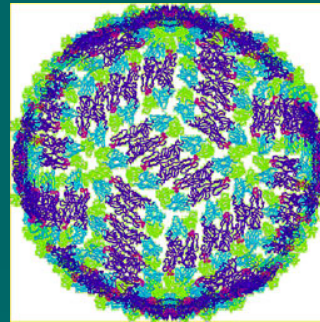


DENGUE, DENGUE HEMORRHAGIC FEVER AND OUR ARIZONA VECTOR



**DR. KIRK SMITH
VECTOR CONTROL
MARICOPA COUNTY**

KEY FACTS

- ❖ Dengue is a mosquito-borne infection that causes a severe flu-like illness, and sometimes a potentially lethal complication called dengue hemorrhagic fever.
- ❖ Global incidence of dengue has grown dramatically in recent decades.
- ❖ About two fifths of the world's population are now at risk.

ORIGIN

- ❖ The exact origins are not clear but it may have originated in Africa and was spread worldwide with the slave trade.
- ❖ The most convincing explanation for the name *denque* is that it is derived from the Swahili "Ka-Dinga pepo" that describes the disease as a sudden cramp like disease caused by an evil spirit.

ORIGIN

- ❖ In the wild the virus has a life cycle very similar to that of yellow fever involving passing between primates living in the jungle canopy and mosquitoes that feed on them.
- ❖ It is believed that the virus was transferred to man by the bite of the tiger-striped mosquito (*Aedes albopictus*) as man began clearing the jungle and building settlements.
- ❖ The most common vector now is the closely-related species *Aedes aegypti* which is African in origin but has spread throughout the tropics in the Old and New Worlds.

ORIGIN

- ❖ The earliest reports of a dengue-like disease are from Chin Dynasty in China (265-420 AD).
- ❖ Earlier confirmed outbreaks occurred in:
 - Cairo and Alexandria (Egypt, 1799)
 - Jakarta (Indonesia, 1799)
 - Philadelphia (United States, 1780)
 - Madras (India, 1780)

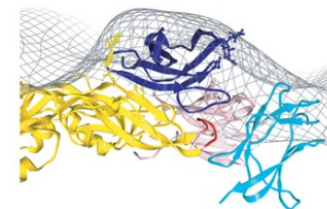
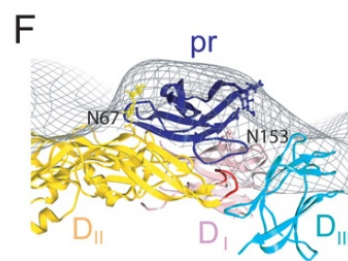
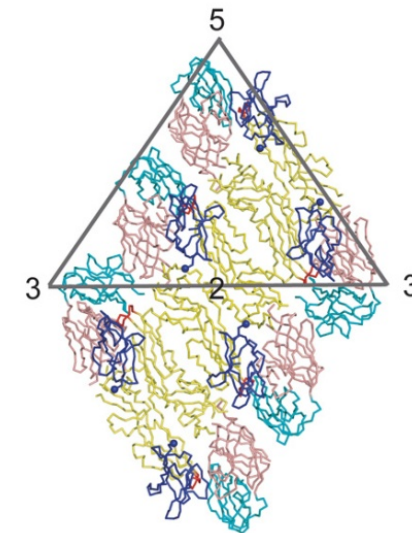
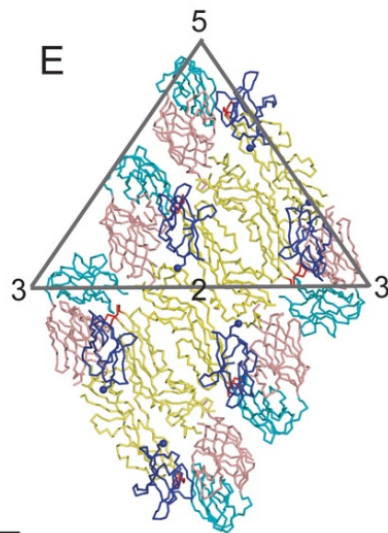
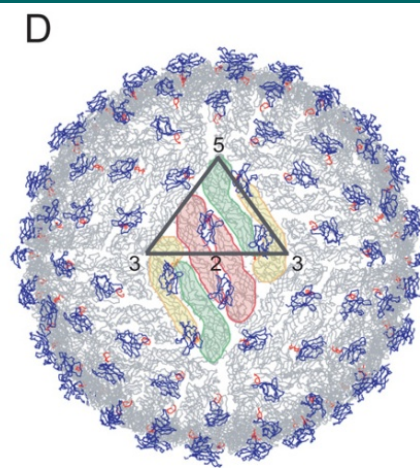
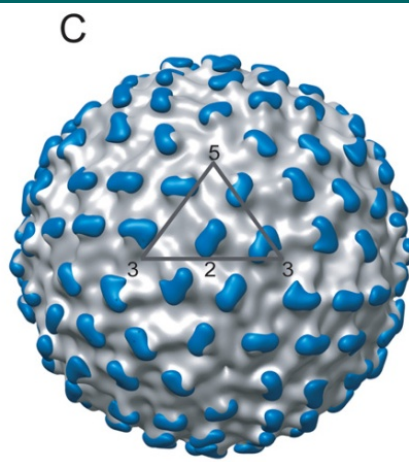
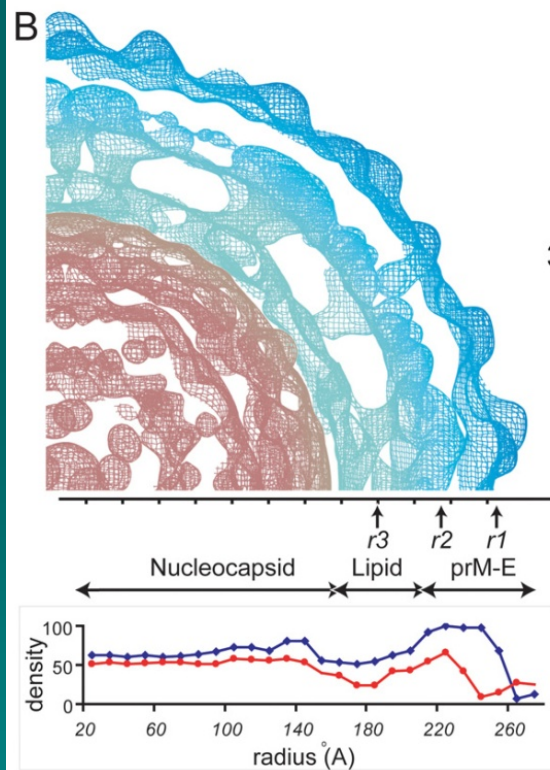
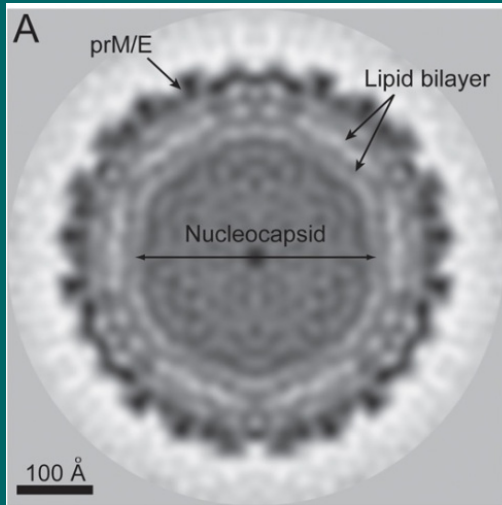
ORIGIN

