



GUIDE FOR EPIDEMIOLOGIC ANALYSIS OF WEST NILE VIRUS MOSQUITO TRAP DATA IN DALLAS COUNTY

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Epidemiology Division

Dallas County Health and Human Services

This guide was developed for the dedicated environmental health staff of the 25 cities within our County, with much appreciation for their constant efforts in protecting the health of our residents.

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1. Maximum Likelihood Estimation (MLE)

a. Definition:

The MLE is a statistical method used in the calculation of West Nile virus infection rates of female *Culex quinquefasciatus* mosquitoes in the area. For the Dallas area, the *Culex quinquefasciatus* species mosquitoes are considered the predominant significant vectors for West Nile. The MLE takes into account the size of each pool tested during a specific time period and their corresponding results.

b. Software for Mosquito Surveillance:

The CDC developed a user-friendly tool to assist with the calculation of West Nile Virus infection rates. This software is a Microsoft Excel Add-In that can be downloaded for free at the following link: <http://www.cdc.gov/ncidod/dvbid/westnile/software.htm> .

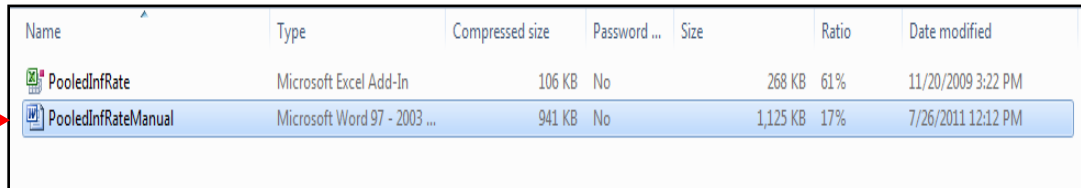
c. Downloading the Microsoft Excel Add-In:

Two versions of the Mosquito Surveillance software are available through the CDC. Each version is compatible with either earlier versions of Microsoft Office (2003 and older) or more recent versions of Microsoft Office (2007 and newer).

The screenshot shows the CDC website page for West Nile Virus software. The main heading is "Software for Mosquito Surveillance". Two red arrows point to the download links for the software: "download Windows Excel 2000/2003 v4 ZIP . (1.43MB)" and "download Windows Excel 2007 v4 ZIP file. (1.53MB)". The page also contains text about mosquito-based surveillance data and a link to contact DVBD.

d. Pooled Infection Rate Manual:

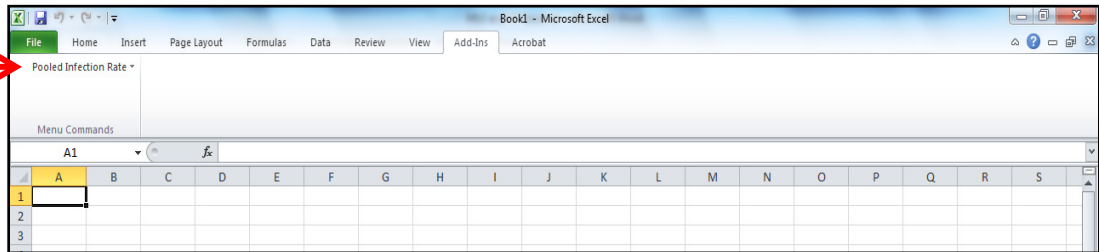
Materials to download using the respective Mosquito Surveillance download options include: (1) the Microsoft Excel Add-In file, named “PooledInfRate”, and (2) a Word document instruction manual, entitled “PooledInfRateManual.” This manual provides step-by-step instructions regarding the use of the “PooledInfRate” Microsoft Excel Add-In.



Name	Type	Compressed size	Password ...	Size	Ratio	Date modified
PooledInfRate	Microsoft Excel Add-In	106 KB	No	268 KB	61%	11/20/2009 3:22 PM
PooledInfRateManual	Microsoft Word 97 - 2003 ...	941 KB	No	1,125 KB	17%	7/26/2011 12:12 PM

e. “PooledInfRate” Microsoft Excel Add-In:

Once installed, the “Pooled Infection Rate” add-in will always be located under the “Add-In” tab of all Microsoft Excel worksheets that are opened on your computer in the future.



f. Example:

	A	B	C	D	E	F	G	H	I
1	Week Ending	Trap Address	Trap Number	Species	Number Tested	Results	Coded Result		
2	4/27/2013	A	Trap 1	Culex quinquefasciatus	10	Negative	0		
3	4/27/2013	B	Trap 2	Culex quinquefasciatus	5	Negative	0		
4	4/27/2013	C	Trap 3	Culex quinquefasciatus	4	Positive	1		
5	4/27/2013	D	Trap 4	Culex quinquefasciatus	8	Negative	0		
6	4/27/2013	E	Trap 5	Culex quinquefasciatus	16	Positive	1		
7	4/27/2013	F	Trap 6	Culex quinquefasciatus	28	Negative	0		
8	4/27/2013	G	Trap 7	Culex quinquefasciatus	2	Negative	0		

a. Prior to using the add-in to calculate the MLE for a specific period of time (e.g. 1 week), make sure that the following information is included in specific columns on your data sheet:

