

# **The Risk Index as a Predictor of Human Cases of West Nile Virus?**

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*B.C. Provincial WNV Meeting*

*March 6<sup>th</sup> , 2006*

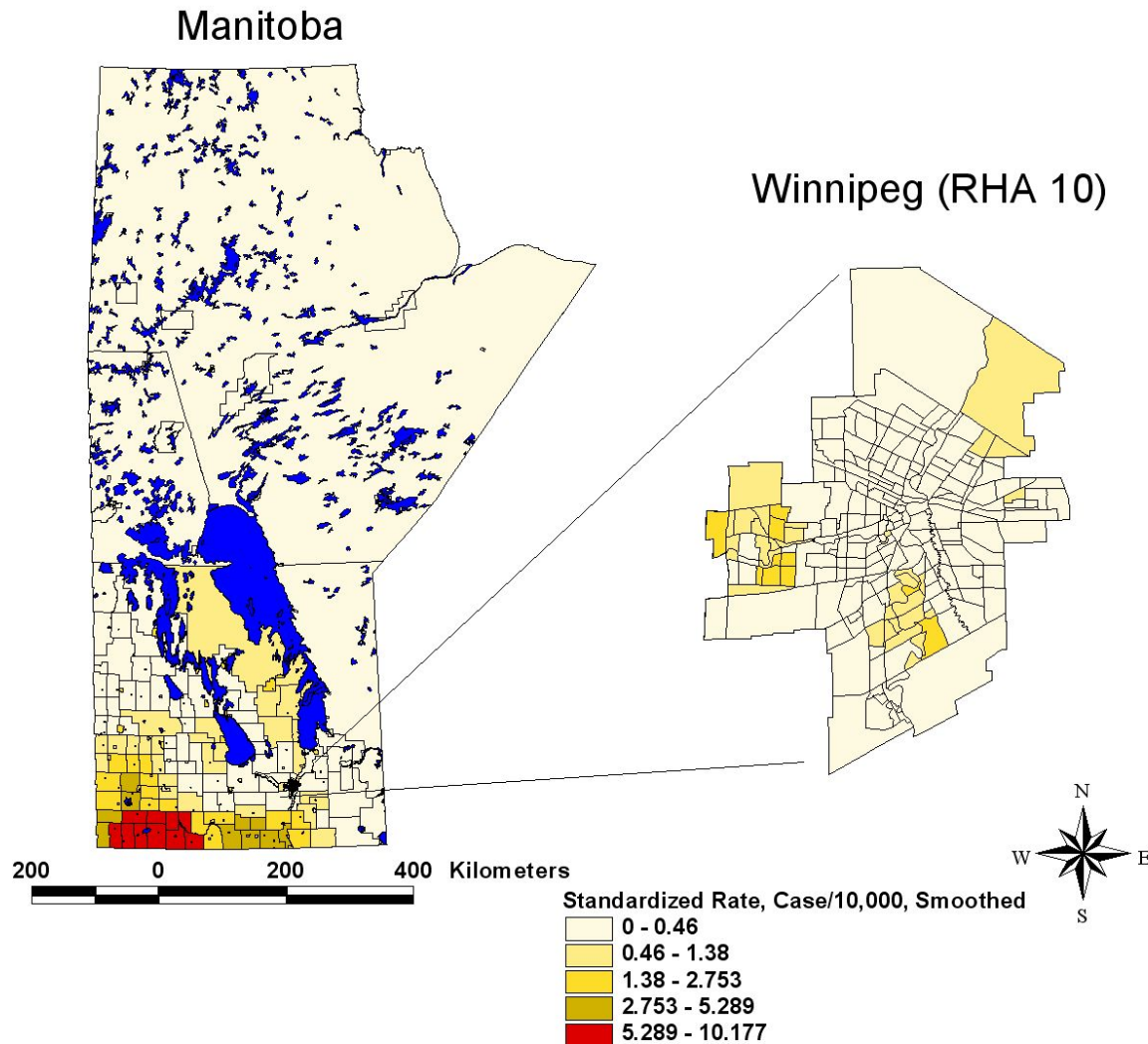
# Risk Assessment

- Risk of human exposure to WNV evolves over the summer and is dependent on
  - Virus in the ecosystem (virus characteristics, host characteristics, amplification vector characteristics)
  - *Culex tarsalis* development (temperature, standing water, time of year, etc)
  - Human behaviour (knowledge, perceived risk, ease and acceptance of prevention activities, social norms, etc)

# Human Cases in Manitoba

- A total of **58** positive West Nile Virus Human cases were identified in Manitoba in 2005.
  - 45 non-neurological cases
  - 10 neurological cases
  - 3 asymptomatic
- One person with WNV died in 2005
- In 2004, there were **3** WNV human cases identified in Manitoba in 2004 (1 WNNS).
- In 2003, there were 143 human cases identified in Manitoba including 2 deaths (35 WNNS).