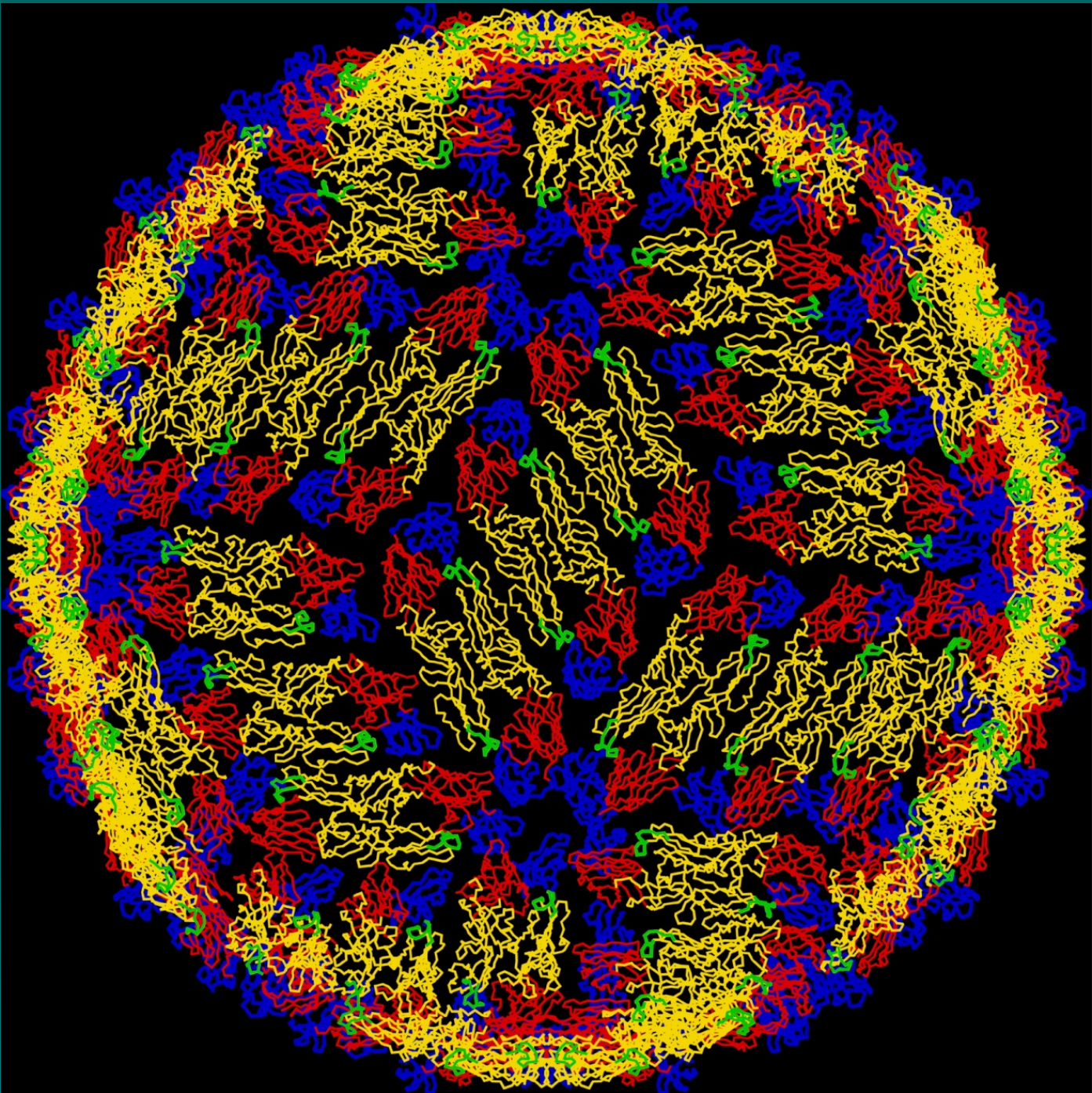
- ❖ The virus was identified in the 1940's when it became a concern to the armies fighting in Pacific arena as it was causing a large number of non-combat casualties to Allied and Japanese forces.
- ❖ Japanese scientists first identified the virus in 1943.
- ❖ By 1956 four serotypes of the virus were identified and every outbreak of the disease since has been due to a virus belonging to one of the four serotypes.

Dengue Fever and Dengue Hemorrhagic Fever are acute febrile diseases caused by four closely related virus serotypes of the genus *Flavivirus*, family **Flaviviridae**.

FLAVIVIRUS

- ❖ This genus includes the *West Nile virus*, *Dengue virus*, *Tick-borne Encephalitis virus*, *Yellow Fever virus*, and several other viruses which may cause encephalitis.
- ❖ Flaviviruses are named from Yellow Fever virus; *flavus* means yellow in Latin. (Yellow fever in turn was named because of its propensity to cause yellow jaundice in victims)





DENGUE FEVER

- ❖ Viral disease transmitted primarily by the *Aedes aegypti* mosquito.
- ❖ There are four genetically distinct serotypes of dengue virus: DEN-1, DEN-2, DEN-3 and DEN-4.
- ❖ Infection with any serotype may lead to an acute illness characterized by fever, headache, bone and joint pain and occasionally, rash and hemorrhagic manifestations.
- ❖ Secondary infection with a different serotype can lead to a more serious form of the disease known as Dengue Hemorrhagic Fever.

Dengue Viruses

- ❖ Each serotype provides specific lifetime immunity, and short-term cross-immunity.
- ❖ All serotypes can cause severe and fatal disease.
- ❖ Genetic variation within serotypes.
- ❖ Some genetic variants within each serotype appear to be more virulent or have greater epidemic potential.

SIGNS AND SYMPTOMS DENGUE

- ❖ Characterized by acute onset of high fever, 3-14 days after the bite of an infected mosquito.
- ❖ Patients develop frontal headache, retro-orbital pain, joint pain, nausea, vomiting, and often a maculopapular rash.
- ❖ Dengue goes by other names, including "breakbone" or "dandy fever." Victims of dengue often have contortions due to the intense joint and muscle pain, hence the name breakbone fever. Slaves in the West Indies who contracted dengue were said to have dandy fever because of their postures and gait.



SIGNS AND SYMPTOMS DENGUE

- ❖ Many patients notice a change in taste sensation. Acute symptoms, when present, usually last about 1 week, but weakness, malaise, and anorexia may persist for several weeks.
- ❖ A high proportion of infections produce no or minimal symptoms, especially in children. Treatment emphasizes relief of symptoms, avoiding aspirin and other non steroidal anti-inflammatory medications and encouraging oral fluid intake.



Dengue Hemorrhagic Fever

- ❖ Some patients with dengue fever go on to develop dengue hemorrhagic fever (DHF), a severe and sometimes fatal form of the disease.
- ❖ At about the time the fever begins to subside, the patient may become restless or lethargic, show signs of circulatory failure, and experience hemorrhagic manifestations.

Dengue Hemorrhagic Fever

- ❖ The most common of these manifestations are mild, such as skin spotting or blood in the urine, but may also include nose or gum bleeding, vomiting blood, and blood in the stool.
- ❖ DHF patients develop low blood platelets and hemoconcentration, the latter as a result of the leakage of plasma from the intravascular compartment.

DENGUE SHOCK SYNDROME (DSS)

- ❖ If patients are not treated correctly they may rapidly progress into DSS, which can lead to profound shock and death.
- ❖ Despite the name, it is the loss of intravascular volume from leaky capillaries rather than hemorrhage, which results in shock.

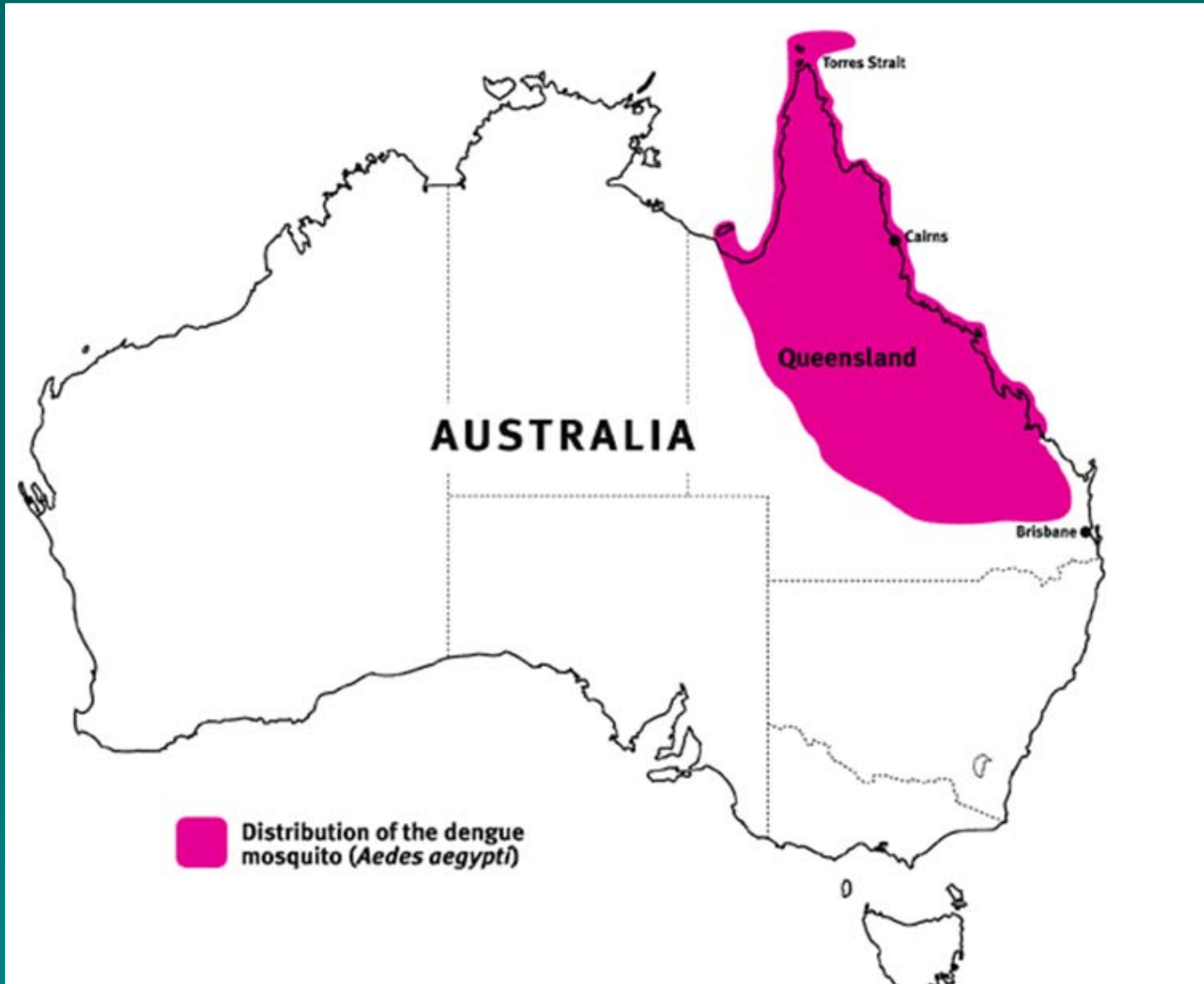
DENGUE SHOCK SYNDROME (DSS)

