



Invasive *Aedes* Mosquitoes in California

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Outline

- **Meet your new neighbors: *Aedes aegypti*, *Ae. albopictus*!**
- **Biology**
- **Current distribution within California**
- **Diseases vectored by each species**
- **Surveillance Tools**
- **Resources**

California now has three species of introduced *Aedes*!

Aedes aegypti



Aedes albopictus



Aedes notoscriptus



Aedes aegypti

- **Originated from Africa. Main dengue vector worldwide.**
- **Very capable vector of dengue viruses. High preference for biting humans, and to a lesser extent, domestic mammals.**
- **Peridomestic. Occupies urban areas with or without vegetation.**
- **Bites, rests, and lays eggs both indoors and outdoors.**





Aedes aegypti

- **Sneaky biter. Prefers ankle height.**
- **Reproduces in water-filled, human-made containers, treeholes, and bamboo internodes holding water.**
- **Unaided, travels only a few hundred yards.**
- **AKA: Yellow Fever Mosquito.**
- **Current infestation detected in 2013: Madera, Fresno and, San Mateo counties.**

***Ae. aegypti* Loves Human Blood!**



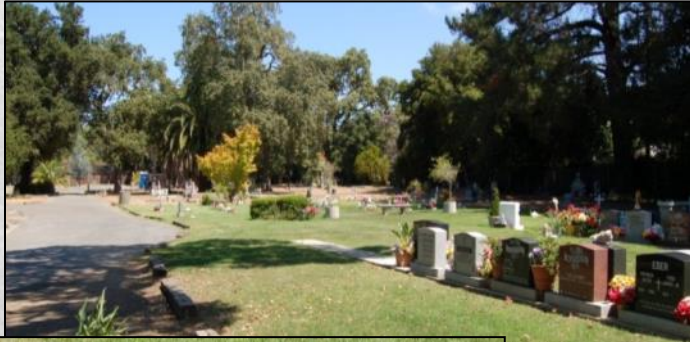
Where does *Aedes aegypti* breed?

Within small containers containing water

Eggs laid singly just above the water line; hatch when flooded

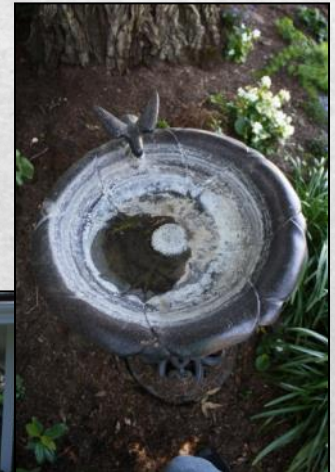
Cemeteries

Permanent vases, personal items

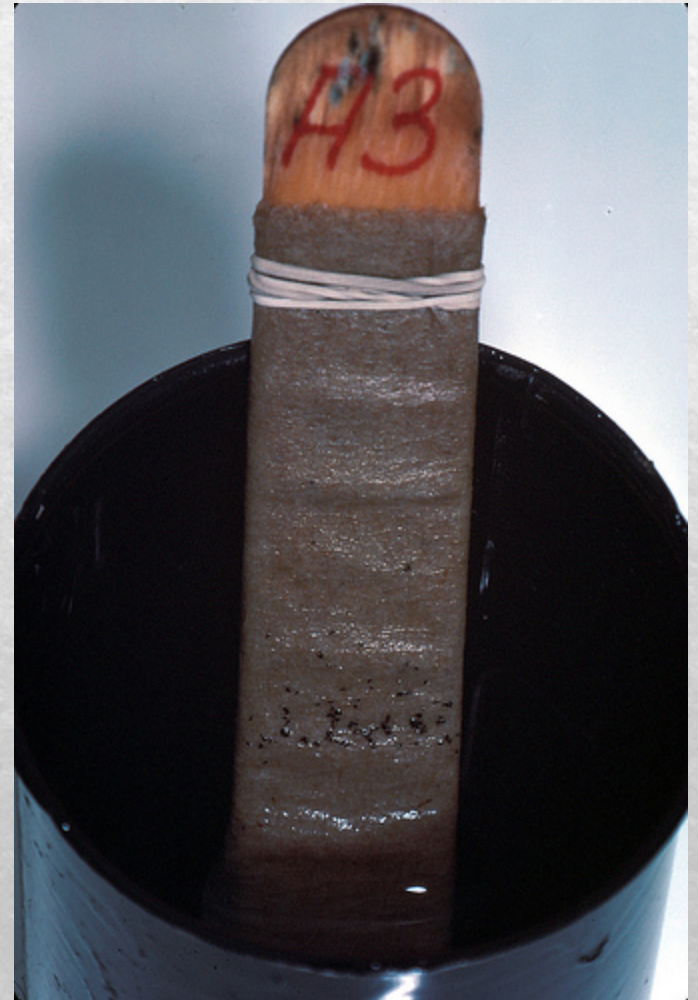
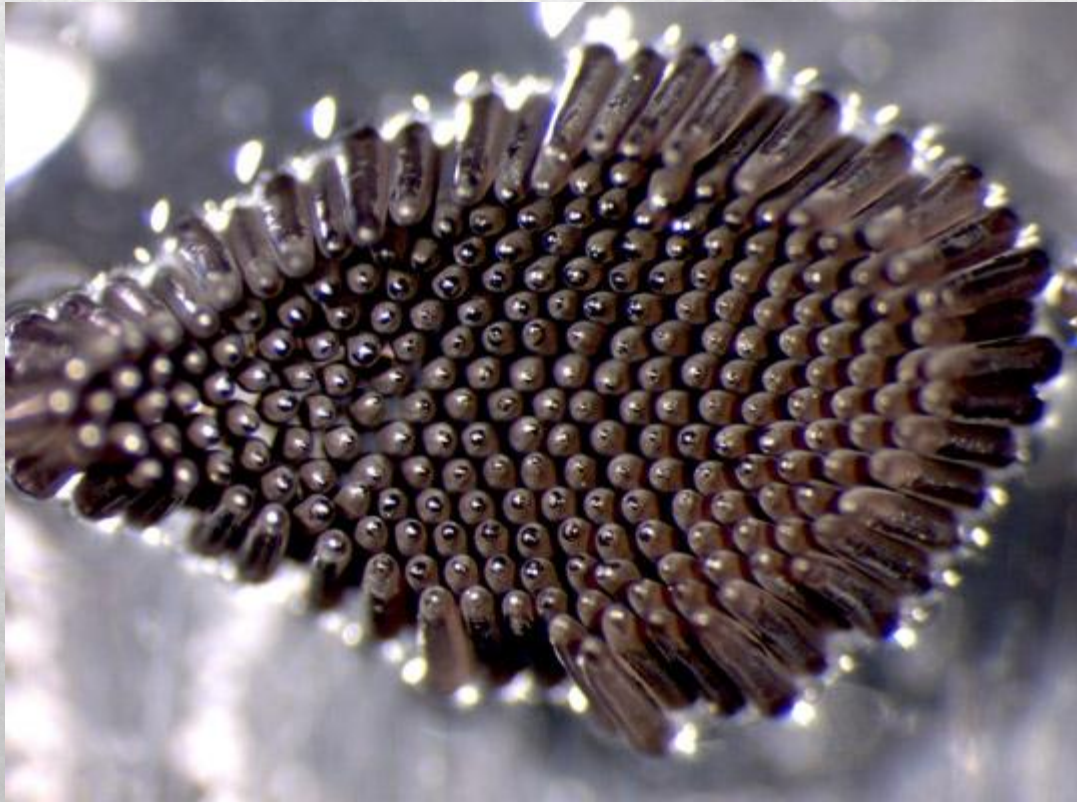