# 2005 Human WNV Cases/10,000 population (smoothed rates, age standardized to 2001 general Manitoba population)

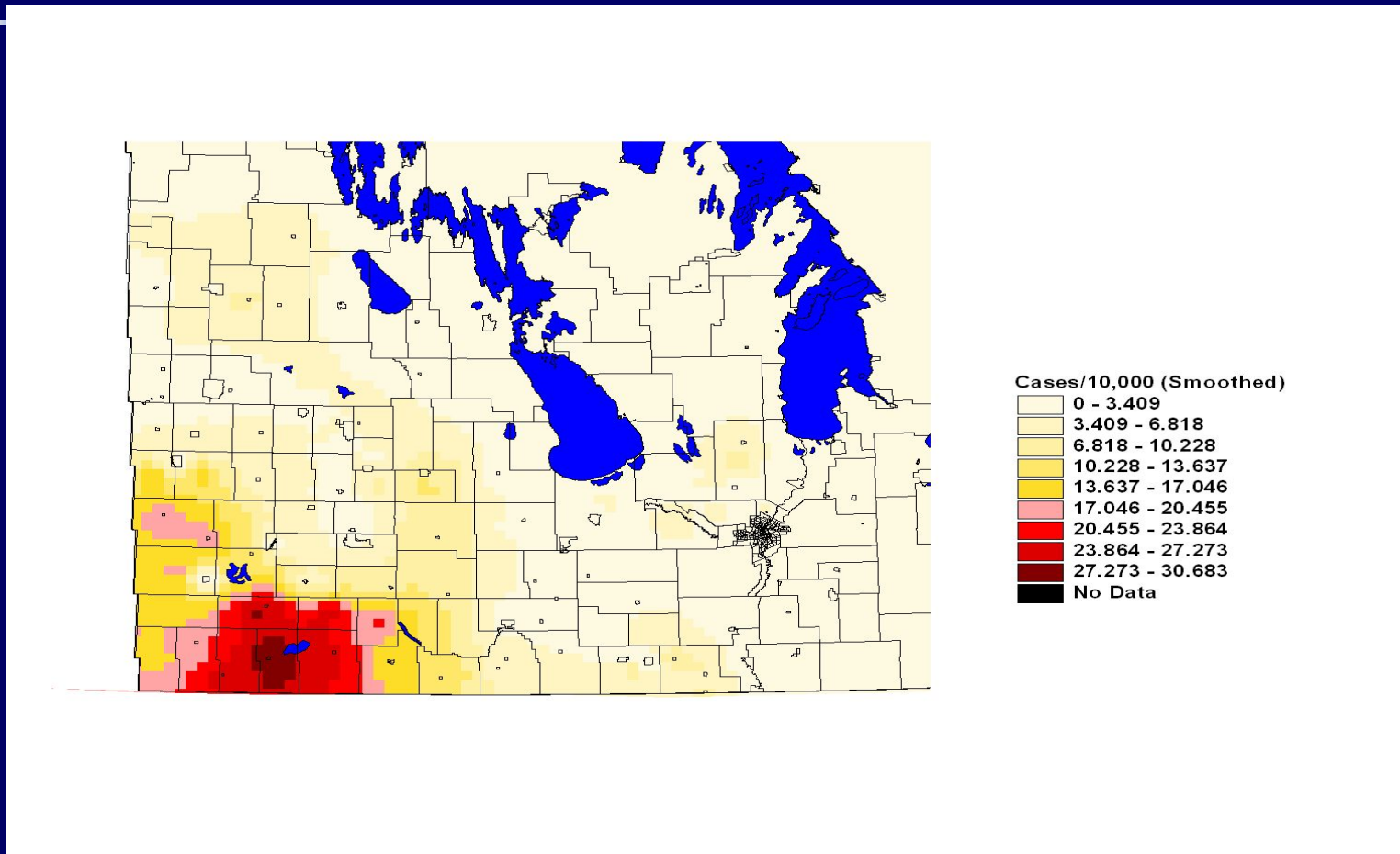


# West Nile Virus Cases

## 2003

### Smoothed and Age Standardized Cases/10,000 Population

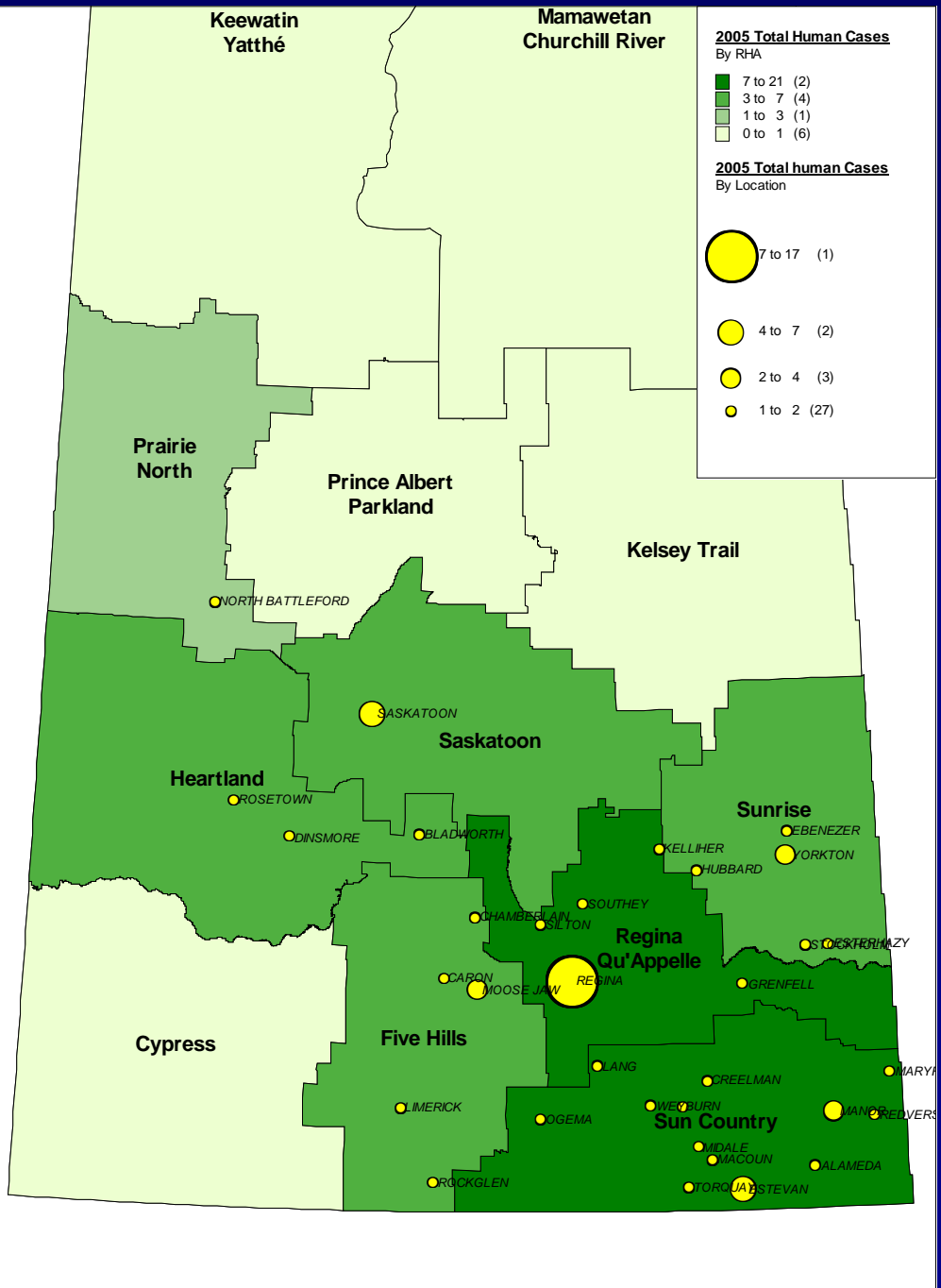
n=141



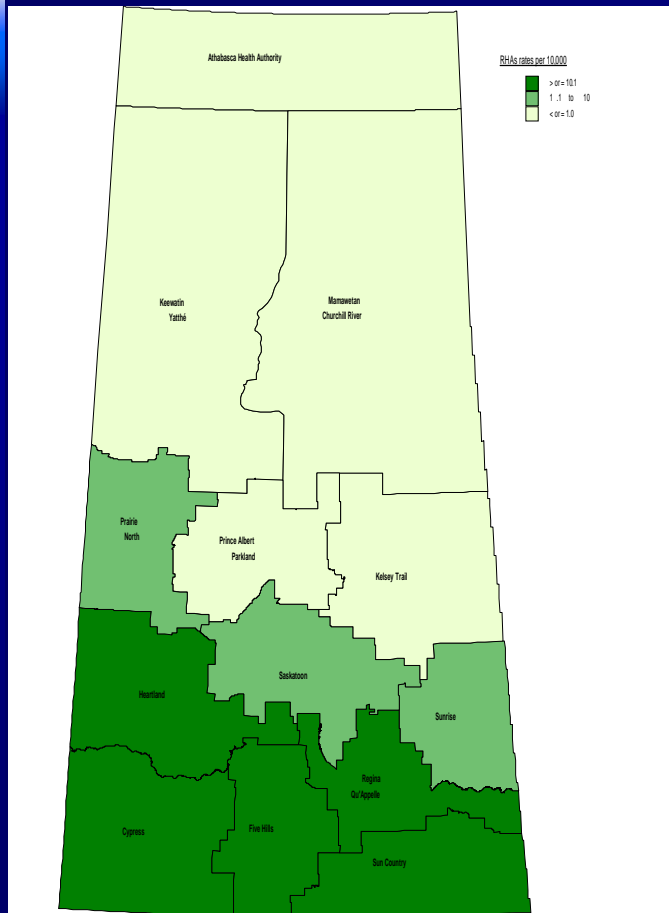
Note: Smoothing was accomplished using a weighted Mean Nearest Neighbor approach (weighted to a base population of 5,000). Rates were age standardized to the 1996 Manitoba General Population