- ❖ Advance warning signs of DSS include severe abdominal pain, protracted vomiting, marked change in temperature (from fever to hypothermia), or change in mental status.
- ❖ Early signs of shock include restlessness, cold clammy skin, rapid weak pulse, narrowing of pulse pressure, and hypotension. Fatality rates among those with DSS may be higher than 10%.

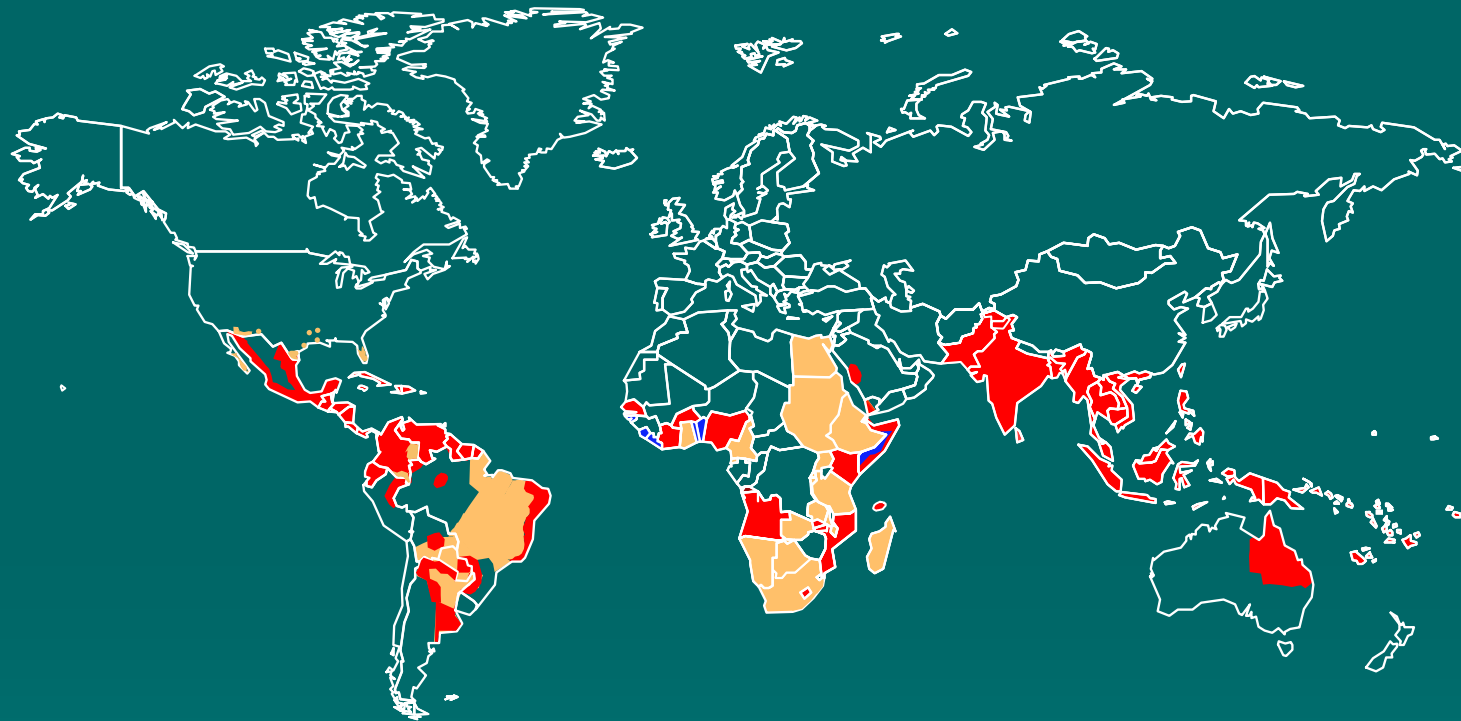
EMERGING TREATMENT



- ❖ Emerging evidence suggests that mycophenolic acid and ribavirin inhibit dengue replication. Initial experiments showed a fivefold increase in defective viral RNA production by cells treated with each drug. *In vivo* studies, however, have not yet been done. Unlike HIV therapy, lack of adequate global interest and funding greatly hampers the development of treatment regime.
- ❖ In Brazilian Traditional medicine, dengue is treated with cat's claw herb, which is for inflammation and does not prevent dengue.

