GEER 2015
Greater Everglades Ecosystem Restoration

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Potential Response of Mosquitoes and Mosquito-Borne Viruses to Ecosystem Restoration of the Greater Everglades Ecosystem

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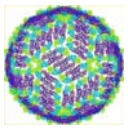


Table 1. Mosquito Species Found in the Everglades

Aedes albopictus
Aedes atlanticus
Aedes infirmatus
Aedes taeniorhynchus
Aedes triseriatus
Anopheles atropos
Anopheles crucians complex
Anopheles punctipennis
Anopheles quadrimaculatus
Anopheles walkeri
Coquillettidia perturbans
Culiseta melanura
Culex (Melanconion) atratus
Culex bahamensis
Culex (Melanconion) cedecei
Culex (Melanconion) erraticus
Culex (Melanconion) iolambdis
Culex nigripalpus
Culex (Melanconion) pilosus
Deinocerites cancer
Mansonia dyari
Psorophora ciliata
Psorophora columbiae
Psorophora ferox
Psorophora howardii
Uranotaenia lowii
Uranotaenia sapphirina
Wyeomyia mitchelli
Wyeomyia vanduzeei

Table 2. Mosquito-Borne Viruses (Arboviruses) Found in South Florida

VIRUS	**GENUS/GROUP**	**VECTOR***	**HOST****
Cowbone Ridge	*Flavivirus*	Unknown	Rodents
eastern equine encephalitis	*Alphavirus*	*Culiseta*	Birds
Everglades	*Alphavirus*/VEE	*Culex (Melanoconian)*	Rodents,Opossum
Flanders	*Rhabdovirus*	*Culex*	Birds
Gumbo Limbo	*Bunyavirus*/C Group	*Culex*	Rodents
Hart Park	*Rhabdovirus*	Unknown	Birds
Highlands J	*Alphavirus*	Culicidae	Birds
Keystone	*Bunyavirus*/Ca Group	*Ae. atlanticus*	Rodents, Deer
Mahogany Hammock	*Bunyavirus*/Guama	*Culex*	Rodents
Pahayokee	*Bunyaviris*/Patois	*Culex*	Rodents
Saint Louis Encephalitis	*Flavivirus*	*Culex*	Birds
Shark River	*Bunyavirus*/Patois	*Culex*	Unknown
Tensaw	*Bunyavirus*/Bun Group	*An. crucians*	Rabbits, Raccoon
trivittatus	*Bunyavirus*/Ca Group	*Aedes*	Rabbits, Deer
West Nile	*Flavivirus*	*Culex, Aedes*	Birds