Resident yards

Bird baths, plant saucers, tires, and other small containers



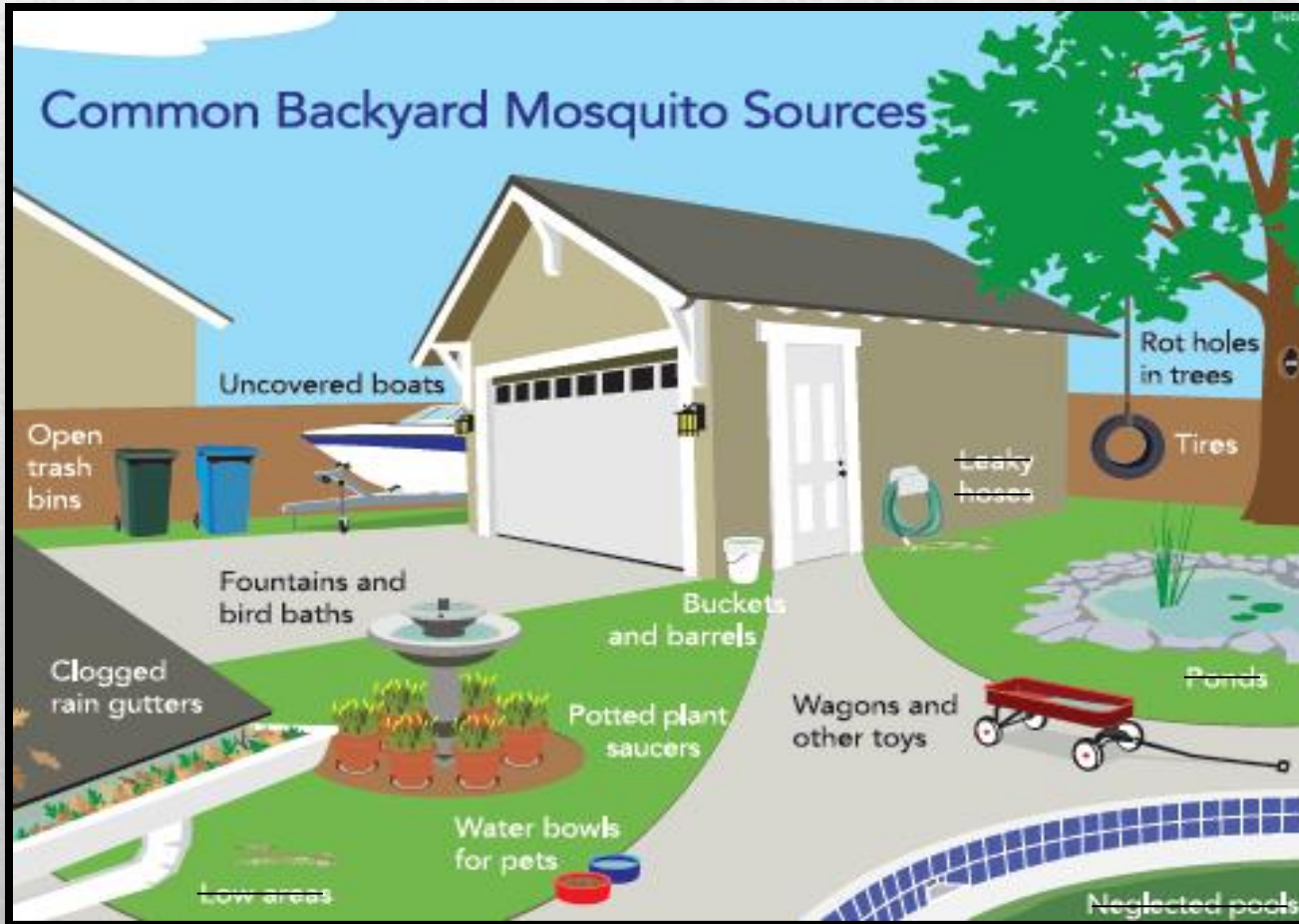
Egg Rafts vs. *Aedes* Eggs



Good Micro-Habitat: Breeding Sources for *Aedes* Mosquitoes



Mosquito Sources



Different from West Nile Virus mosquitoes.

Look for man-made sources!

How did *Aedes aegypti* arrive in California?

- Unknown. Genetically linked to populations in Texas – Louisiana.



Current US Distribution

Aedes aegypti



Aedes albopictus



Aedes albopictus: Asian Tiger Mosquito

- **Originated from Southeast Asia.**
- **Associated with thickets and vegetation.**
- **Mostly an outdoor (garden) mosquito.**
- **Aggressive day biter.**
- **Bites humans but also a variety of available domestic and wild vertebrates that do not carry the dengue viruses, lowering the mosquito's capacity to transmit them.**



Aedes albopictus: Asian Tiger Mosquito

- Main dengue vector in some areas but is mostly a secondary vector.
- Shows preference for treeholes and bamboo internodes with water, can also utilize human-made containers.
- Utilizes water-filled containers around or further away from households.
- Short flight range: (< 650 ft).





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COVERAGE



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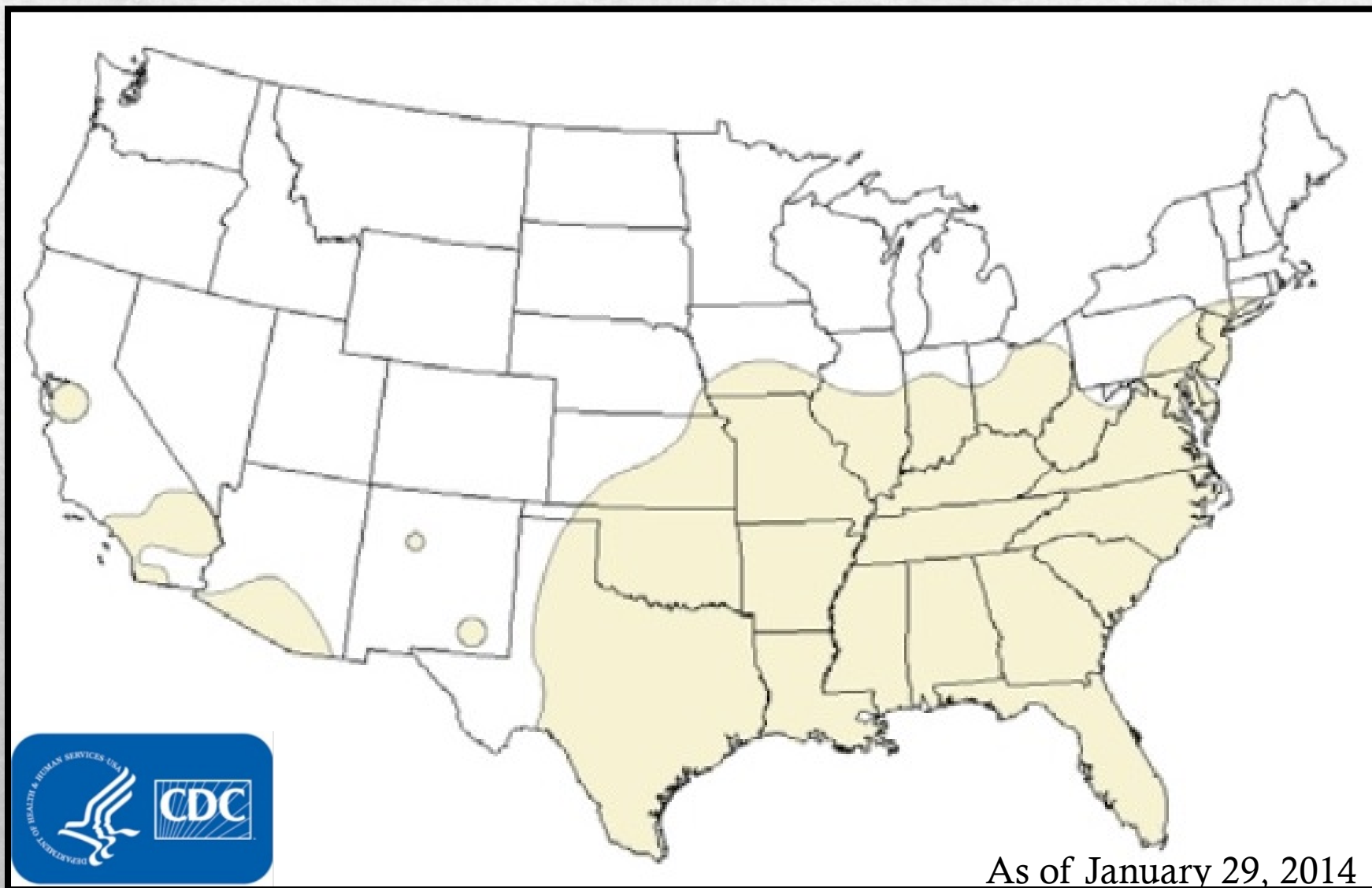
2011 Detection