# Human Cases in Saskatchewan

- A total of **59** positive West Nile Virus Human cases were identified in Saskatchewan in 2005.
  - 48 less severe cases
  - 8 neurological cases (3 severe)
  - 3 asymptomatic
- Two people with WNV died in 2005
- In 2004, there were **5** WNV human cases identified in Saskatchewan
- In 2003, there were 947 human cases identified in SK including 7 deaths (63 WNNS)



# West Nile virus human disease rates, by health region, 2003, Saskatchewan

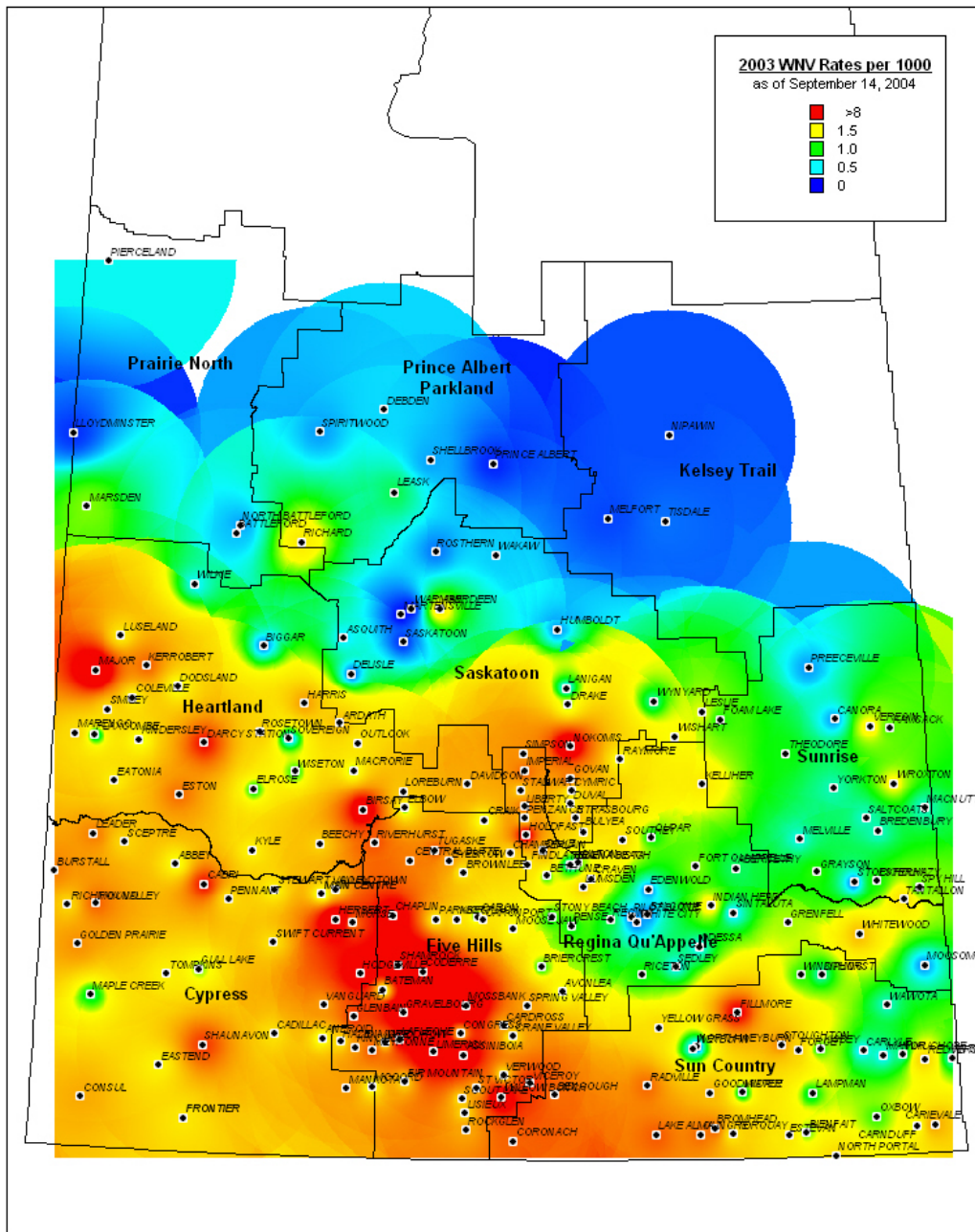


Cases per 10,000 population  
(to April 15, 2004)