EPIDEMIOLOGY

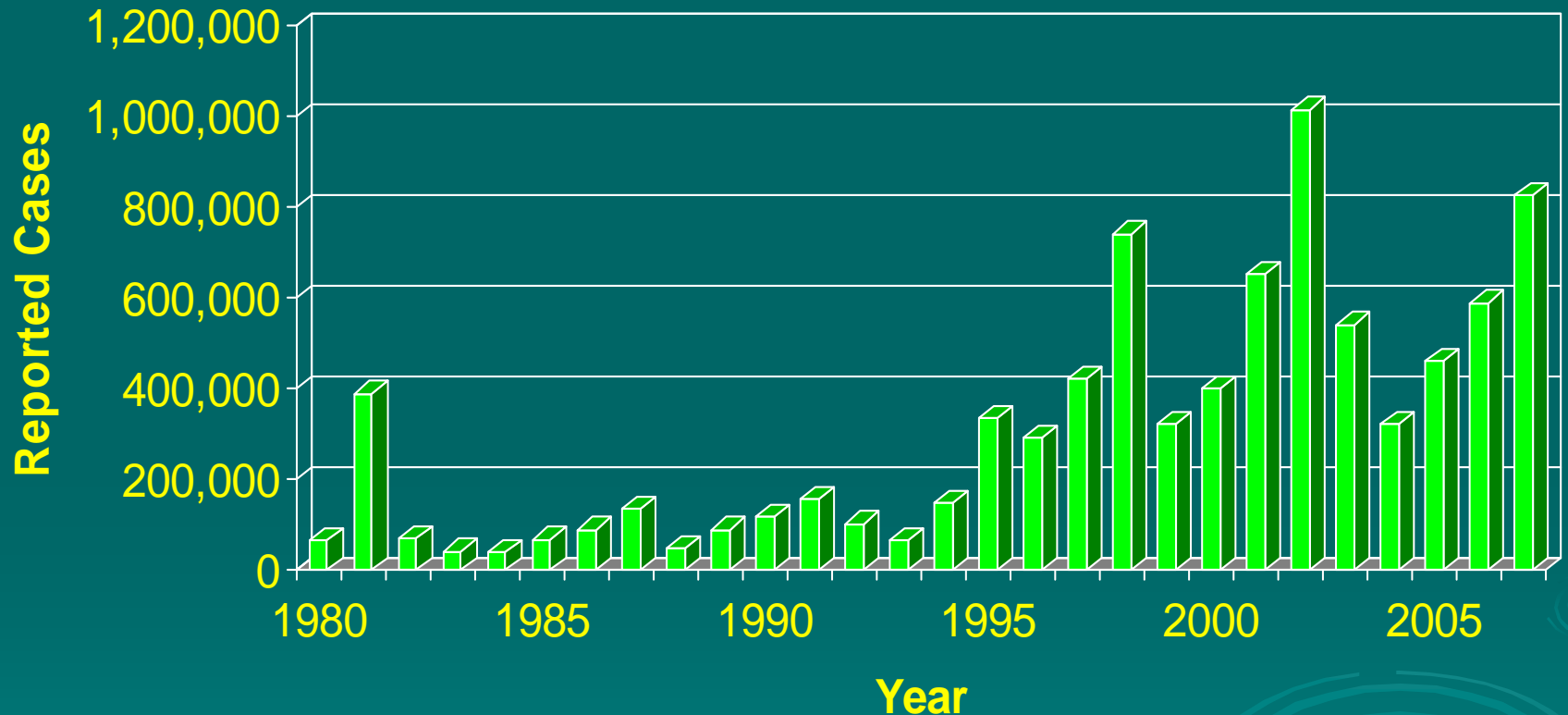


World Distribution of Dengue - 2005



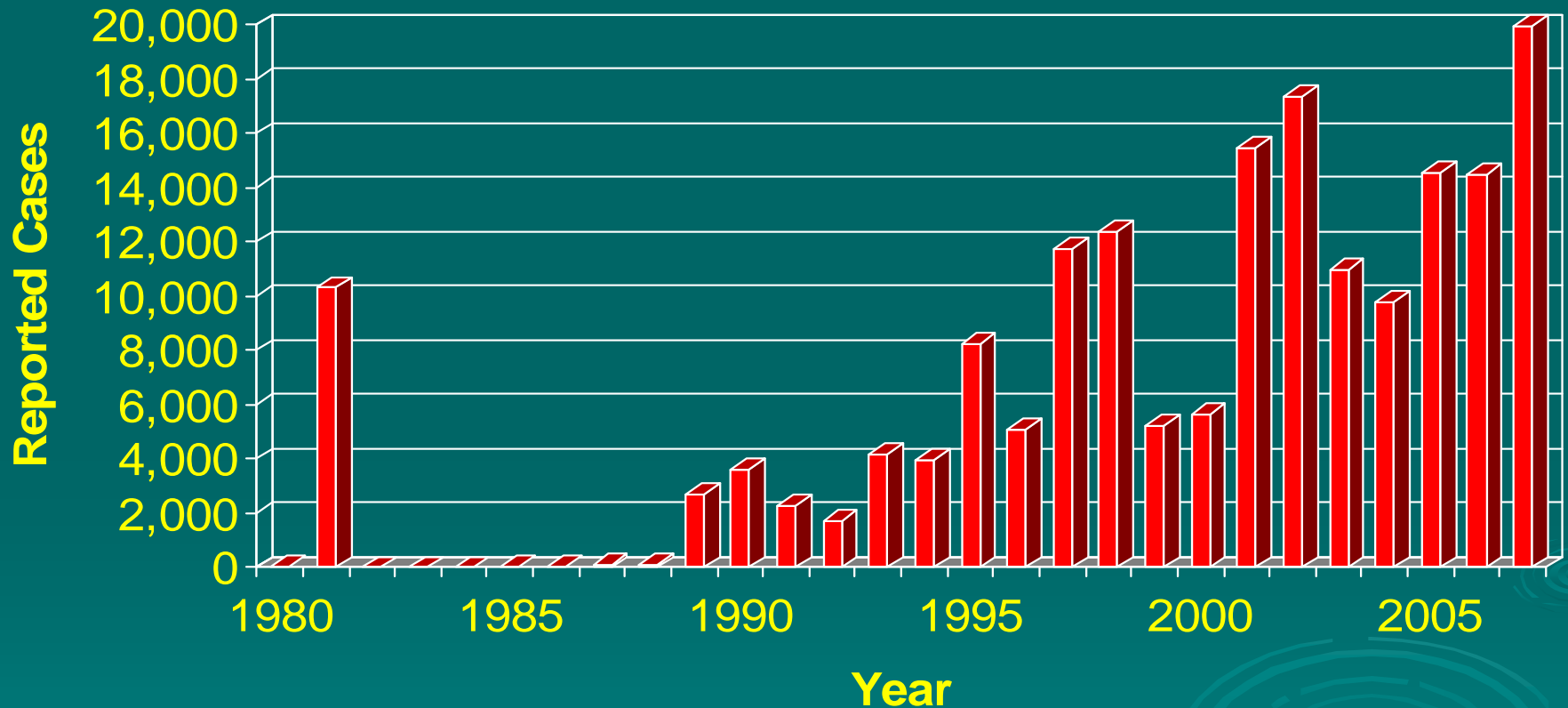
-  Areas infested with *Aedes aegypti*
-  Areas with *Aedes aegypti* and dengue epidemic activity

Reported Cases of Dengue in the Americas, 1980 – 2007 *



* Data: PAHO (Nov. 30, 2007)

Reported Cases of DHF in the Americas, 1980 – 2007 *



* Data: PAHO (Nov. 30, 2007)

Presence of DEN-3 in the Americas, 1994 -2007



- 1994-1995
- 1997-2007
- Not reported

SOURCE: Pan American Health Organization,
Nov. 30, 2007



Recent Dengue in the U.S.A.

- ❖ Dengue epidemics occurred in the USA in the 1800s and the first half of the 1900s
- ❖ Recent indigenous transmission
 - Texas:
 - 1980: 23 cases, first locally acquired since 1945
 - 1986: 9 cases, 1995: 7 cases, 1997: 3 cases, 1998: 1 case, 1999: 18 cases, 2005: 25 cases
 - Hawaii:
 - 2001-2002: 122 cases (first since 1944)

Dengue Fever Expanding Its Foothold In Texas

- ❖ A dengue outbreak in the Brownsville, Tex., area in 2005 involved 25 hospital cases, 16 of which were classified as DHF, the CDC reports in the Aug 10 issue of *Morbidity and Mortality Weekly Report*.
- ❖ Aug 9, 2007 Dengue fever is gaining a firmer foothold in southern Texas, putting residents at risk for the most dangerous form of the disease, dengue hemorrhagic fever (DHF), the Centers for Disease Control and Prevention (CDC) reported today.

Dengue in Arizona

- ❖ In 2008 there were six cases (3 confirmed, 3 probable).
- ❖ All were imported cases
 - Asia – 2
 - Caribbean – 1
 - Mexico – 1
 - Central America – 2
- ❖ Five patients were in Maricopa County

Reasons for Dengue Expansion in the Americas

- ❖ Extensive vector infestation, with declining vector control
- ❖ Unreliable water supply systems
- ❖ Increasing non-biodegradable containers and poor solid waste disposal
- ❖ Increased air travel
- ❖ Increasing population density in urban areas

Trouble Ahead

- ❖ 2.5 billion people at risk world-wide
- ❖ In the Americas, 50-fold increase in reported cases of DHF
- ❖ Widespread abundance of *Aedes aegypti* in at-risk areas