- **Index site: El Monte Trailer Park (LA County).**
- **Resident service request on Sept 2, 2011.**
- **2011 population not genetically different from 2001 infestation population (origin: lucky bamboo from China).**
- **Successfully overwintered multiple years.**
- **Infestation area now covers five counties.**



Current US Distribution

Aedes albopictus



As of January 29, 2014

California Distribution

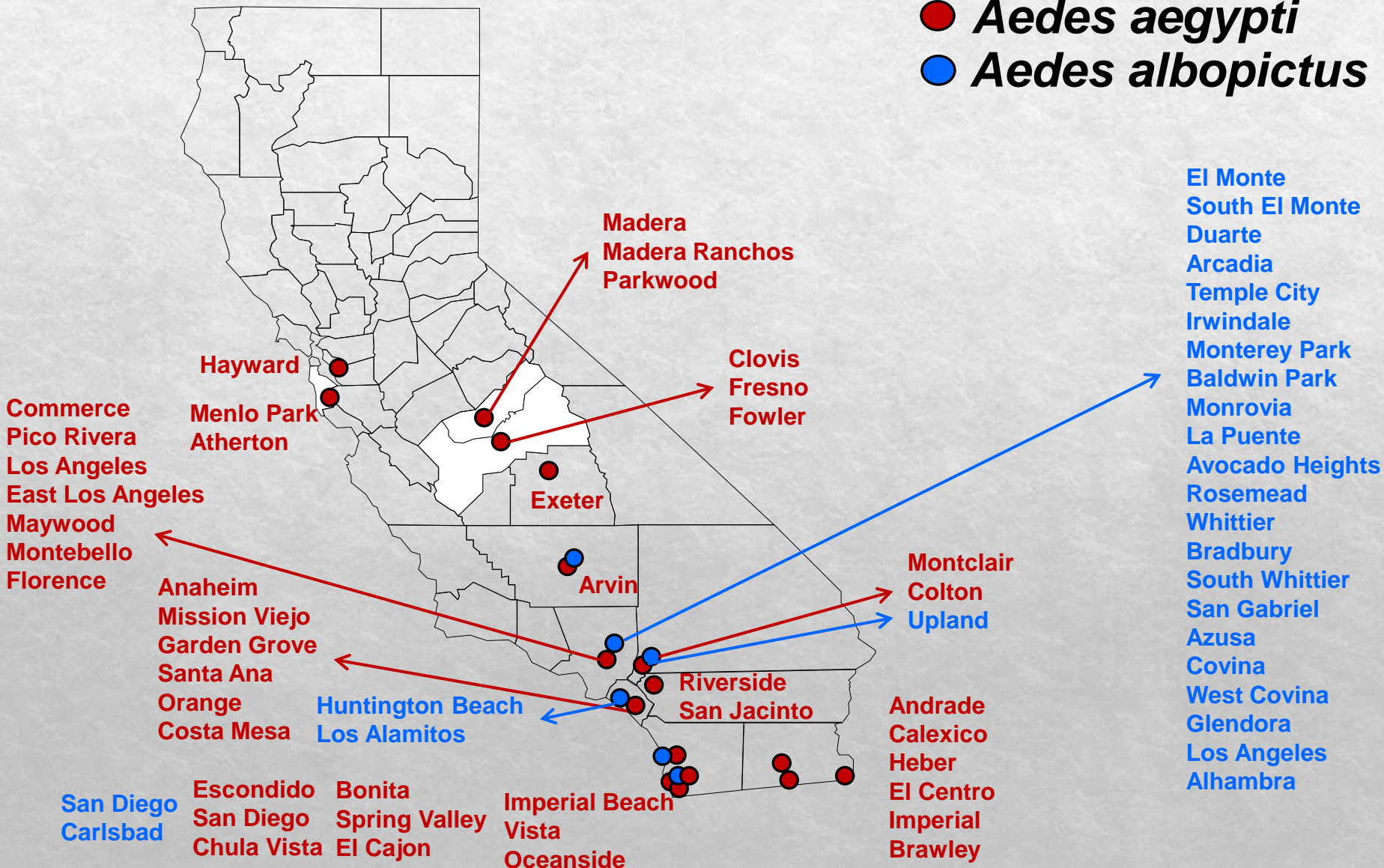


Aedes aegypti and *Aedes albopictus* Mosquitoes

Detection Sites in California, 2011-2015

Updated November 4, 2015

● *Aedes aegypti*
● *Aedes albopictus*



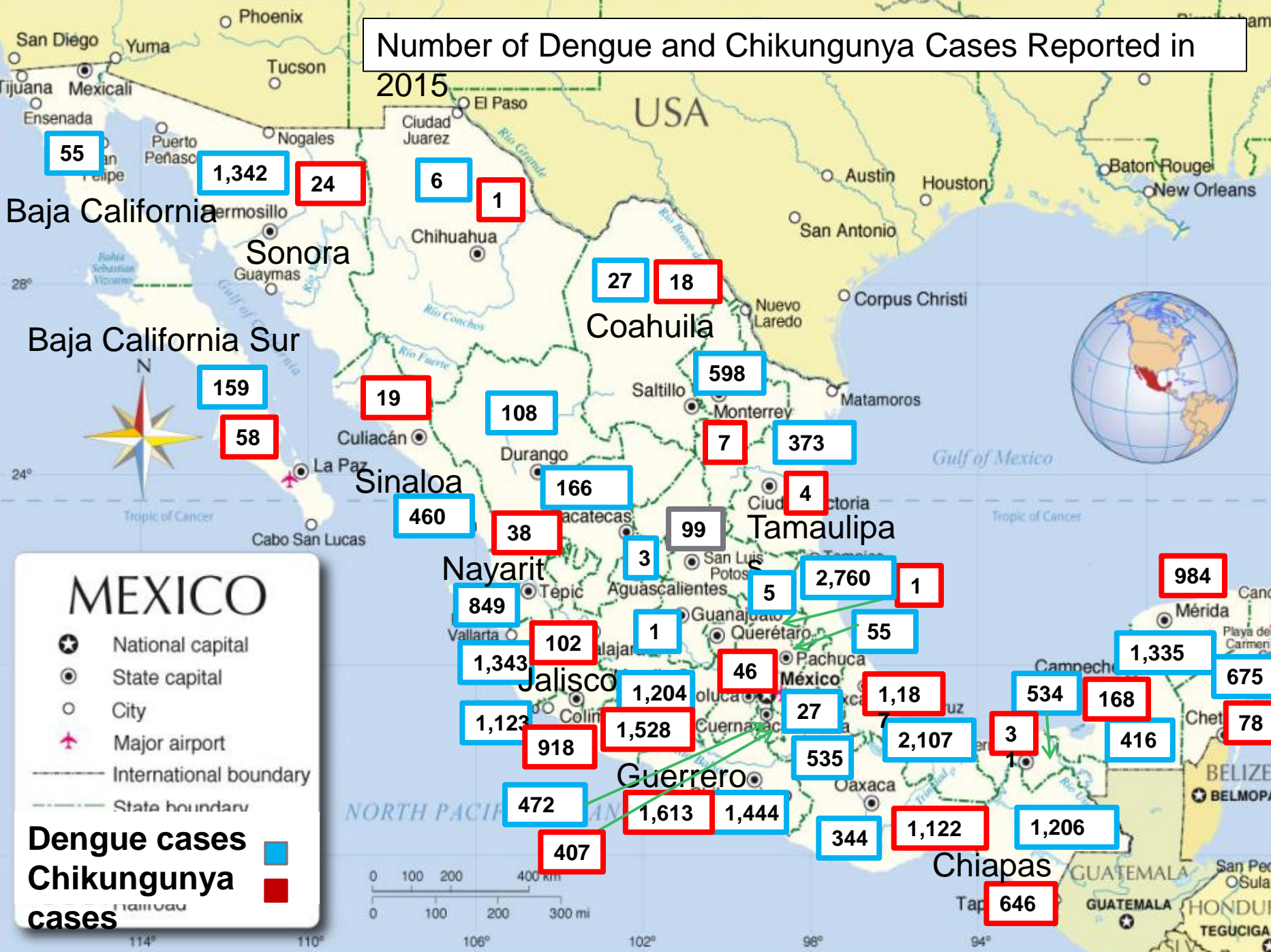
Why Do We Care About These Introduced Mosquitoes?