Dark Green > 10.1

Light Green 1.1 – 10

Gray < 1.0



# Cluster Analysis

1 primary cluster

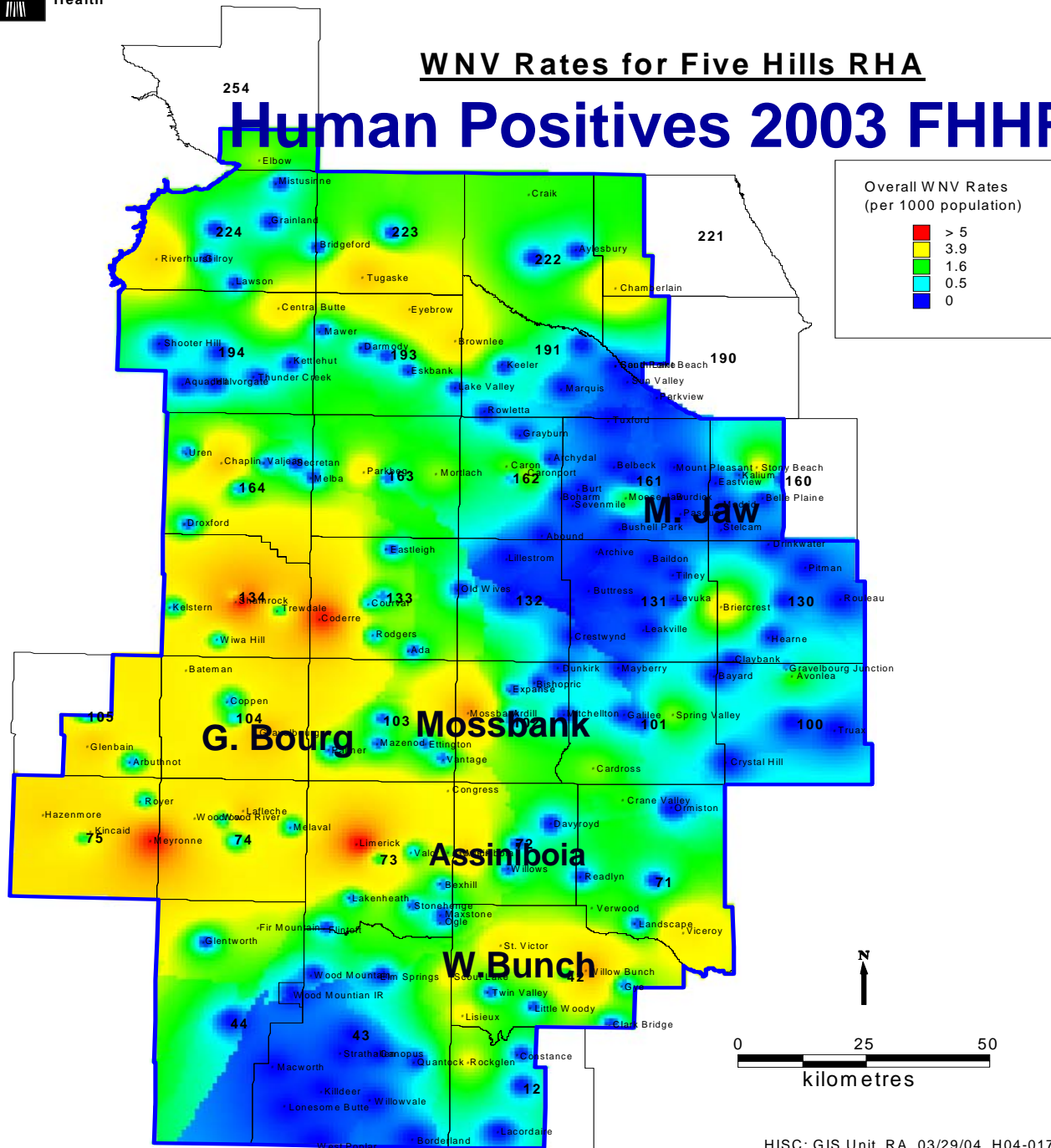
- Missouri Coteau

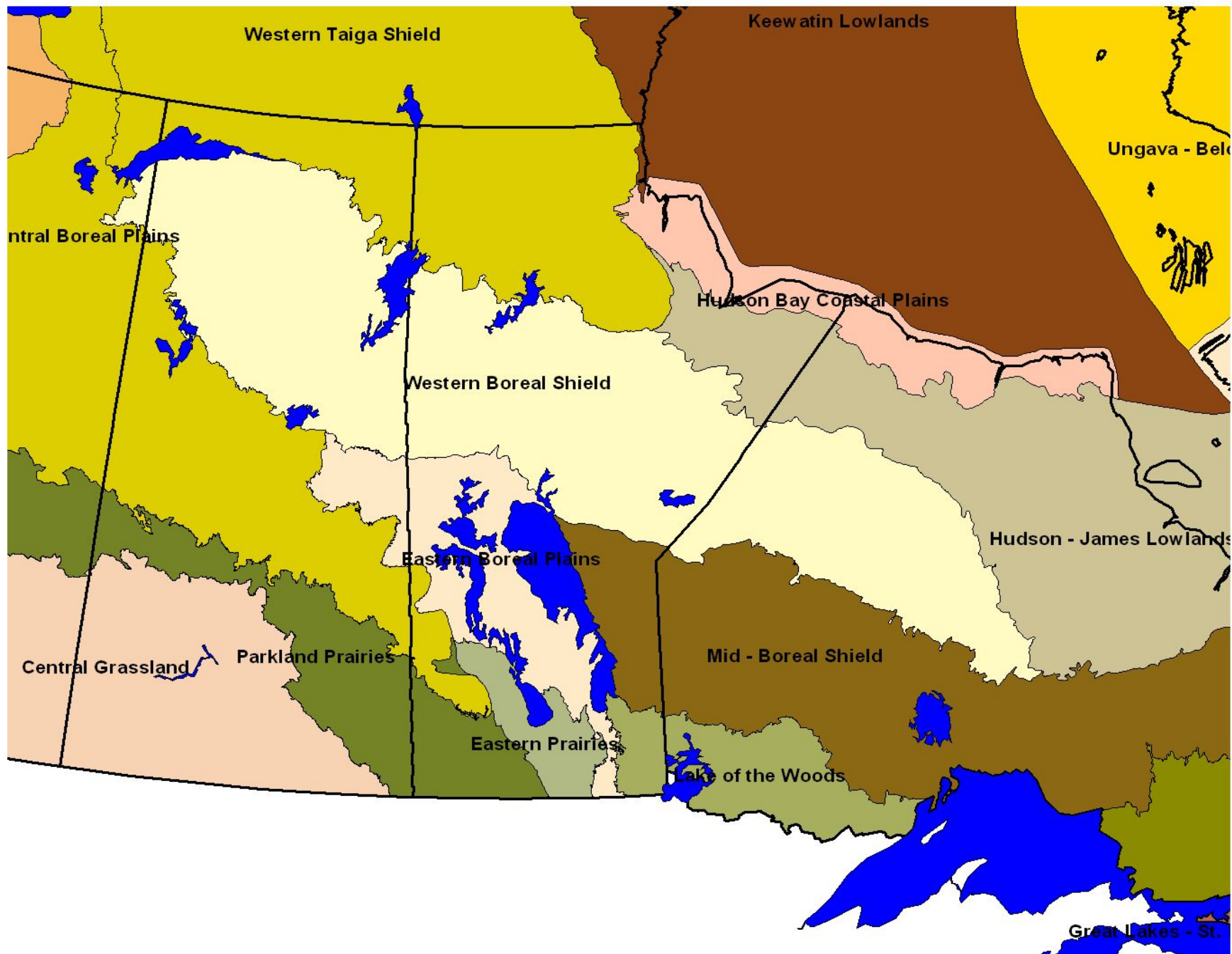
3 secondary clusters

- West Central (Leader – Kindersley – Major)
- Last Mountain Lake
- Southeast (Fillmore)

