

A mollusc on the leg of a beetle: human activities and the global dispersal of vectors and vector-borne pathogens

Paul Reiter

Insectes et Maladies Infectieuses

Institut Pasteur

Paris



INSTITUT PASTEUR

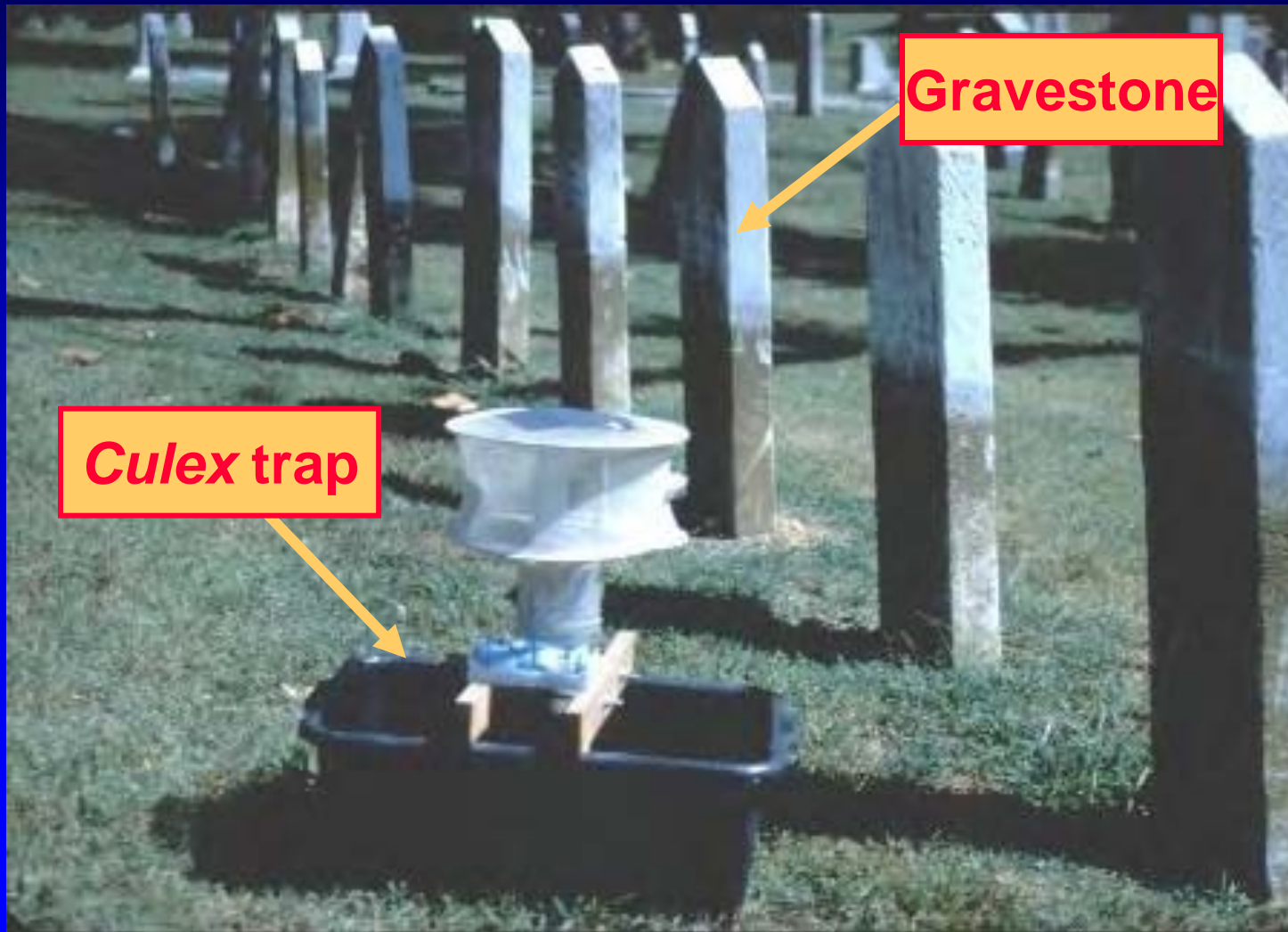
“On the dispersal of freshwater bivalves”



Passive dispersal



History ...



In 1982, 1000 km from the coast ...



Aedes albopictus, the Asian Tiger



INSTITUT PASTEUR

Memphis: a long way from ~~Asia~~ anywhere



INSTITUT PASTEUR

How did it get there?

- Airplane?
- Ship?
- Cargo?



In the old days ...



INSTITUT PASTEUR

Days, even weeks in port!



INSTITUT PASTEUR

Before globalization ...



The romance
of the sea ...!



INSTITUT PASTEUR

...satellites, computers, containers ...



INSTITUT PASTEUR

...less than one minute to load ...!



INSTITUT PASTEUR

A sad change ...!



"Can't you
stay a little
longer ...?"



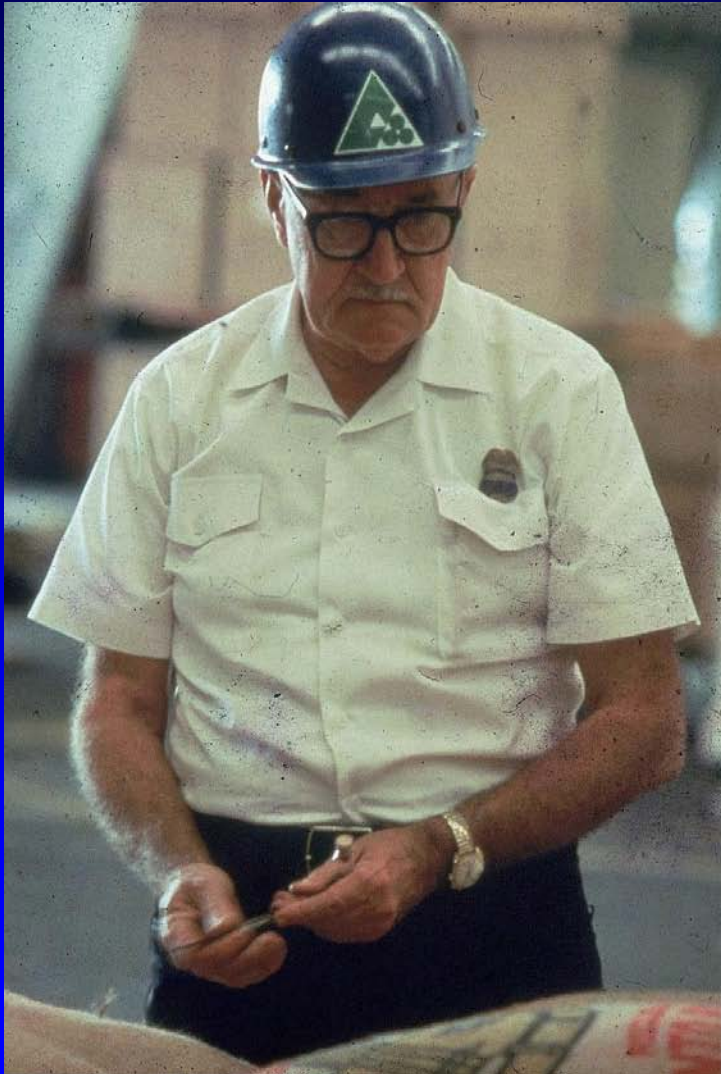
INSTITUT PASTEUR

Inspection is not an easy task...



INSTITUT PASTEUR

...nor a very happy one!



INSTITUT PASTEUR

... and if we find insects, a big job!



INSTITUT PASTEUR

1985: *Ae. albopictus* in Houston...



The Federal Government steps in!

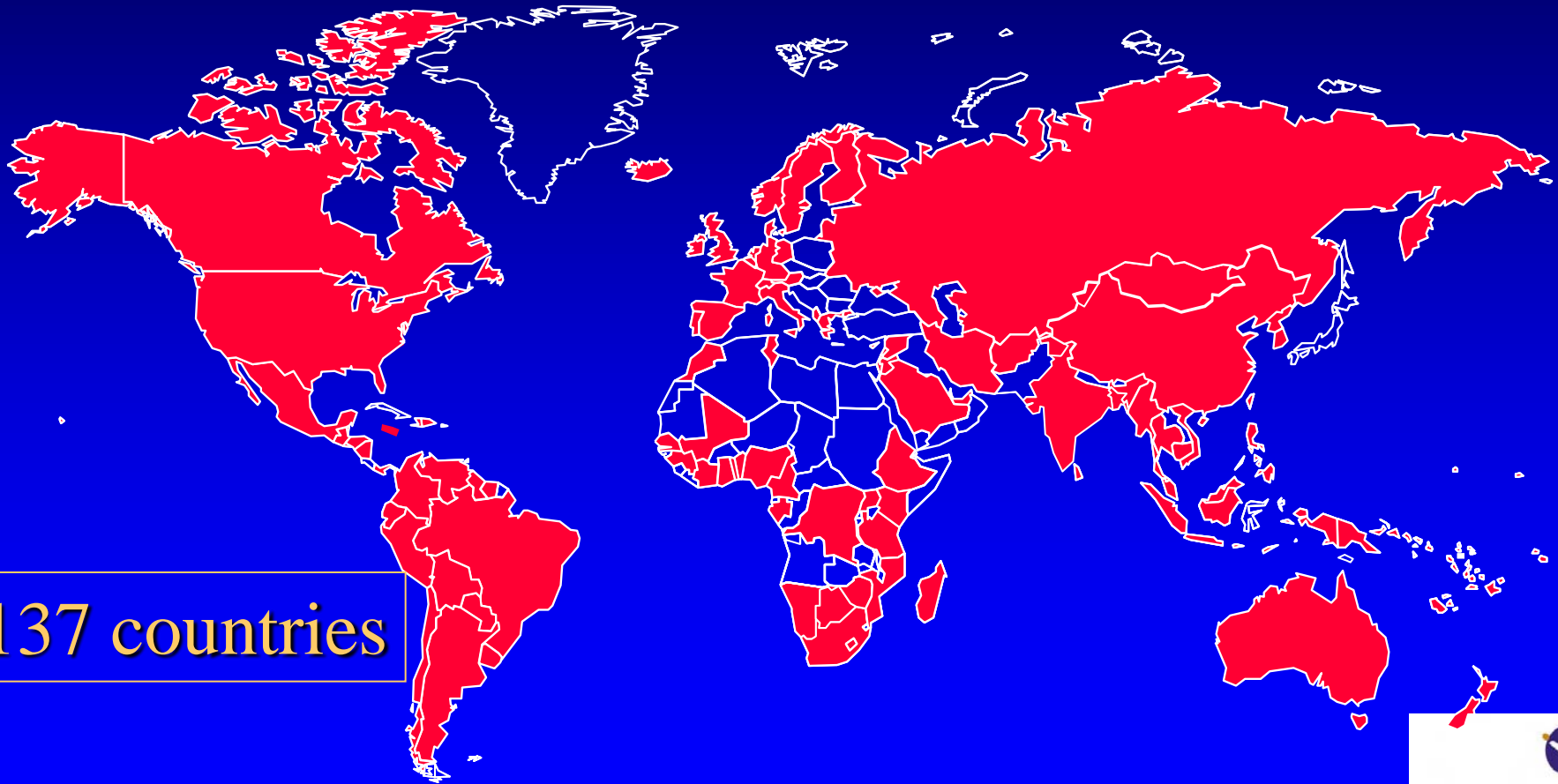


INSTITUT PASTEUR

A world
trade in
used
tyres!!!