<i>Ae. aegypti</i>	Primary	Yellow fever, Dengue
	Primary	Chikungunya
	Competent	WNV, Ross River, Murray Valley, etc.
<i>Ae. albopictus</i>	Secondary	Chikungunya, Dengue
	Competent	>30 viruses (WNV, EEE, SLE, LAC, etc.)

Dengue: 5 days on average where the viremia of a person is sufficient to “infect” a mosquito.

Chikungunya: 7 days on average.

Number of Dengue and Chikungunya Cases Reported in 2015



MEXICO

- ★ National capital
- ⦿ State capital
- City
- ✈ Major airport
- International boundary
- - - State boundary

Dengue cases ■

Chikungunya cases ■



Current Hawaiian Dengue Outbreak

Number of confirmed cases that visited potential exposure areas on the island of Hawaii* (n=23)

*Data is subject to change as additional information is collected from cases

(As of 11/6/2015)



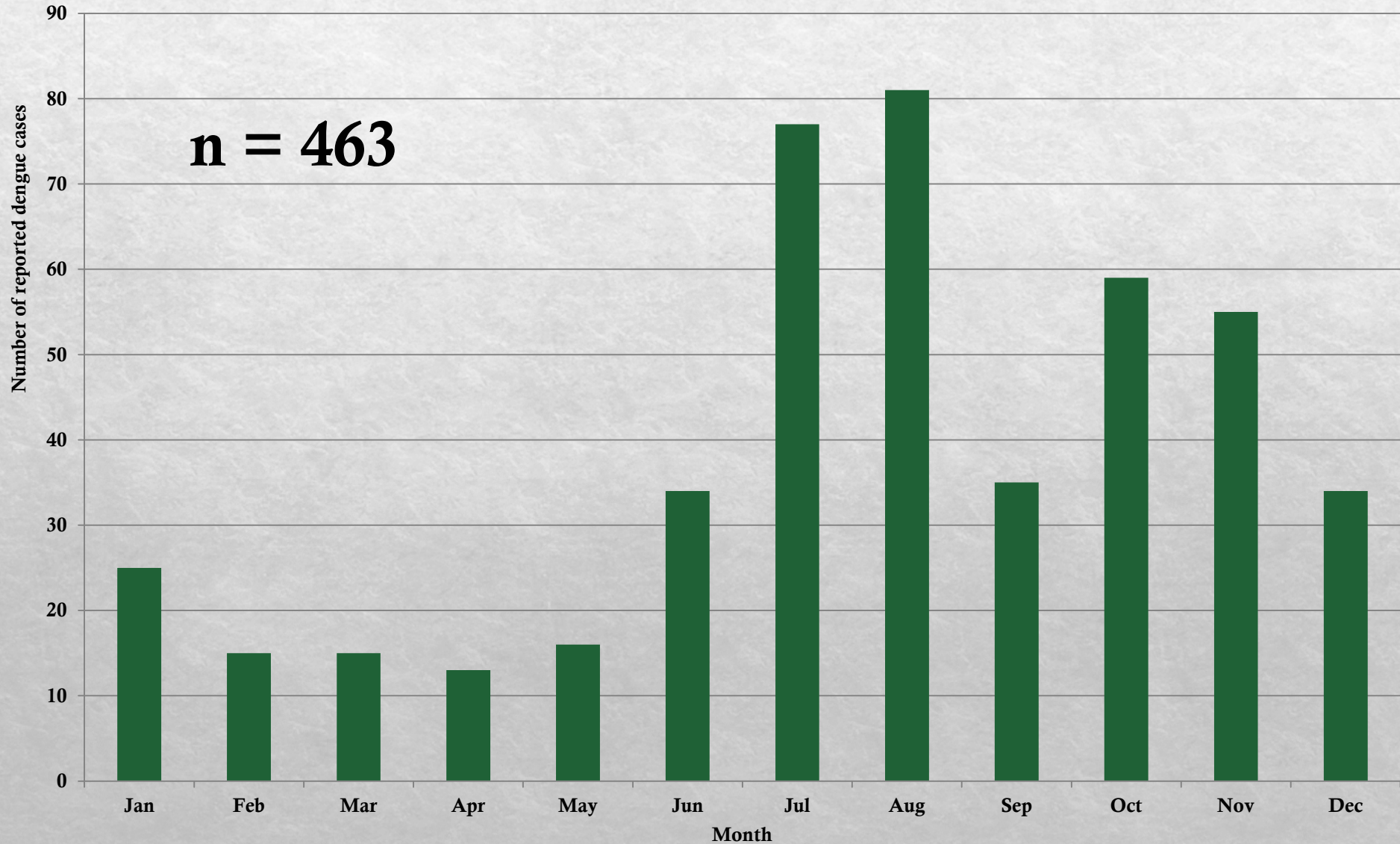
Map data ©Google

Total number: 56 (November 17).
46 locals, 10 visitors – 2 from CA!

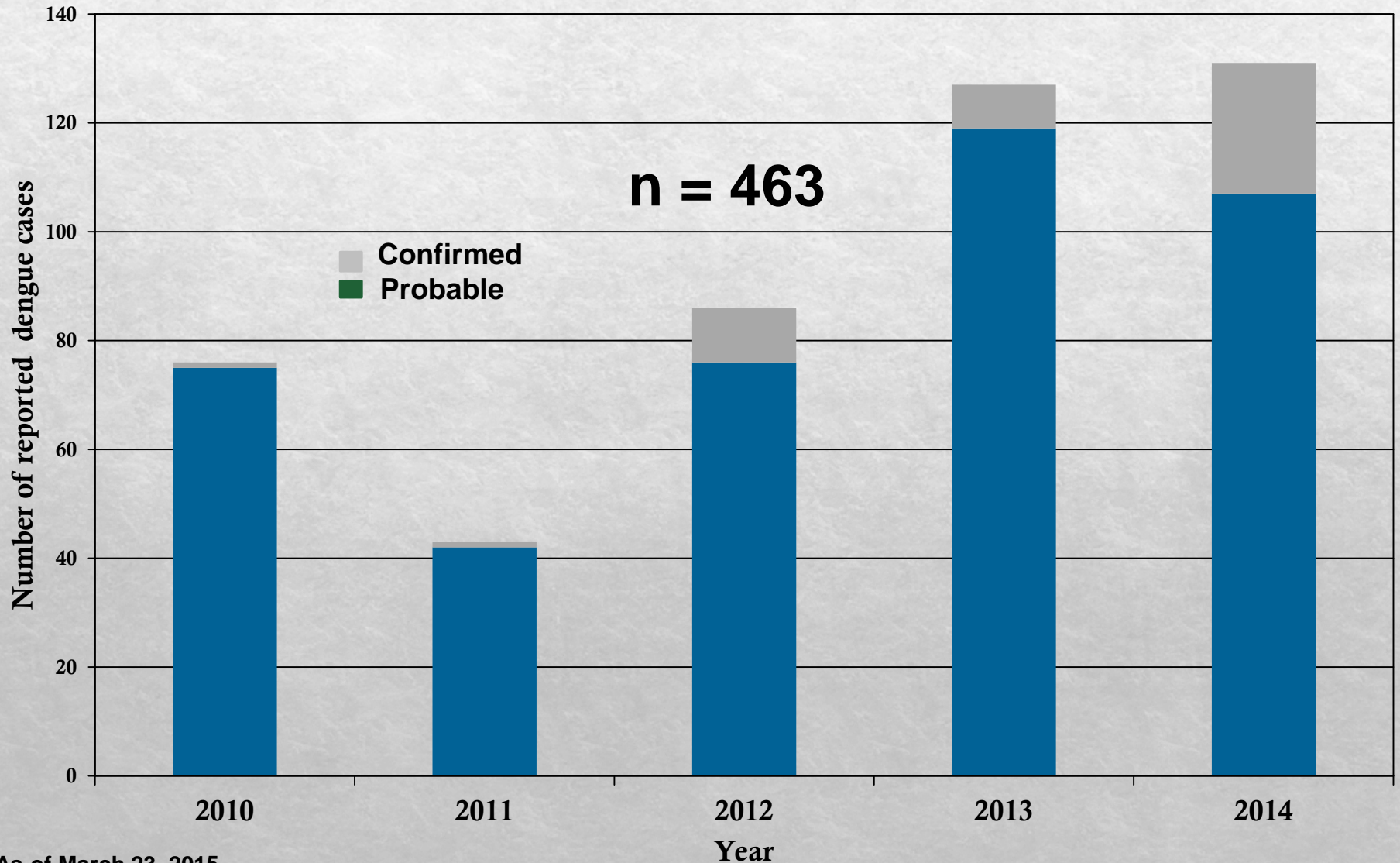
Map numbers do not refer to confirmed cases, but represent places where confirmed cases visited.