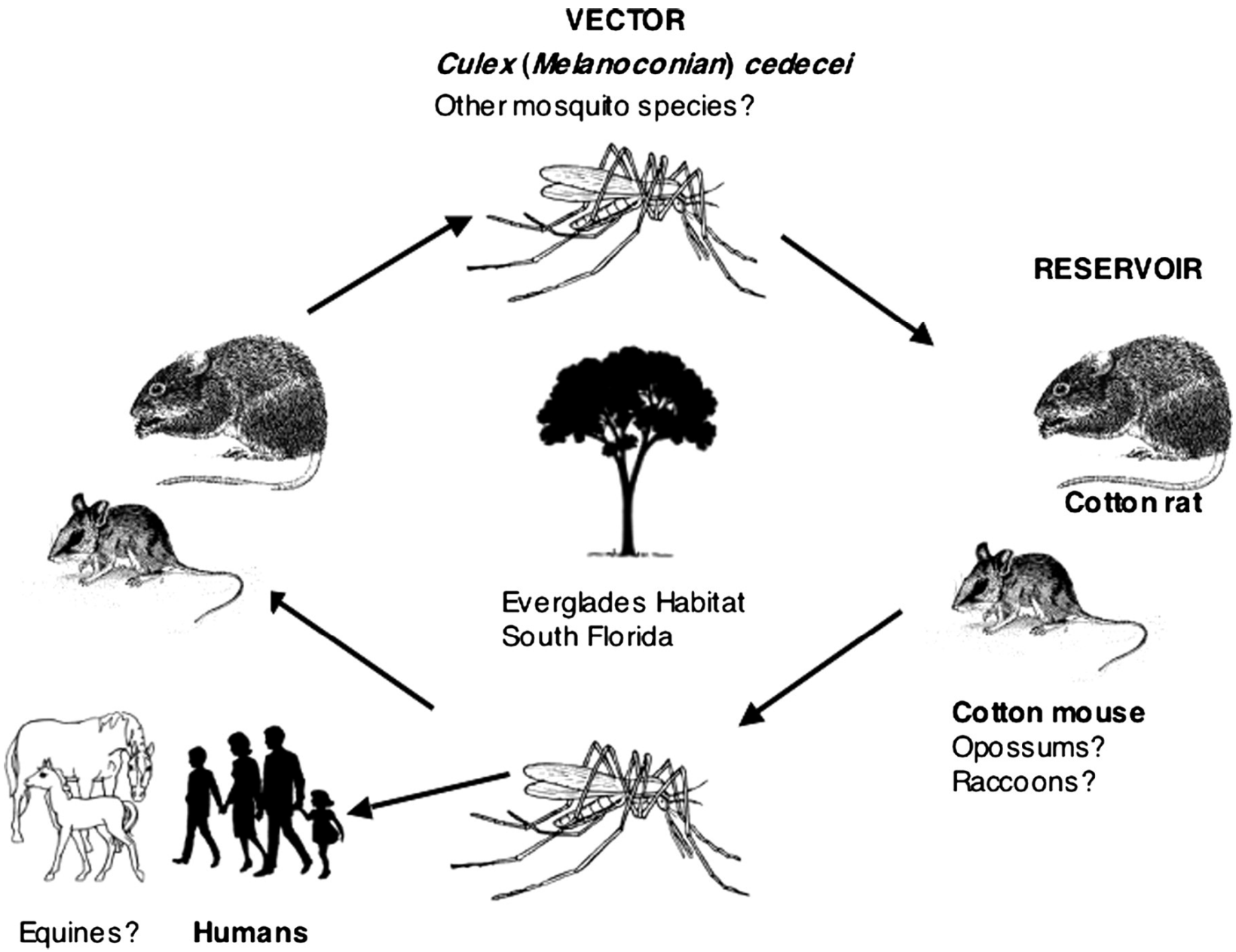
*Determined by virus isolation, no voucher specimens available for identification or verification.

**Determined by either virus isolation or serological evidence of infection.

Table 3. Arboviruses endemic to the Everglades (in red)

VIRUS	GENUS/GROUP	VECTOR*	HOST**
Cowbone Ridge	*Flavivirus*	Unknown	Rodents
eastern equine encephalitis	*Alphavirus*	*Culiseta*	Birds
Everglades	*Alphavirus*/VEE	*Culex (Melanoconion)*	Rodents,Opossum
Flanders	*Rhabdovirus*	*Culex*	Birds
Gumbo Limbo	*Bunyavirus*/C Group	*Culex*	Rodents
Hart Park	*Rhabdovirus*	Unknown	Birds
Highlands J	*Alphavirus*	Culicidae	Birds
Keystone	*Bunyavirus*/Ca Group	*Ae. atlanticus*	Rodents, Deer
Mahogany Hammock	*Bunyavirus*/Guama	*Culex*	Rodents
Pahayokee	*Bunyaviris*/Patois	*Culex*	Rodents
Saint Louis Encephalitis	*Flavivirus*	*Culex*	Birds
Shark River	*Bunyavirus*/Patois	*Culex*	Unknown
Tensaw	*Bunyavirus*/Bun Group	*An. crucians*	Rabbits, Raccoon
trivittatus	*Bunyavirus*/Ca Group	*Aedes*	Rabbits, Deer
West Nile	*Flavivirus*	*Culex, Aedes*	Birds

*Determined by virus isolation, no voucher specimens available for identification or verification.
**Determined by either virus isolation or serological evidence of infection.


VECTOR
Culex (*Melanoconian*) *cedecei*
Other mosquito species?
RESERVOIR
Cotton rat
Everglades Habitat
South Florida
Cotton mouse
Opossums?
Raccoons?
Equines?
Humans