Prevention

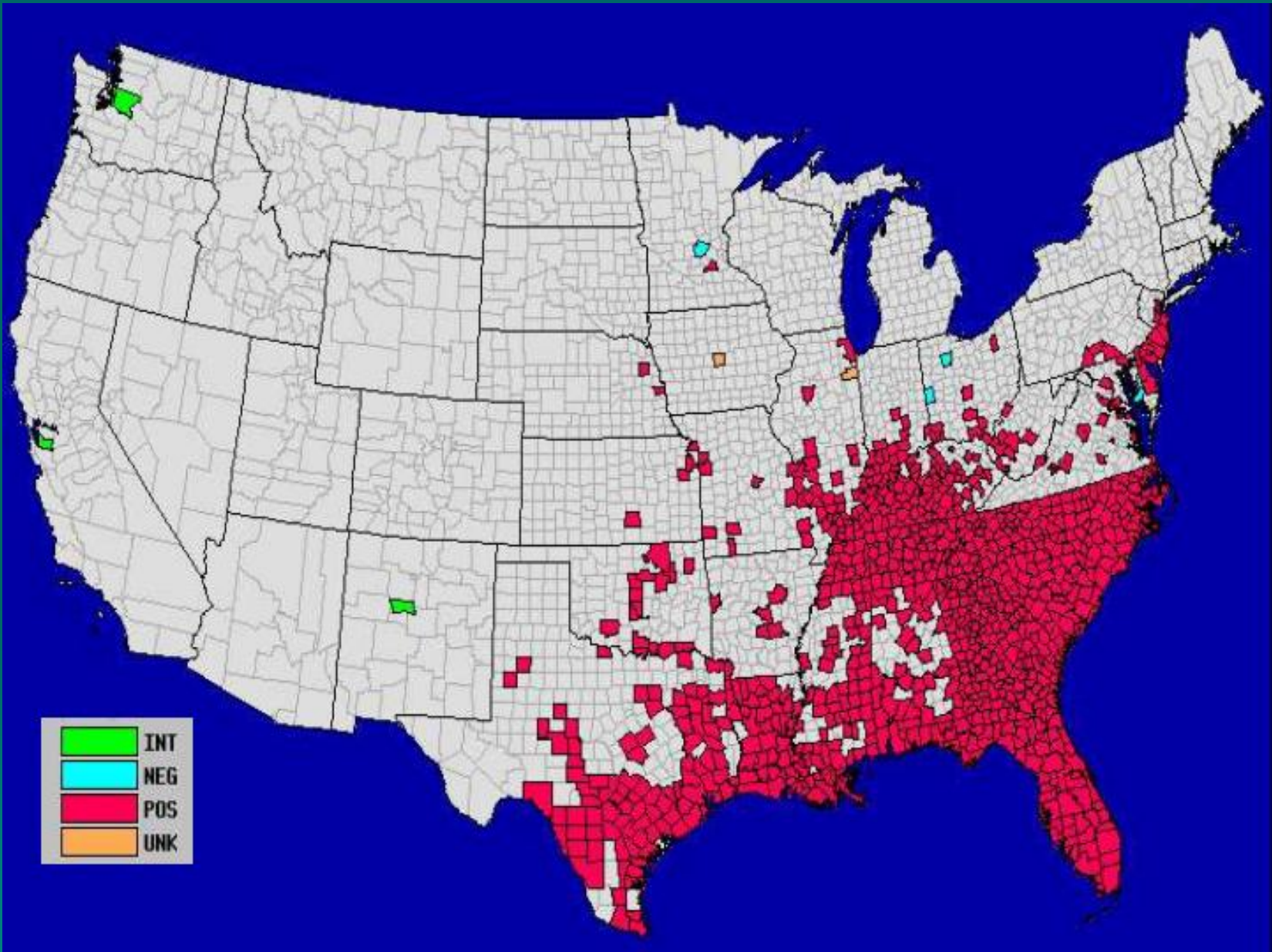
- ❖ Primary prevention of dengue is controlling the vector.
- ❖ Our main species of concern is the Yellow Fever mosquito, *Aedes aegypti*.
- ❖ However the Asian Tiger mosquito, *Aedes albopictus* is widespread in the eastern half of the United States.

Aedes albopictus



PCAS FEHD HKSARG

Aedes albopictus in the USA



Aedes aegypti



Aedes aegypti

❖ Geographic Distribution

- The species is found throughout most tropical to subtropical world regions.
- In the eastern United States, *Ae. aegypti* occurs in Mississippi, Alabama, Georgia, Florida, Tennessee, Kentucky, South Carolina, North Carolina, Virginia, New York, Delaware, Maryland and the District of Columbia.
- Western states include Arizona, Arkansas, Illinois, Kansas, Louisiana, Missouri, Oklahoma, New Mexico and Texas.



Aedes aegypti

❖ Eggs

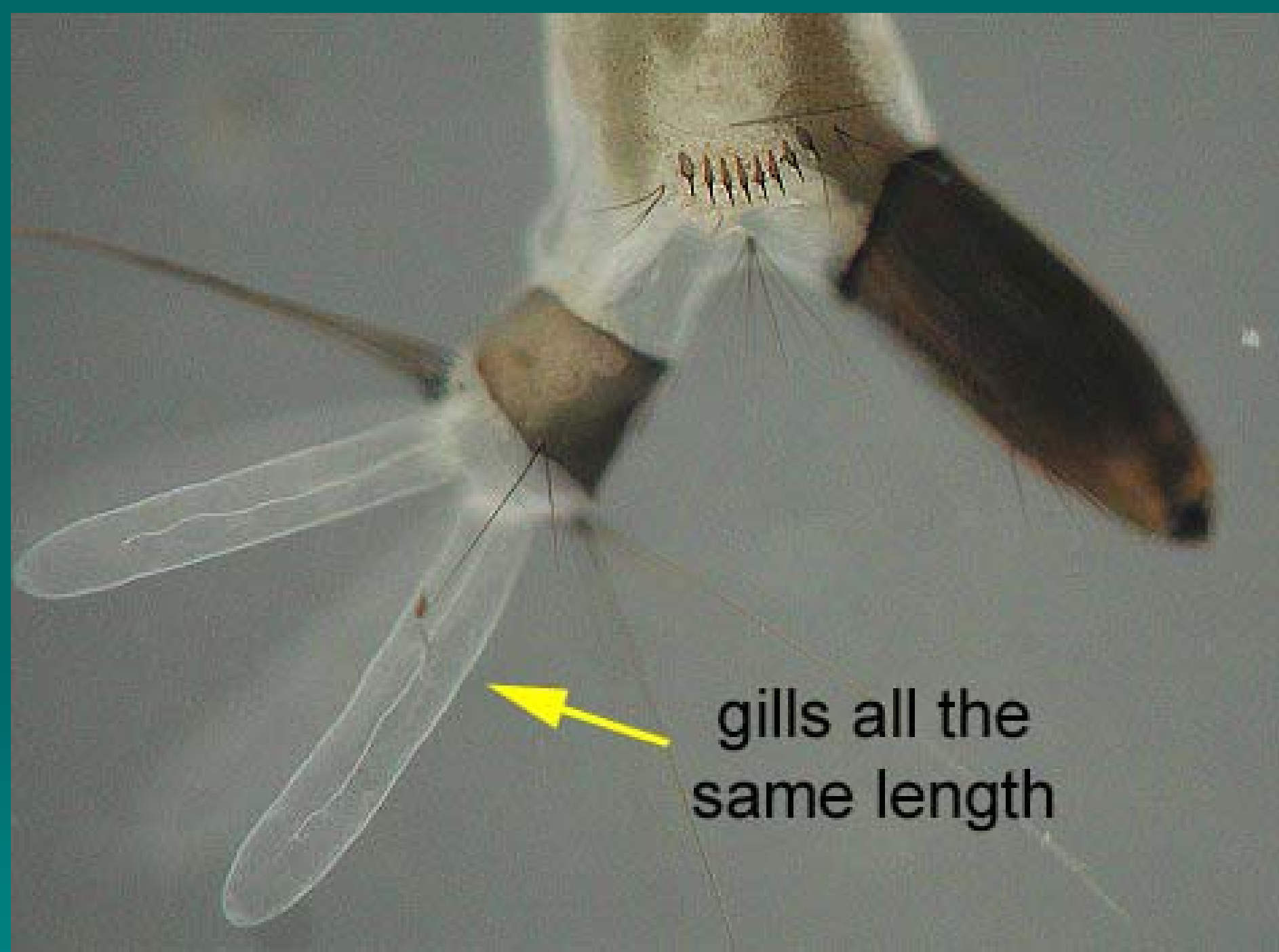
- The eggs are deposited on damp surfaces within artificial containers such as cans, jars, urns or rain-water containers. Old automobile tires provide an excellent larval habitat and an adult resting site. Larvae are also encountered in natural water retaining cavities in tree holes and herbaceous plants. The eggs can resist desiccation for up to 1 year. Eggs hatch when flooded by water.



Aedes aegypti

❖ Larval Behavior

- Larvae feed on the aquatic microbiota that develops in artificial containers. The total time for development through all 4 instars is dependent upon water temperature and food supply, and typically ranges from 4 to 10 days. Larvae die at temperatures below 10 degrees and above 44 degrees Celsius.



gills all the
same length

'pitchfork'-shaped comb
scales in 1 row





Aedes aegypti

❖ Blood feeding

- The yellow fever mosquito is a peridomestic species found not far from human dwellings. It is an early morning or late afternoon feeder, but females will take a blood meal at night under artificial illumination. Human blood is preferred over other animals with the ankle area as a favored feeding site. Adults frequently reside in dwellings in darkly lighted closets, cabinets, or cupboards. The adult is reported to fly only a few hundred yards from breeding sites.