Ae. albopictus is the vector.

Seasonality of Imported Dengue Cases in California, 2010-2014



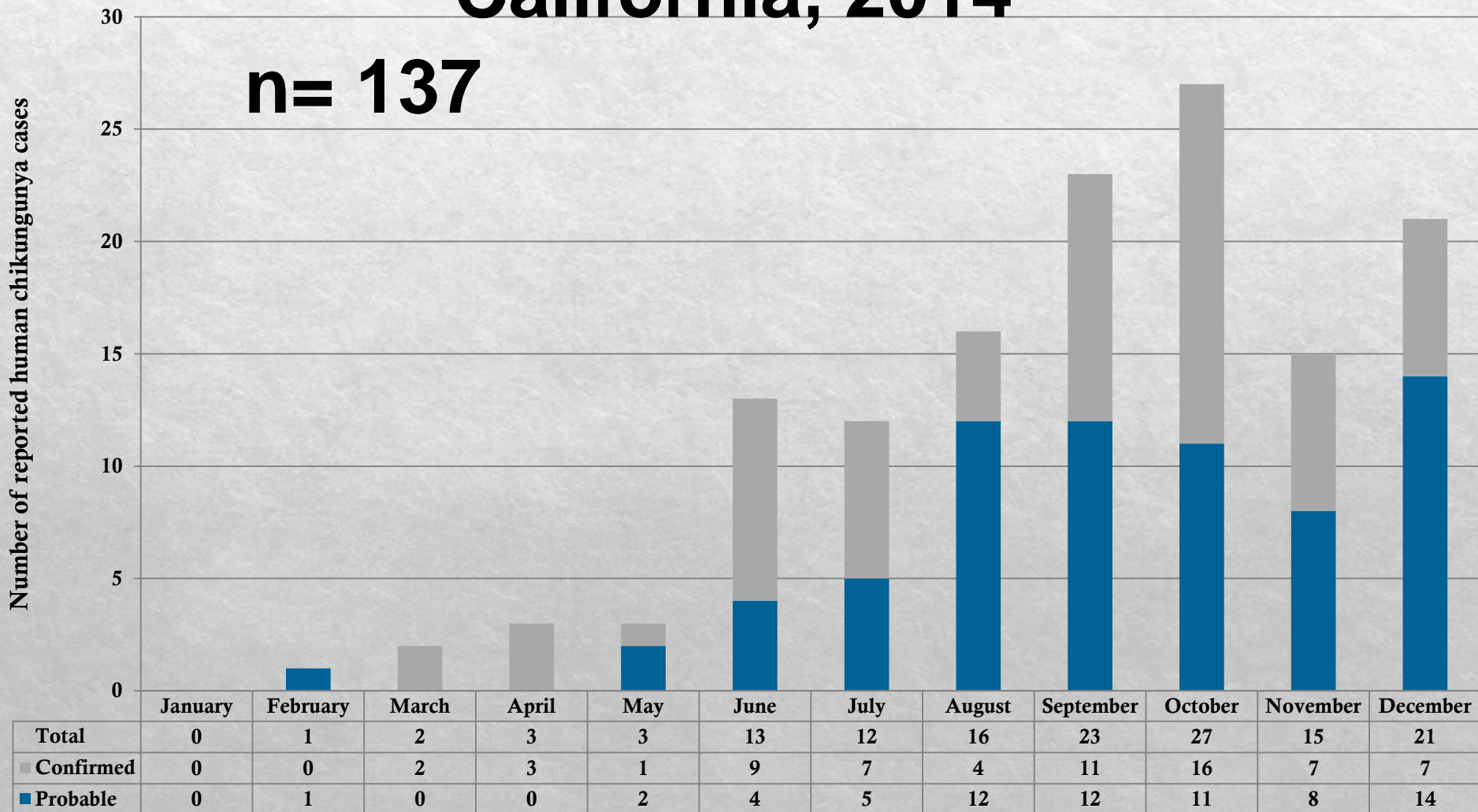
Imported Human Dengue Cases in California 2010-2014*



