

Dengue Fever: A Threat to the Southeastern United States?

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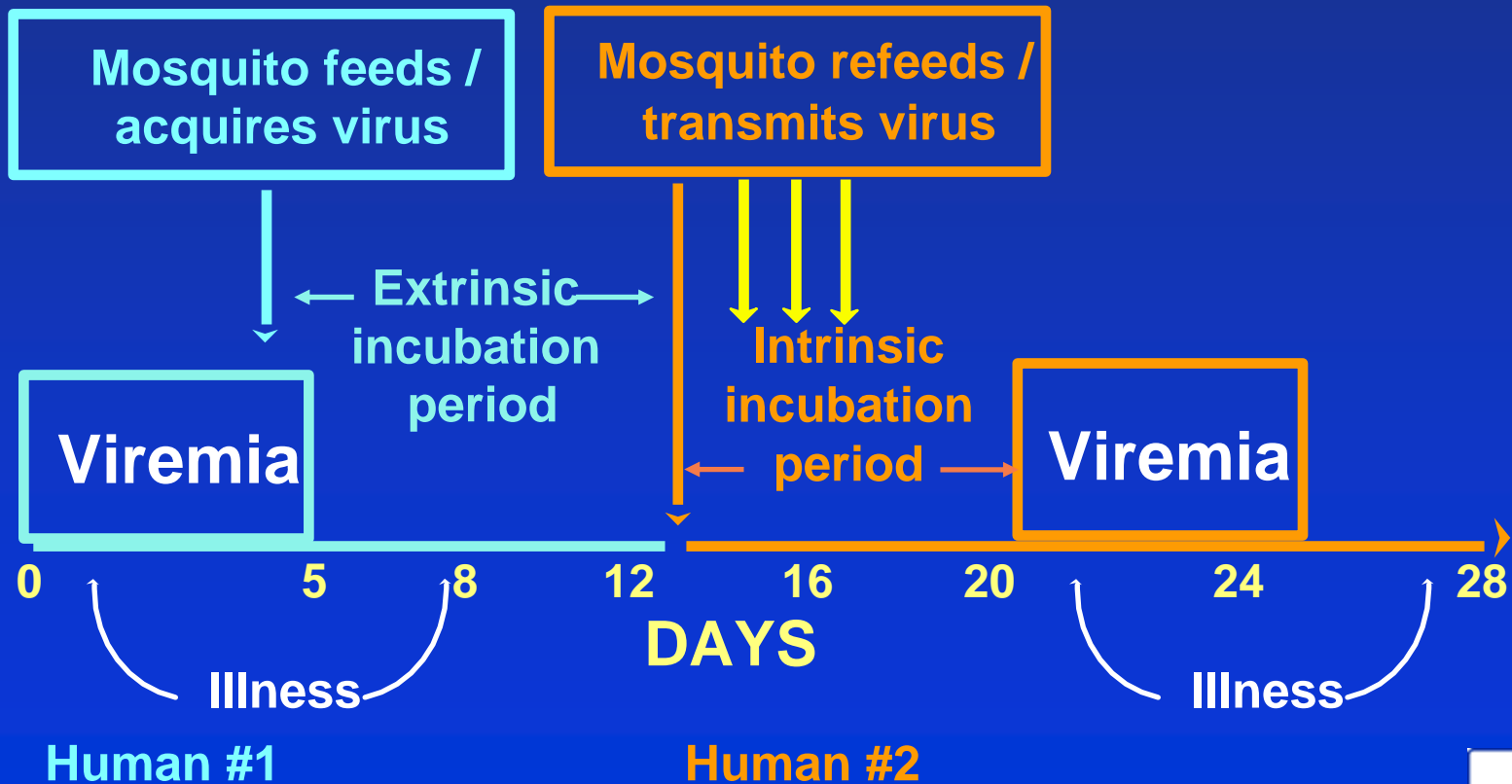
Dengue virus

- An arbovirus; transmitted by mosquitoes
- Four virus serotypes (DEN-1, 2, 3, 4)
- Causes dengue (headache, fever, joint/retrorbital pain, rash, bleeding) and dengue hemorrhagic fever (DHF)

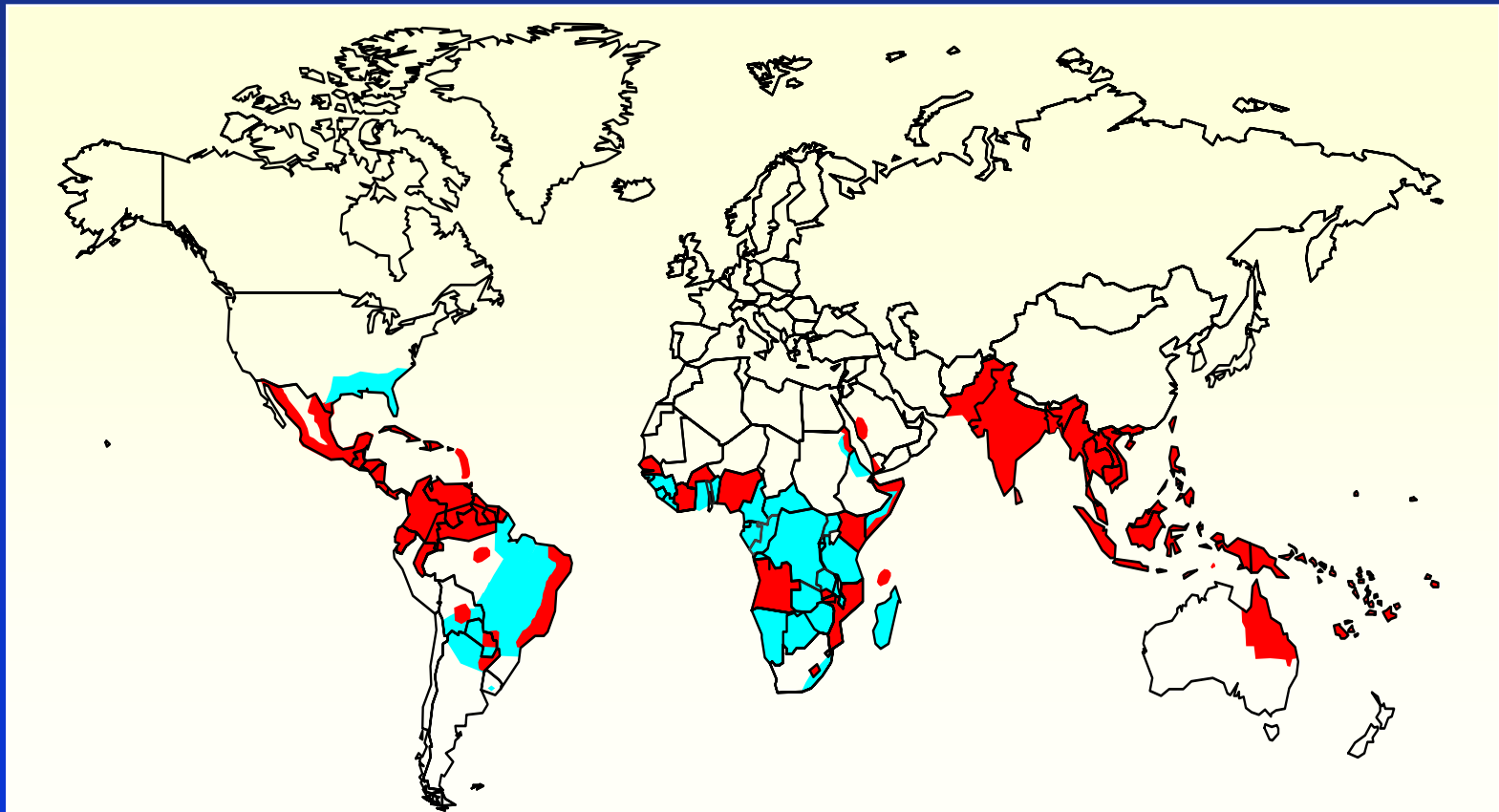
Dengue viruses

- Each serotype provides specific lifetime immunity but only short-term cross-immunity
- All serotypes can cause severe and fatal disease
- Genetic variation within serotypes; some appear to be more virulent or have greater epidemic potential