Japanese exports of used tires

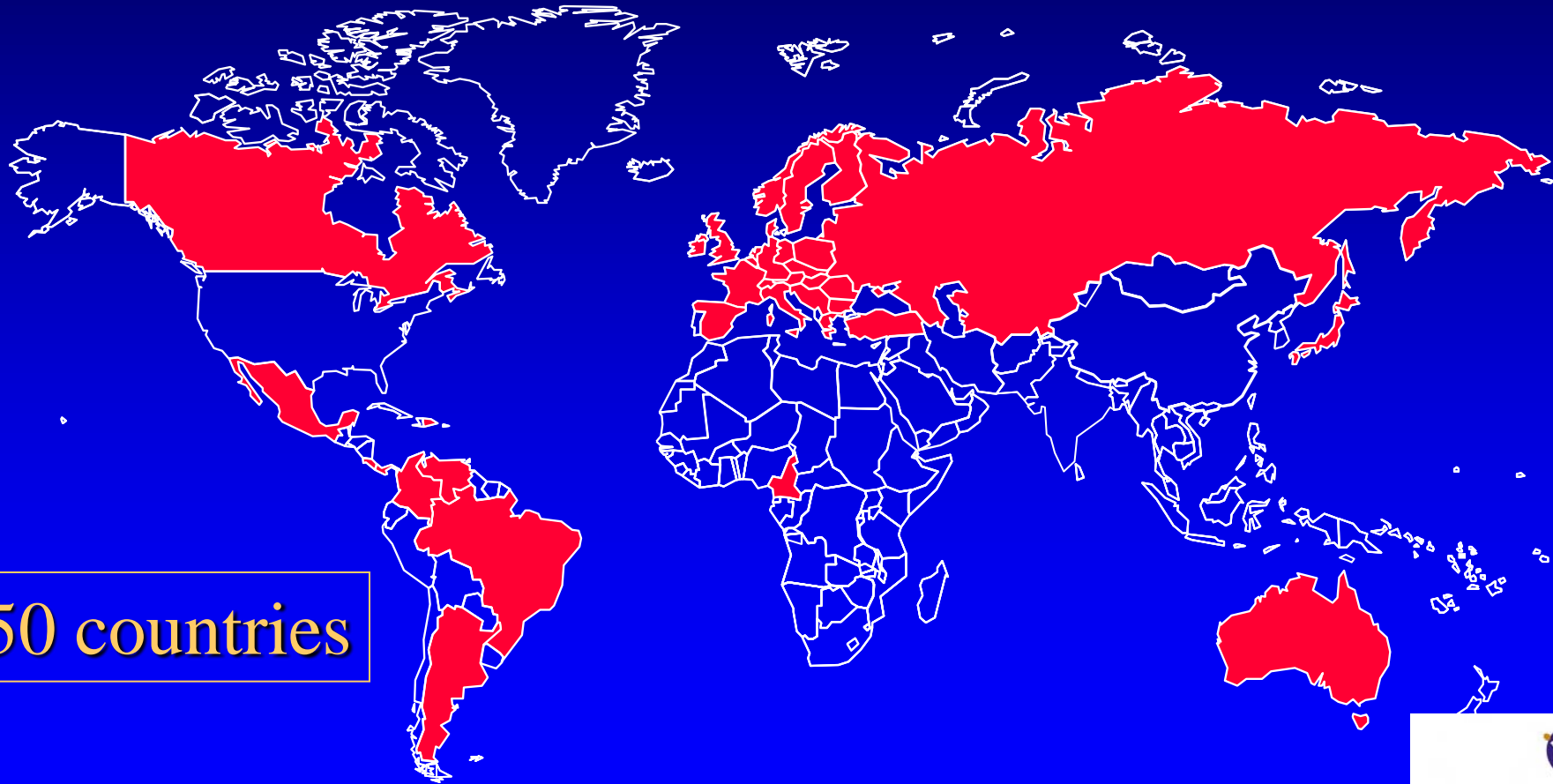


137 countries



INSTITUT PASTEUR

U.S. imports of used tires

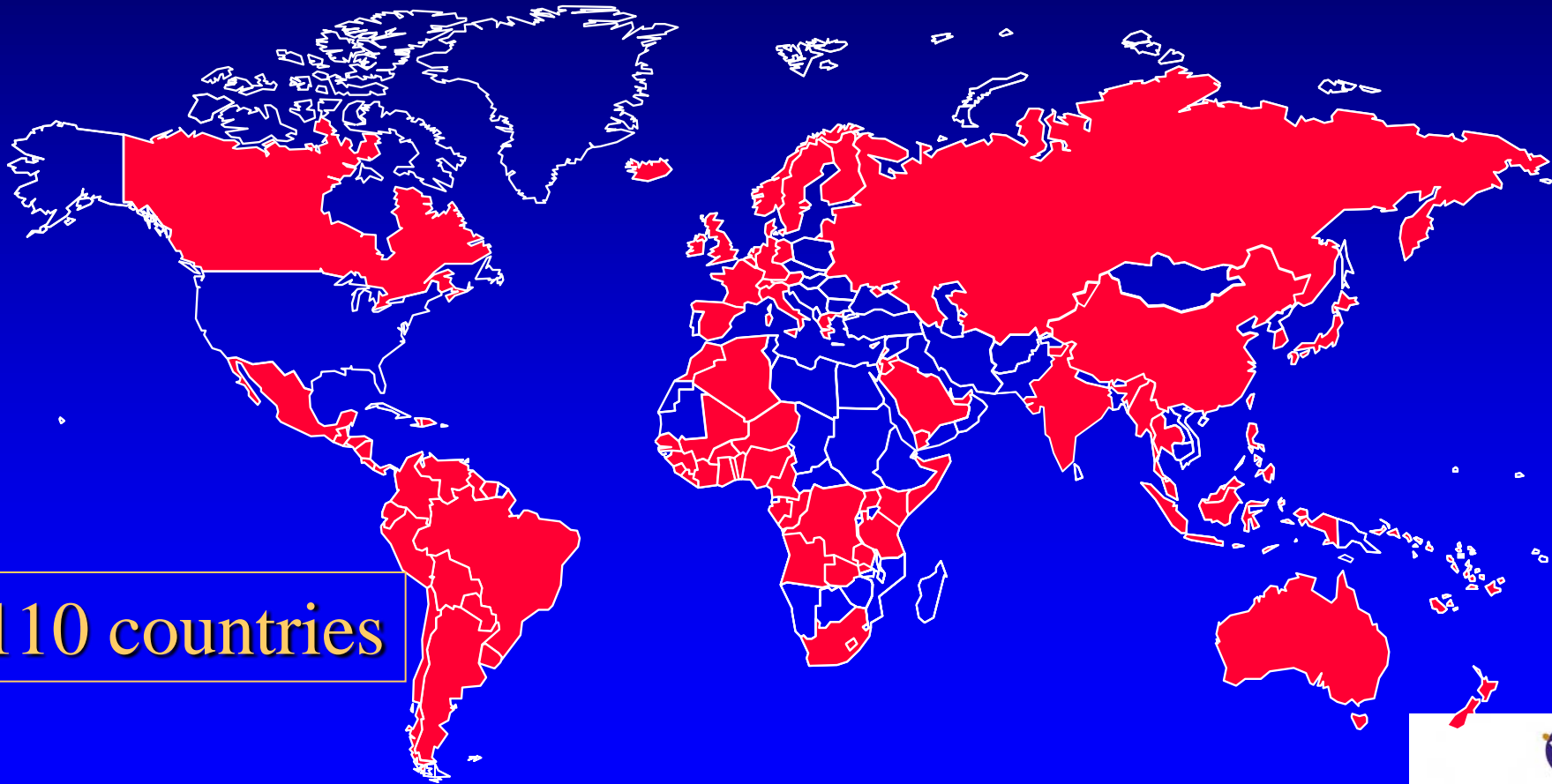


50 countries



INSTITUT PASTEUR

U.S. exports of used tires

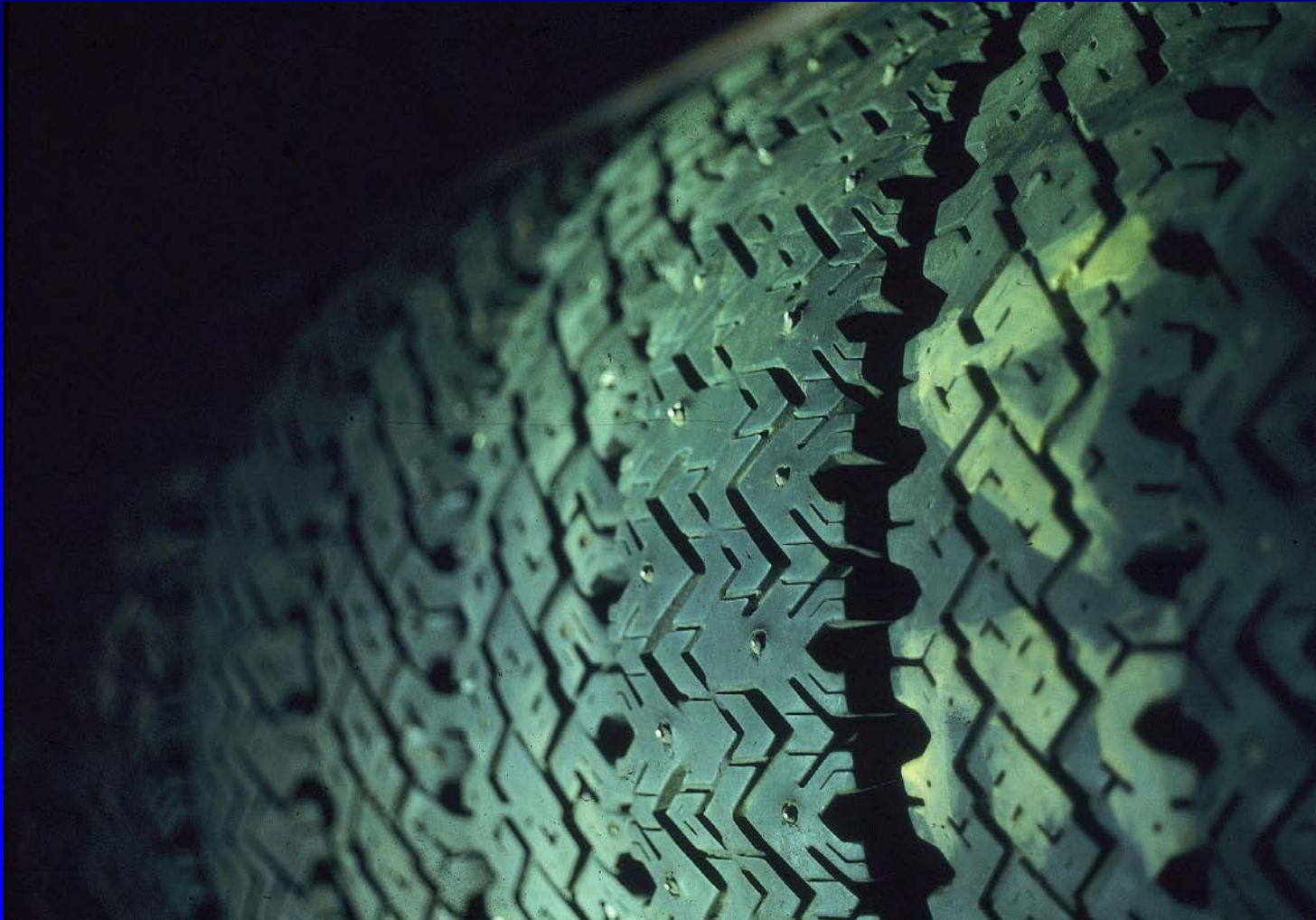


110 countries



INSTITUT PASTEUR

In the Dominican republic ... WHO vehicle



*Snow tires,
South
Korea*



INSTITUT PASTEUR

Tire taxonomy ...



*Made in
Great
Britain*



INSTITUT PASTEUR

In the Dominican Republic...