- i. The number of **female** *Culex quinquefasciatus* tested in each pool. If a trap contains any female *Culex quinquefasciatus* mosquitoes, the DSHS and DCHHS mosquito laboratories will sort them into “pools” of up to 50, and then submit one pool for WNV-testing.
- ii. West Nile Virus testing results of the pool as binary variables, coded as follows:

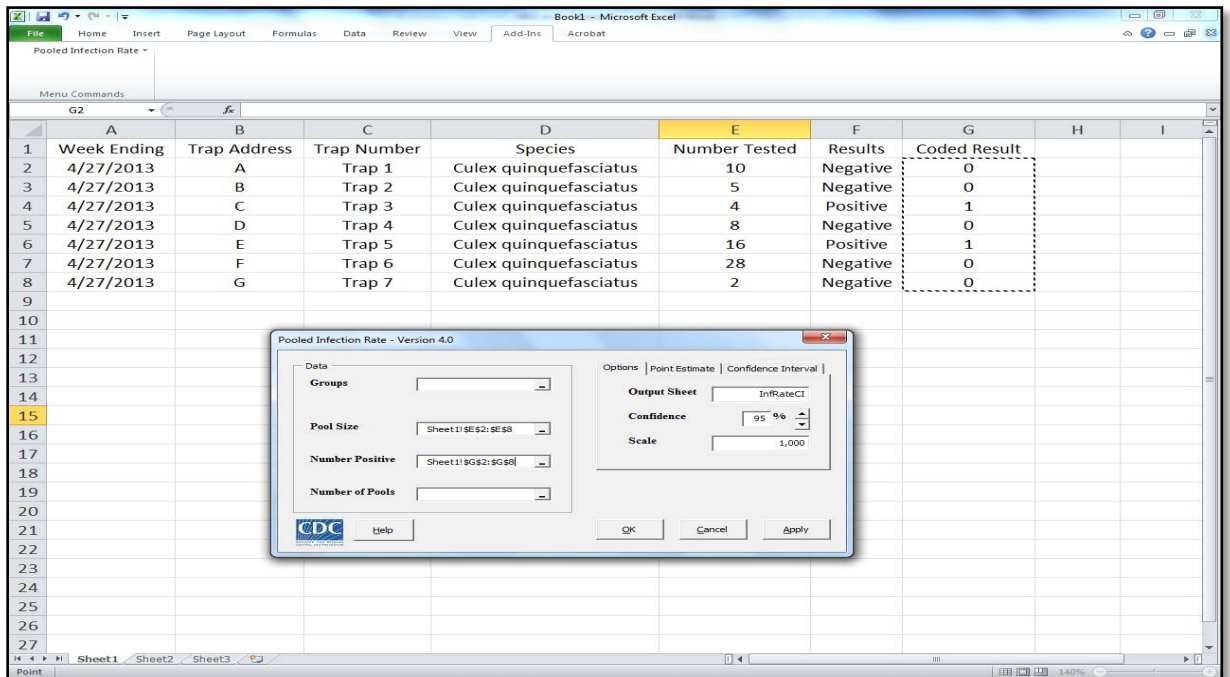
Negative = 0

Positive = 1

b. Under the Excel “Add-Ins” tab click on “Pooled Infection Rate” and select “One Sample...”

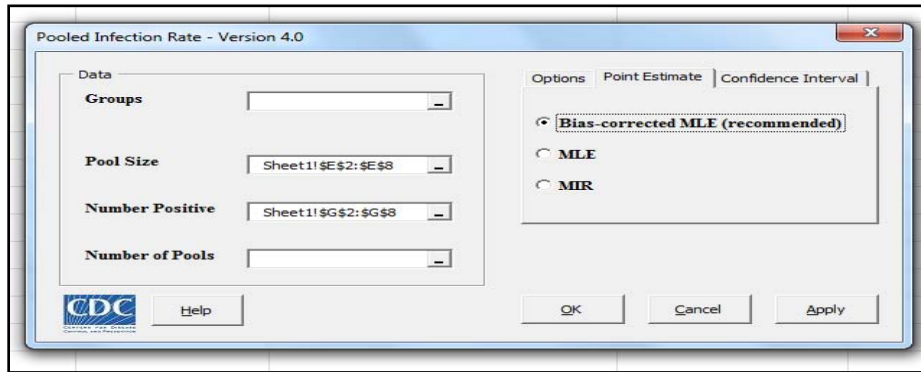
	A	B	C	D	E	F	G	H	I
1	Week Ending	Trap Address	Trap Number	Species	Number Tested	Results	Coded Result		
2	4/27/2013	A	Trap 1	Culex quinquefasciatus	10	Negative	0		
3	4/27/2013	B	Trap 2	Culex quinquefasciatus	5	Negative	0		
4	4/27/2013	C	Trap 3	Culex quinquefasciatus	4	Positive	1		
5	4/27/2013	D	Trap 4	Culex quinquefasciatus	8	Negative	0		
6	4/27/2013	E	Trap 5	Culex quinquefasciatus	16	Positive	1		
7	4/27/2013	F	Trap 6	Culex quinquefasciatus	28	Negative	0		
8	4/27/2013	G	Trap 7	Culex quinquefasciatus	2	Negative	0		