Transmission of dengue virus by *Aedes aegypti*

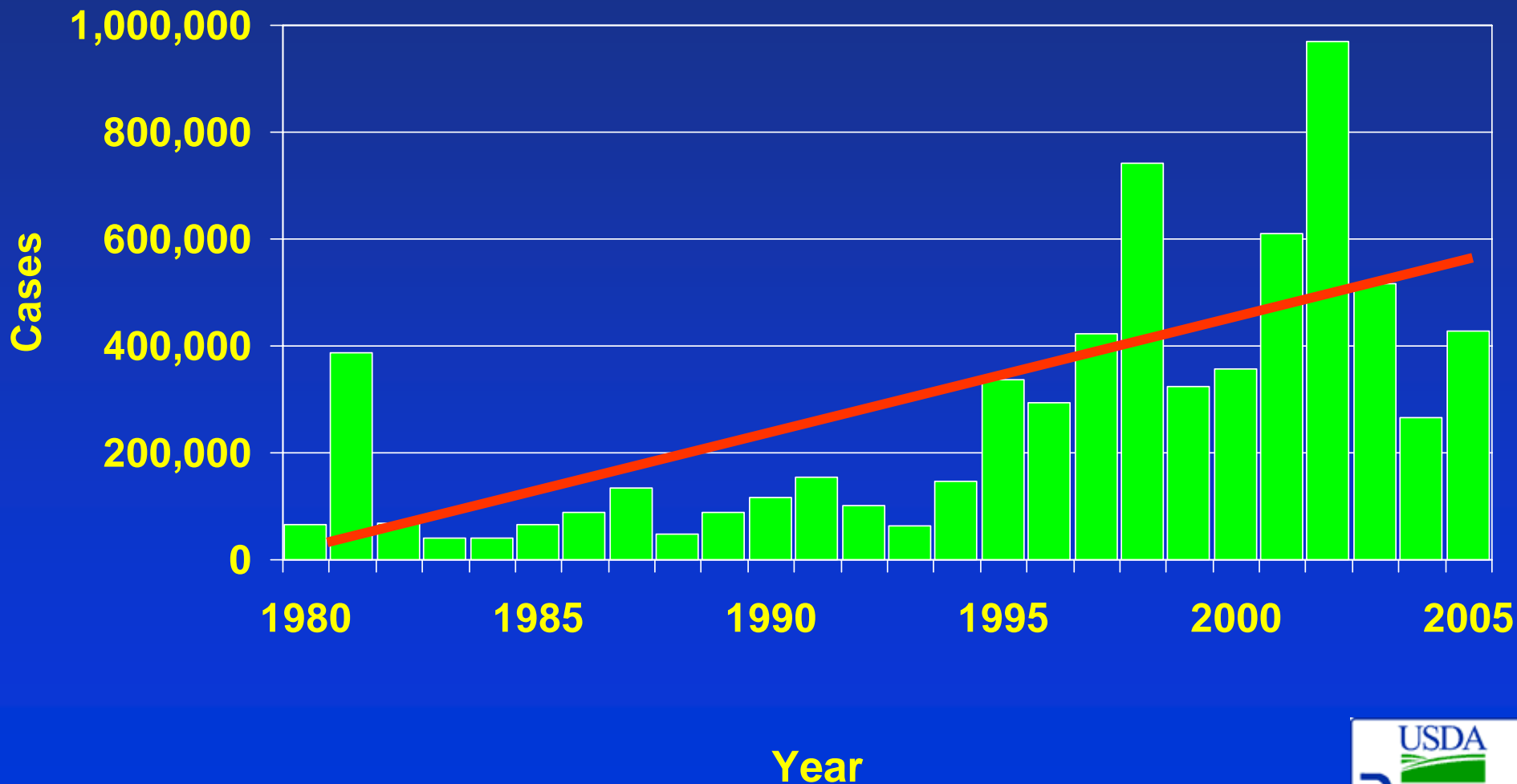


World distribution of dengue 2005



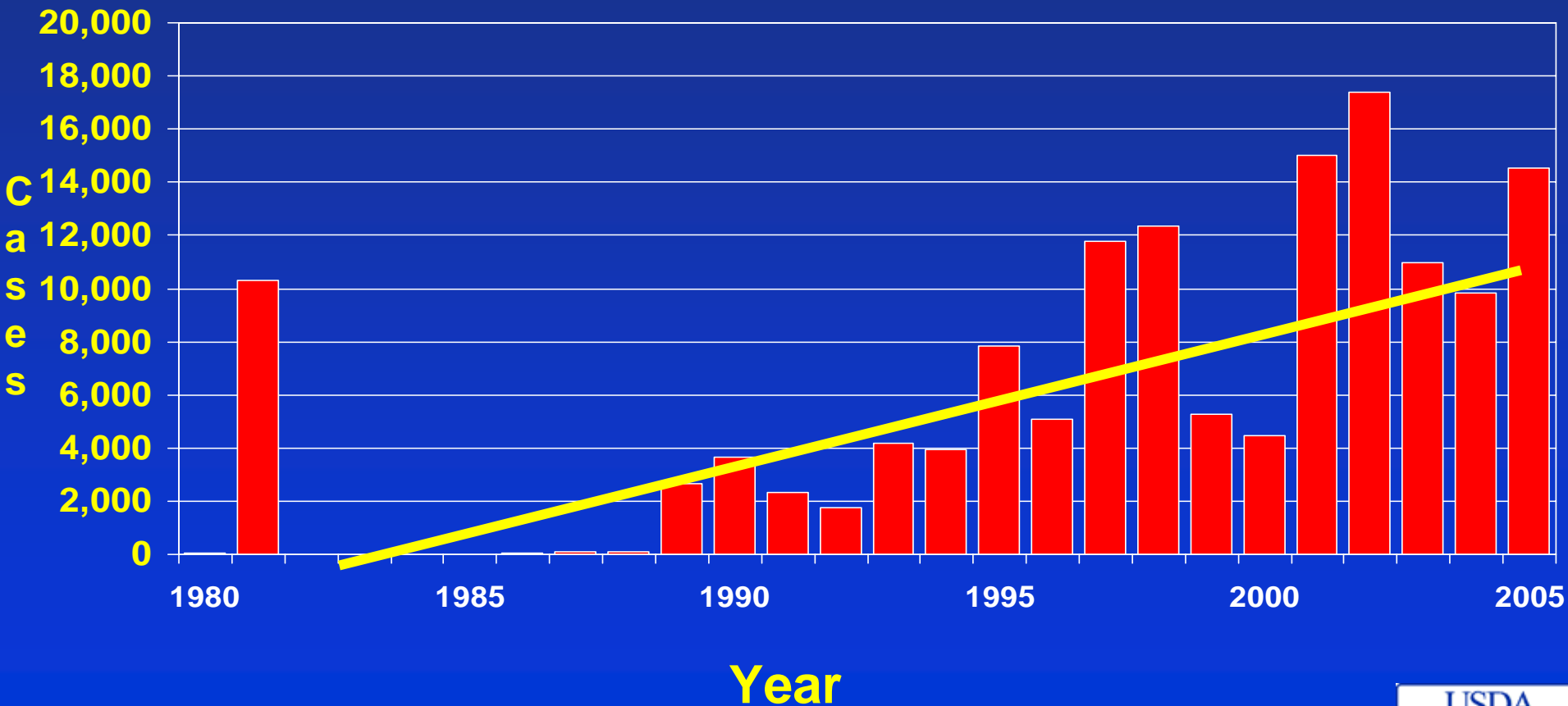
- Areas infested with *Aedes aegypti*
- Areas with *Ae. aegypti* and recent dengue epidemics

Dengue in the Americas 1980 – 2005*



* Source: PAHO (Jun. 22, 2006)

Dengue hemorrhagic fever in the Americas 1980 – 2005*



* Source: PAHO (Jun. 22, 2006)

Critical factors needed for local transmission of dengue in the southeastern U.S.

- Presence of a competent vector (*Aedes aegypti* and/or *Aedes albopictus*)
- Frequent introductions of dengue viruses (in humans) during periods when vectors are active and abundant