*Made in the
German
Democratic
Republic*



INSTITUT PASTEUR

In the Dominican Republic...

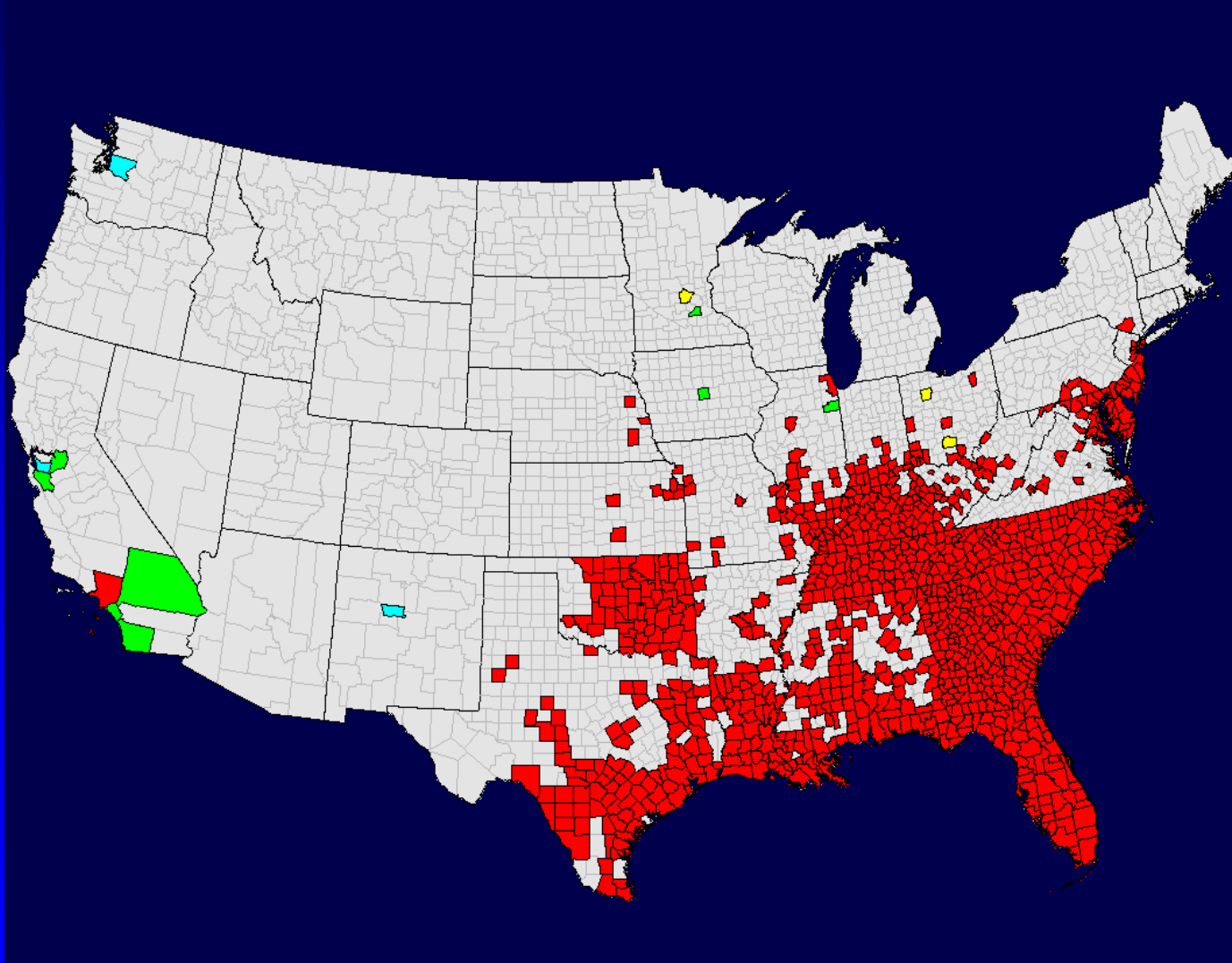


*Made in
France*



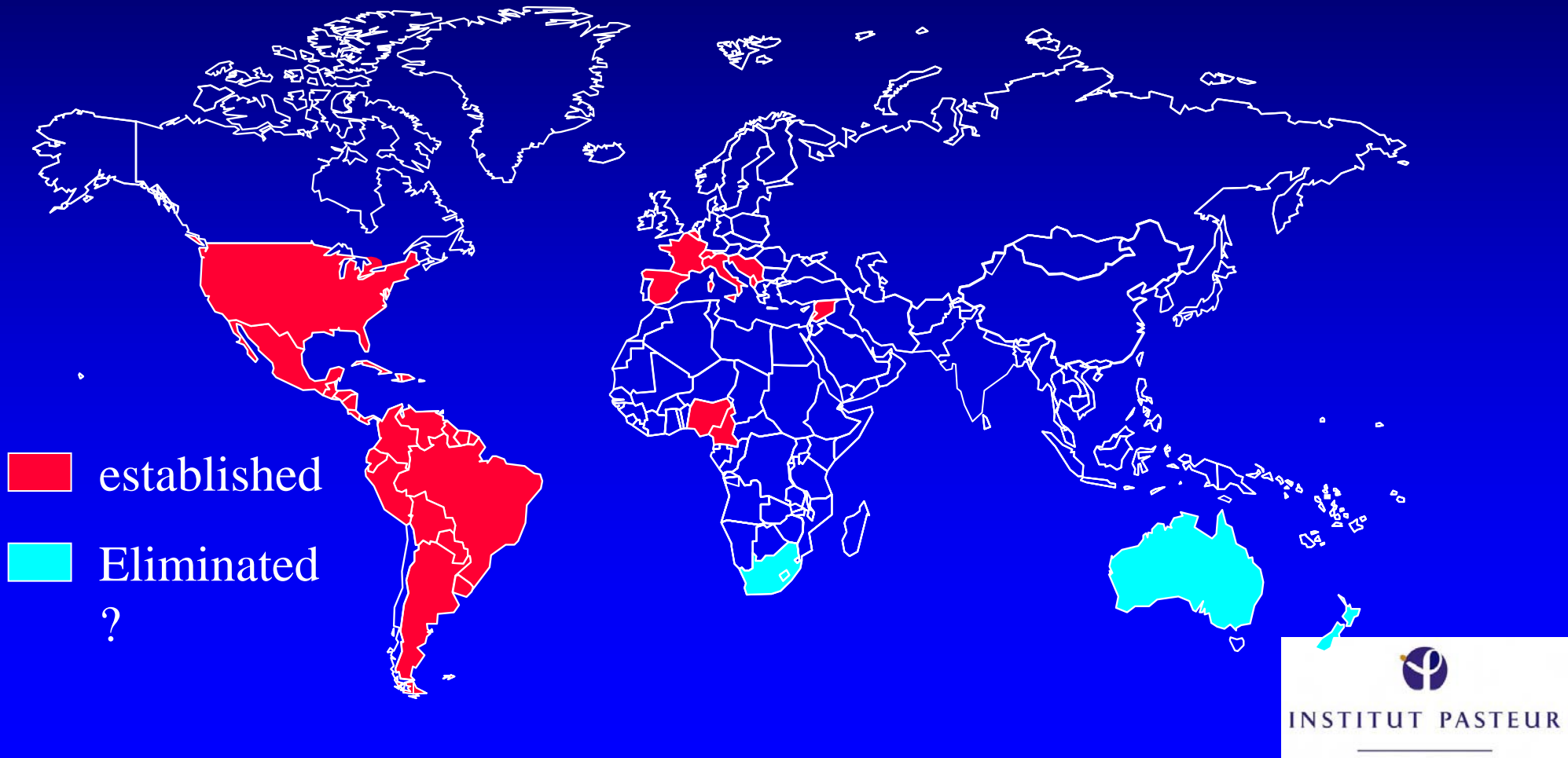
INSTITUT PASTEUR

Distribution of *Ae. Albopictus*, 2004

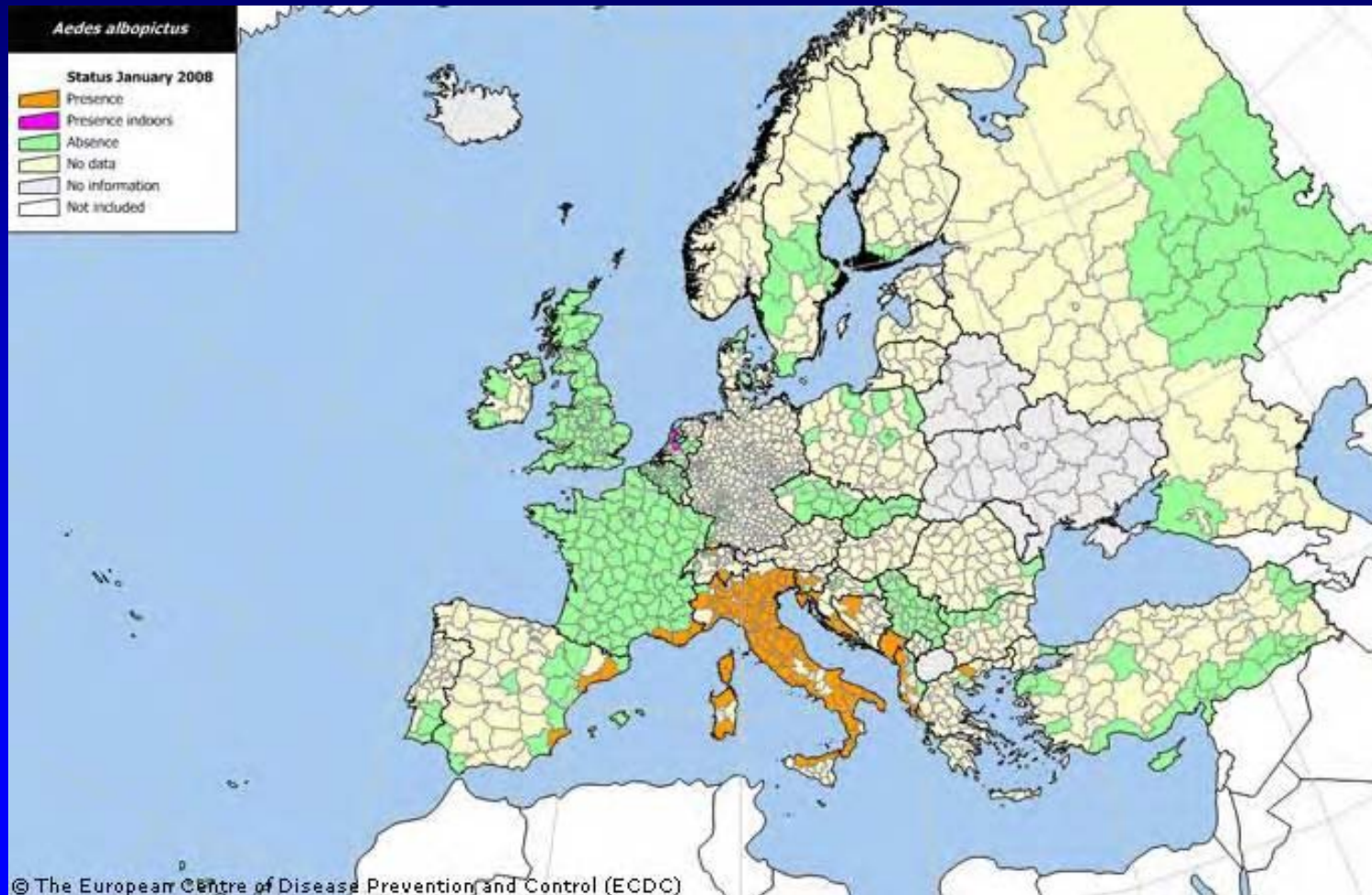


INSTITUT PASTEUR

Infestations of *Ae. Albopictus*: 1979-2007

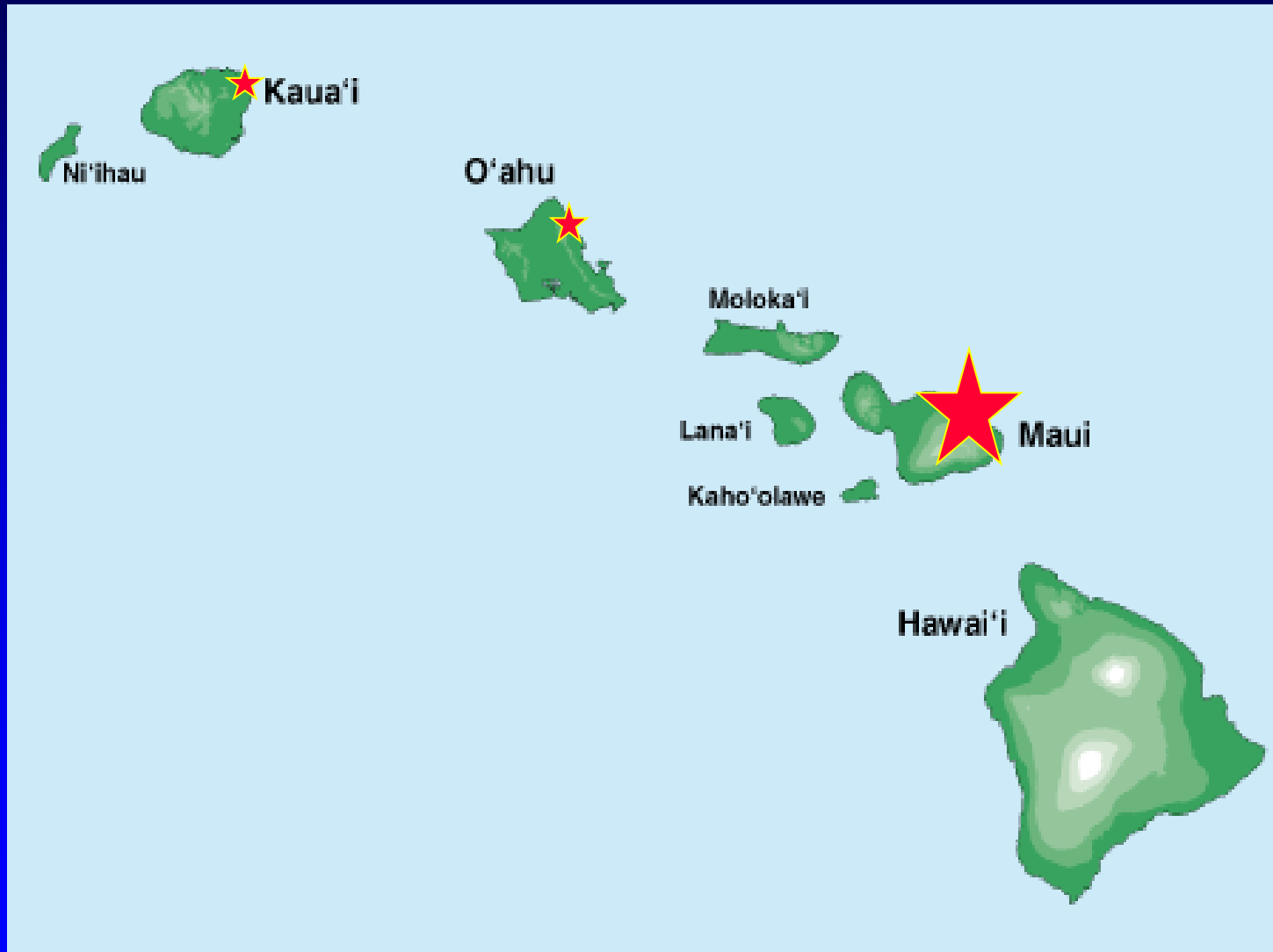


Aedes albopictus, 2008



INSTITUT PASTEUR

Dengue in the Hawaiian Islands, 2001



Aedes albopictus vs. *Ae. aegypti*

	Tahiti	Hawaii
Population	220,000	1,200,000
