- ◆ Presence of reservoir hosts
- ◆ Pathogen amplification and transmission
- ◆ Opportunities for human exposure

Complex Impact of climate



Climate, weather and VBZD

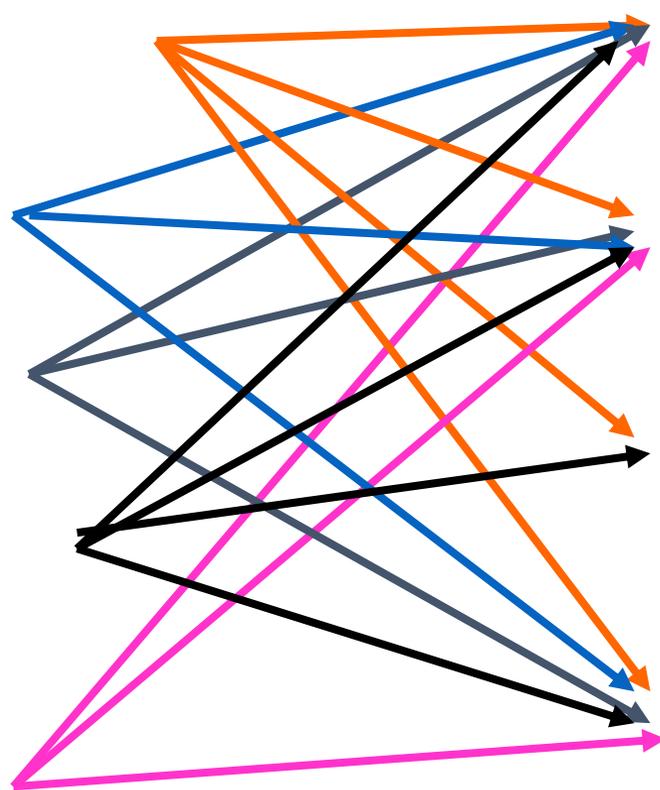
Temperature

Rainfall

Humidity

Variability

Extreme
Events



Vector survival

Presence of
reservoir hosts

Pathogen
transmission

Opportunities for
human exposure

Difficulty to
predict how
bad WNV
transmission
will be in
future years



Infection of
reservoir
hosts

Disease of
human
hosts



Multi-Year Comparison of Community- and Species-Level West Nile Virus Antibody Prevalence in Birds from Atlanta, Georgia and Chicago, Illinois, 2005–2016

Joseph R. McMillan,¹ Gabriel L. Hamer,² Rebecca S. Levine,¹ Daniel G. Mead,³ Lance A. Waller,^{1,4} Tony L. Goldberg,⁵ Edward D. Walker,⁶ Jeffrey D. Brawn,⁷ Marilyn O. Ruiz,^{8,†} Uriel Kitron,^{1,9} and Gonzalo Vazquez-Prokopec^{1,9*}

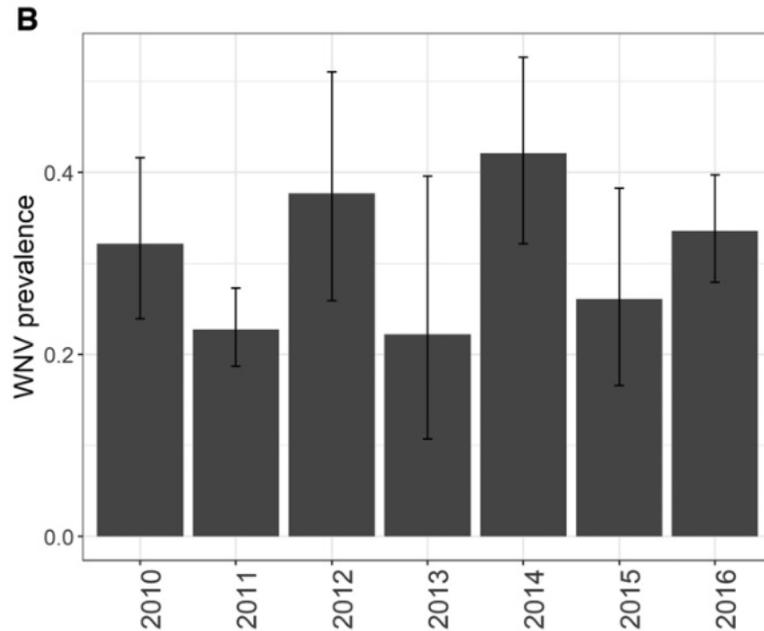


FIGURE 3. (A) Estimated WNV seroprevalence in birds by sampling location in Atlanta, Georgia, 2010–2016. (B) Estimated WNV seroprev-

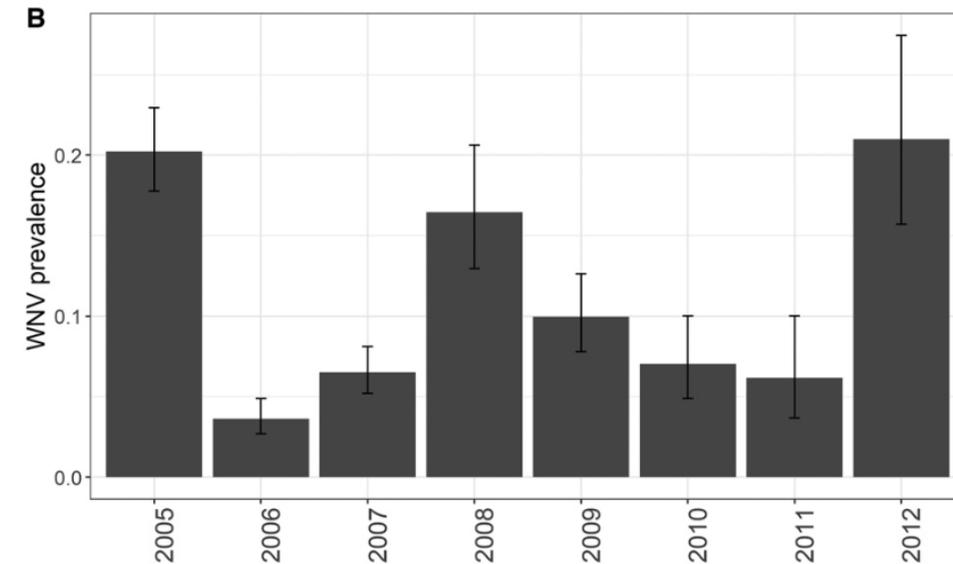


FIGURE 4. (A) Estimated WNV seroprevalence in birds by location in Chicago, Illinois, 2005–2012. (B) Estimated WNV seroprevalence in birds by year in Chicago, Illinois, 2005–2012. Bars represent the estimate; lines represent the 95% CI of the estimate. Sampling location maps and descrip-

- Bird seroprevalence (% birds w/WNV antibodies) varies by year and location.
- Poor predictability of susceptibility and the intensity of WNV transmission.

Conclusions

- In an increasingly globalized world, vector-borne disease **(re)emergence will be more common.**
- When vector-human-environments are suitable, malaria introductions will lead **to localized transmission:** need to ascertain case and understand vector ecology and control options.
- Travelers and clinicians need to be better educated about post-travel behavior: **use repellent to prevent pathogen introductions!**
- **West Nile virus is endemic in the US.** Cycles or increases in transmission in geographic areas are likely due to reduction in immunity in avian reservoirs. Humans are colliding with a heterogeneous transmission cycle.