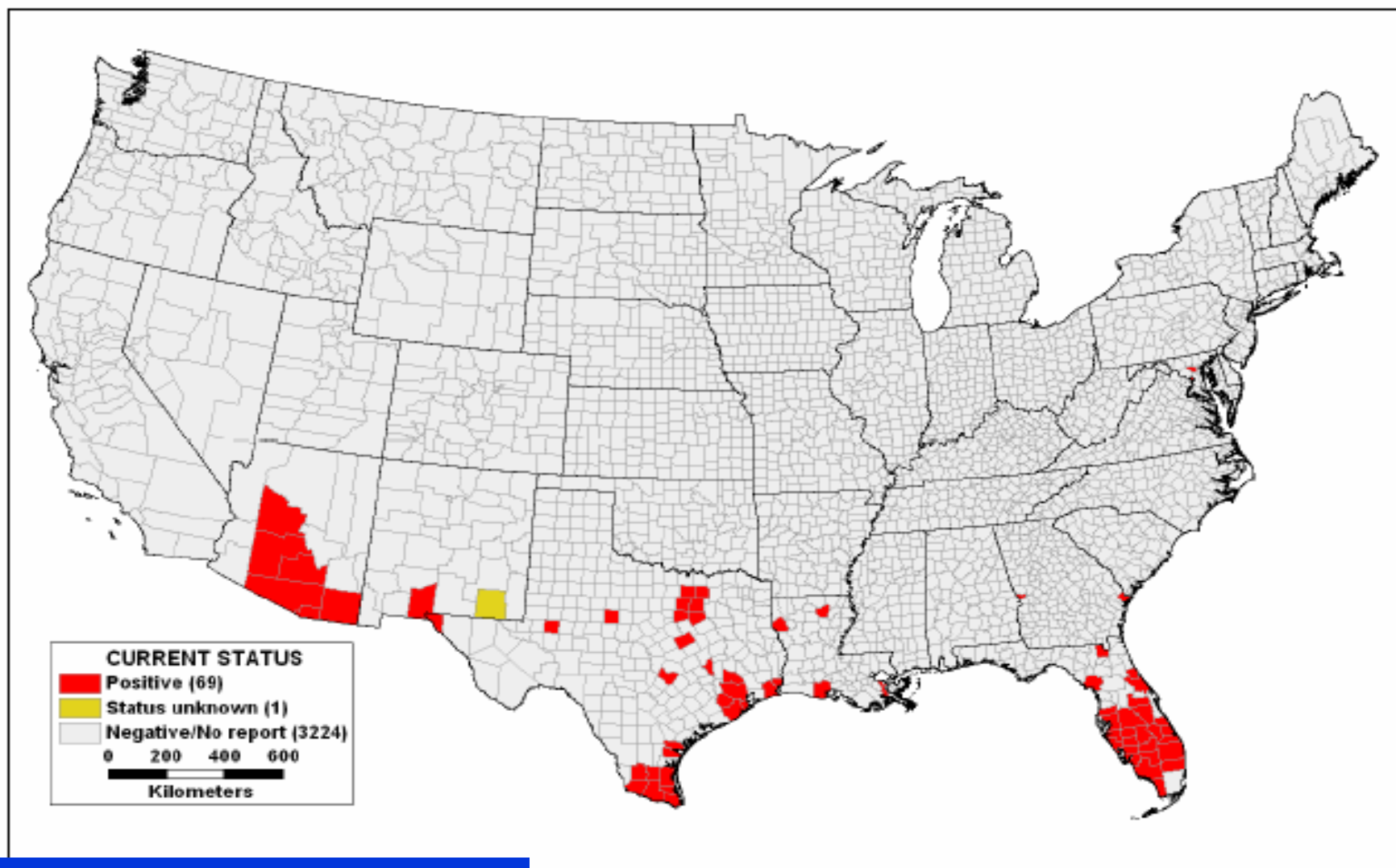
Aedes aegypti



Aedes aegypti

- Lives around human habitations in urban areas
- Lays eggs and produces larvae preferentially in artificial containers
- Strong preference for human blood; primarily a daytime feeder often found indoors
- Most important vector of dengue viruses in the world

Reported distribution of *Aedes aegypti* in the U.S., 2005



Courtesy: Dr. Chester Moore

Aedes albopictus

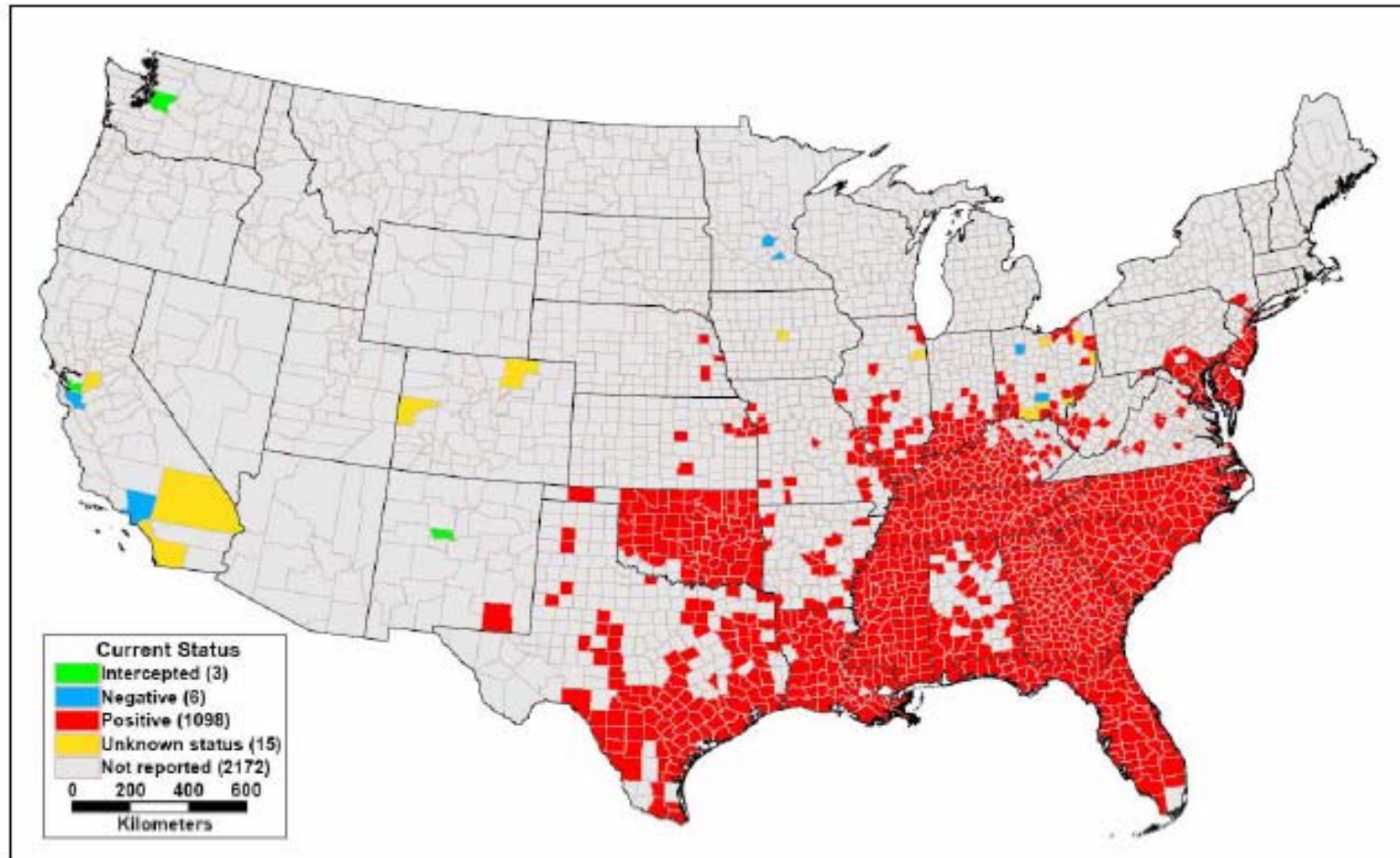


Photo: Courtesy Oklahoma State University

Aedes albopictus

- Lives near human habitations in suburban/rural areas
- Lays eggs and produces larvae in natural or artificial containers
- Female regarded as “catholic” feeder
- An aggressive, daytime feeder in outdoor areas
- Very competent vector of DEN viruses in the laboratory

Reported distribution of *Aedes albopictus* in the U.S., 2005

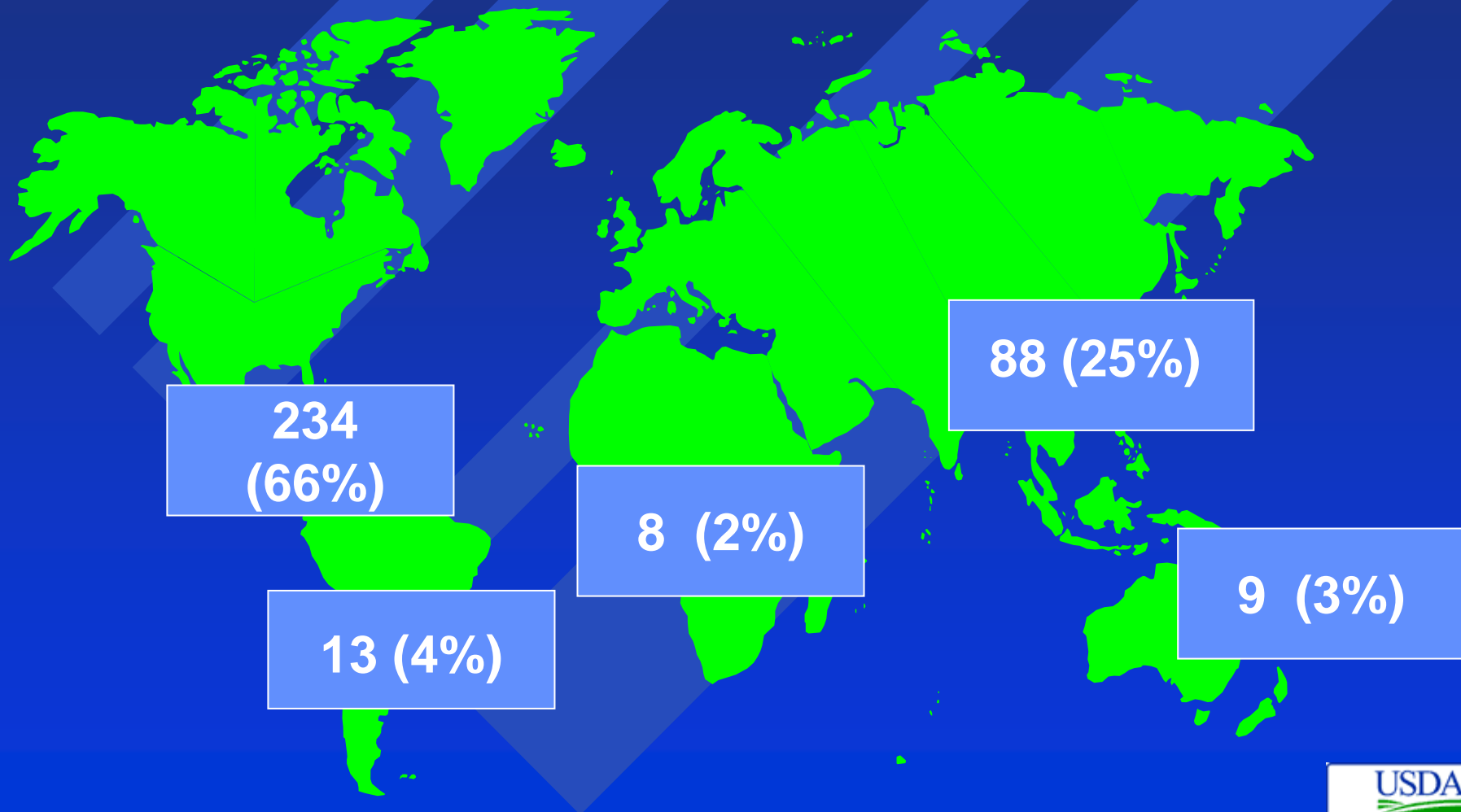


Courtesy: Dr. Chester Moore

Factors favoring dengue transmission in southeastern U.S.