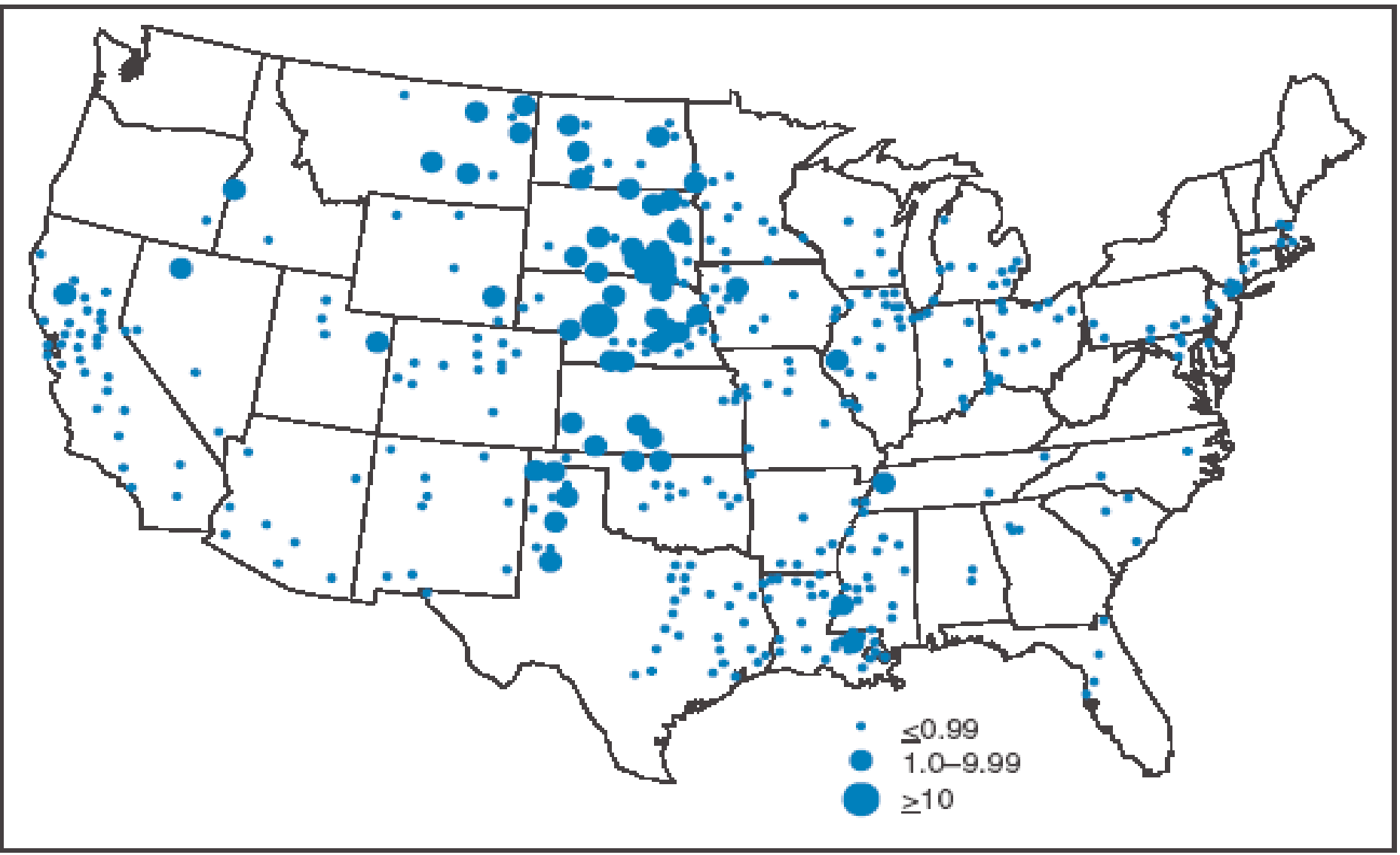
WNV Rates for Five Hills RHA

# Human Positives 2003 FHHR





**FIGURE 1. Incidence\* of West Nile virus neuroinvasive disease† in humans — United States, 2005§**



\* Per 100,000 county residents.

† Meningitis, encephalitis, or acute flaccid paralysis.

§ Provisional data as of December 1, 2005.

# Mosquito Infection Rates

- MIR (Minimum Infection Rate)
  - Assumes that a positive pool only has 1 infected mosquito
  - Under-estimates infection rate if pools size is large or infection rates are high
- MLE-IR (Maximum Likelihood Estimate)
  - Defined as the most likely infection rate based on the distribution of infected individuals in a number of pools
  - Usually higher than MIR
  - Over-estimates infection rate if pool number and size is small

# Risk or Vector Index

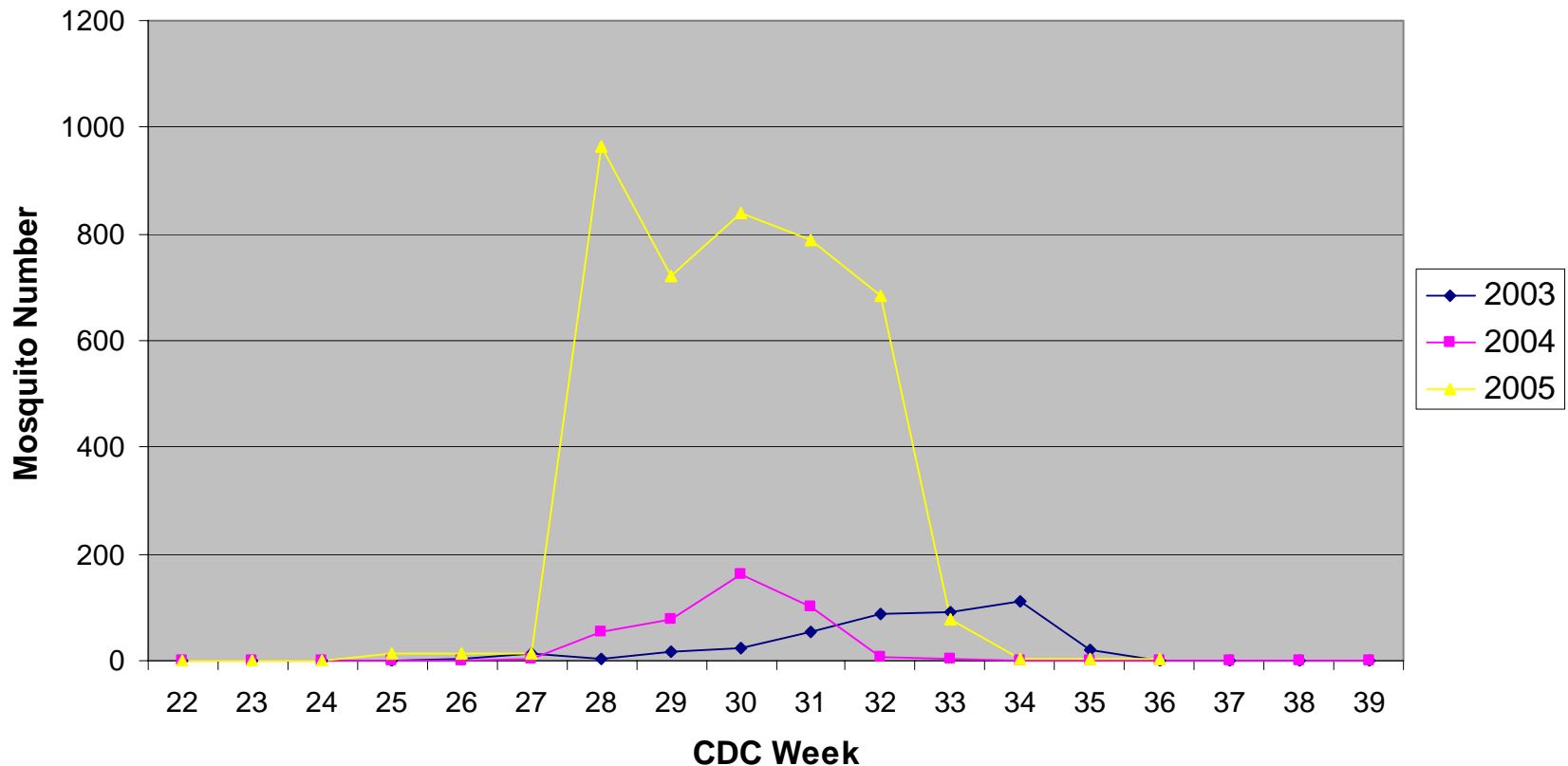
The risk index is calculated as:

*Risk Index = (MLE-IR times the number of mosquitoes per trap) divided by 1000*

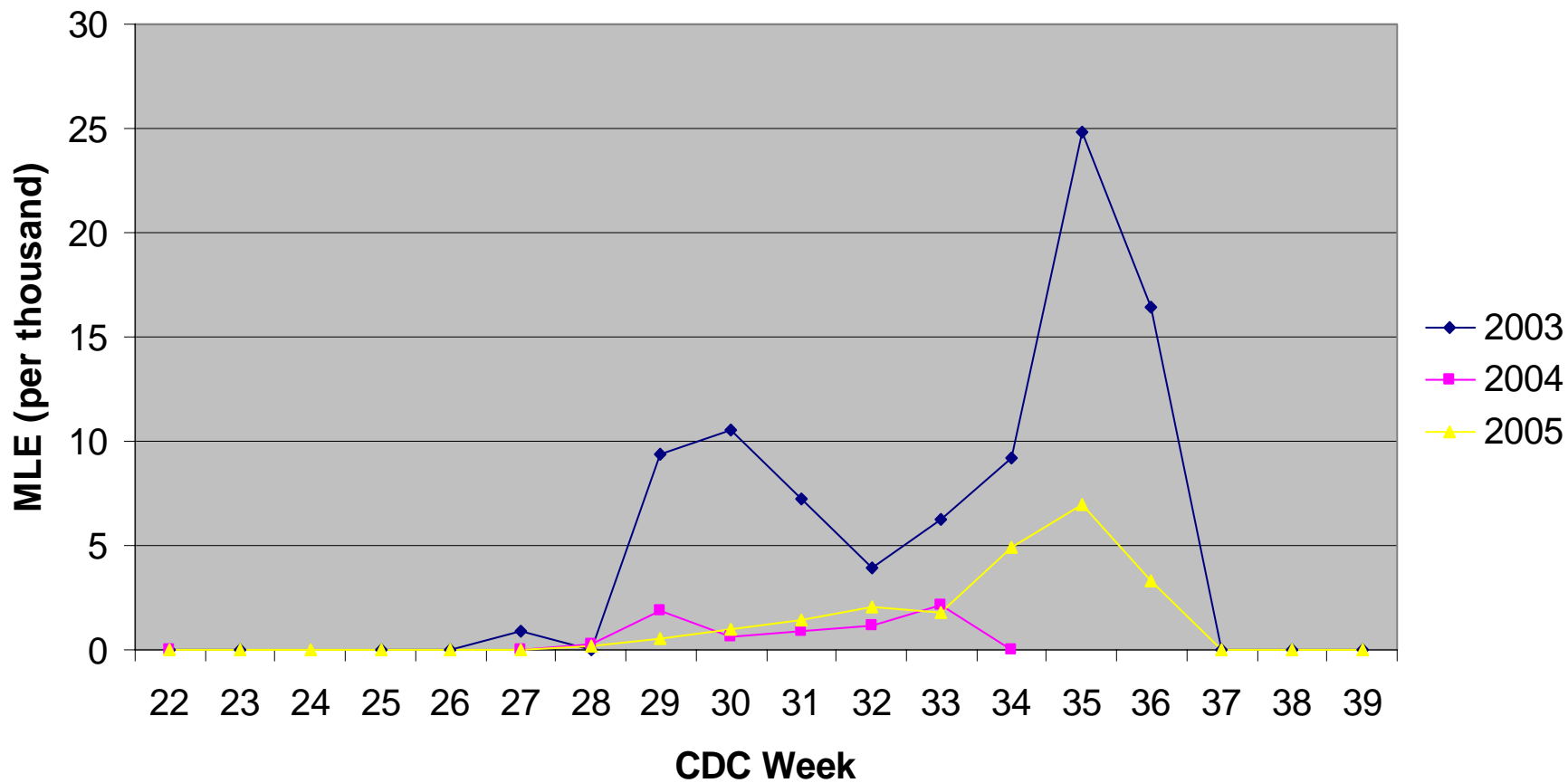
- A value of 1.00 – 4.00 indicates a significant rise in the risk to humans particularly if accompanied by a sharp rise in the numbers of vector mosquitoes