Mosquito	<i>Ae. aegypti</i>	<i>Ae. albopictus</i>
Dengue (2001)	35,000	64



Jesse Merle Jones
2004 Xcel Pro
presented by
SOBE NO FEAR

ty Long

© PhotoMurray.com

Samoa

O'ahu

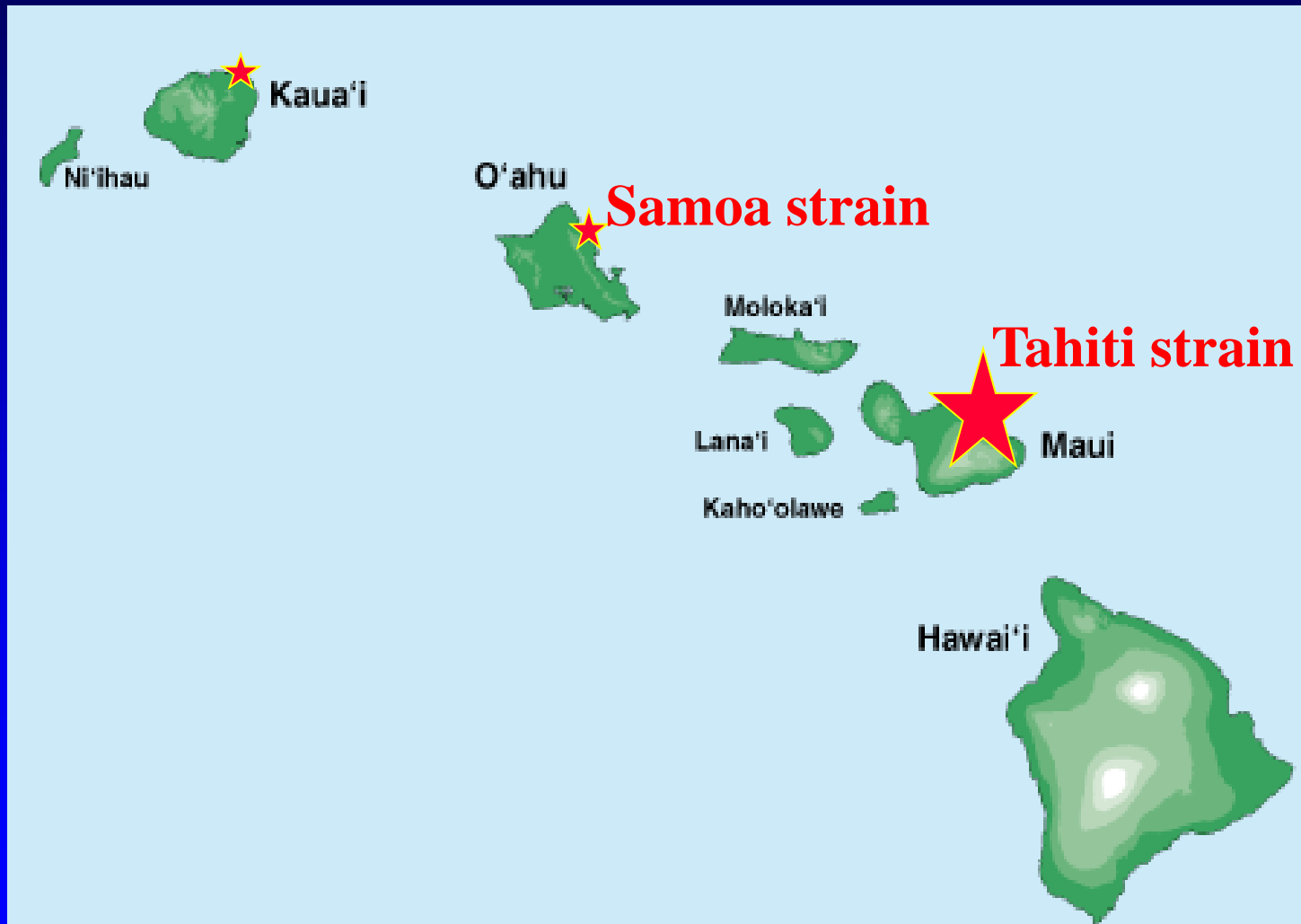
Catarras

Maria

Need a place to stay? Go to www.surfandboard.com
© 2002 Rachel Tanner (www.chantlik-photo.com)

Need a place to stay? Go to www.surfandboard.com
© 2002 Rachel Tanner (www.chantlik-photo.com)

Dengue in the Hawaiian Islands, 2001





STITUT PASTEUR

Back to history ...



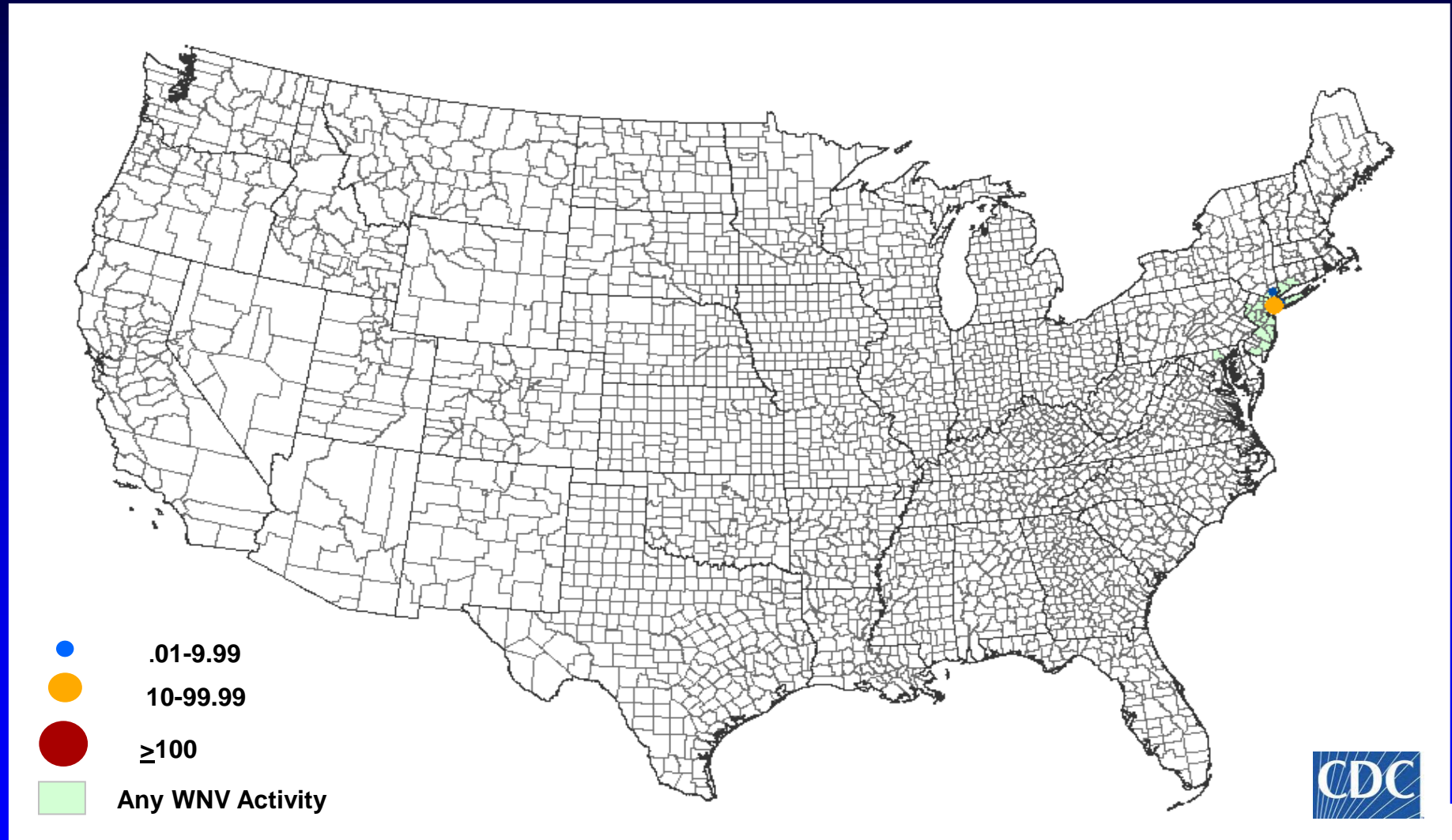
INSTITUT PASTEUR

Its raining crows!