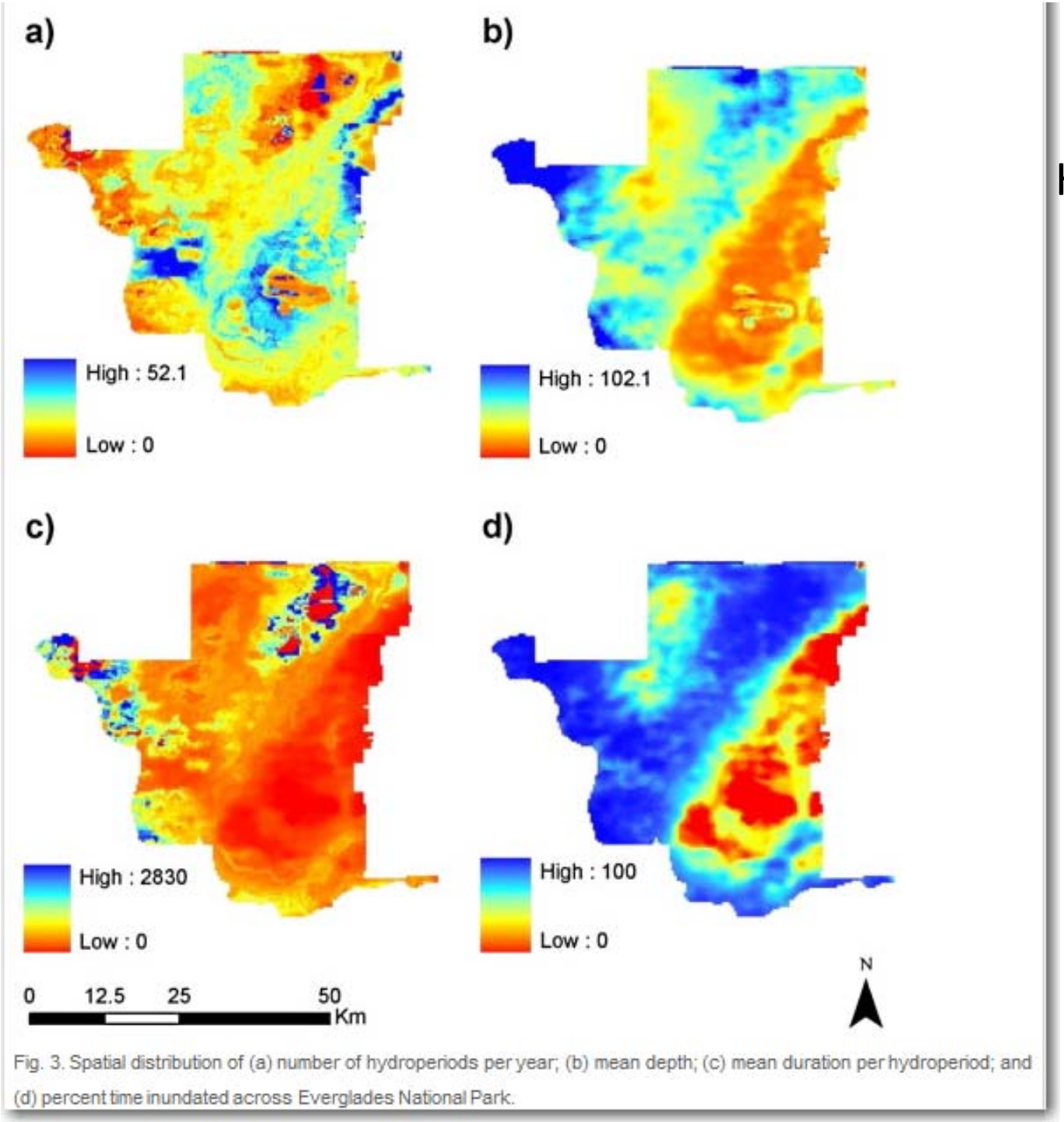


Fig. 3. Spatial distribution of (a) number of hydroperiods per year; (b) mean depth; (c) mean duration per hydroperiod; and (d) percent time inundated across Everglades National Park.

HYDROLOGY DRIVES:

VEGETATION
WILDLIFE
MOSQUITOES
ARBOVIRUSES

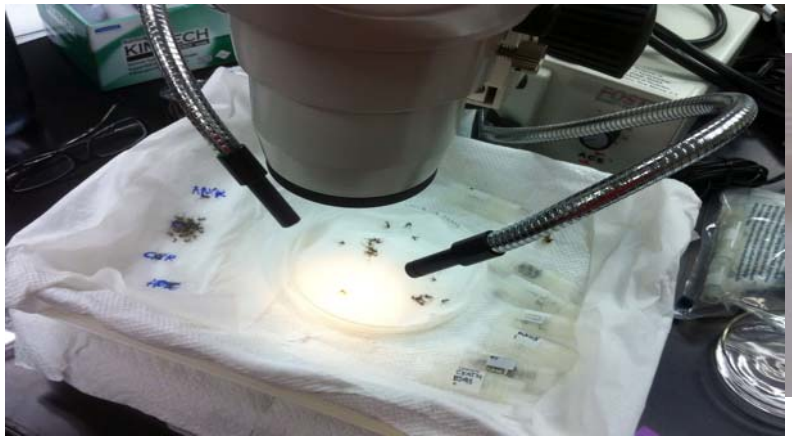
Todd et al. 2010. Hydrological drivers of wetland vegetation community distribution within Everglades National Park, Florida *Advances in Water Resources, 33: 1279-1289*