# Weekly Average Trap Counts

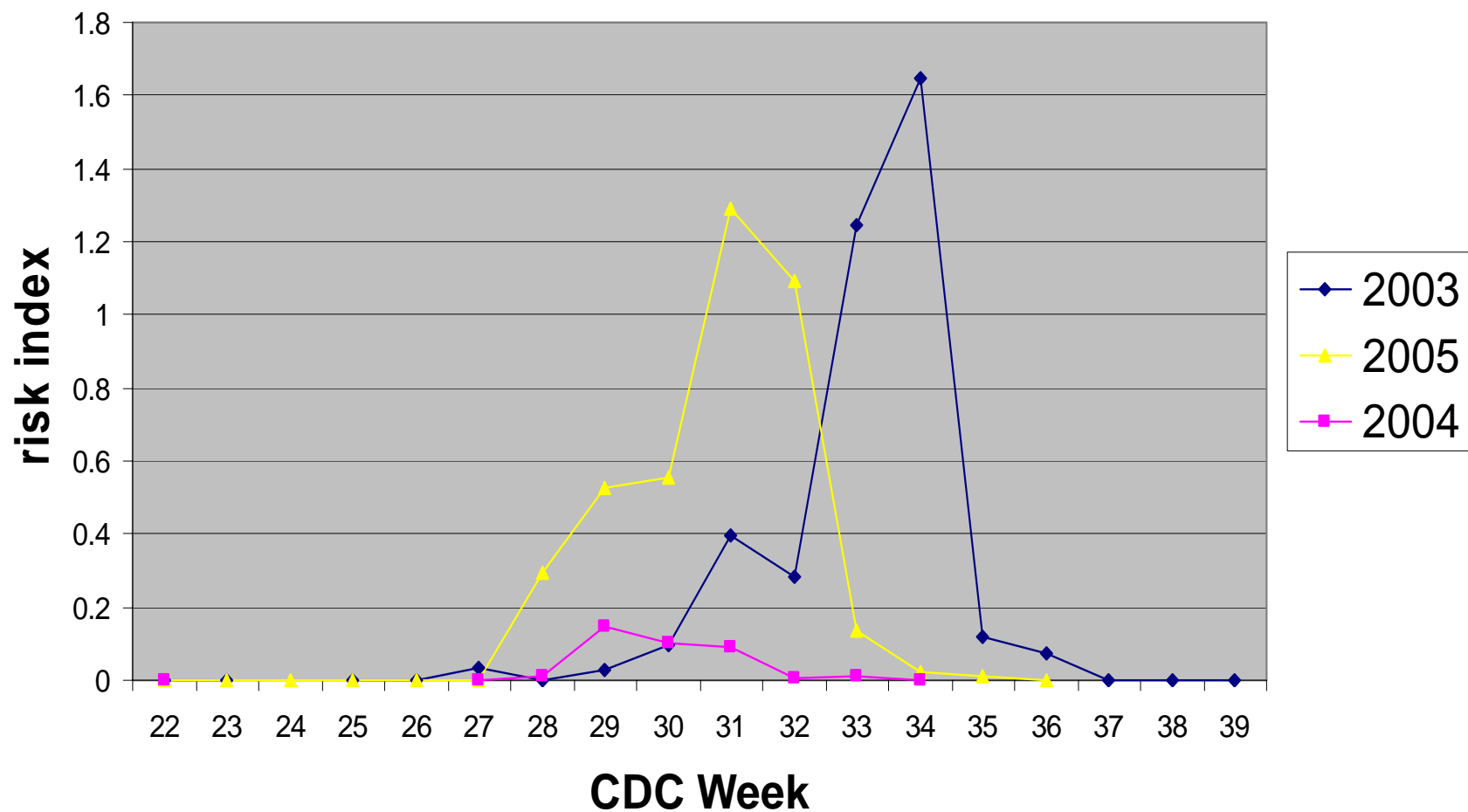
*Cx.tarsalis* average per trap comparison of 2003, 2004 and 2005 by week for Manitoba



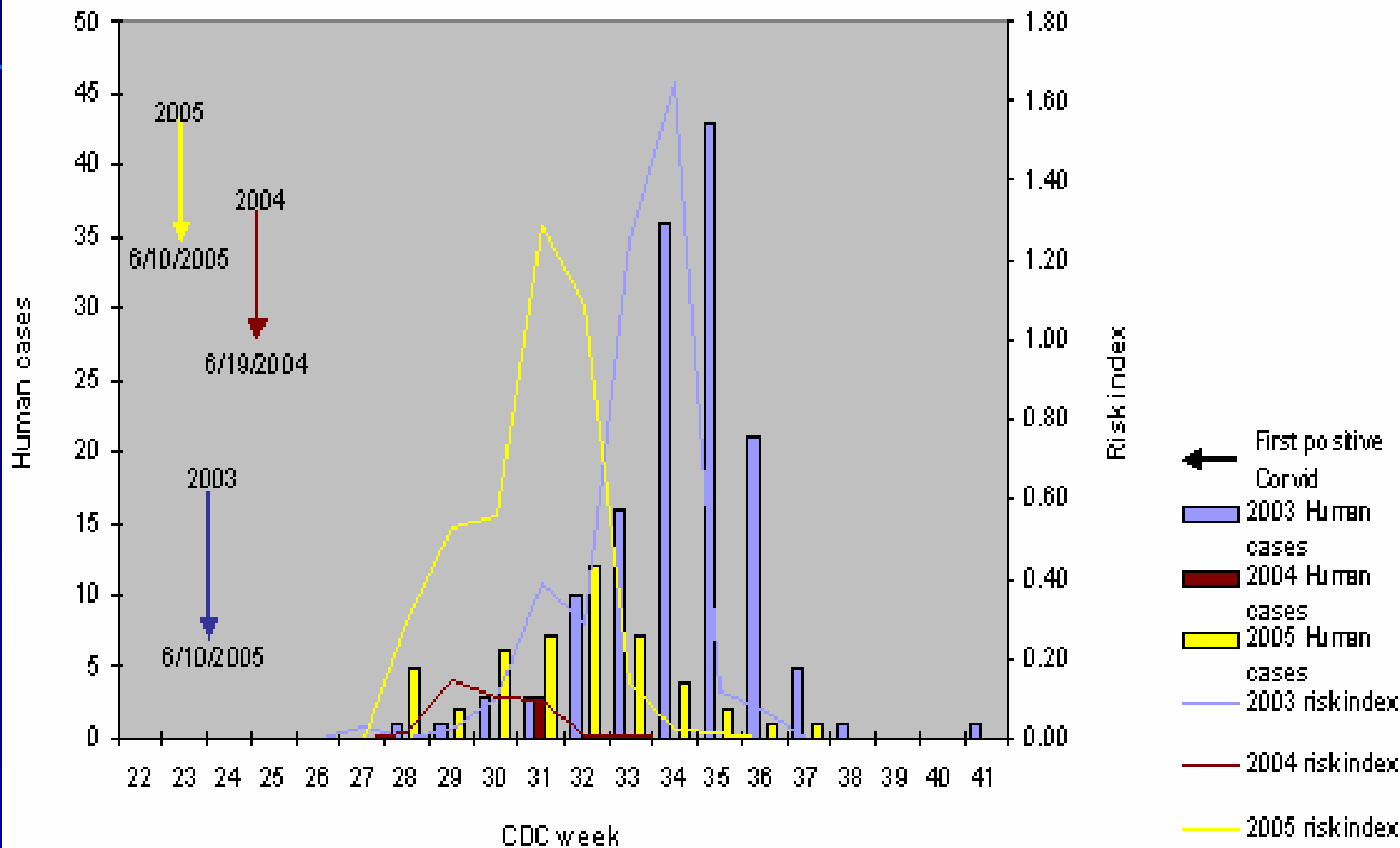
## MLE comparison of 2003, 2004 and 2005 by week for Manitoba