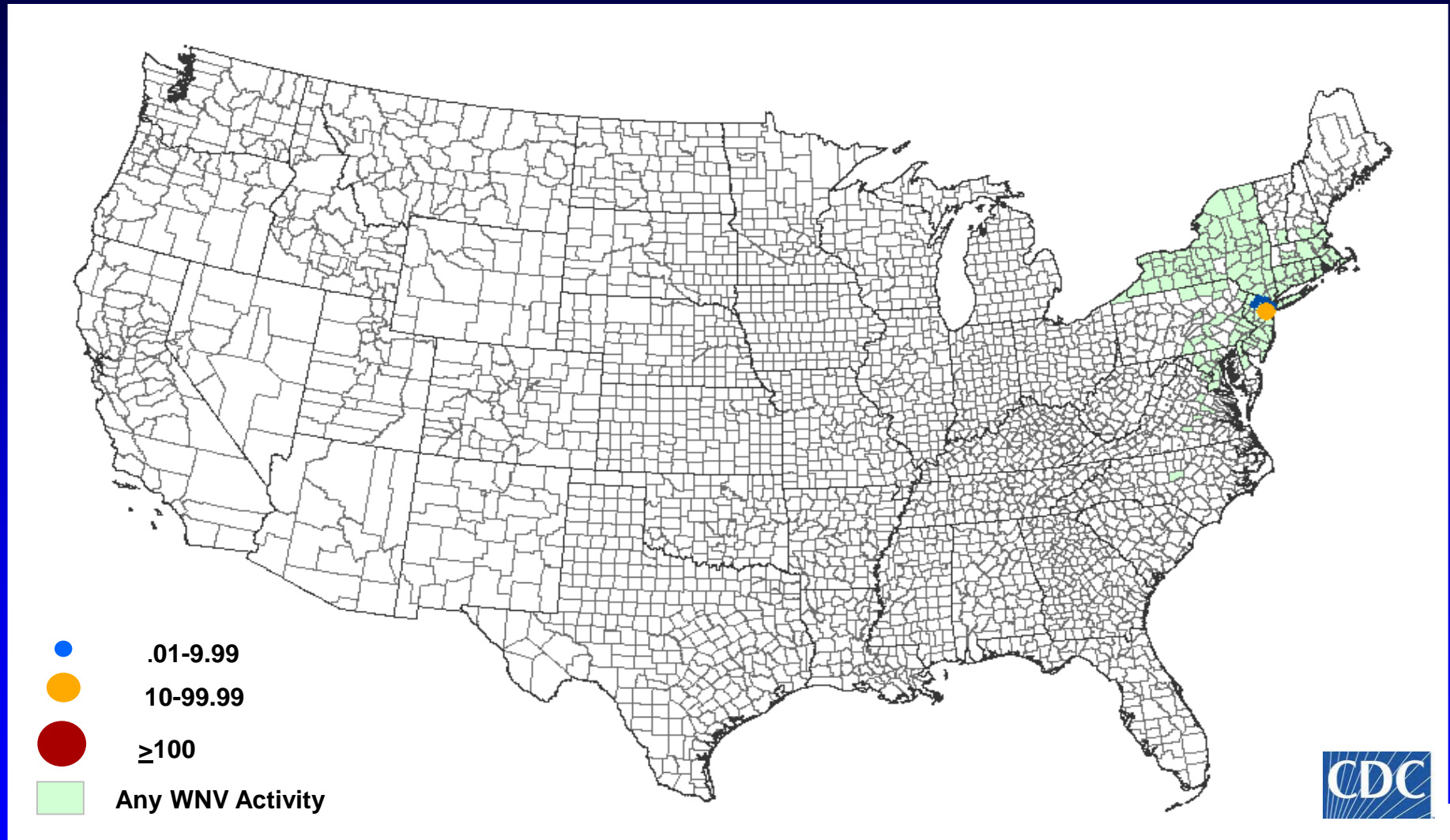


INSTITUT PASTEUR

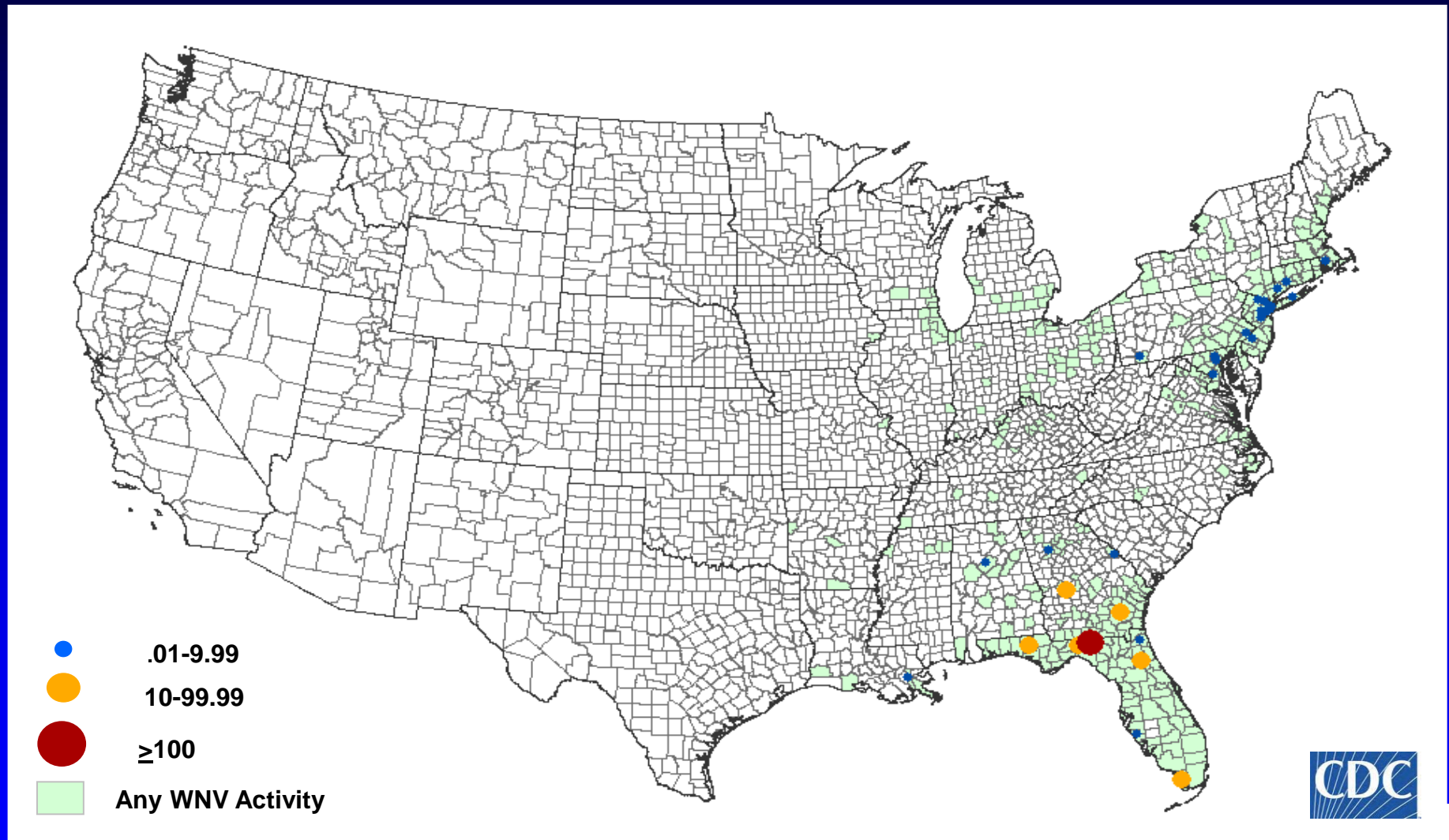
Incidence per Million, 1999



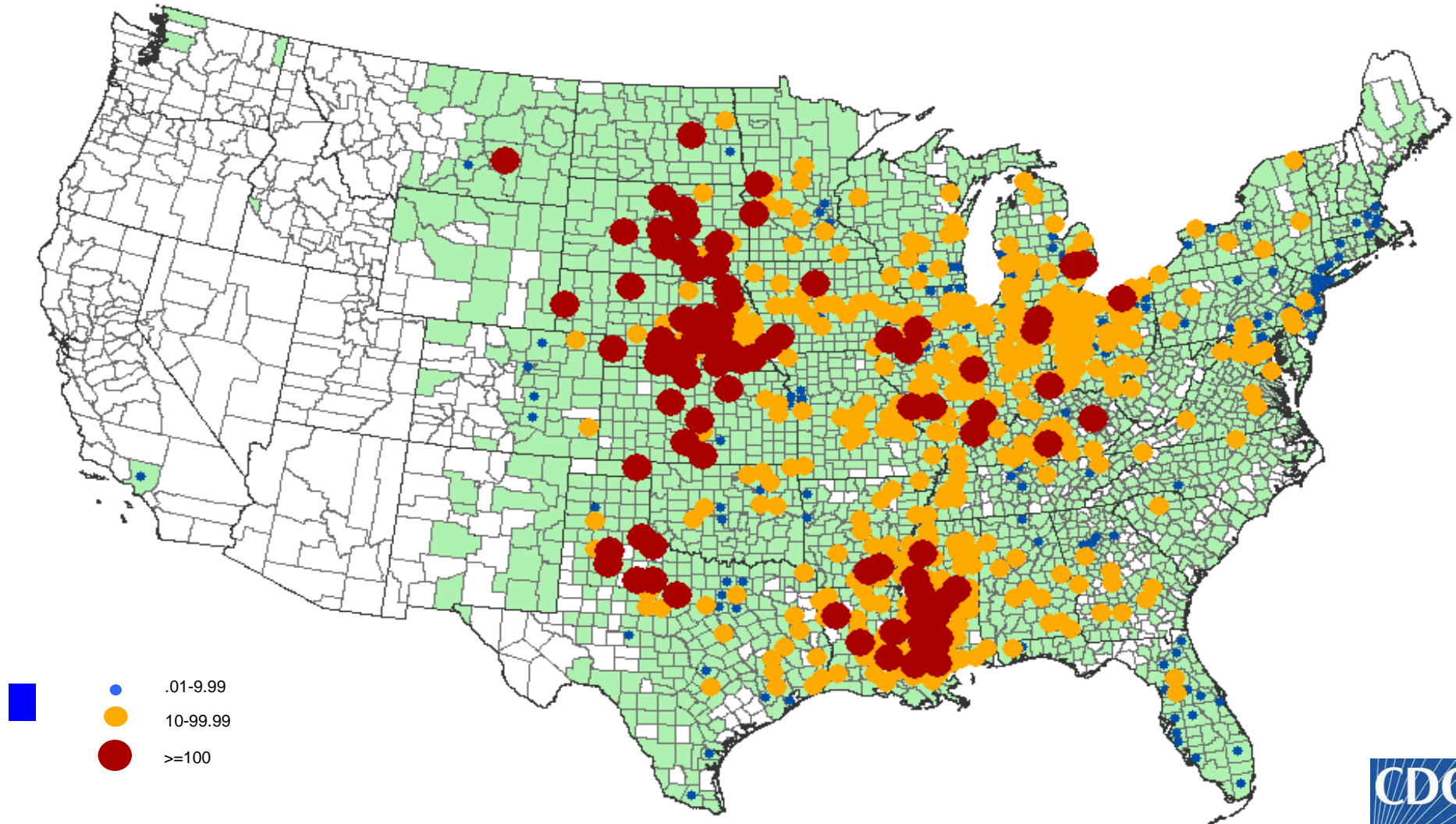
Incidence per Million, 2000



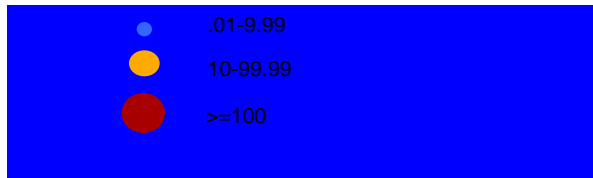
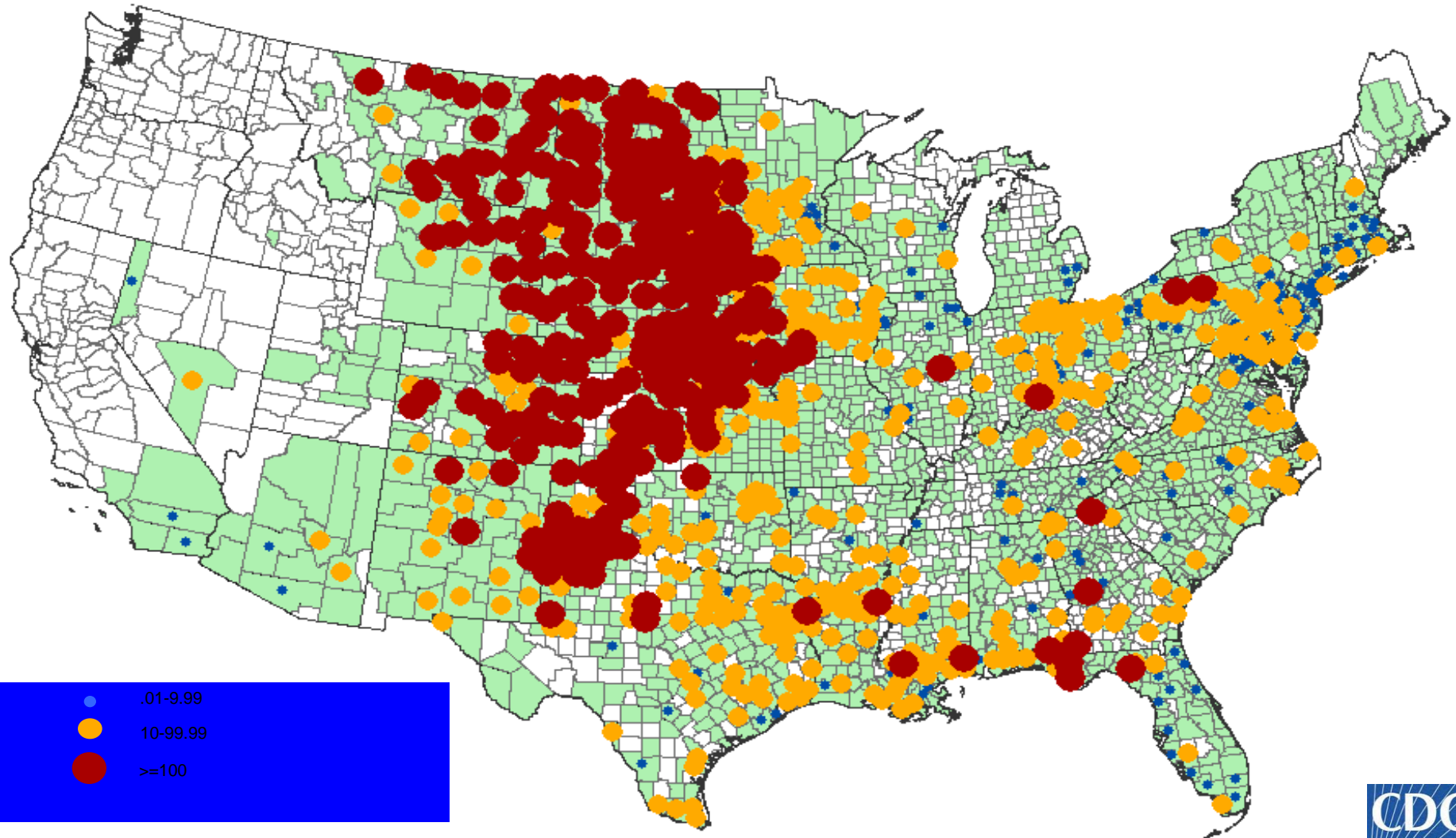
Incidence per Million, 2001