c. A pop-up box entitled “Pooled Infection Rate – Version 4.0” box appears



- Click in the “**Pool Size**” field located on the left hand side of the “Pooled Infection Rate” box, then, on the Excel worksheet, select (click and drag) all **cells with the number of female mosquitoes tested** for each trap collected that week.
- Next, click in the “**Number Positive**” field located directly below the “Pool Size” field. In the Excel worksheet, select (click and drag) all **cells with the corresponding binary results (1 or 0)** for each one of the traps tested that week.
- **Note:** *The number of cells selected under “Pool Size” must be the same as the number of cells selected under “Number Positive”*

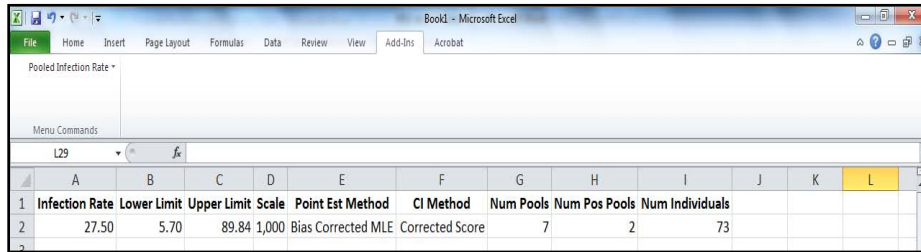
d. Calculating the MLE



On the right hand side, under the “Point Estimate” tab, select “Bias-corrected MLE (recommended)”. Then, click on “OK”.

e. MLE Results

MLE calculation results will display in the “InfRateCI” tab that is automatically generated once you click “OK” in previous step.



f. Following is the explanation of the above information:

Item in File	Explanation	Value in this example
Infection Rate	MLE	27.50
Lower Limit	Lower limit of the MLE confidence interval	5.70
Upper Limit	Upper limit of the MLE confidence interval	89.84
Num Pools	Number of Pools included in this calculation	7
Num Pos Pools	Number of West Nile Positive Pools included in this calculation	2
Num individuals	Total number of <i>Cx. quinquefasciatus</i> included in this calculation	73

Note: The MLE is always expressed per 1,000 species tested. In this example: 27.50 per 1,000 *Cx. quinquefasciatus*.

1. Vector Index

a. **Importance:** Objective method of following trends in mosquito infection rates, adjusted for mosquito abundance in the area.

b. **Definition:**

Measure of infectivity that takes into account the following information:

- **Vector species composition** – Key species carrying West Nile virus in our region. (In Dallas, there is only 1 predominant bridge vector of importance for WNV.)
- **Vector species population density** – Vector abundance relative to trapping effort.
- **Vector species infection rate** – Proportion of vector population infected with WNV.

c. **Vector Index formula:**

$$VI = \sum_{i=species} NiPi$$

- N is the average number of *Culex quinquefasciatus* collected per trap night
- P is the estimated infection rate

d. **Vector Index Calculation (weekly):**

- i. **Step 1:** Calculate average mosquito density (Average female *Cx. quinquefasciatus* per trap night). In this calculation, use numbers of female *Cx. quinquefasciatus* identified in each trap collected over the course of 1 week. Include traps which did not catch any mosquitoes, but exclude any malfunctioning traps (e.g. trap knocked over, trap batteries without charge). For consistency include only gravid traps, which comprise >95% of area traps, and exclude data from any CO₂-baited light traps. Use of CDC MMWR “week-ending” dates will facilitate comparisons between data from past years.