Aedes aegypti

❖ Seasonality

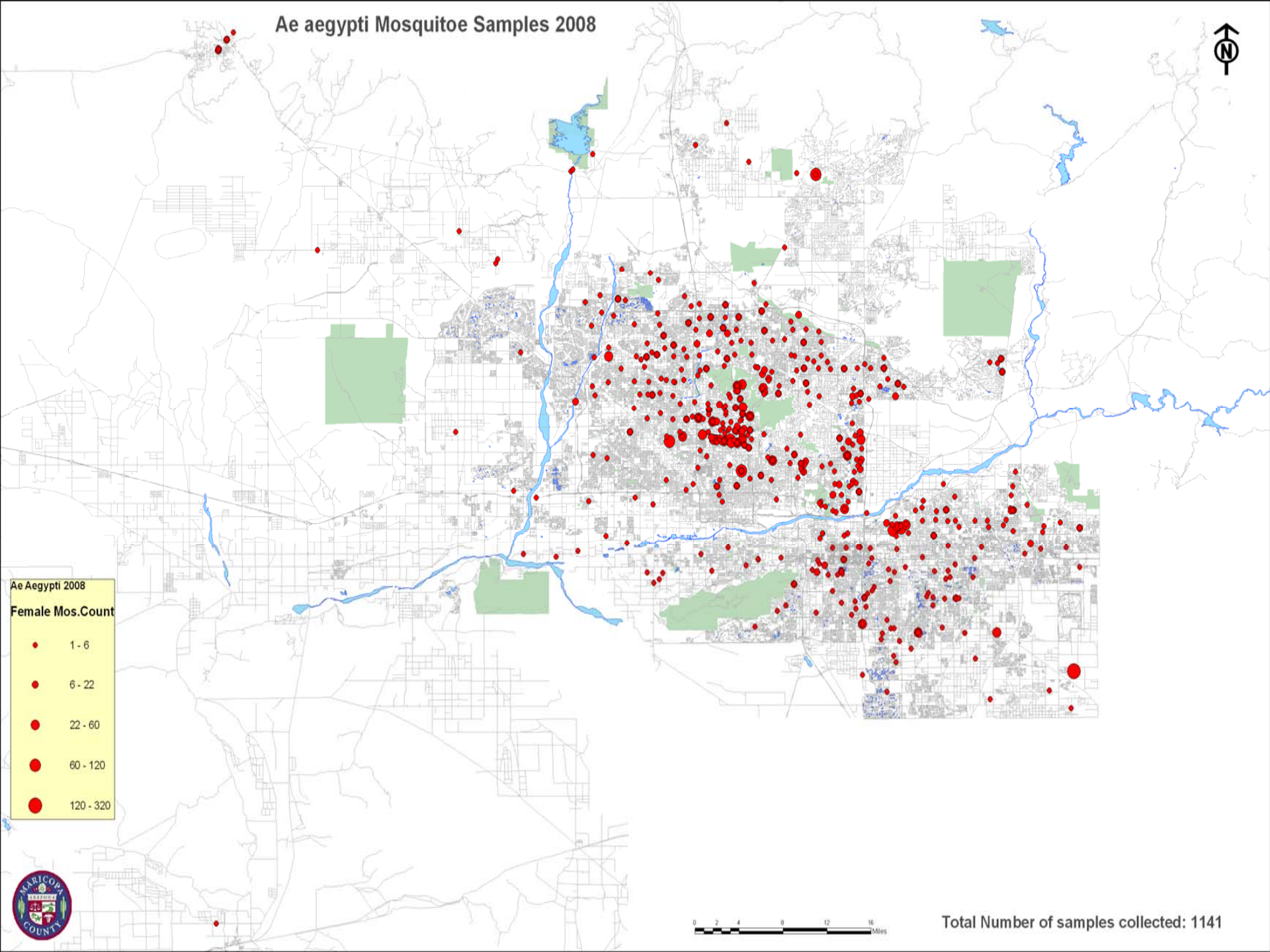
- The species is active all year in the south. Unlike some other *Aedes* spp., populations in the south remain reproductively active during winter. Adults are killed by temperatures below freezing and do not survive well at temperatures below 5 degrees Celsius. On average, females live up to a month, but males die sooner.



MCE
Vocal Call
Do not
Worry

03/26/2007 09:20

Ae aegypti Mosquito Samples 2008



Ae Aegypti 2008
Female Mos.Count

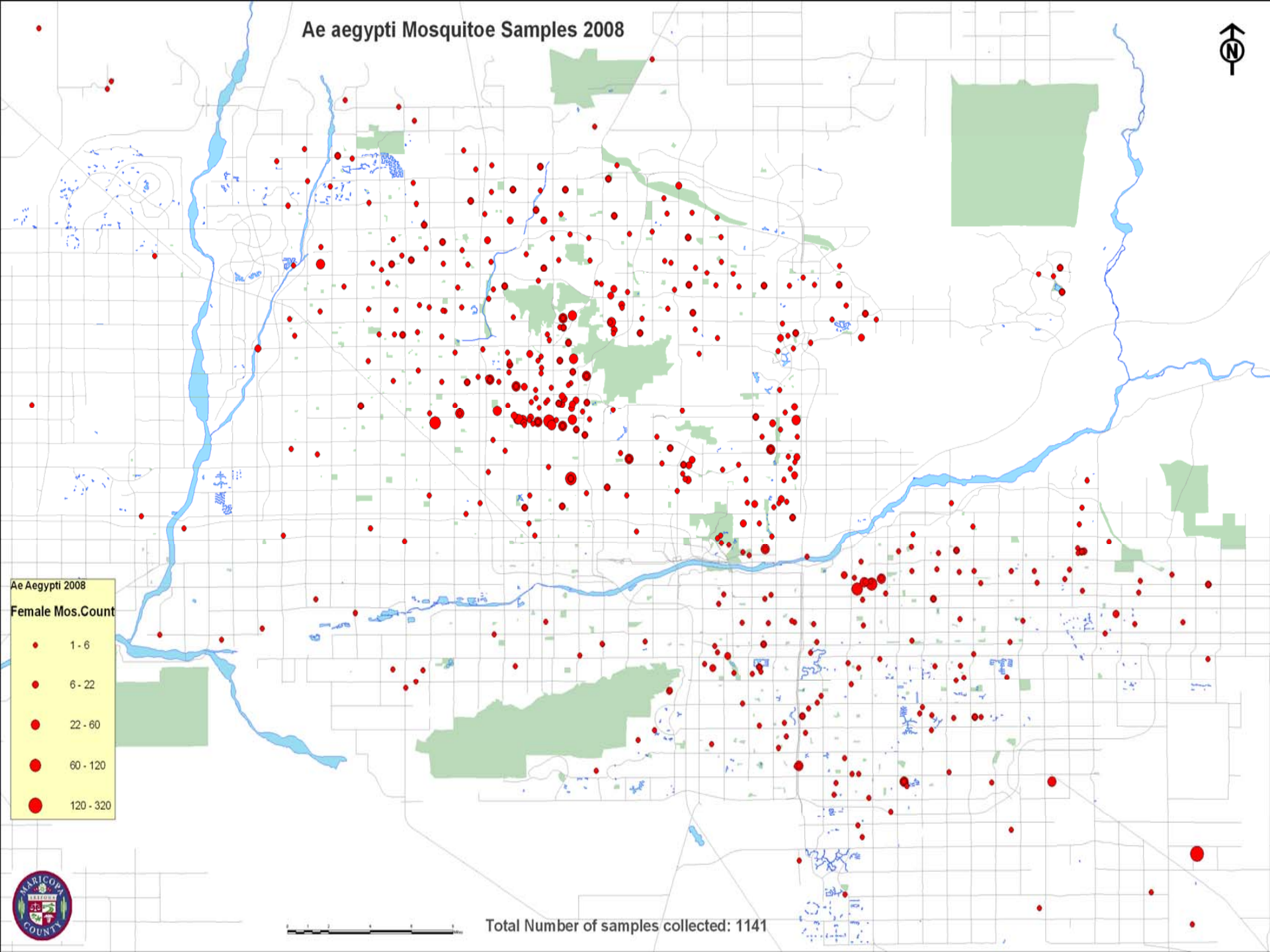
	1 - 6
	6 - 22
	22 - 60
	60 - 120
	120 - 320



Total Number of samples collected: 1141



Ae aegypti Mosquito Samples 2008



Ae Aegypti 2008
Female Mos.Count

	1 - 6
	6 - 22
	22 - 60
	60 - 120
	120 - 320



Total Number of samples collected: 1141

Gravid Trap



New Data Suggests That This Trap Is Effective
For Monitoring *Aedes aegypti*

The BG-Sentinel trap



Aedes aegypti

❖ Adult Description

- Medium-sized blackish mosquito easily recognized by a silvery-white 'lyre-shaped' pattern of scales on its scutum. Segments 1 to 4 of the hind tarsi possess broad basal white rings, segment 5 is white. The coloration of both sexes is similar.