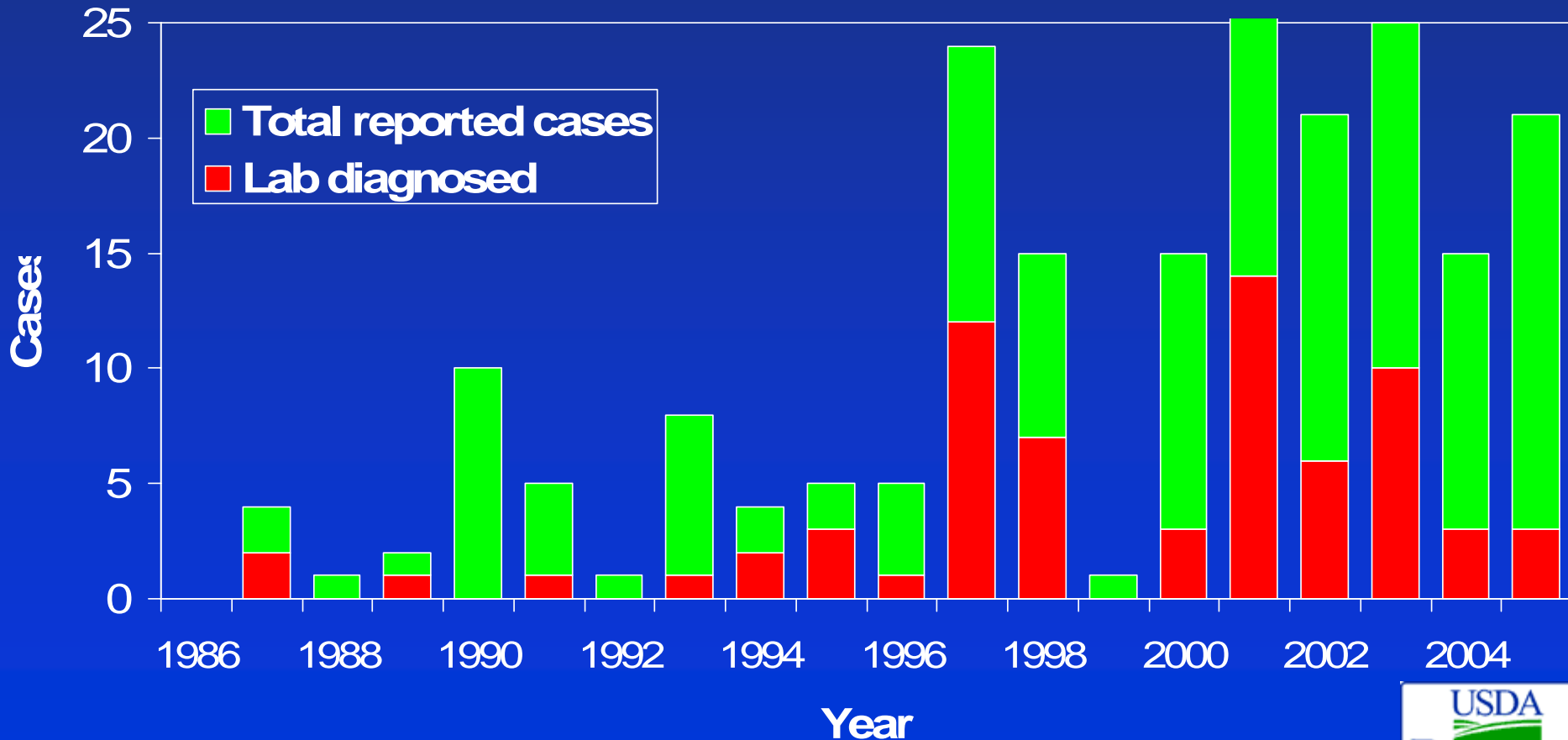
- Good vectors (*Aedes aegypti* & *Ae. albopictus*) are widely distributed in domestic environment
- Human population is highly susceptible
- Frequent vector-host contact
- Virus endemic in “nearby” countries
- Absence of clinical diagnosis

Region of origin for imported dengue in the U.S., 1991-2000*



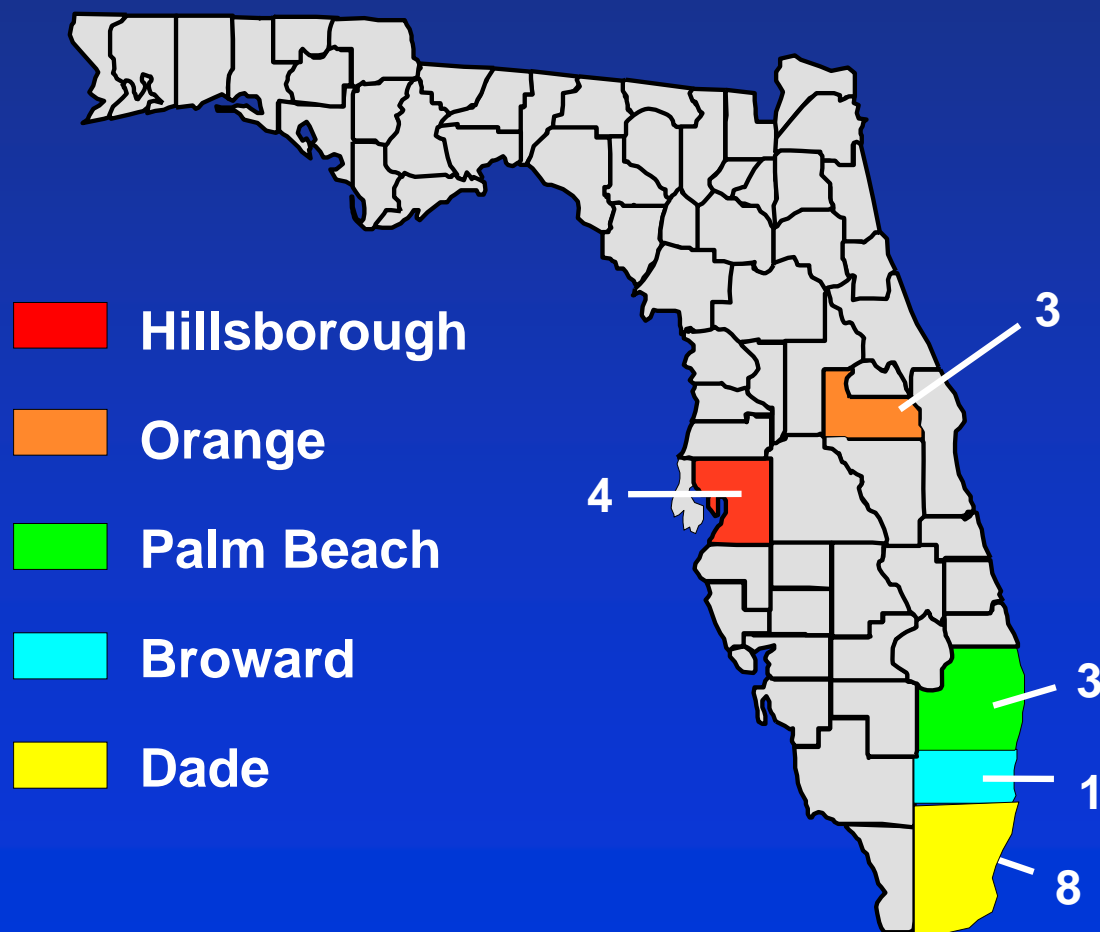
* Source: CDC

Annual occurrence imported DEN, Florida, 1986 – 2005*



* Source: Florida DOH

Imported dengue by Florida county (April 1997 - March 1998)



