Disease Ecology

Lab 10

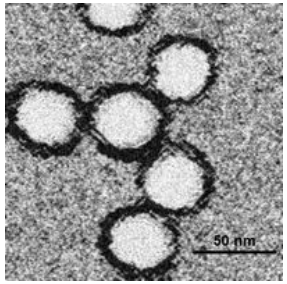
Disease Ecology

The ecological study of host-pathogen interactions within the context of their environment and evolution.

Pathogens can be transmitted in many ways

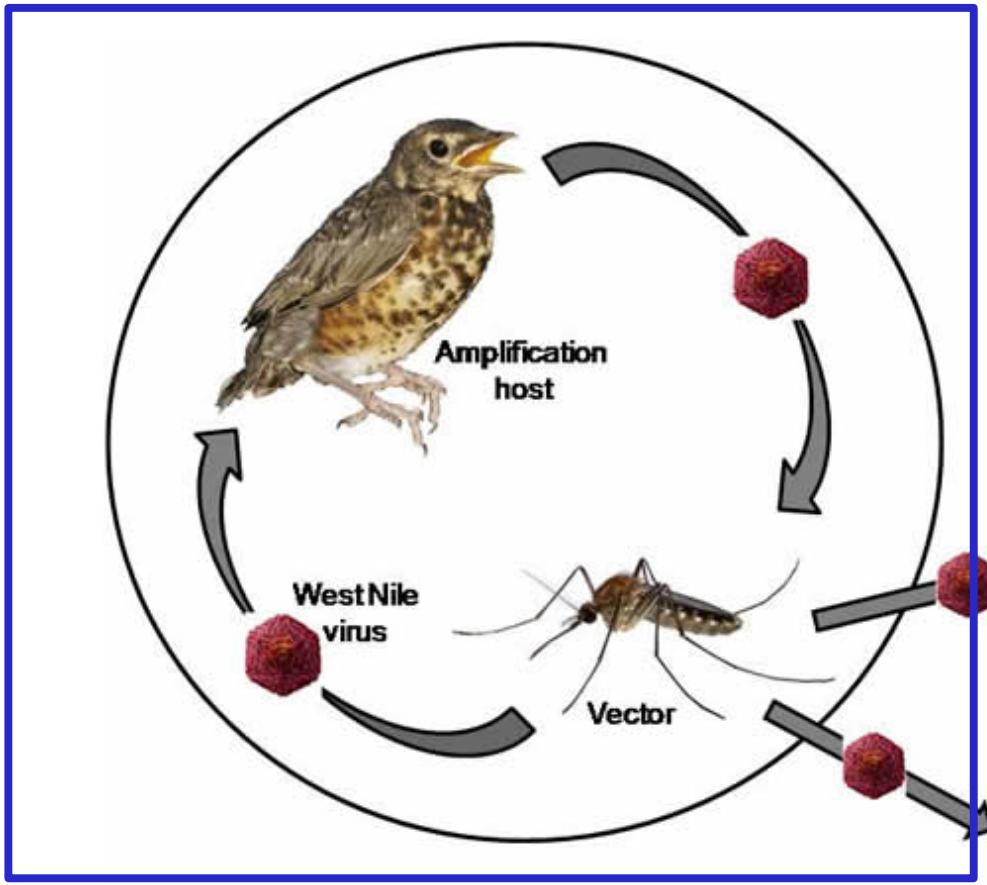
- Direct contact between hosts
- Through air, water, soil or other surfaces
- Biting arthropods→ **Vector**