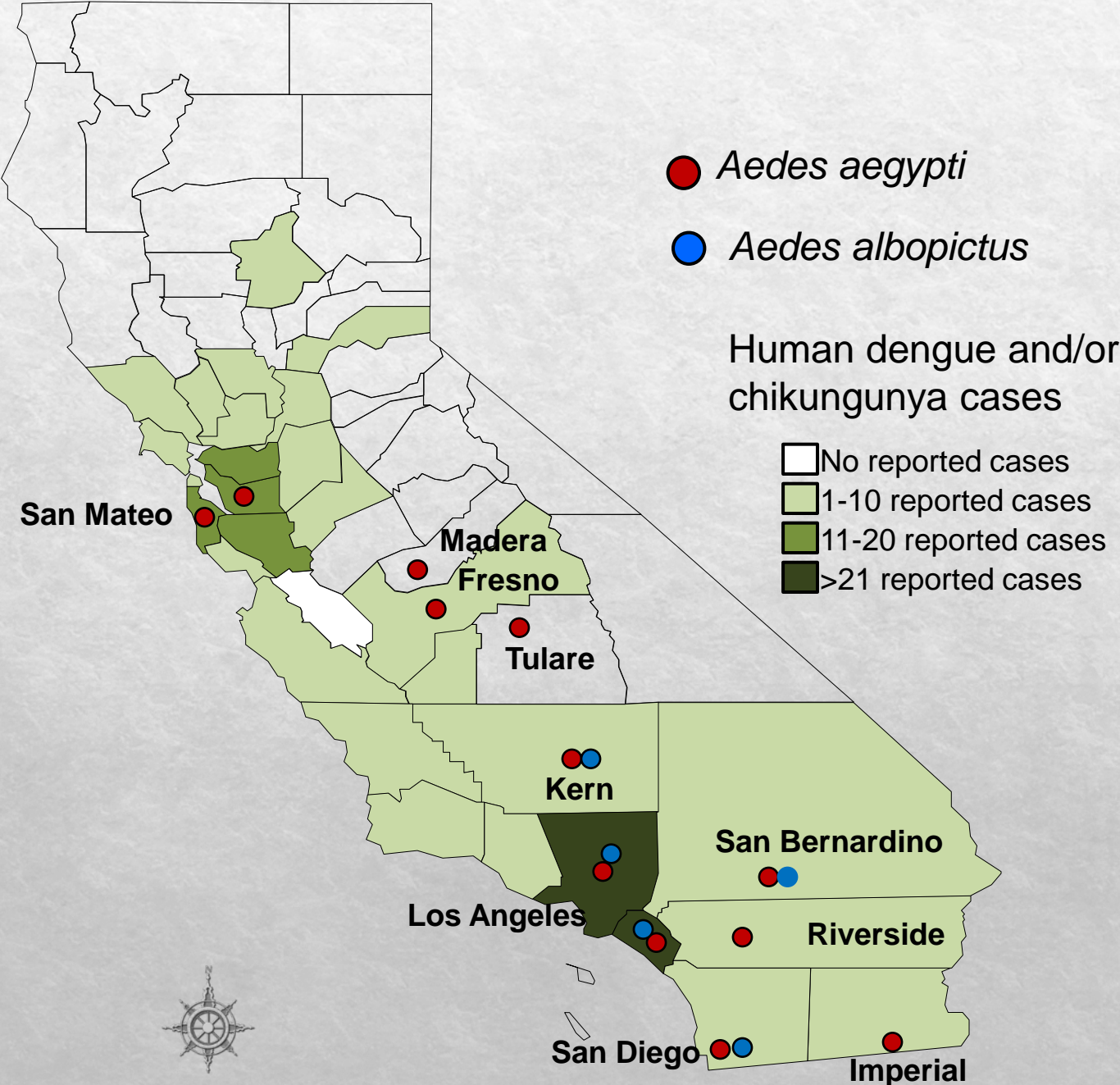
* As of March 23, 2015

Month of symptom onset for chikungunya cases reported in California, 2014

n = 137



California, USA



Nuisance Mosquitoes



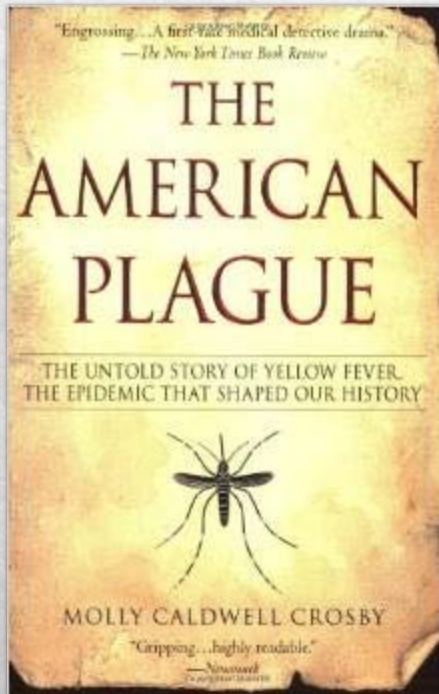
Quality of life. Nobody wants to be eaten alive while enjoying the outdoors.

MONEY!!!

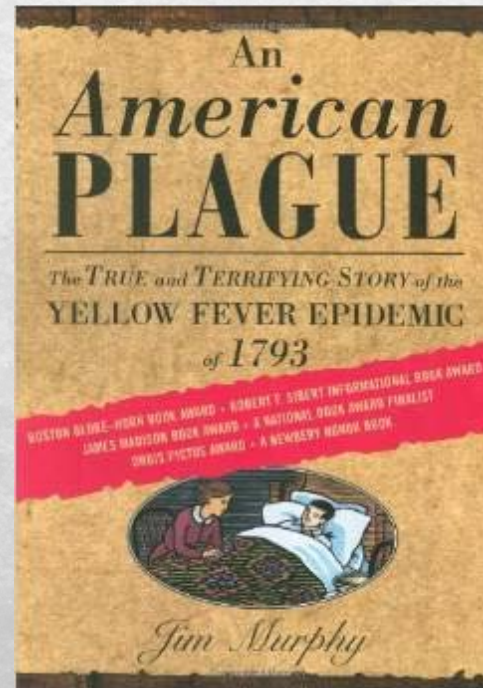
How to Preserve Your Health?

- **Dress appropriately.**
- **Wear repellent.**
- **Keep doors shut, inspect window screens.**
- **Be mosquito aware.**

Lessons from the Past



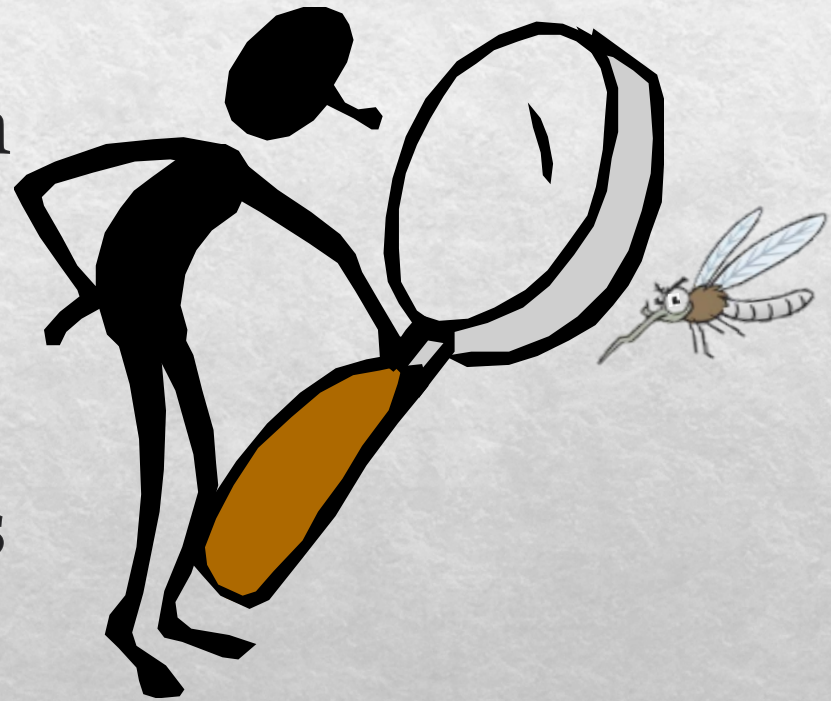
**1878 Memphis:
5,000 dead**



**1793 Philadelphia:
4,000 – 5,000 dead**

Surveillance

- Larval habitat
- Human landing catch
- Ovipositing females
 - Eggs/Adults
- Host-seeking females
- Public participation



Oviposition Cups

Ovicups, Ovitrap

- 12-20 oz dark plastic cups
- Cheap
- Inconspicuous
- Check weekly
 - Check for eggs/Refill water/infusion
- Collects eggs
 - Requires hatching for ID



Oviposition Cups

- Requires medium for oviposition (wood, paper, velour)
- **Support mosquito production if not maintained**
 - **Eggs may hatch even if not submerged**



AGO Trap

- Up to 8 weeks between inspections
- Doesn't support mosquito production
- Aids in control by removing gravid females
- Collects adults
 - Quick identification
- Estimate abundance
- No moving parts
- **Large and visible to public**
- **Damage to specimens**
- **Limited production/Not for sale**



AGO Trap components

CDC Guidelines for Assembly



A. $\frac{3}{4}$ " black polypropylene netting

B. Polyethylene cylinder that serves as the trap entrance

C. Sticky surface covering the interior of the capture chamber that is made of a black styrene

D. Screen barrier at the bottom

E. Black pail lid

F. Black polyethylene pail (5 gal.)

G. Micro-drainage holes to allow excess infusion to drain from the trap

H. 10 liters of water

I. 30 g hay packet (do not use alfalfa or leguminosae)

**The sticky (capturing) surface faces the inside of the cylinder
Make sure that the sticky board lays flat on the cylinder**



The bottom screen prevents mosquitoes from reaching the infusion inside the pail.

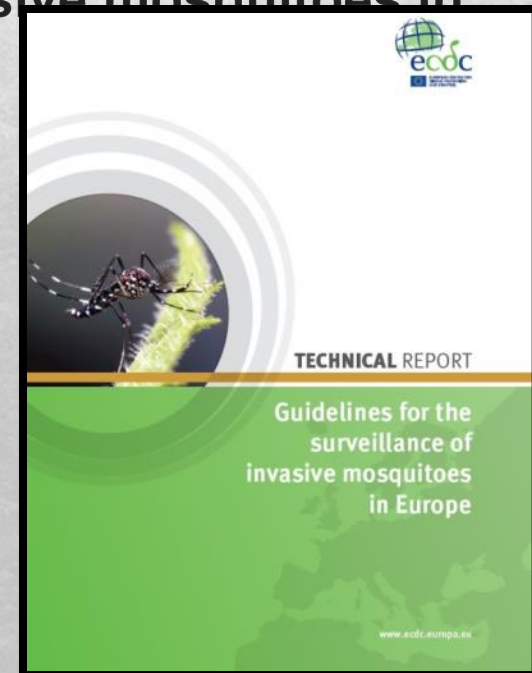


Can We Eradicate Our Invasive Mosquitoes??