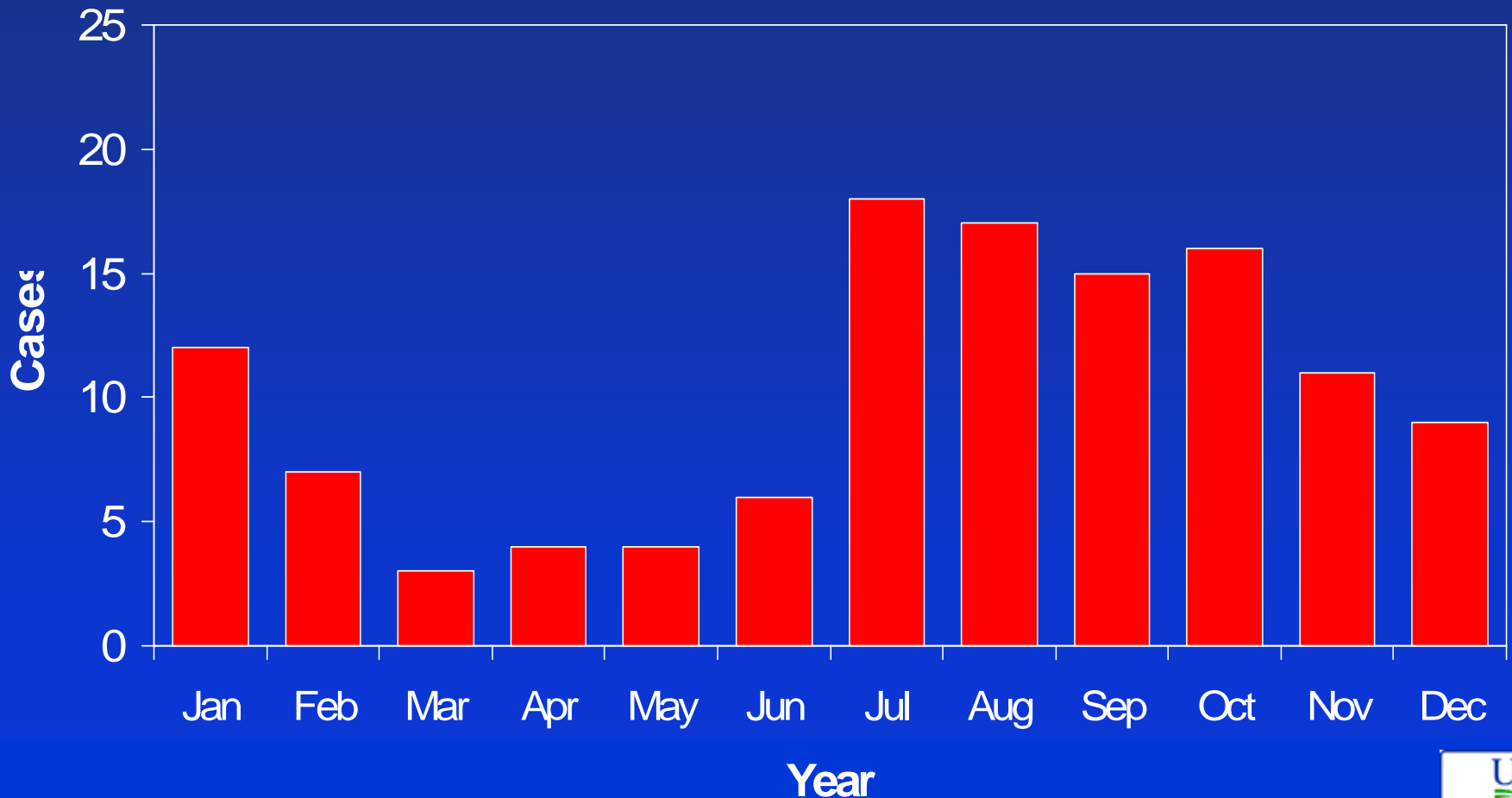
Source: Dr. Julia Gill, Florida Dept. of Health

Origin of imported dengue cases, Florida, 1986 – 2005*

- Puerto Rico- 19
- Nicaragua- 9
- Haiti- 8
- Trinidad/Tobago, Bali- 6
- Costa Rica, Ecuador- 5
- Bahamas, Virgin Islands, Dominican Republic, Honduras, Brazil- 4
- Barbados, Cuba- 3

* n= 95; Source: CDC and Florida DOH

Seasonal occurrence of imported dengue, Florida, 1986 – 2005*



* Source: Florida DOH

Factors mitigating dengue transmission in southeastern U.S.

- Relatively short viremia (ave. 5-7 days) in infected person
- Housing conditions and lifestyles minimize vector-human contact
- Vector distribution is variable and uneven
- Critical vector density for secondary transmission may not exist

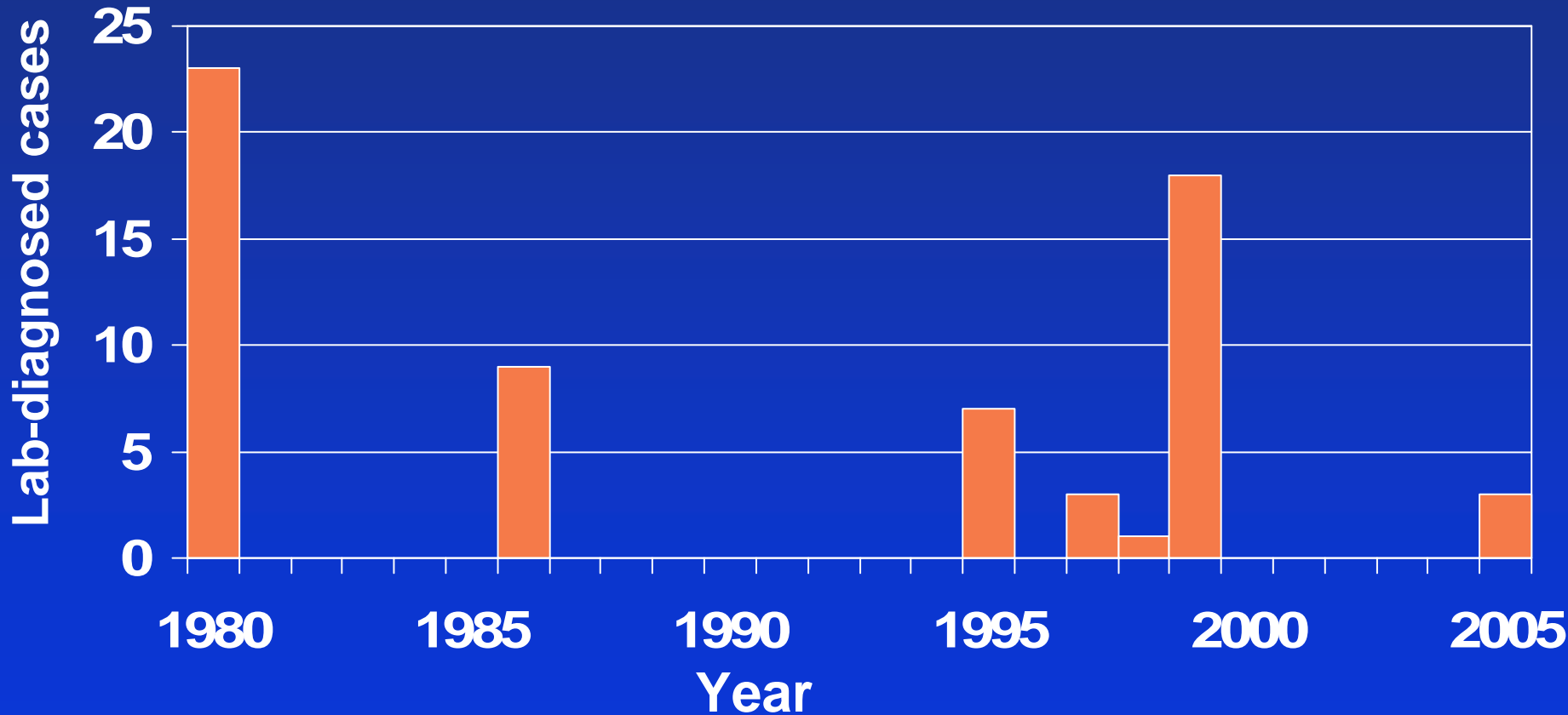
Worst case (human)/best case (virus) scenario leading to dengue transmission in southeastern U.S.

- Several viremic travelers arrive in an area without mosquito control
- One or both dengue vectors are present
- Housing conditions/lifestyles permit ready access to viremic and later to susceptible hosts
- Initial infections are inapparent or not clinically-diagnosed promptly

Recommendations for detecting local transmission in southeastern U.S.