West Nile Virus



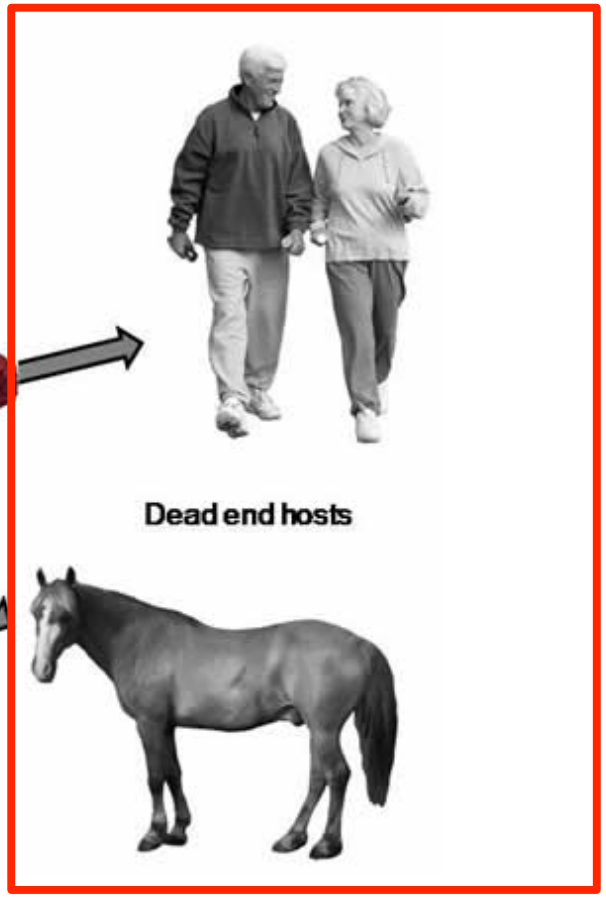
- Virus in the family Flaviviridae
- Most infections in people (80%) are asymptomatic
- The most common symptoms are similar to the flu
  - Encephalitis in rare cases

West Nile Virus Transmission Cycle



Primary transmission cycle

Incidental hosts



***WNV infects 330 species of birds!**

What influences human WNV prevalence?

1. Vector density
- Temperature
- Stagnant water

What influences human WNV prevalence?

2. Hosts

Bird species vary in their susceptibility to WNV

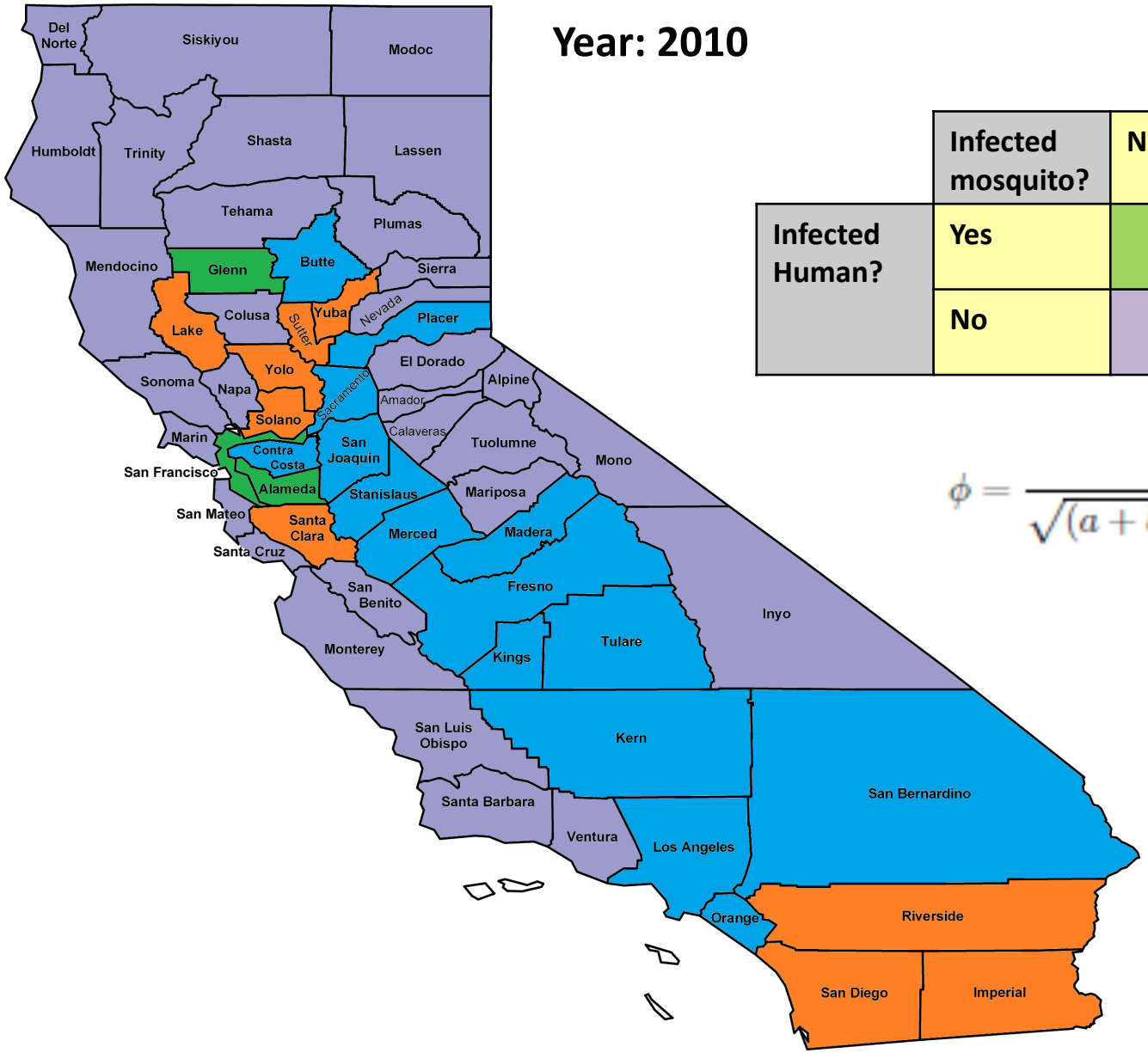
"reservoir competence"