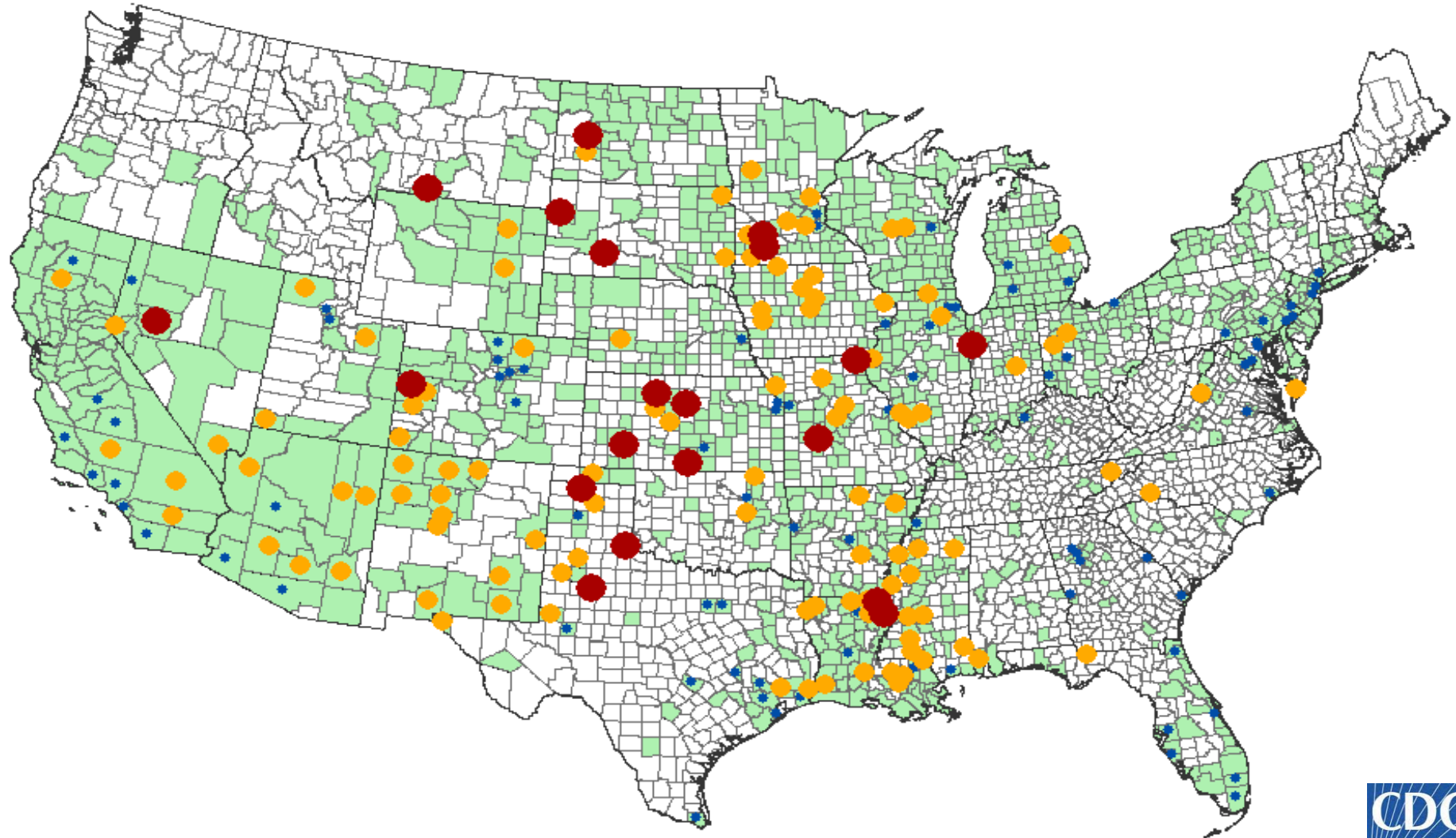
Incidence per Million, 2002



Incidence per Million, 2003



Incidence per Million, 2004

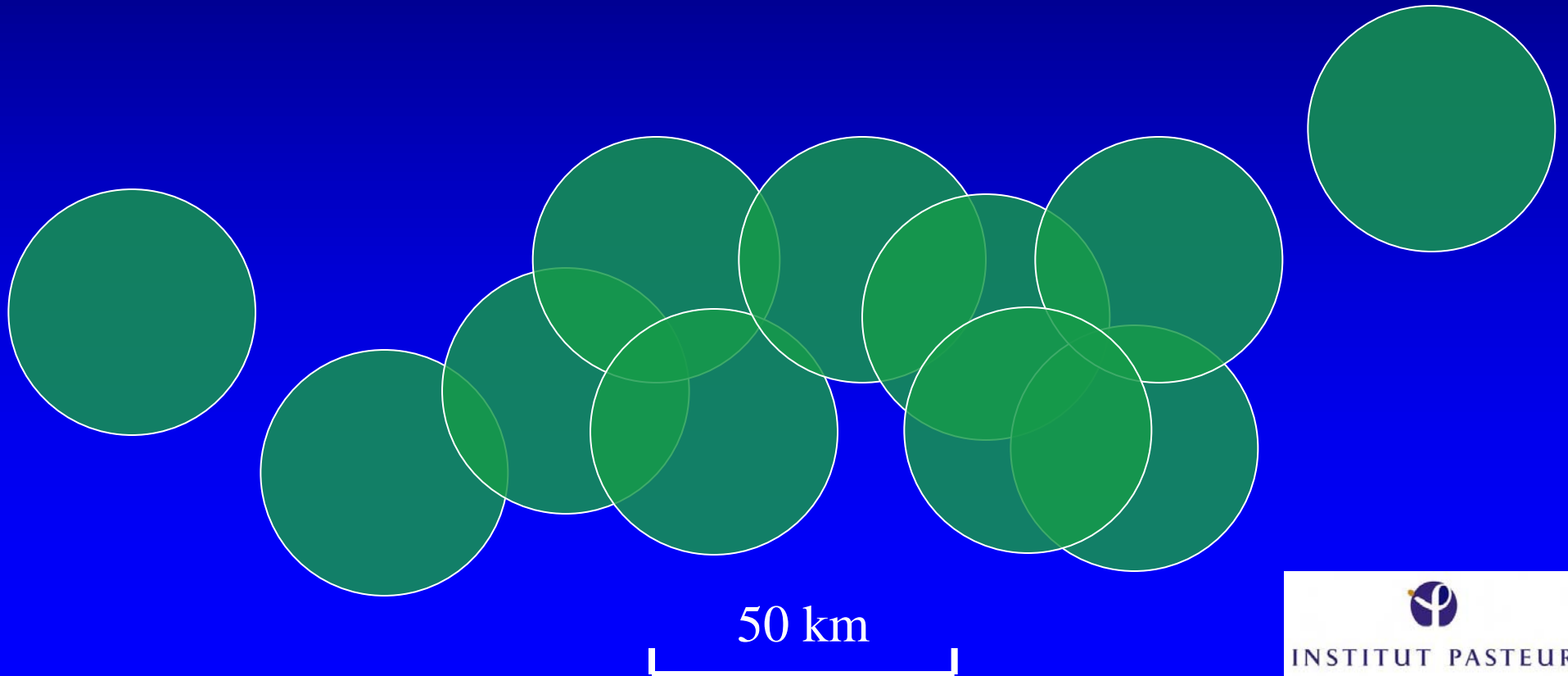


INSTITUT PASTEUR

Grant Campbell

A firestorm of infections

QuickTime™ and a decompressor are needed to see this picture.