- State and national public health officials are aware of dengue activity in American tropics
- Physicians in travel clinics and potential foci of introduction:
 - can clinically diagnose (and treat) dengue
 - know procedures for collecting specimens for laboratory diagnosis
- A laboratory is available to provide prompt, accurate testing services
- Monitor/control distribution, density, and behavior of dengue vectors

Indigenous dengue in the continental U.S., 1980-2005*

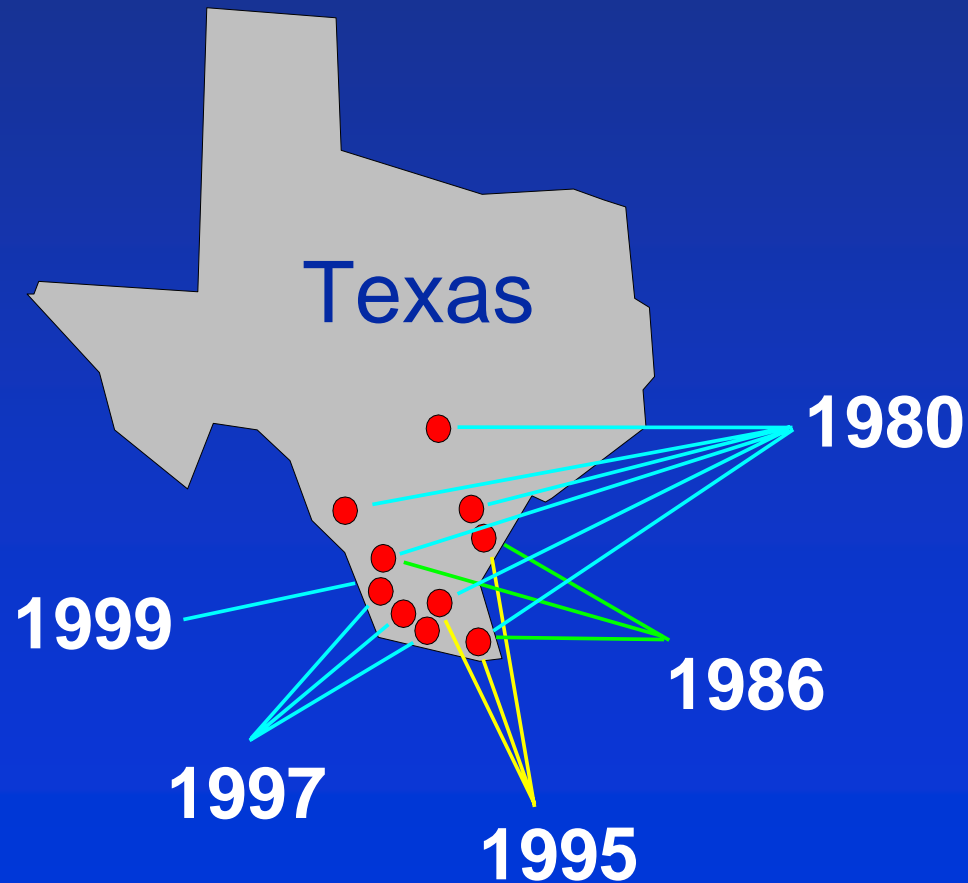


* Source: CDC (n = 64)

DEN virus transmission in the U.S. (i.e., Texas)

- Dengue epidemics occurred in the U.S. in the 1800s and the first half of the 1900s
- **Indigenous cases (n=64) detected since 1945**
 - 1980: 23 cases
 - 1986: 9 cases
 - 1995: 7 cases
 - 1997: 3 cases
 - 1998: 1 case
 - 1999: 18 cases
 - 2005: 3 cases

Indigenous dengue in the US 1946 -1999



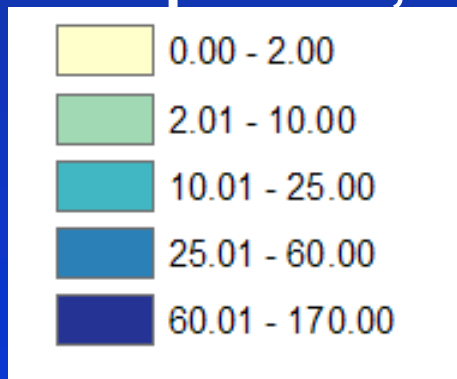
Dengue in Texas and Mexico 1980-1999*



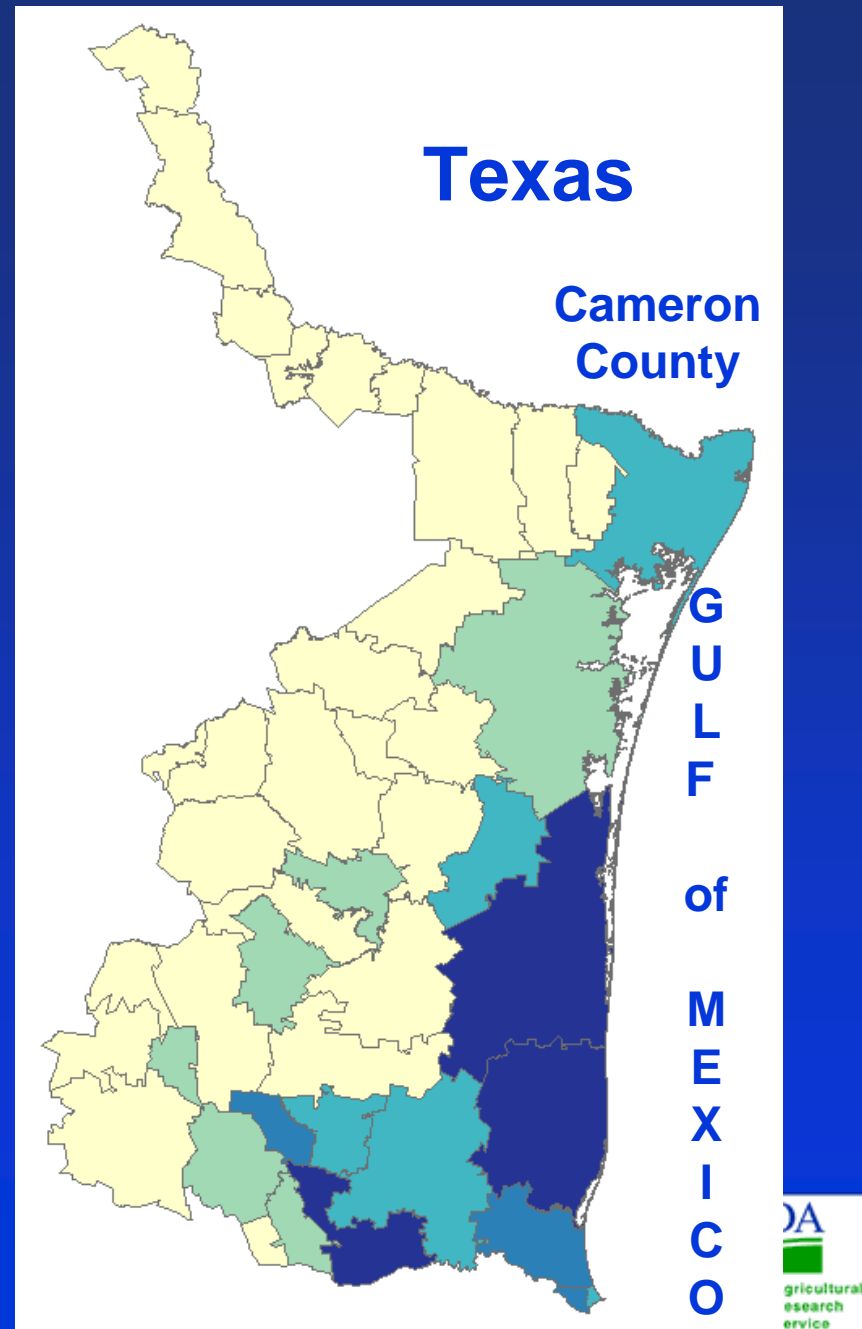
* Source: CDC

Dengue in Tamaulipas state, Mexico through October, 2005

Cases per 100,000



Data: Courtesy
Secretaría de Salud,
Tamaulipas, Mexico



DEN activity along U.S.- Mexico Border, 2005*

- Mid to late 2005- Tamaulipas state with 4,000+ cases (6x no. in same period in 2004); DEN-2 predominant serotype
- Sep.- Dec. 2005- Brownsville, TX had 6 DEN cases and 6 DHF cases (1 locally acquired)
- Dec. 2005- Binational serosurvey → prevalence and risk factors

* Data courtesy Dr. Mary Ramos (CDC)
and colleagues from CDC and Texas DOH

Conclusions of 2005 Binational Study

- Estimated that **23% of Matamoras'** population of 376,000 (**85,000**; 95% C.I. 50,000 to 120,000) were infected with DEN virus in 2005 epidemic
- Ca. **2.5% of Brownsville's** population 162,000 (**>4,000**; 95 C.I. 0 to 8,700) **were infected with DEN virus**
- Large silent epidemic that accompanied this DEN outbreak was detected

Results from 1999 Nuevo Laredo, Mexico - Laredo, Texas DEN Study*

- Large outbreak detected in Nuevo Laredo, MX adjacent to Laredo, TX
- In 288 serum samples from **Nuevo Laredo**, **16%** (95% C.I. 12-20) had anti-dengue **IgM** antibodies and **48%** (41-55) had **IgG** antibodies
- In 228 serum samples from **Laredo**, **1.3%** (95% C.I. 0-3) had anti-dengue **IgM** antibodies and **23%** (17-28) had **IgG** antibodies

* Reiter, et al., 2003, EID 9(1):86-89.

Possible “Protective” Factors for DEN along the US-Mexican Border

- “Lifestyles” where air conditioning (AC) units are widely used and certain human behavior occurs were suggested by Reiter, et al. (2003) from a study in Laredo-Nuevo Laredo, Mexico.
- From 2005 study, central and room AC was found in 46% and 40% of Texas houses studied compared to only 4% and 27%, respectively, of Mexican houses studied.