METHODS

CATCH

COUNT

SORT



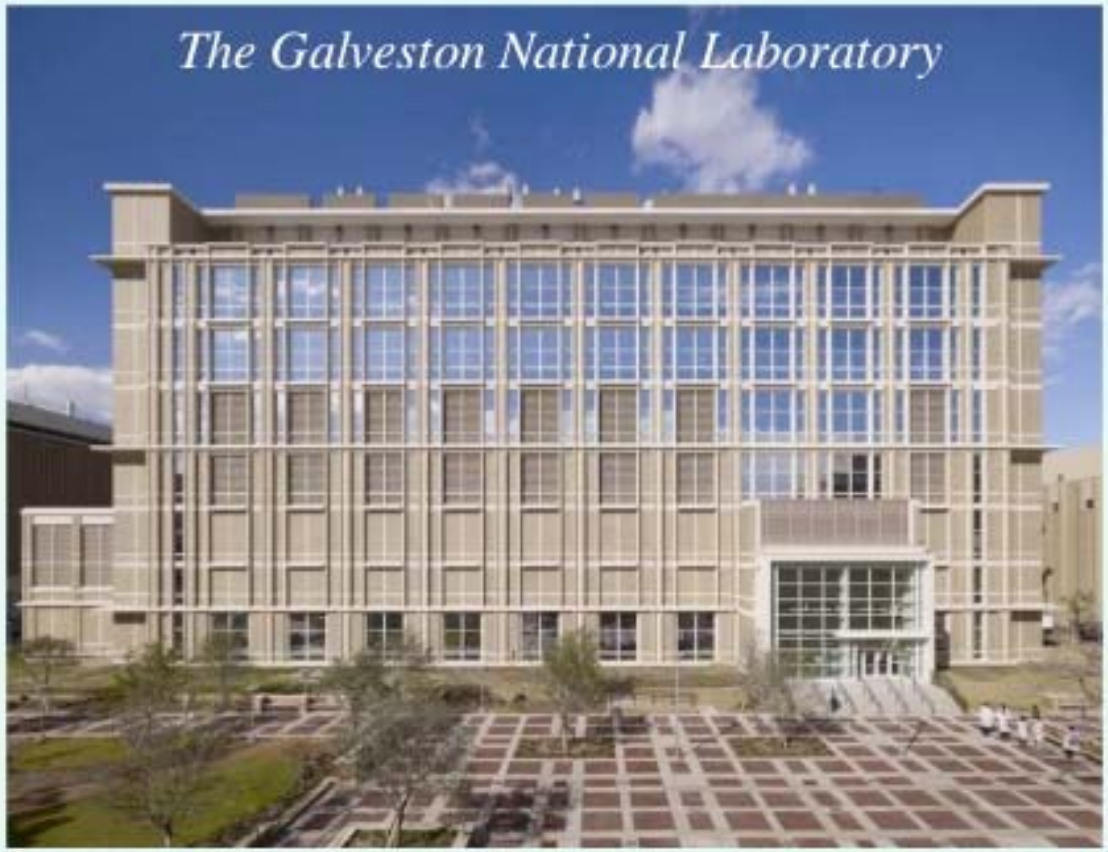
IDENTIFY

POOL

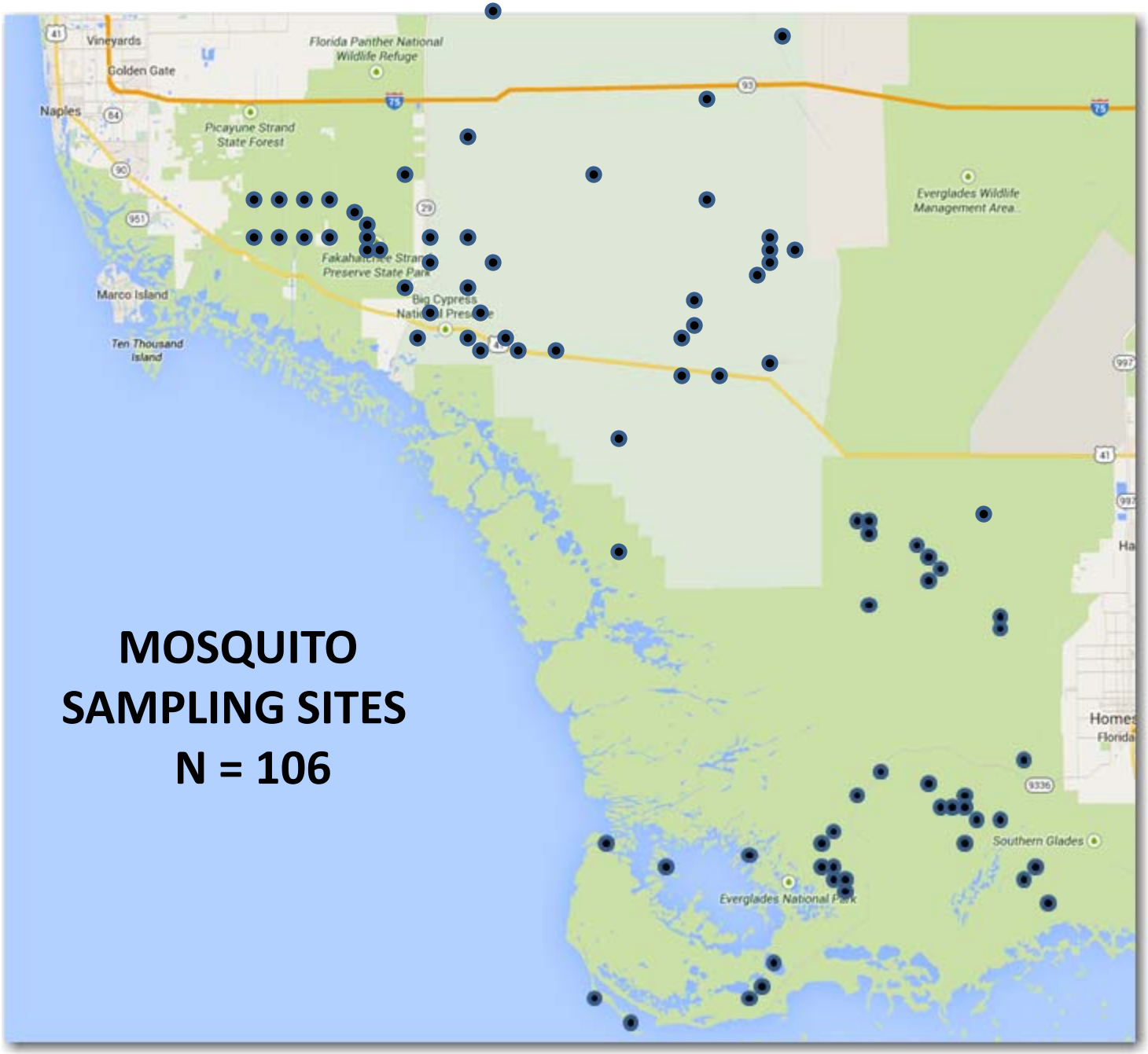
FREEZE

The Galveston National Laboratory, a national resource for emerging diseases and bioterrorism threats