- **Probably not.**
- **Control efforts for invasive mosquitoes more costly than for native species.**
- **2014-2015 winter did not kill either species.**
- **Are these new infestations or are we only now finding established sites?**
- **How do we prevent the mosquitoes from colonizing additional sites?**
- **To minimize the spread of the mosquitoes, the public AND vector control agencies will have to work together.**

Resources

- **California invasive *Aedes* mosquito surveillance and response plan**
 - **Guidance for local vector control agencies and health departments**
 - **CDPH – April 2014**
- **Guidelines for the surveillance of invasive mosquitoes in Europe**
 - **European Centre for Disease Prevention and Control, 2012**



Hantavirus Cardiopulmonary Syndrome



Hantavirus Cardiopulmonary Syndrome (HCPS)

What is HCPS?

How do you become infected?

Preventative measures.

What is HCPS?

Caused by rodent-borne viruses that affect the lungs and other organs of the body.

In California, the Sin Nombre virus is the main cause of HCPS.

The virus is carried mostly by the deer mouse *P. maniculatus* which sheds the virus through urine, feces and saliva.

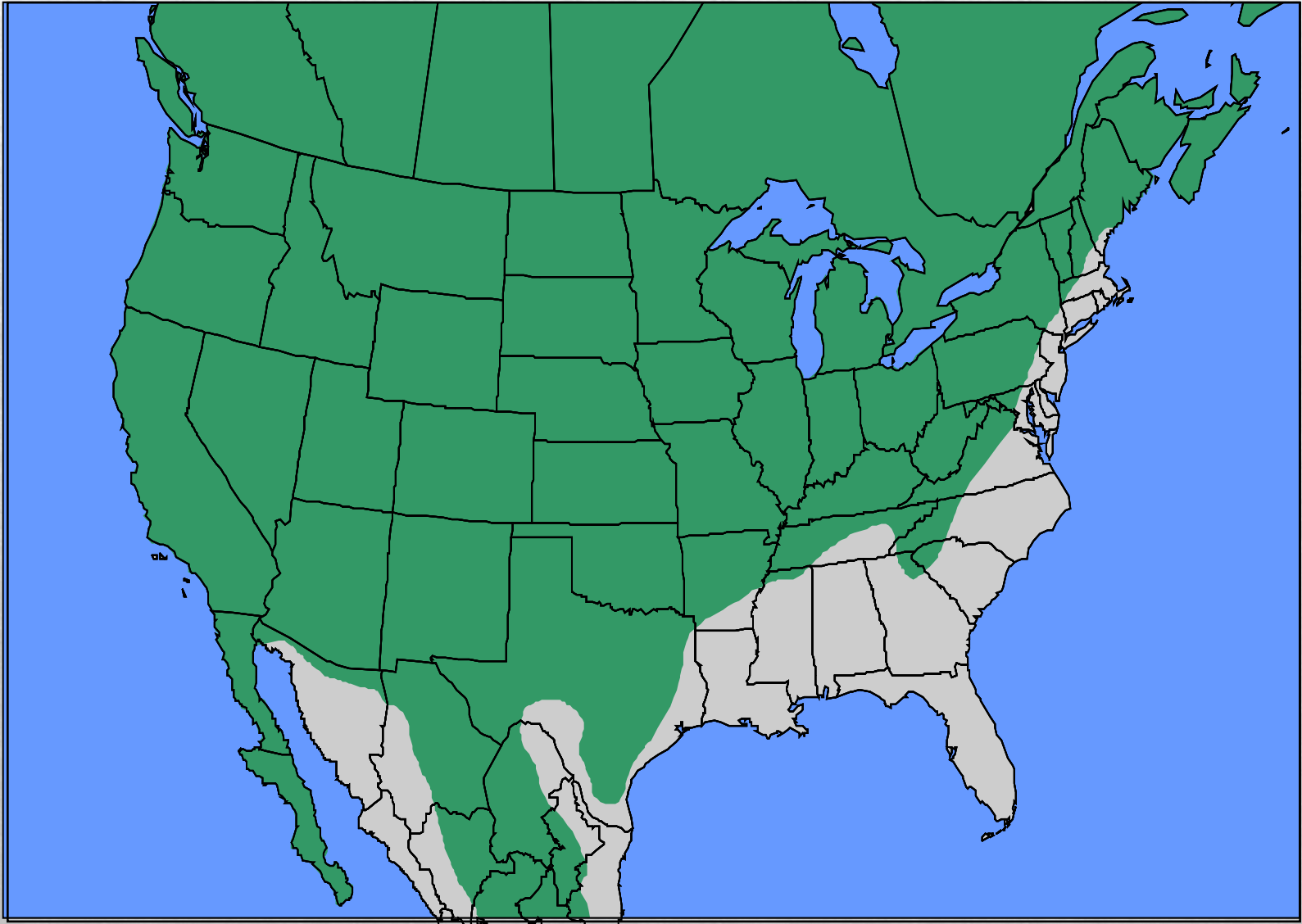
There is no specific treatment and the mortality rate is approximately 35%.

The Culprit



Peromyscus maniculatus

Distribution of *P. maniculatus*



How do Humans Become Infected?

People usually become infected through the inhaling airborne rodent feces, urine or saliva particles while sweeping, vacuuming or otherwise disturbing their (enclosed) surroundings.

Eating contaminated food.

Mechanical transfer (e.g., “hand-to-mouth”) of contaminated material.

What are the Symptoms??

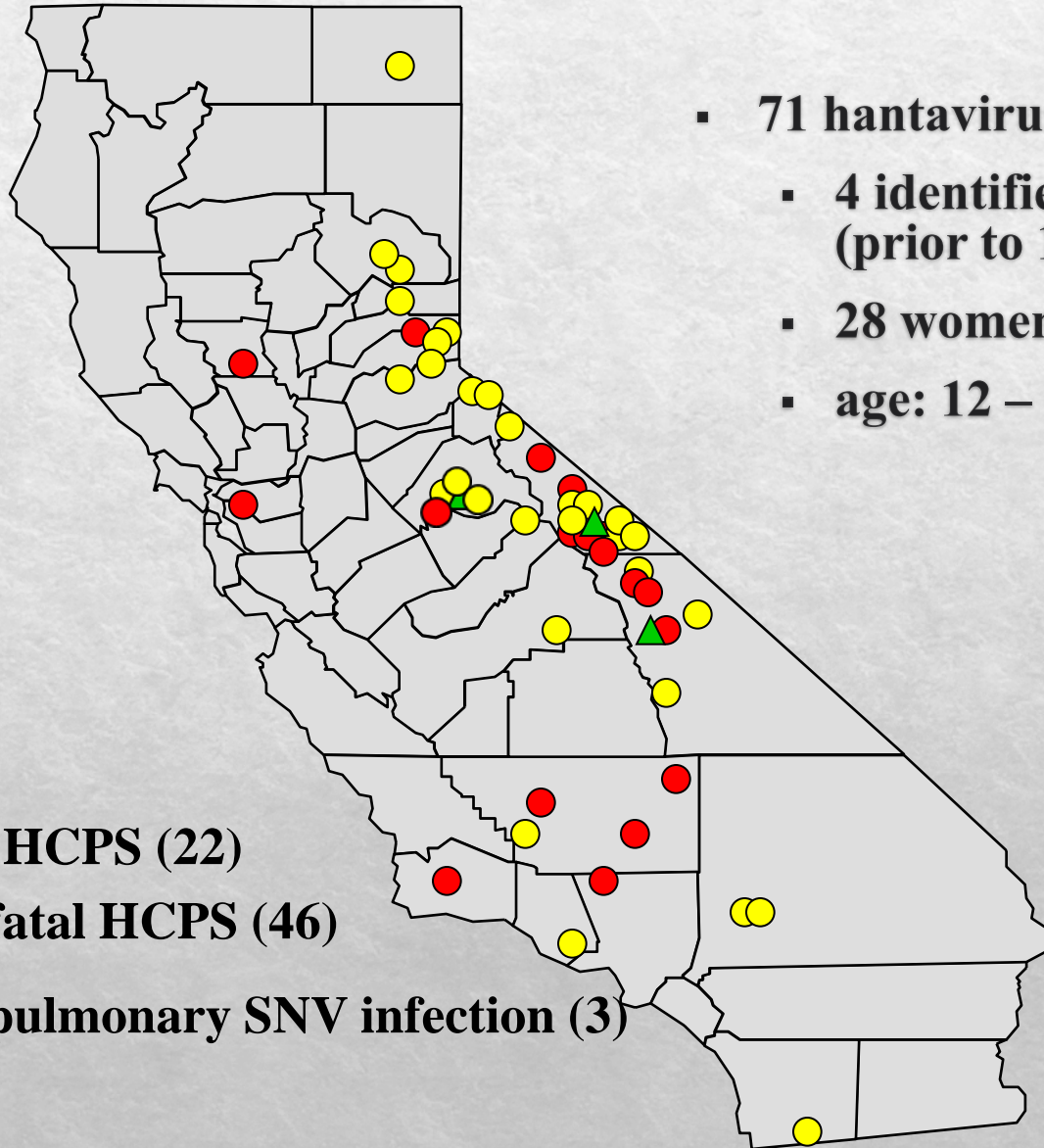
Incubation period between 5 - 45 days.