- Some die before the pathogen replicates in high numbers, while others are unaffected and produce high viral titers

Objective in lab:

- Look for ***spatial*** associations between infected reservoir hosts (birds), vectors (mosquitoes), veterinary (horses), and sentinel animals (chickens) and human WNV cases
  - phi coefficient
- Look for ***temporal*** associations between infected reservoir hosts (birds), vectors (mosquitoes), and sentinel animals (chickens) and human WNV cases
  - Pearson's product-moment correlation

Determining spatial association: Phi-coefficient



Year: 2010

	Infected mosquito?	No	Yes
Infected Human?	Yes	a	b
	No	d	c

$$\phi = \frac{bd - ac}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}.$$

CA county	Human cases	Mosquito cases
Alameda	1	
Alpine		
Amador		
Butte	1	7
Calaveras		
Colusa		
Contra Costa	4	4
Del Norte		
El Dorado		
Fresno	23	130
Glenn	2	
Humboldt		
Imperial		10
Inyo		
Kern	15	277
Kings	1	65
Klamath		
Lake		3
Lassen		
Los Angeles	4	57
Madera	7	9
Marin		
Mariposa		
Mendocino		
Merced	1	9
Modoc		
Mono		
Monterey		
Napa		
Nevada		
Orange	1	19
Placer	3	36
Plumas		
Riverside		71
Sacramento	12	205
San Benito		
San Bernardino	5	41
San Diego		1
San Francisco	1	
San Joaquin	6	57
San Luis Obispo		
San Mateo		
Santa Barbara		
Santa Clara		10
Santa Cruz		
Shasta		
Sierra		
Siskiyou		
Solano		1
Sonoma		
Stanislaus	12	86
Sutter		26
Tehama		
Trinity		
Tulare	12	168
Tuolumne		
Ventura		
Yolo		11
Yuba		2
Total cases	**111**	**1305**