Conclusions

- Under certain local circumstances (i.e., a vector species has frequent contact with humans and numerous virus introductions are occurring) **DEN virus transmission may appear in focal areas of Florida, as was seen in Mexico during the last 25 years.**
- While the potential for transmission is present, **large-scale outbreaks are unlikely.**

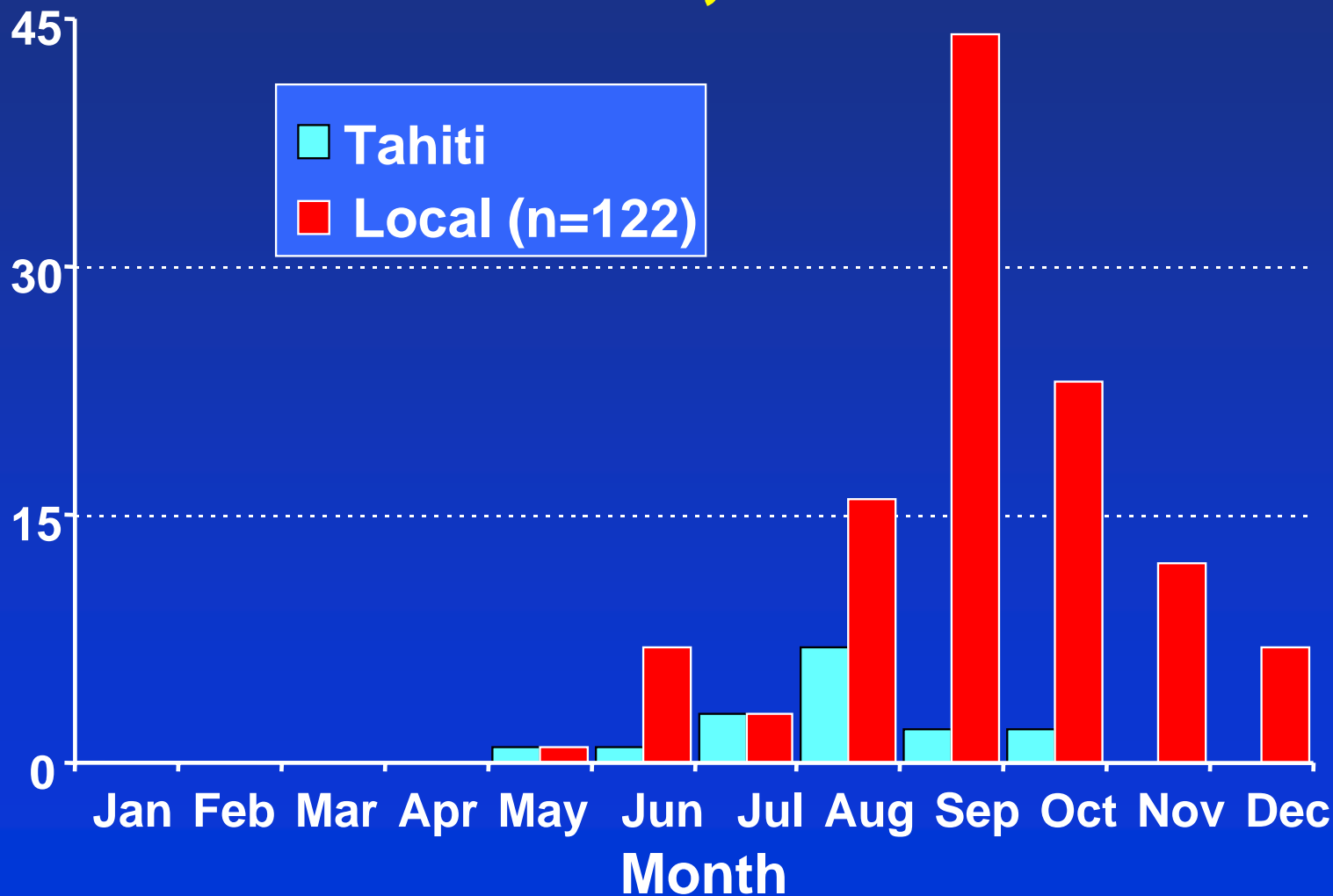
Local DEN transmission in Matamoros, Tamaulipas, Mexico

- 132 serum samples from 111 houses
- 109 (82%) anti-DEN IgG positives
- 30 (23%) anti-DEN IgM positives
 - 17 (57%) reported fever in preceding 3 months (14 received medical care)
 - 15 (50%) reported dengue-like illness (fever + 2 or more DEN symptoms);
 - 1 reported bleeding

Local DEN transmission in Brownsville, Texas

- 141 serum samples from 118 houses
- 3/4 (75%) anti-DEN IgM positives denied travel to Mexico in preceding 3 months and denied any international travel
- 13/65 (20%) anti-DEN IgG positives were born in US and denied travel to Mexico in preceding 3 months and denied any international travel

Imported and local dengue cases Hawaii, 2001



Source: Hawaii DOH/Epidemiology Branch

MAUI

★ confirmed dengue cases
(n = 89)



updated 3/15/02

0 20 Miles

Source: HDOH/Epidemiology Branch



Typical scene from eastern Maui, Hawaii

Conclusions from 2001 DEN outbreak in Hawaii

- DEN-1 virus responsible for outbreak and transmitted by *Aedes albopictus*
- Local transmission likely the result of recent importation of dengue virus from endemic countries

Thanks for your attention.



Aedes aegypti/*Ae. albopictus* infestation indices

Matamoras

Brownsville

Breteau

30

17

House

19%

15%

Container

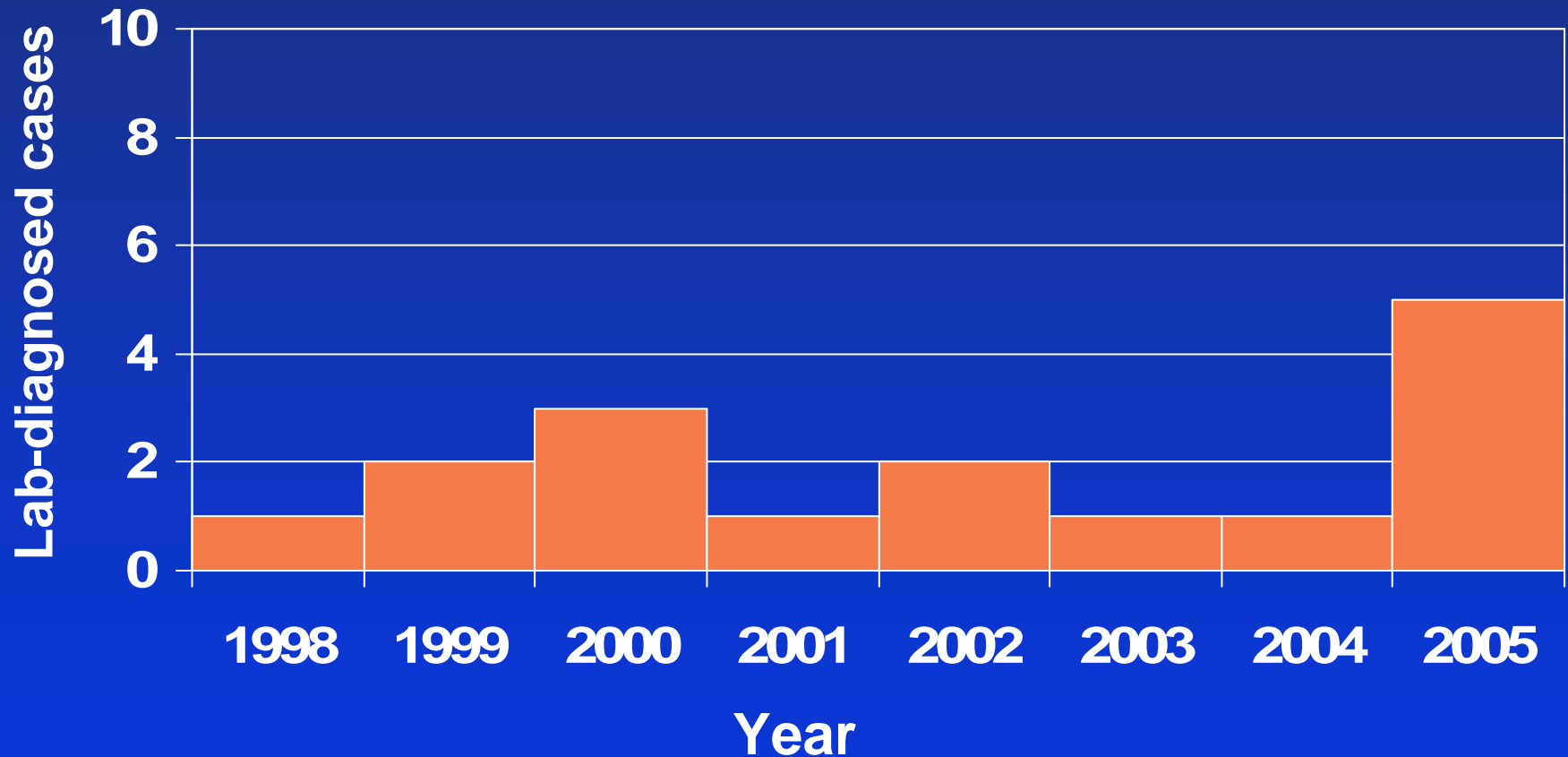
5%

4%

Comparison of 1999 and 2005 DEN serologic results

	<u>Mexico</u>		<u>Texas</u>	
	<u>Nuevo Laredo</u>	<u>Matamoras</u>	<u>Laredo</u>	<u>Brownsville</u>
IgM	16%	23%	1%	2%
IgG	48%	82%	23%	50%