scutum has lyre-shaped
pattern of white scales

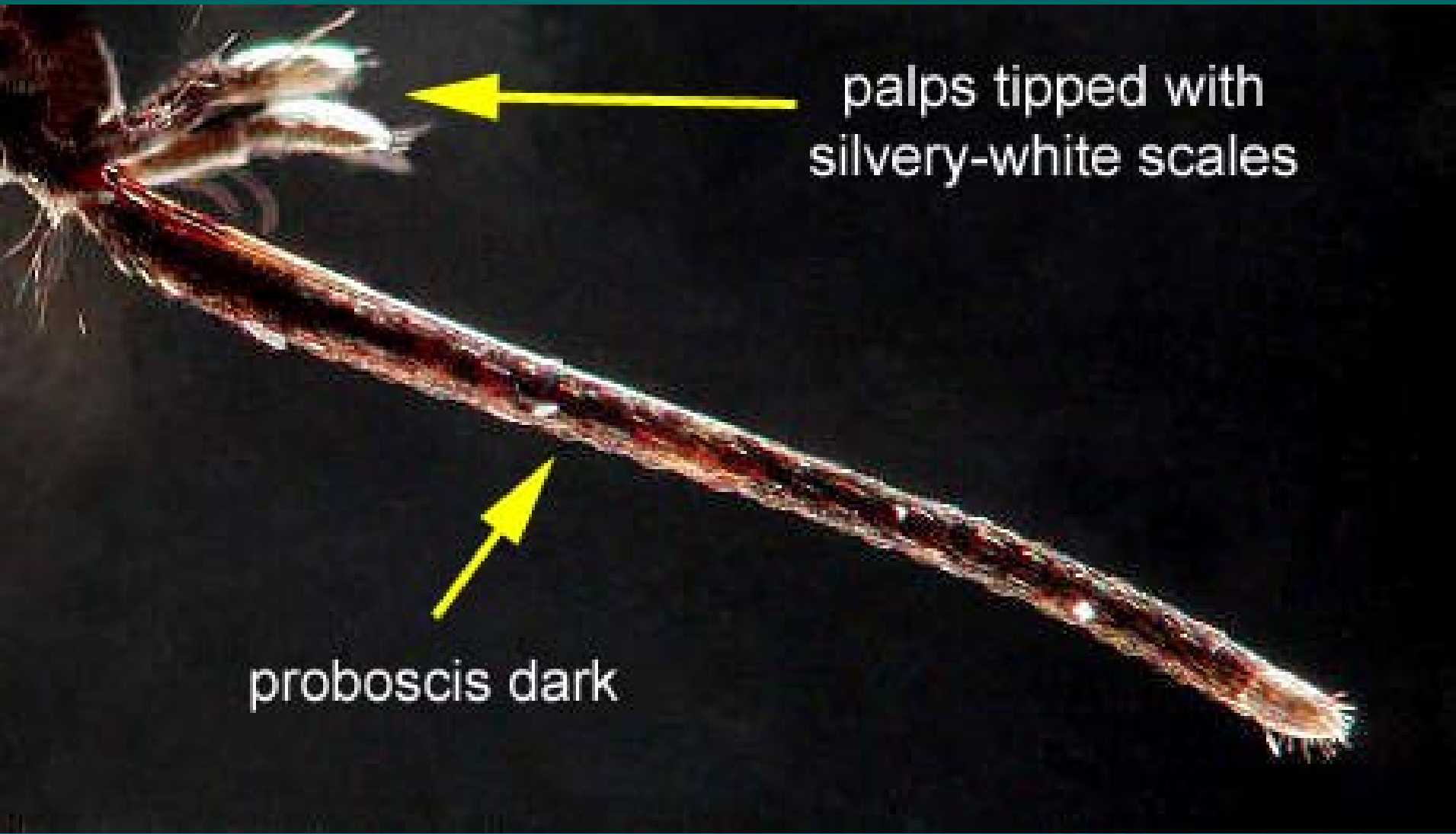
eye

antenna



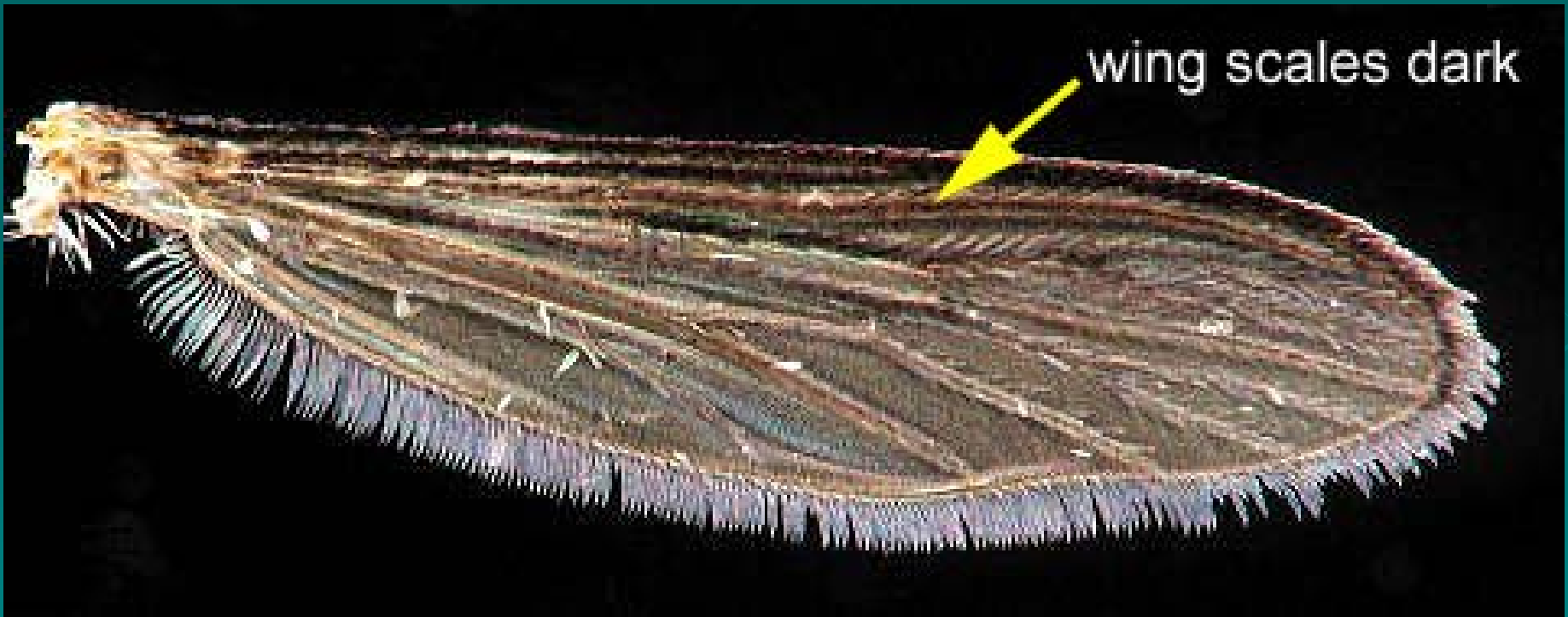
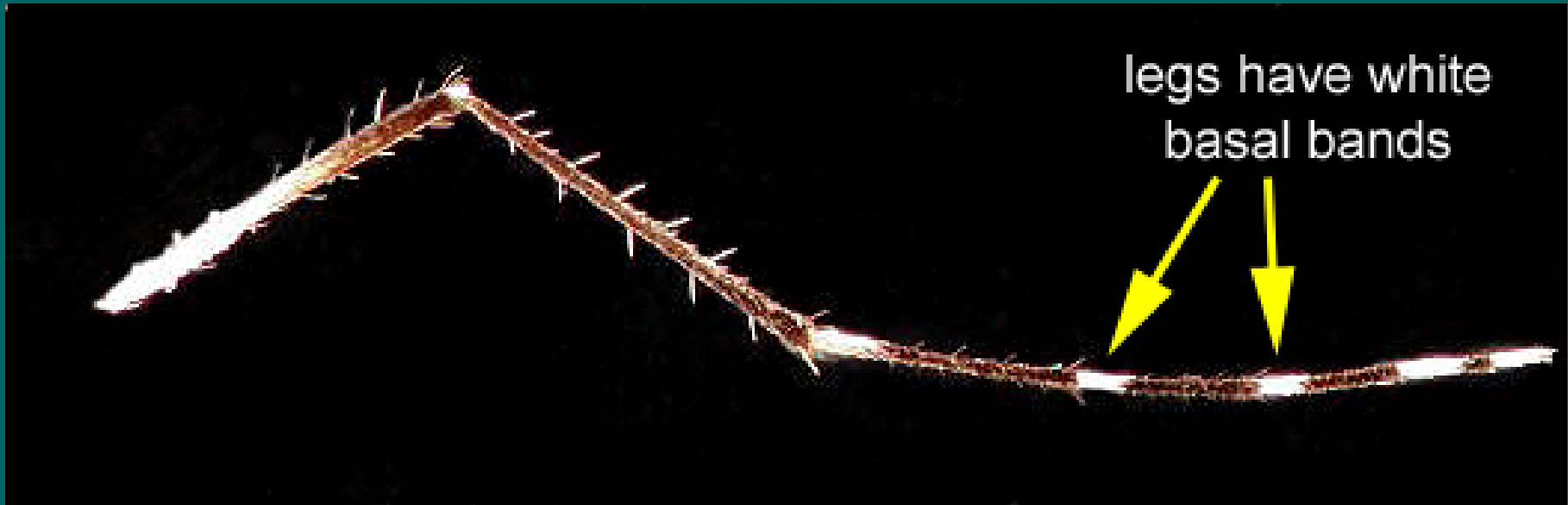
clypeus has
white scales





palps tipped with
silvery-white scales

proboscis dark



Control Methods

- ❖ Eliminate the breeding sites.
- ❖ Manage the immatures.
- ❖ Surface application residues for adults.
- ❖ Fogging?