Traps placed in 1 week	Species	# Females in each trap
A	<i>Cx. quinquefasciatus</i>	10
B	<i>Cx. quinquefasciatus</i>	5
C	<i>Cx. quinquefasciatus</i>	4
D	<i>Cx. quinquefasciatus</i>	8
E	<i>Cx. quinquefasciatus</i>	16
F	<i>Cx. quinquefasciatus</i>	28
G	<i>Cx. quinquefasciatus</i>	2
N = Average Female <i>Cx. quinquefasciatus</i> per trap night = 73/7 = 10		

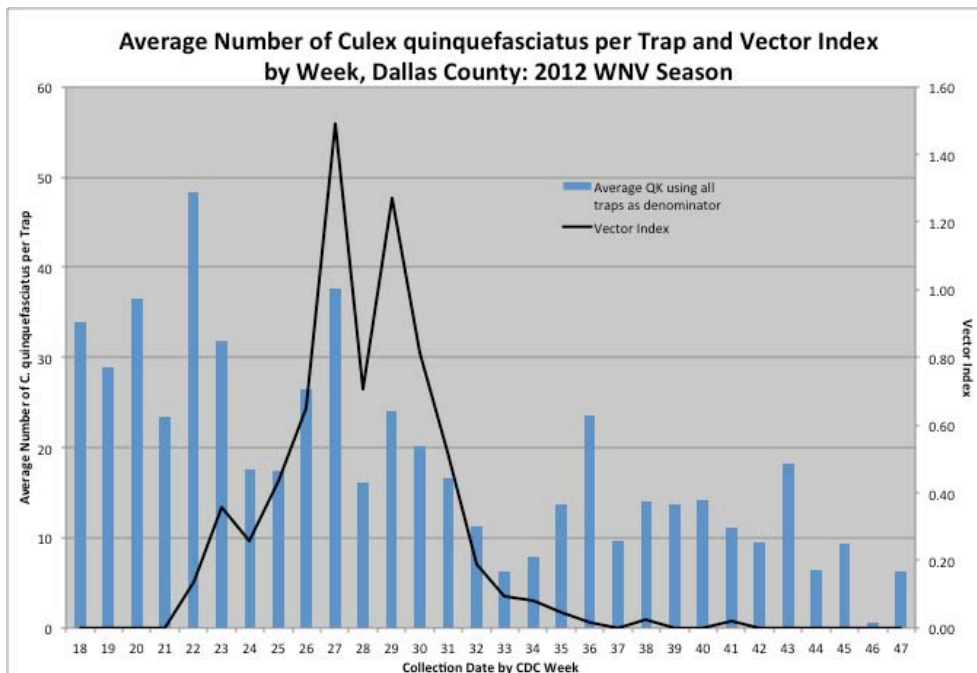
ii. **Step 2:** Calculate infection rate as **proportion** of all mosquitoes

Trap Site	Species	# Females	WNV Positive (0=No; 1=Yes)
A	<i>Cx. quinquefasciatus</i>	10	0
B	<i>Cx. quinquefasciatus</i>	5	0
C	<i>Cx. quinquefasciatus</i>	4	1
D	<i>Cx. quinquefasciatus</i>	8	0
E	<i>Cx. quinquefasciatus</i>	16	1
F	<i>Cx. quinquefasciatus</i>	28	0
G	<i>Cx. quinquefasciatus</i>	2	0
P = Infection Rate = MLE/1000 = 27.50/1000 = 0.0275	Lower Limit	Upper Limit	Confidence Interval
	0.0057	0.08984	0.95

iii. **Step 3:** Calculate weekly Vector Index to adjust for mosquito abundance

Vector Index Calculation	<i>Cx. quinquefasciatus</i>
N = Average per trap night	10
P = Proportion Infected	0.0275
Vector Index = Average per trap x Proportion Infected	0.275

iv. **Step 4:** Plotting the Vector Index



References:

- Biggerstaff BJ. PooledInfRate, version 4.0: a Microsoft® Excel© Add-In to compute prevalence estimates from pooled samples. Centers for Disease Control and Prevention, Fort Collins, CO U.S.A., 2009.
<http://www.cdc.gov/ncidod/dybid/westnile/software.htm>
- Jones RC, Weaver KN, Smith S et al. Use of the vector index and geographic information system to prospectively inform West Nile virus interventions. *J A Mosquito Contr Assoc* 2011;27:315-319.
- Nasci RS, Doyle M, Biggerstaff BJ, LeBailly A. Calculation and application of a vector index (VI) reflecting the number of WN virus infected mosquitoes in a population. In: 71st Annual Meeting of the American Mosquito Control Association. 2005 April 3-7; Vancouver, Canada. Poster accessed at:
<http://www.colorado.gov/cs/Satellite/CDPHE-DCEED/CBON/1251607766375>
Access link for “Resources for Public Health Professionals” and then “Calculation of infected mosquitoes in a population (CDC poster).”
- Ruktanonchai D. Epi-Aid 2012-069 Final Report: Evaluation of the impact of adult mosquito control during a West Nile virus outbreak in Dallas, Tarrant, Denton, and Collin Counties — Texas, 2012. Centers for Disease Control and Prevention, Fort Collins, CO U.S.A., February 5, 2013.