Annual occurrence of imported dengue, Arizona, 1998 - 2005*



* Source: Dr. Craig Levy, AZ Dept of Health (n = 16)

Dengue in Cameron County, TX through mid-November 2005*

15/18 with travel history to Mexico

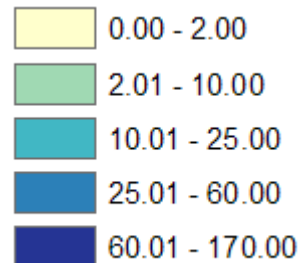


* Source: Texas DOH

Dengue in Mexico, through mid-November



Cases per 100,000



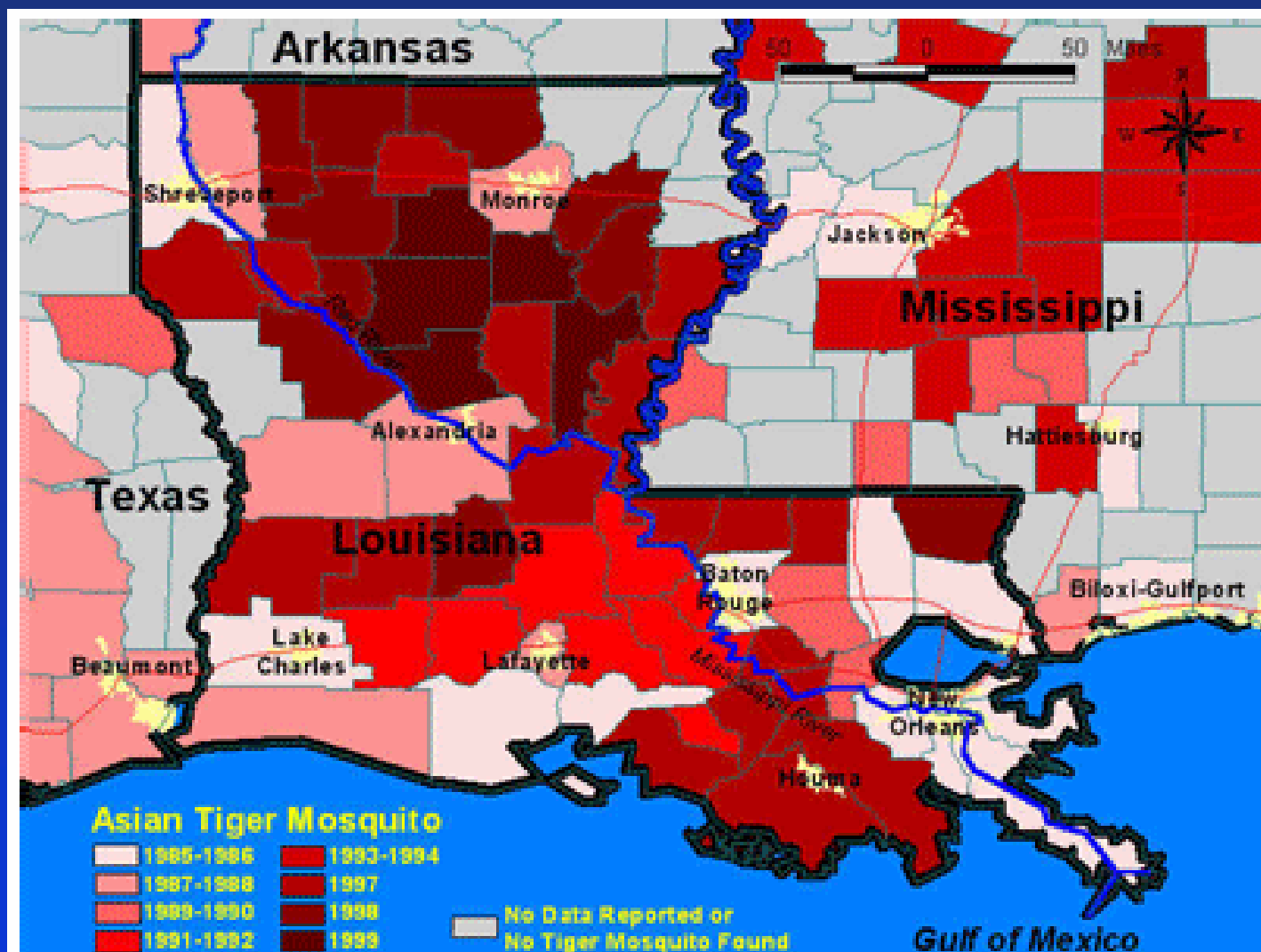
Source: Sistema Único de Información para la Vigilancia Epidemiológica. Preliminary data. Published in *Boletín Epidemiología*, week 46, 2005. Retrieved from <http://www.dgepi.salud.gob.mx/boletin/boletin.htm>

Regional origin of imported dengue cases, Florida, 1986 – 2005*

- Caribbean Basin – 52 (55%)
- Central America – 21 (22%)
- South America – 15 (16%)
- SE Asia/South Pacific – 6 (6%)
- Africa – 1 (1%)

* n= 95; Source: CDC and Florida DOH

Aedes albopictus in Texas, Arkansas, Louisiana & Mississippi*

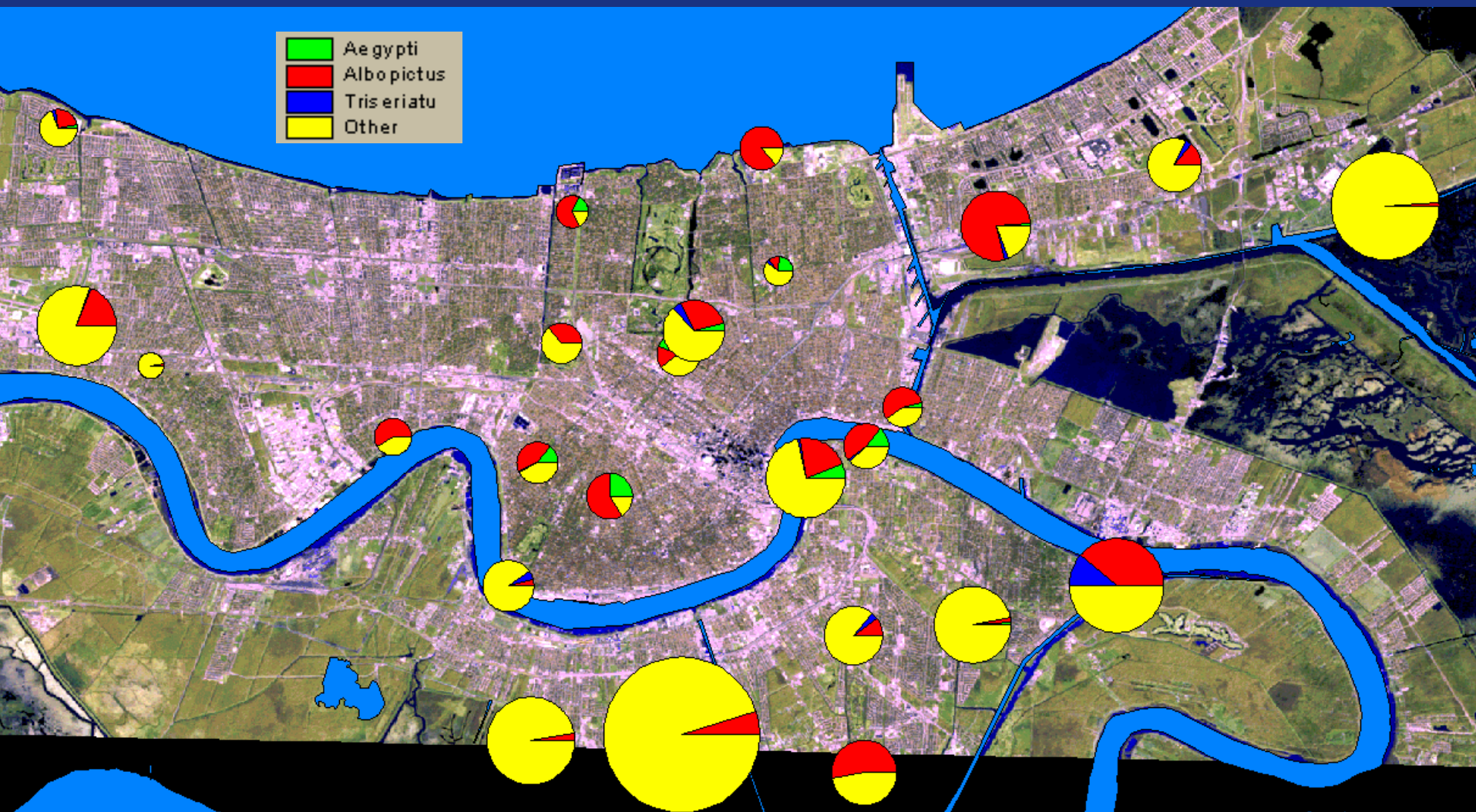


Range data aggregated by drainage basin.

Map Data Sources: US Centers for Disease Control and

* Source: Dr. Dawn Wesson, Tulane University

Spatial Patterns of *Aedes aegypti*, *Aedes albopictus*, and *Ochlerotatus triseriatus* in Greater New Orleans Region, Summer 2000



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