Breeding Sites



















02.15.2008 13:38



08/17/2006 15:23

Immature Control



CLARKE **5% SKEETER ABATE®**

www.clarkemosquito.com

AN INSECTICIDE FOR CONTROL OF MOSQUITO AND MIDGE LARVAE

ACTIVE INGREDIENT

Temphos (0,0'-(thiodi-4, 1-phenylene) 0,0,0'0'-tetramethyl phospho- rothioate)	5%
Other Ingredients	95%
Total	100%

KEEP OUT OF REACH OF CHILDREN WARNING/AVISO

See Below for Additional Precautionary Statements

PRECAUTION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente

FIRST AID

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For Medical Emergencies, call the International Poison Control Center at 1-800-214-7753.

IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing the eye. Call a poison control center or doctor for treatment advice.

IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by a poison control center or doctor. Have person sip a glass of water if able to swallow. Do not give anything by mouth to an unconscious person.

and cleaners of equipment must wear a chemical-resistant apron.

Engineering Controls: Pilots must use an enclosed cockpit and must wear chemical resistant gloves when entering or leaving an aircraft contaminated by pesticide residues. Used gloves must be stored in a closed chemical resistant container, such as a plastic bag, to prevent contamination of the inside of the cockpit.

User Safety Requirements: Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been heavily contaminated with this product. Do not reuse them.

USER SAFETY RECOMMENDATIONS

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic organisms such as stoneflies, water fleas, and shrimp. Non-target aquatic organisms in waters treated with this product may be killed. Some populations reestablish rapidly, but diversity may be affected. Avoid use of maximum application rate in ecologically sensitive areas. Do not contaminate water by cleaning of equipment or disposing of wastes. For information on endangered species consult EPA's website: www.epa.gov/espp/.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its

Altosid[®] XR

EXTENDED RESIDUAL BRIQUETS



A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE
(INCLUDING THOSE WHICH MAY TRANSMIT WEST NILE VIRUS)

SPECIMEN LABEL

ACTIVE INGREDIENTS:

(S)-Methoprene (CAS #65733-16-6)
(Dry Weight Basis): 2.1%

OTHER INGREDIENTS: 97.9%
Total 100.0%

EPA Reg No. 2724-421

**PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC
ANIMALS - CAUTION**

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

KEEP OUT OF REACH OF CHILDREN
CAUTION
SEE ADDITIONAL PRECAUTIONARY STATEMENTS

FIRST AID
Call a poison control center or doctor for treatment advice.

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20
-------------------	---

Biological Larvicide

VectoBac® G

Granules

ACTIVE INGREDIENT:

<i>Bacillus thuringiensis</i> , subspecies <i>israelensis</i> , strain AM 65-52, fermentation solids and solubles . . .	2.80%
OTHER INGREDIENTS	97.20%
TOTAL	100.00%

Potency: 200 International Toxic Units (ITU) per mg
(Equivalent to 0.091 billion potency: ITU per pound)

The percent active ingredient does not indicate product performance and potency measurements are not Federally standardized.

EPA Reg. No. 73049-10
EPA Est. No. 33762-IA-001

List No. 05108

INDEX:

- 1.0 First Aid
- 2.0 Precautionary Statements
 - 2.1 Hazard to Humans (and Domestic Animals)
 - 2.2 Environmental Hazards
- 3.0 Directions for Use
- 4.0 Storage and Disposal
- 5.0 Application Directions
- 6.0 Notice to User

standards of at least N-95, R-95 or P-95. Repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.

2.2 ENVIRONMENTAL HAZARDS

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

4.0 STORAGE AND DISPOSAL

Do not contaminate potable water, food or feed by storage or disposal.

Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

5.0 APPLICATION DIRECTIONS

VectoBac G is an insecticide for use against mosquito larvae.

Mosquitoes Habitat	Suggested Range Rate*
--------------------	-----------------------

(Such as the following examples):

Irrigation ditches, roadside ditches, flood water, standing ponds, livestock watering ponds	2.5 - 10 lbs. / acre
---	----------------------

AGNIQUE® MMF G

MOSQUITO LARVICIDE & PUPICIDE

Monomolecular Surface Film for Control of Immature Mosquitoes and Midges

CAN BE USED IN: • Habitats Containing Birds, Fish, Pets and Wildlife
• Ponds • Pools • Ditches • Irrigation Water • Potable Water Containers
• Flood Water Areas • Other Areas Where Mosquitoes Breed and Develop

STOP MOSQUITOES BEFORE THEY START



ACTIVE INGREDIENT :

Poly (oxy-1,2-ethanediyl), α -(C₁₆₋₂₀ branched and linear alkyl)- ω -hydroxy 32.0%

INERT INGREDIENTS..... 68.0%

TOTAL..... 100.0%

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMAN AND DOMESTIC ANIMALS

CAUTION: Avoid contact with skin or clothing. Causes moderate eye irritation. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum or using tobacco. Wear long-sleeved shirt and long pants, socks, shoes, and gloves. Avoid contact with eyes or clothing. Wear protective eyewear.

KEEP OUT OF REACH OF CHILDREN

CAUTION

APPLICATION DIRECTIONS

This product may be applied by both ground and aerial applications. To use, calculate the desired rate based on water surface area. The water depth is not a factor in rate determination. Apply the desired rate of AGNIQUE® MMF G onto the surface of the water. The MMF G will spread to cover hard to access areas. For large areas with dense vegetation it is recommended that application is made in several locations to assist in the spreading action. AGNIQUE® MMF G is not visible on the surface of the water. Excess MMF G on the water surface will form a white globule.

APPLICATION SITES

This product is for the control of immature mosquitoes and midges in areas where they breed and develop. This product may be used in habitats including potable water

Adult Control









INSECTICIDE

Specimen Label

SHAKE WELL BEFORE USING
For Pest Management Professionals and Commercial Use Only.

ACTIVE INGREDIENT:

β-Cyfluthrin, Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,
2-dimethyl-cyclopropanecarboxylate 11.8%

OTHER INGREDIENTS: 88.2%
Total: 100.0%

Contains 1 lb cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate per gallon.
SHAKE WELL BEFORE USING

EPA Reg. No. 432-1363

EPA Est. No.



Insecticide

Specimen Label

- * ONLY FOR SALE TO, USE AND STORAGE BY PEST CONTROL OPERATORS AND/OR COMMERCIAL APPLICATORS
- * FOR RESIDENTIAL, INDUSTRIAL AND INSTITUTIONAL CONTROL OF MAJOR NUISANCE PESTS LISTED ON THE LABEL
- * CONTROLS NUMEROUS PESTS IN AND AROUND HOUSEHOLDS AND OTHER STRUCTURES
- * WILL NOT DAMAGE PAINTS, PLASTICS, FABRICS OR OTHER SURFACES WHERE WATER ALONE CAUSES NO DAMAGE
- * FOR INSECT CONTROL ON COMMERCIAL AND RESIDENTIAL TURF AND LANDSCAPE ORNAMENTAL PLANTS

ACTIVE INGREDIENT:

*Deltamethrin 4.75%

OTHER INGREDIENTS: 95.25%
Total: 100.00%

*Contains 0.42 lb deltamethrin per gallon.

CAUTION!

Before application to entire plants, test treat a small area and watch for signs of sensitivity. Some plant species may be sensitive to the final spray solution.





Repellents







Thank You!



jfboc@worldonline.fr
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