$$\phi = \frac{bd - ac}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}.$$

	Infected mosquito?	No	Yes
Infected Human?	Yes	3	15
	No	32	9

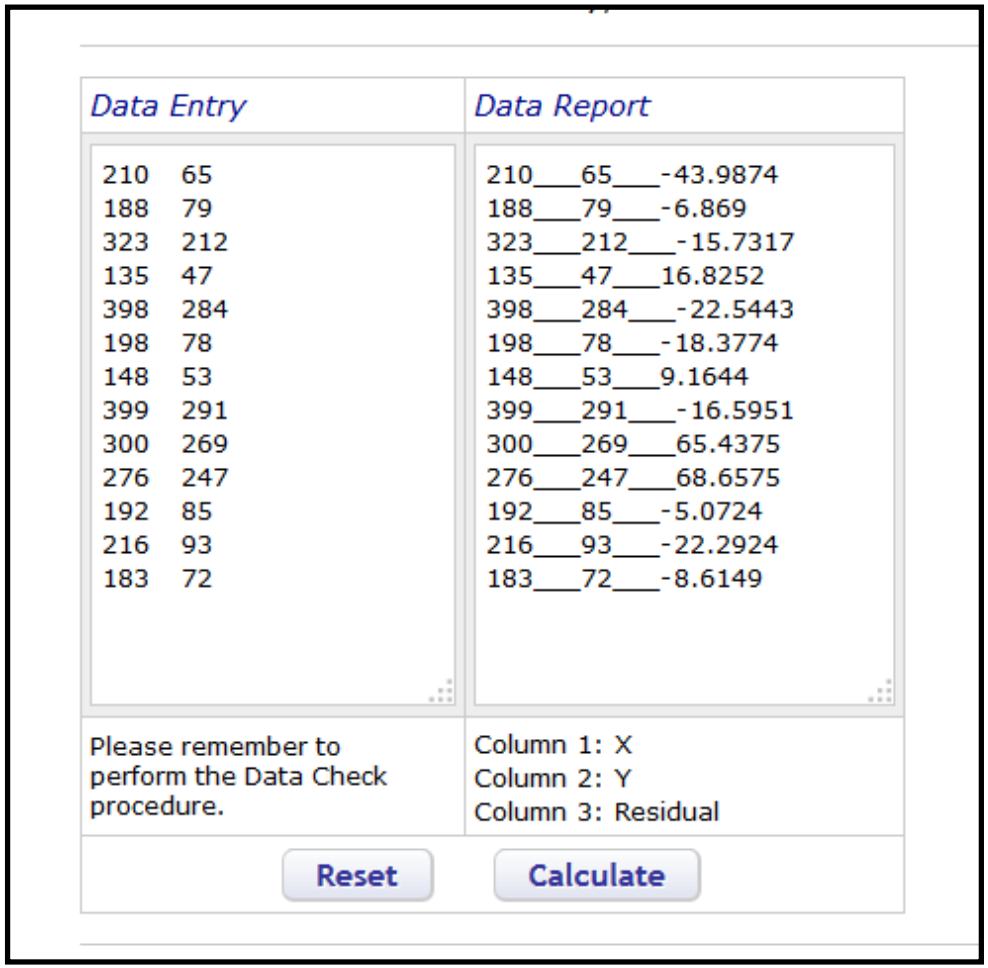
$$\Phi = \frac{(15 * 32) - (3 * 9)}{\sqrt{(3+15)(9+32)(3+9)(15+32)}} \quad =.70$$

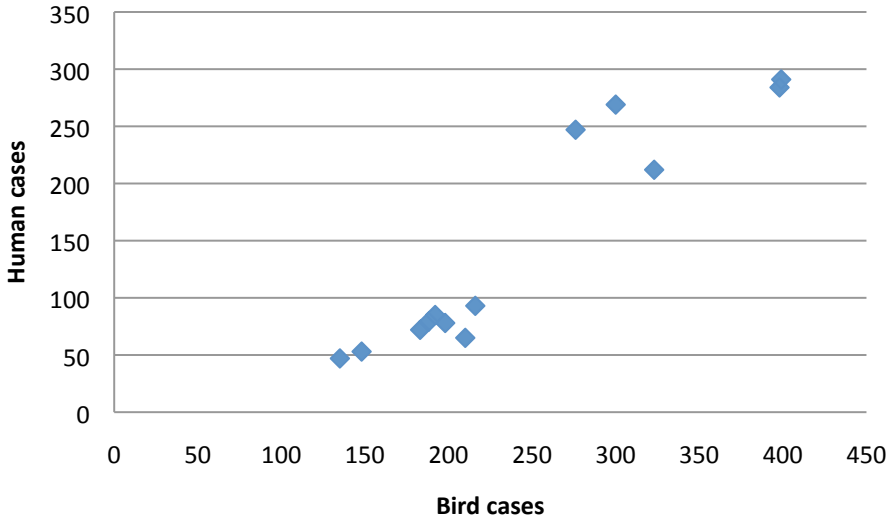
*Phi values range between -1 (perfect negative association) and 1 (perfect positive association. A phi value of 0 indicated no relationship.

Determining temporal association: Pearson's product-moment correlation (r)

	X	Y
Year	Bird cases	Human cases
2002	210	65
2006	188	79
2007	323	212
2008	135	47
2009	398	284
2010	198	78
2011	148	53
2012	399	291
2013	300	269
2014	276	247
2015	192	85
2016	216	93
2017	183	72

http://www.vassarstats.net/corr_big.html





N	13	
Mean	243.5385	144.2308
Variance	7737.7692	9653.6923
Std.Dev.	87.9646	98.2532
Std.Err.	24.397	27.2505

r	r^2	Slope	Y Intercept	Std. Err. of Estimate
0.9408	0.8851	1.050835	-111.687874	34.7861

t	df	P		
9.21	11		one-tailed	<.0001
			two-tailed	<.0001

0.95 and 0.99 Confidence Intervals for rho