Dr. Jim LeDuc
Director

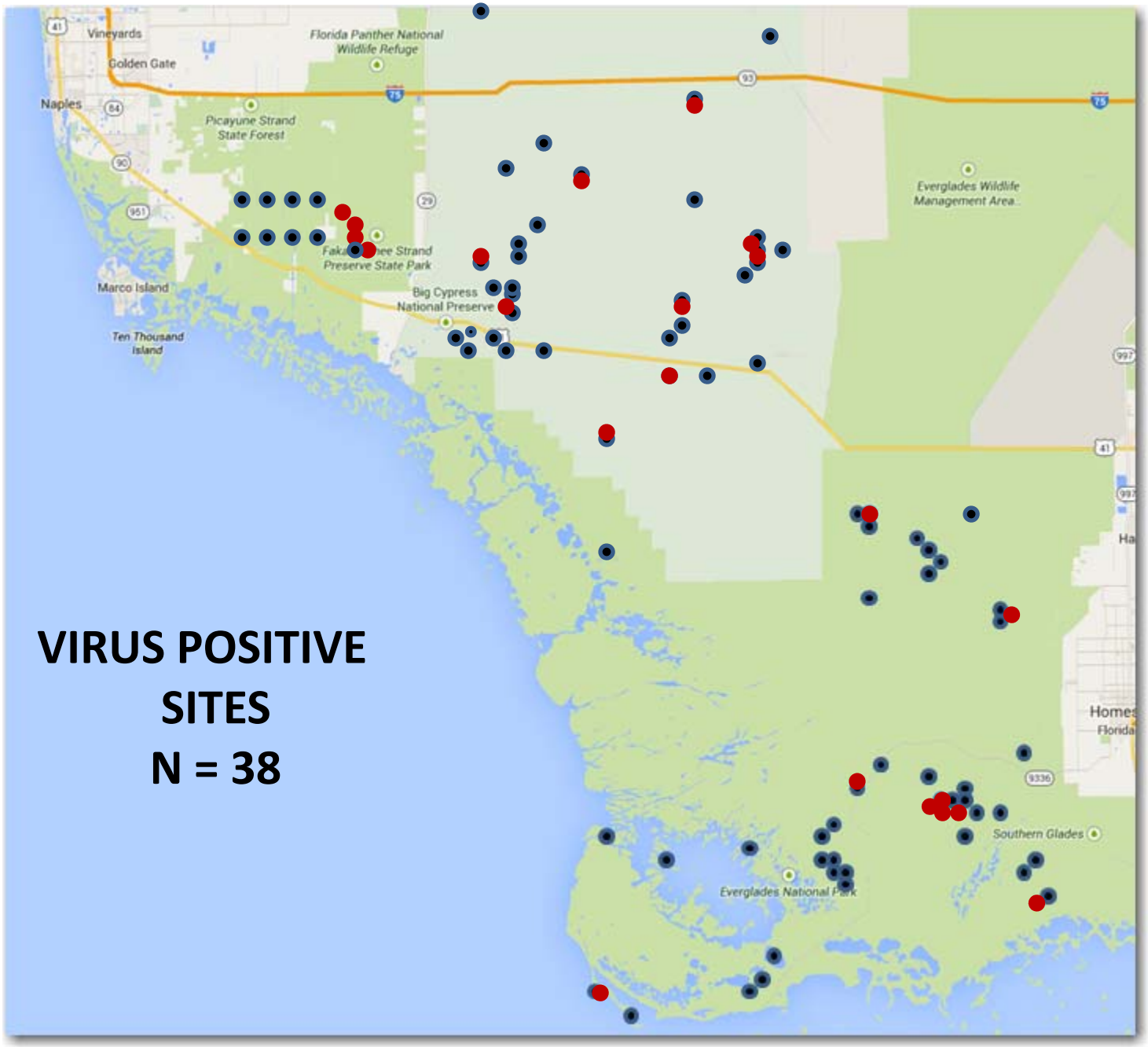


THE UNIVERSITY OF TEXAS MEDICAL BRANCH


MOSQUITO
SAMPLING SITES
N = 106
Vineyards
Golden Gate
Naples
Florida Panther National Wildlife Refuge
Picayune Strand State Forest
Everglades Wildlife Management Area
Marco Island
Ten Thousand Island
Big Cypress
Southern Glades
Everglades National Park

MOSQUITO COLLECTION SUMMARY

LOCATION	DATE	# SITES	#MOSQUITOES	MEAN#/TRAP	# SPECIES
EVER	JUN-AUG 13	55	157,526	2,864	30
BICY	JUN-AUG 14	38	119,557	3,146	24
FAK	10 AUG 13	5	20,629	4,126	14
PIC	2 AUG 14	8	35,031	4,379	16
TOTAL		106	332,743	3,139	30


VIRUS POSITIVE
SITES
N = 38
Vineyards
Golden Gate
Naples
Florida Panther National
Wildlife Refuge
Picayune Strand
State Forest
Everglades Wildlife
Management Area
Big Cypress
National Preserve
Marco Island
Ten Thousand
Island
Southern Glades
Everglades National Park

VIRUS ISOLATION SUMMARY

LOCATION	# POOLS	# ISOLATES	#VIRUSES	PREVALENCE
EVER	1,380	49	6	1/1,408
BICY	973	11	2	1/4,347
FAK	77	7	3	1/549
PIC	188	0	0	0
TOTAL	2,618	67	7	1/1,960