Back to history again ...



INSTITUT PASTEUR

A beautiful ship ...



INSTITUT PASTEUR

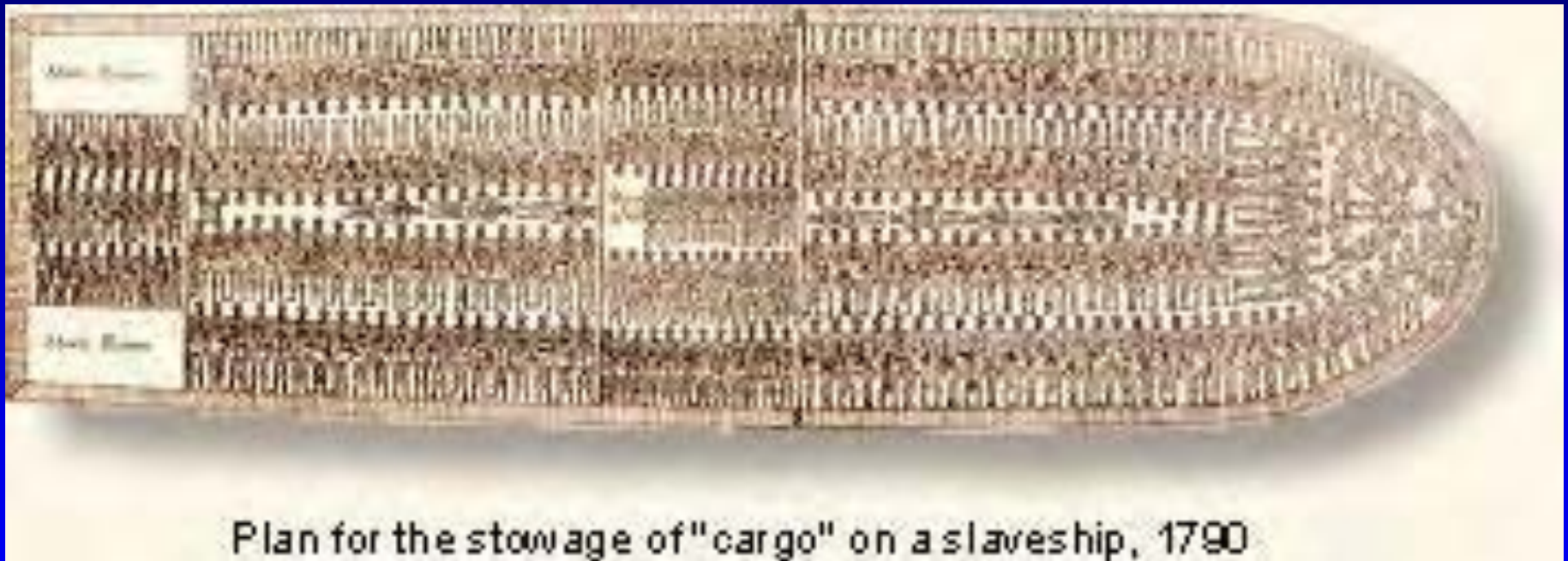
A tragic era ...



The Triangle Route ...



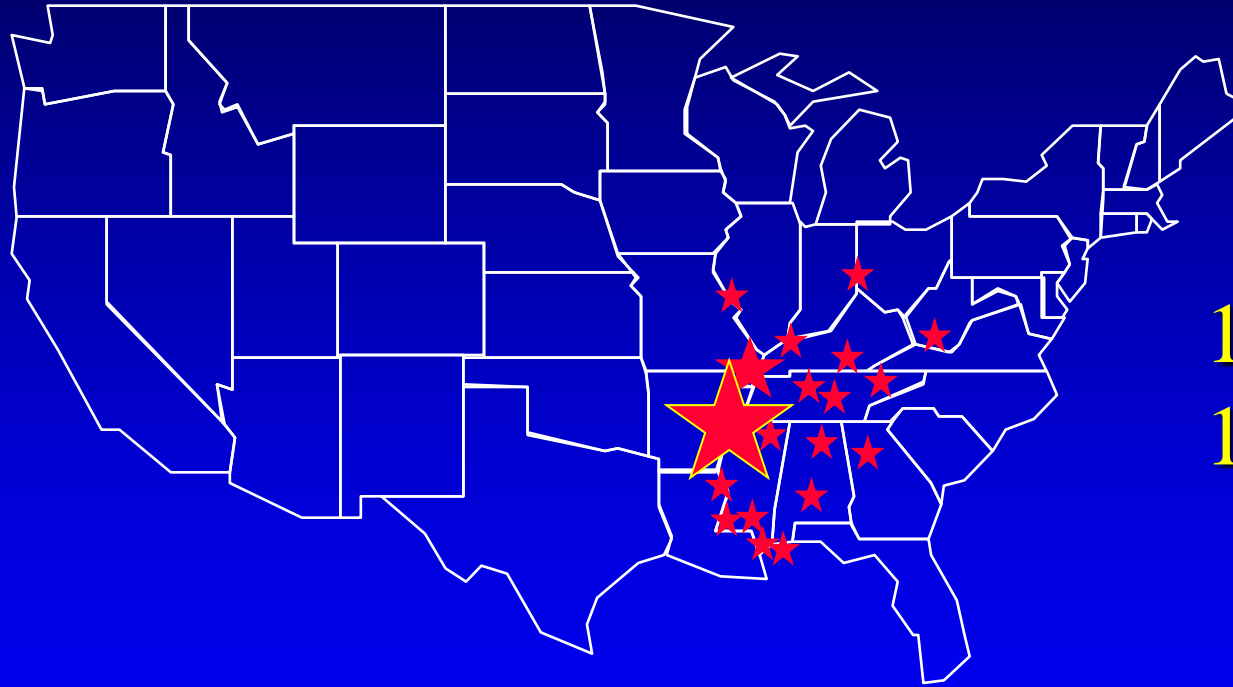
Humans ... and mosquitoes...and viruses



And yellow fever outbreaks ...



1878: widespread Yellow Fever epidemic



100,000 cases,
19,500 in Memphis





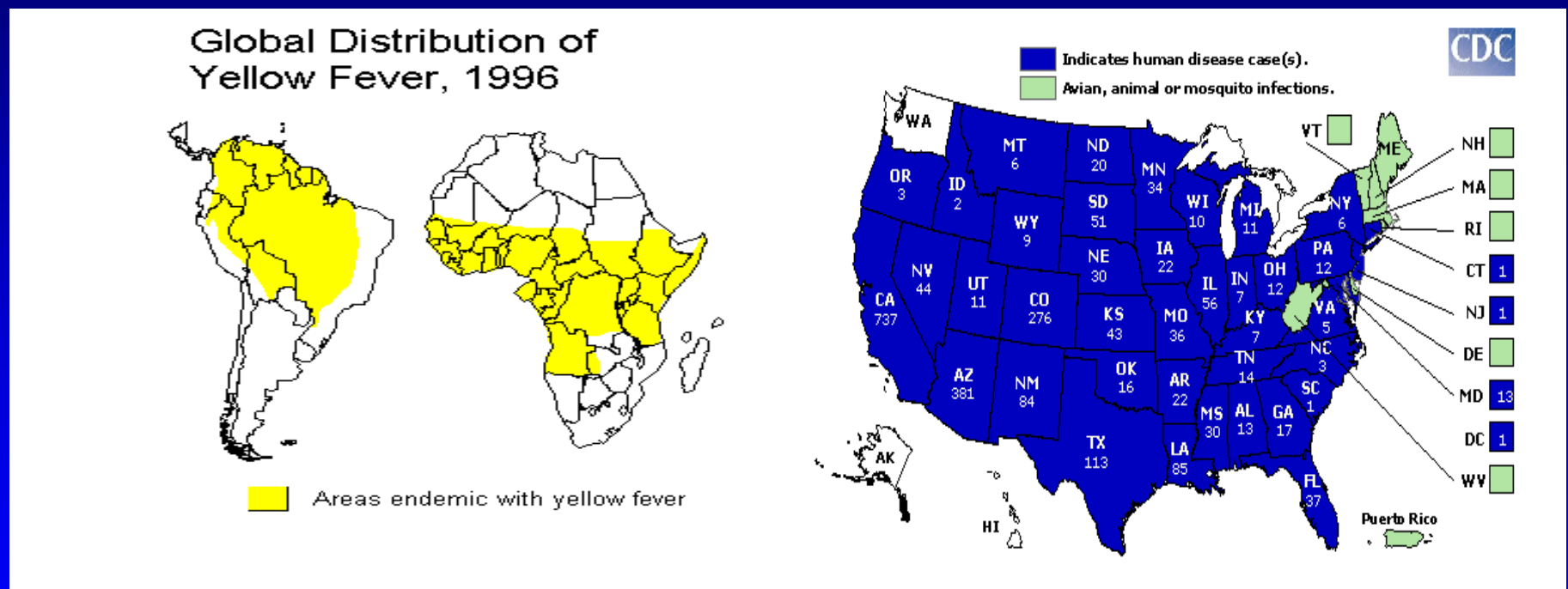
1878

Goré Island, Senegal



INSTITUT PASTEUR

Yellow Fever & West Nile virus are now enzootic ...



Conclusion

Quantum leap in:

- Mobility of vectors
- Mobility of pathogens
- Difficulty of interception



And now...

CHIKUNGUNYA!