Initially, headaches, fever, diarrhea, abdominal pain, muscle pain are common.

Symptoms don't start with upper respiratory distress. However, within 3-5 days severe upper respiratory distress usually will lead to S.O.B., loss of consciousness and pulmonary edema

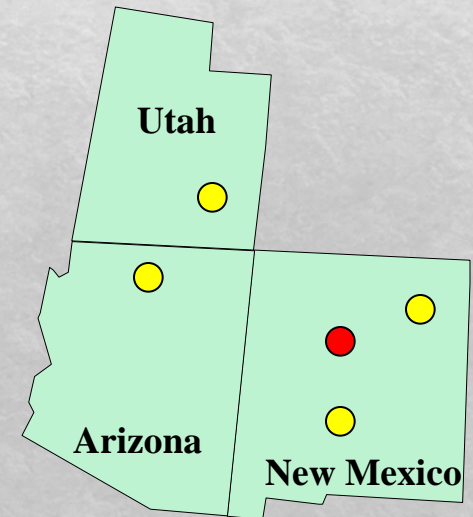
Treatment is supportive: intubation & ventilation, oxygen supplementation.

Hantavirus Infection in California Residents 1980-2015



- 71 hantavirus infections
 - 4 identified retrospectively (prior to 1993)
 - 28 women, 43 men
 - age: 12 – 74 years

- Fatal HCPS (22)
- Non-fatal HCPS (46)
- ▲ Non-pulmonary SNV infection (3)



Mapped by suspected site of exposure

Suspected or Confirmed Exposure Circumstances for CA Cases

38% Peridomestic

20% Occupational

6% Occupational or Peridomestic

28% Recreational

8% Unknown

How to Prevent HCPS

Never dry-sweep or vacuum enclosed areas. Mop using hot, soapy water or, preferably, use a 1-10% bleach solution.

Do not handle rodents, rodent feces or rodent bedding without proper protective equipment.



Equipment Storage Room



Reduce Rodent Incentives: Nesting



**Minimize storage of unused equipment
in or around buildings.**

Reduce Rodent Incentives: Food/Nesting



Ensure that food and empty containers are inaccessible to Rodents (store and dispose in sealed containers).

Eliminate Rodent Access



Seal around all pipes and conduit.

Eliminate Rodent Access

Mice can enter small openings (0.75 inch) in diameter.

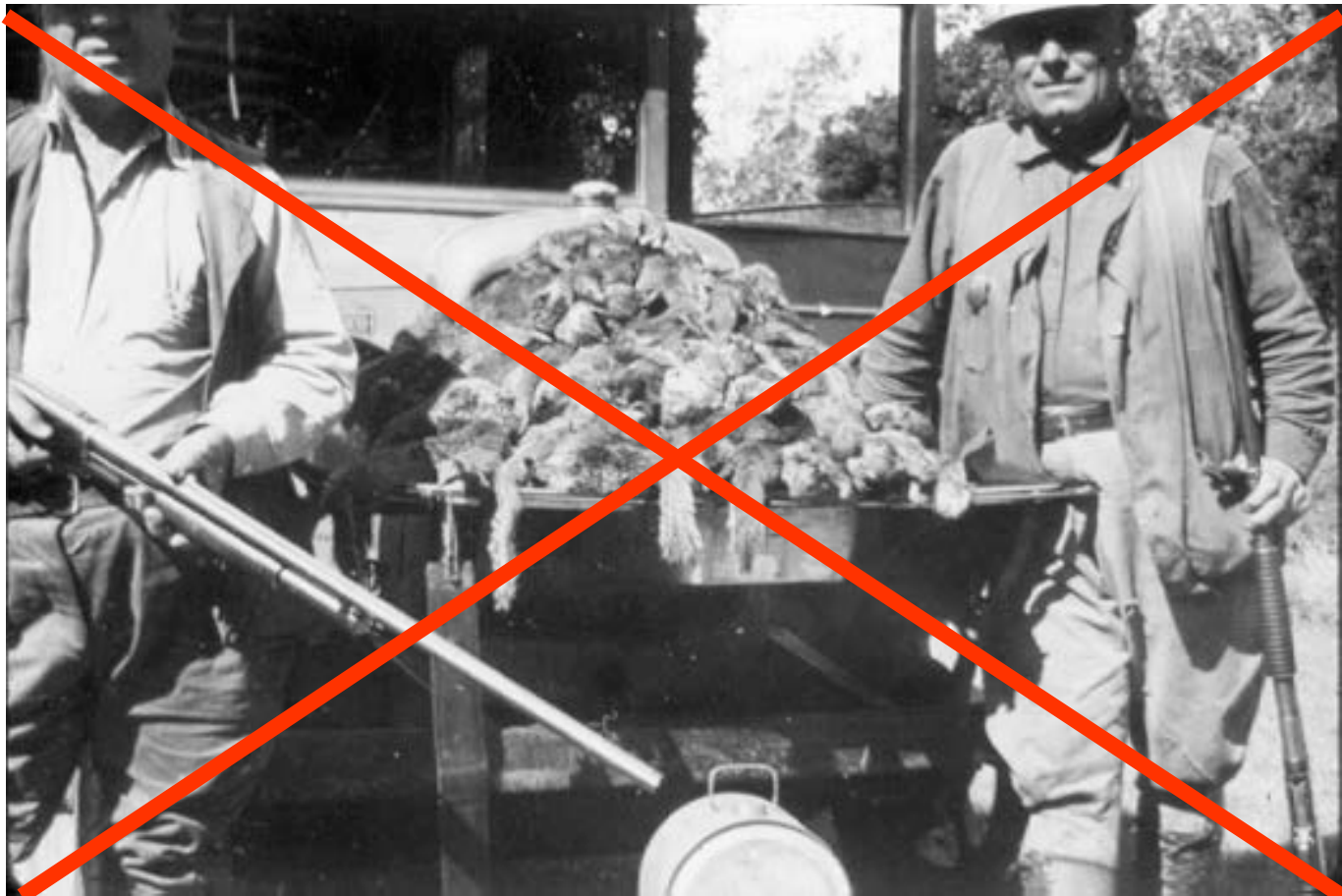
A variety of materials can be used to seal the openings:

- **1/4-inch galvanized hardware cloth**
- **sheet metal**
- **mortar**
- **concrete**
- **expanding foam**



California Bureau of Vector Control

The good ol' days: State plague control program (ca. 1930's).



Perform Proper Rodent Removal

Place the traps in areas rodents frequent, including runways, at entry points, and in close proximity to nesting areas.

Snap traps should be placed with the trigger ends facing the wall (perpendicular to the wall).

No glue traps!



Perform Proper Rodent Removal

**Wear gloves when handling
dead rodents.**

Double bag carcasses.

Dispose outside of buildings.



Disinfection

The careful use of disinfectants is one of the simplest and most effective means of reducing the risk of the spread of hantavirus.

Hantaviruses are sensitive to dilute household bleach, detergents, and most general-purpose household disinfectants.

Reduce Exposure to Contaminated Materials and Areas: Bleach

A 10% solution (1:10 dilution) of bleach is an adequate surface disinfectant for wiping down potentially contaminated surfaces.

A bleach solution breaks down, so it should be made fresh each day.

Wash Your Hands!!



Questions?

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