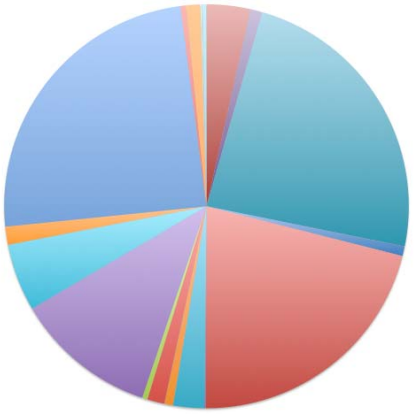
VIRUS ISOLATION SUMMARY

VIRUS	# ISOLATIONS
EVERGLADES	27
KEYSTONE	12
TENSAW	9
SHARK RIVER	9
GUMBO LIMBO	5
MAHOGANY HAMMOCK	4
ST LOUIS ENCEPHALITIS	1

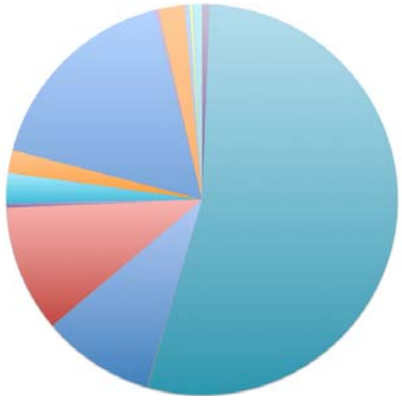
POTENTIAL KEY VECTOR SPECIES

SPECIES	EVER	KEYV	MHV	SRV	GLV	SLEV	TENV	TOTAL
Aedes atlanticus		9						9
Aedes infirmatus								
Aedes taeniorhynchus							1	1
Aedes triseriatus								
Anopheles atropos							2	2
Anopheles crucians complex							6	6
Anopheles punctipennis								
Anopheles quadrimaculatus								
Anopheles walkeri								
Coquilettidia perturbans								
Culiseta melanura								
Culex atratus	2			1				3
Culex bahamensis								
Culex cedecei	17	1	4	8	5			35
Culex erraticus		1						1
Culex iolambdis								
Culex nigripalpus	7	1				1		9
Culex pilosus								
Deinocerites cancer								
Mansonia dyari								
Psorophora columbiae								
Psorophora ferox								
Uranotaenia lowii								
Uranotaenia sapphirina								
Wyeomyia mitchellii	1							1
Wyeomyia vanduzeei								
TOTAL	27	12	4	9	5	1	9	67