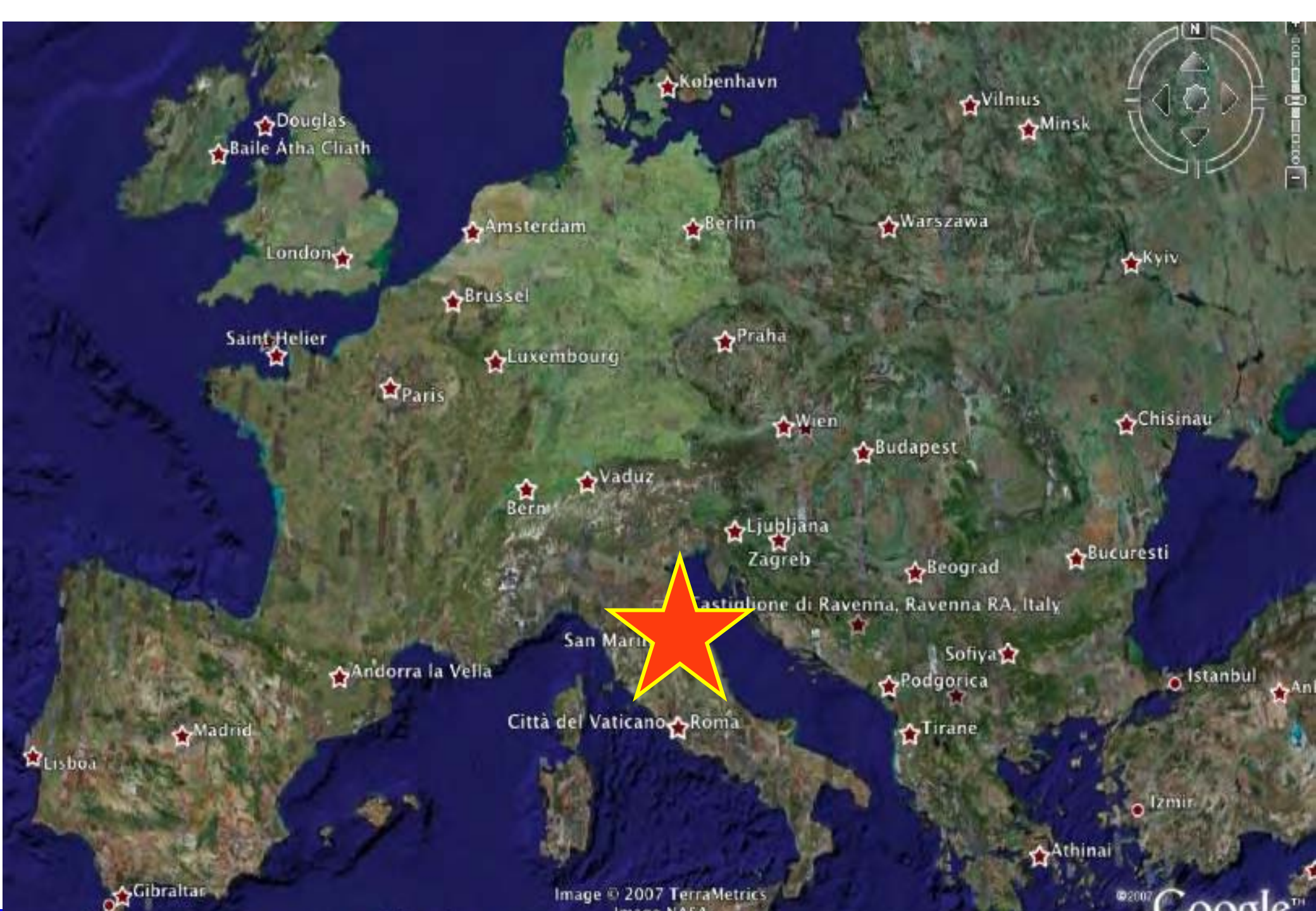


INSTITUT PASTEUR



Image NASA

Image © 2007 TerraMetrics



- Douglas
- Baile Átha Cliath
- London
- Saint Helier
- Paris
- Amsterdam
- Brussel
- Luxembourg
- Bern
- Vaduz
- Andorra la Vella
- Madrid
- Lisboa
- Gibraltar
- København
- Berlin
- Praha
- Wien
- San Marino
- Città del Vaticano
- Roma
- Warszawa
- Budapest
- Ljubljana
- Zagreb
- Castiglione di Ravenna, Ravenna RA, Italy
- Beograd
- Podgorica
- Tirane
- Vilnius
- Minsk
- Kyiv
- Chisinau
- Bucuresti
- Sofiya
- Istanbul
- Izmir
- Athina

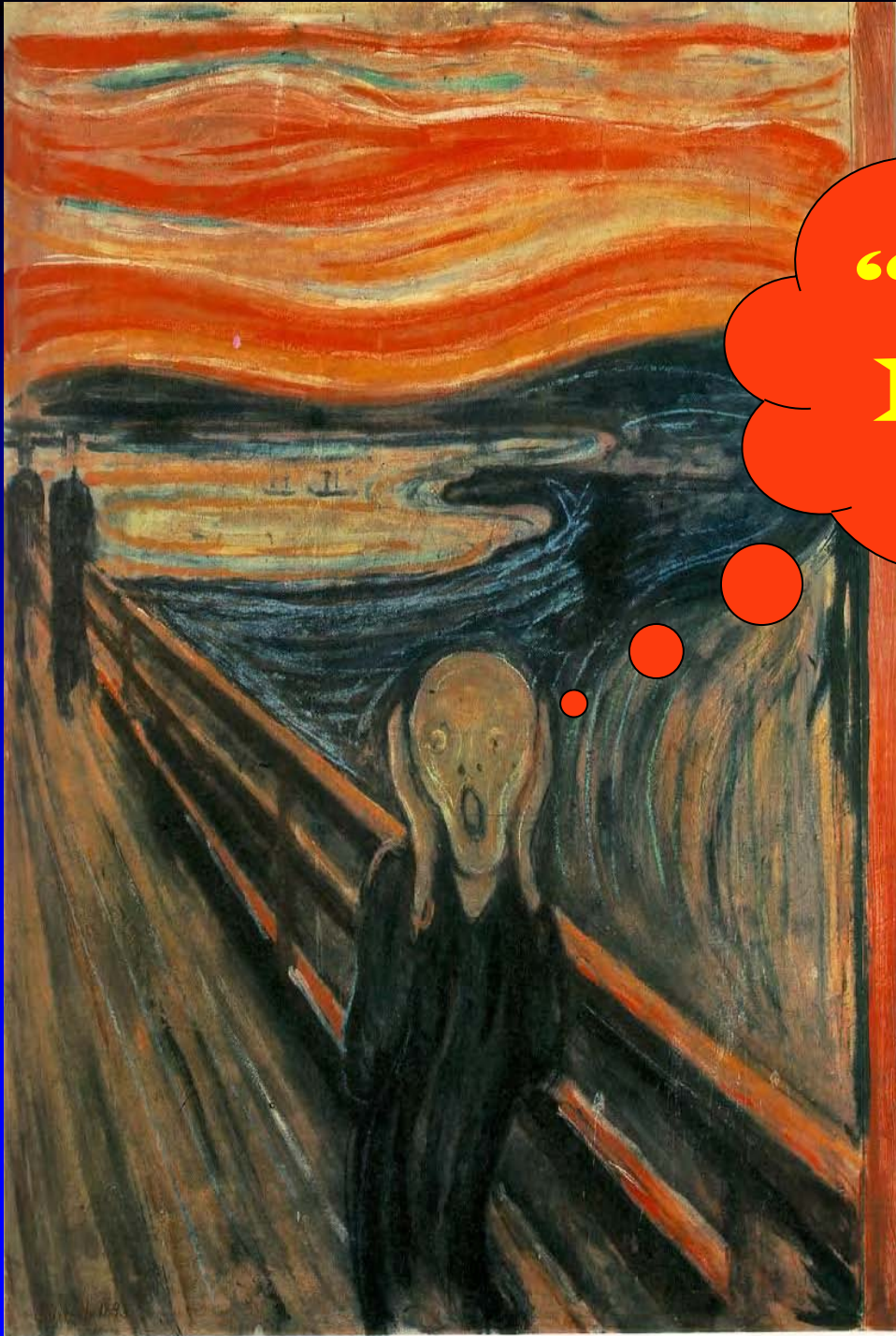


Castiglione di Ravenna, Ravenna RA, Italy

Classic passive dispersal

- World trade: used tyres
- Japanese mosquito → USA
- Exotic mosquito: → Europe
- CHIK: forest → coast
- Urban epidemics: Mombassa & Lamu
- CHIK: Africa → oceanic islands
- CHIK: Mauritius → India
- Urban epidemics: India → pandemic Asia
- CHIK: India → Italy





“It’s too late ...!”



INSTITUT PASTEUR

QuickTime™ and a
decompressor
are needed to see this picture.

 QuickTime™ and a
decompressor
are needed to see this picture.

QuickTime™ and a
decompressor
are needed to see this picture.



WHO press statement ...

"We cannot say that the disease was **caused** by climate change, but the conditions in Italy are now suitable for the Tiger mosquito."



“This is the first case of an epidemic of a tropical disease in a developed, European country”, said Dr. Roberto Bertollini, director of the World Health Organization. “Climate change creates conditions that make it easier for this mosquito to survive ...this is a real issue ...it is not something a crazy environmentalist is warning about...”



... what a relief ...!

"There is now no chance that it will spread over the mountains to Germany. The temperature in the mountains is now very low. The mosquitos are dying off."



Delta of the River Po

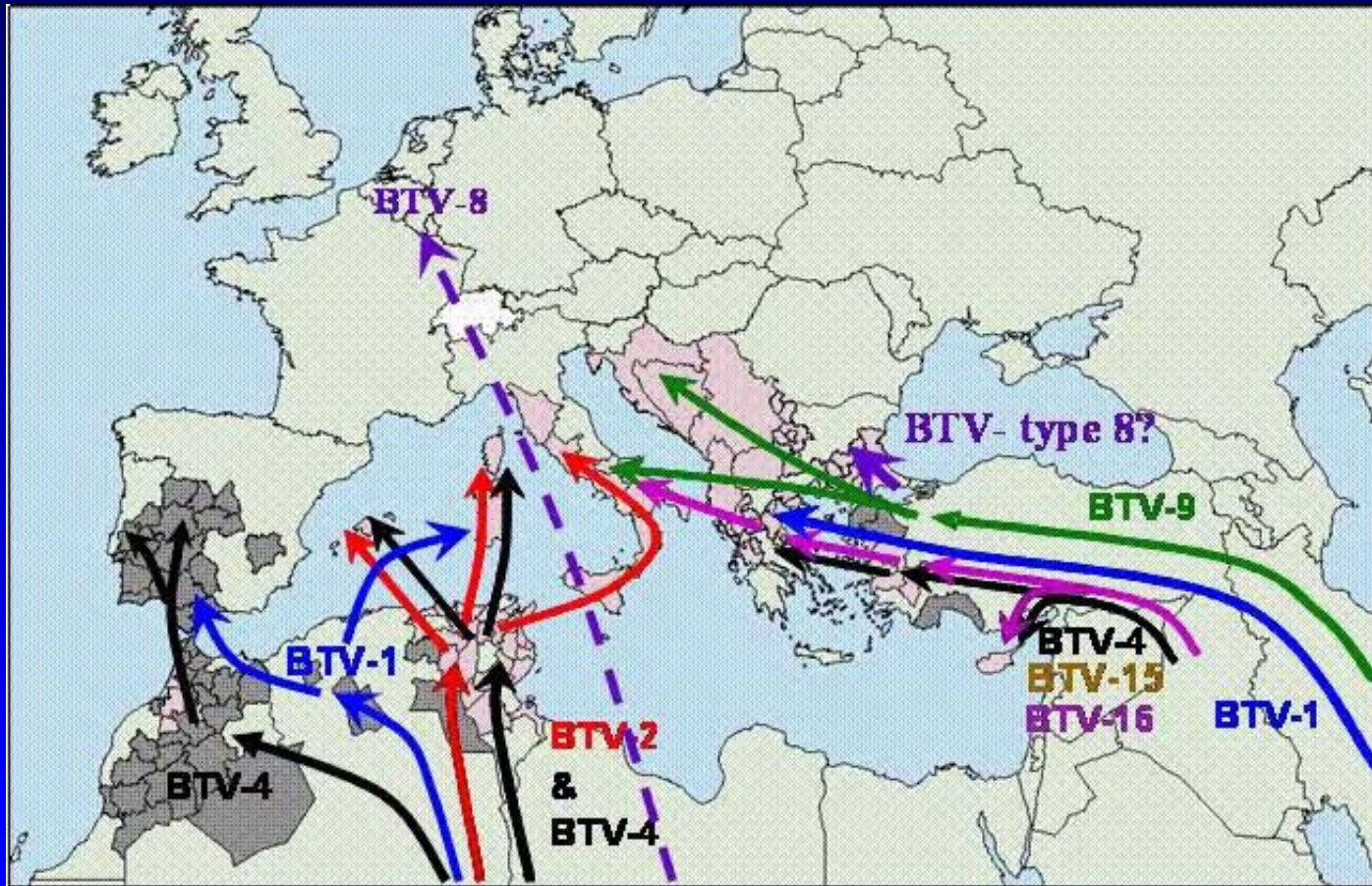


Castiglione di Ravenna, Ravenna RA, Italy

The super vector!



Climate change?



Recent introductions

- *Trypanosoma evansi*: France
- Rift Valley fever: Comorro Islands
- Bluetongue: Europe