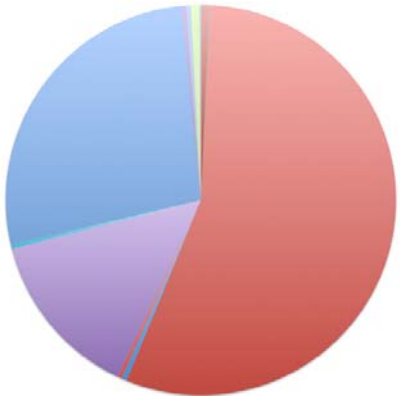
MOSQUITO SPECIES COMPOSITION



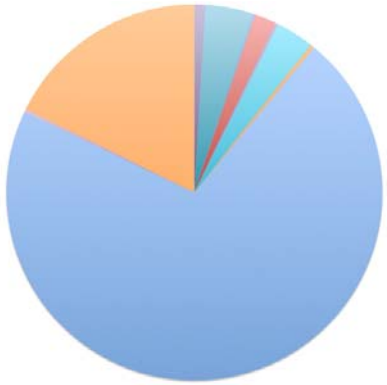
EVERGLADES 2013



BIG CYPRESS 2014



FAKAHATCHEE 2013



PICAYUNE 2014

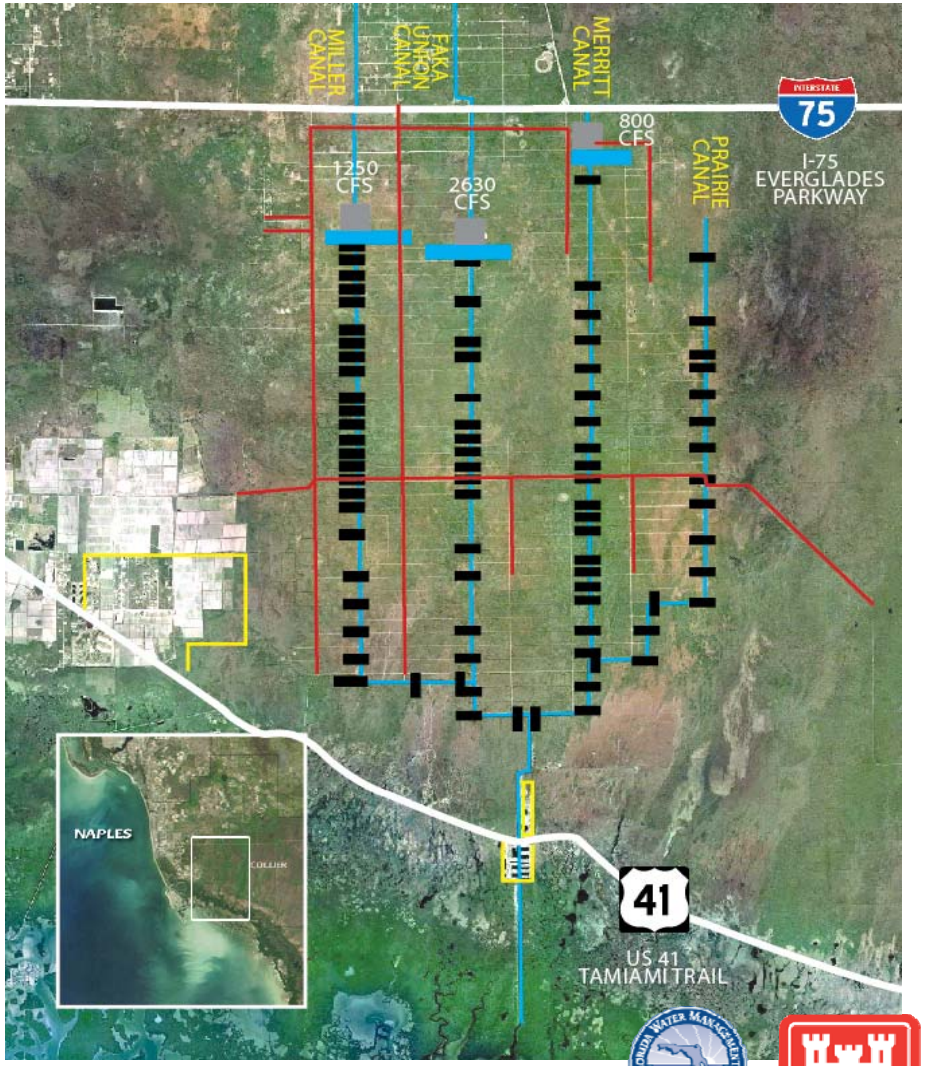
- Cx. nigripalpus
- Ae. taeniorhynchus
- An. crucians complex
- Cx. cedecei
- Cx. erraticus
- Ps. columbiae
- An. atropos
- Ae. atlanticus
- Ae. infirmatus
- Wy. mitchellii
- Ae. albopictus
- Ae. fulvus palens
- Ae. triseriatus
- An. punctipennis
- An. quadrimaculatus
- An. walkeri

Picayune Strand Restoration

Project Overview

The Picayune Strand Restoration Project (PSRP) was one of the first Comprehensive Everglades Restoration Plan (CERP) projects under construction. The project includes 55,000 acres of native Florida wetlands and uplands located between Interstate 75 and US-41 in southwest Florida.

- Project Features
  - 3 spreader canals
  - 3 pump stations: Merritt, Faka Union, and Miller
  - Plugging 48 miles of canals (with more than 100 plugs)
  - Removing and degrading 260 miles of roads



PSRP Successes

- Evidence of Restoration in Prairie Canal Restoration Area
  - Panther sightings
  - Increase in bird population
  - Exotic species control

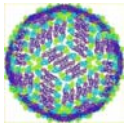
SITES POSITIVE ● AND NEGATIVE ● FOR VIRUSES

PICAYUNE
POOLS TESTED
188

FAKAHATCHEE
POOLS TESTED
77

CONCLUSIONS

- **30 SPECIES OF MOSQUITOES AND 7 SPECIES OF ARBOVIRUSES WERE FOUND IN THE GREATER EVERGLADES ECOSYSTEM**
- **Arboviruses are prevalent and widely distributed within EVER, BICY, and Fakahatchee, but not Picayune**
- **Restoration is likely to alter the species composition of mosquitoes and reservoir hosts, and permit the establishment of arboviruses in Picayune**



Everglades Mosquito and Arbovirus Project

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Pedro Ramos
Ron Clark
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Jimi Sadle

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