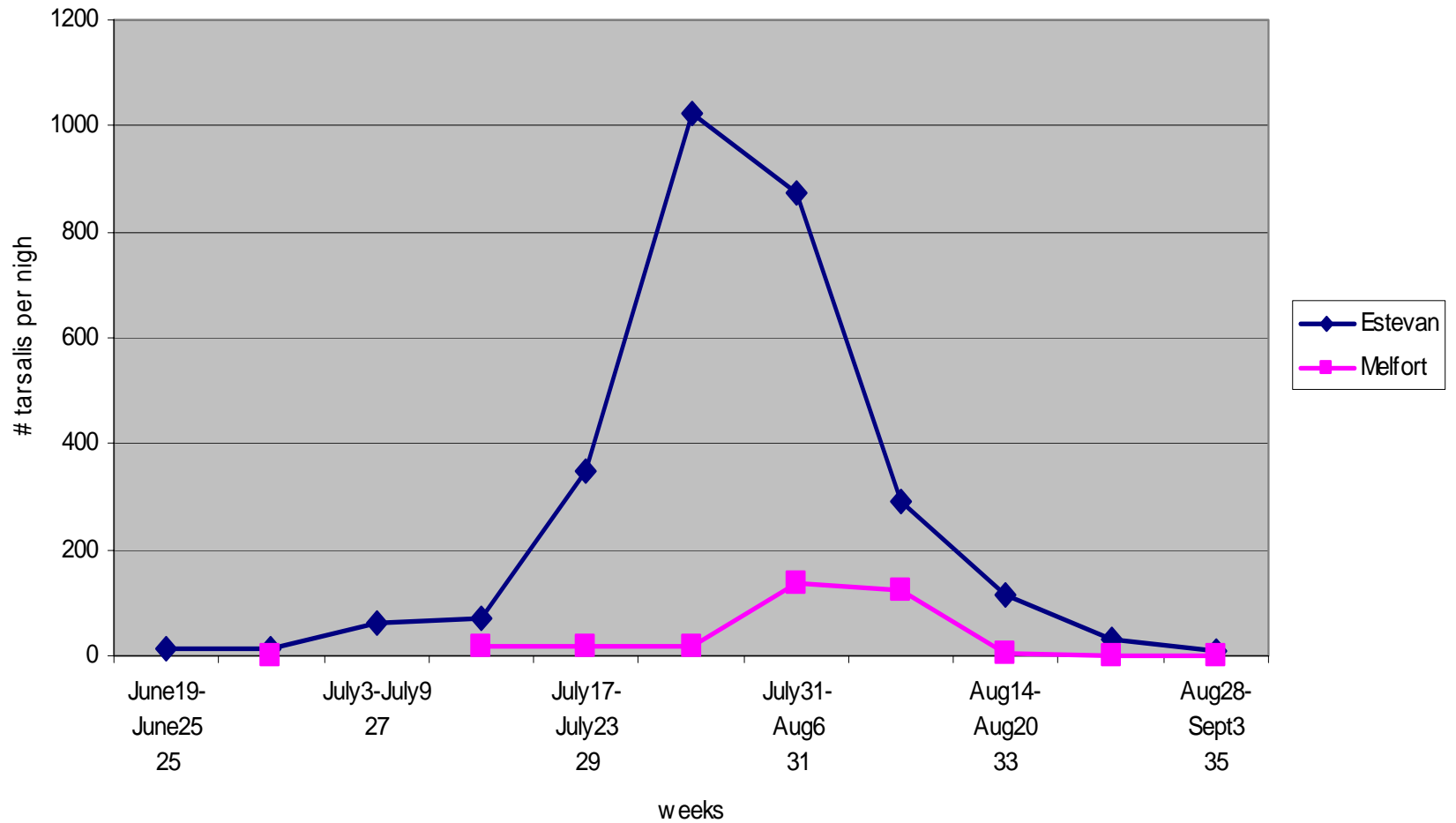
## Risk index comparison 2003, 2004 and 2005 for Manitoba



### WNV human cases vs mosquito risk index 2003/2004/2005 comparison by CDC week

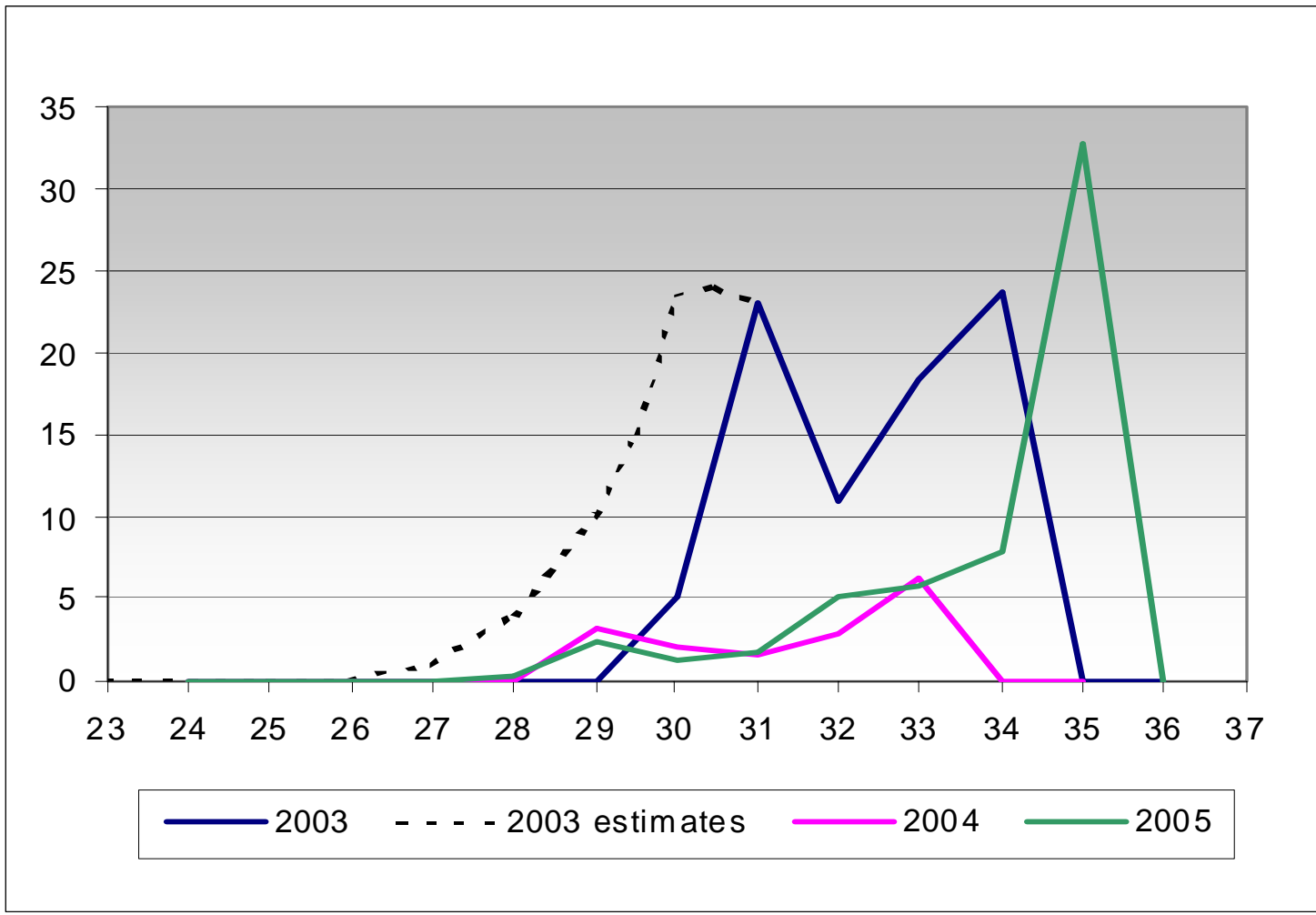


## Saskatchewan WNV Surveillance, comparison of two trap sites: Estevan and Melfort, number of *Culex tarsalis* caught per night in a CDC trap.



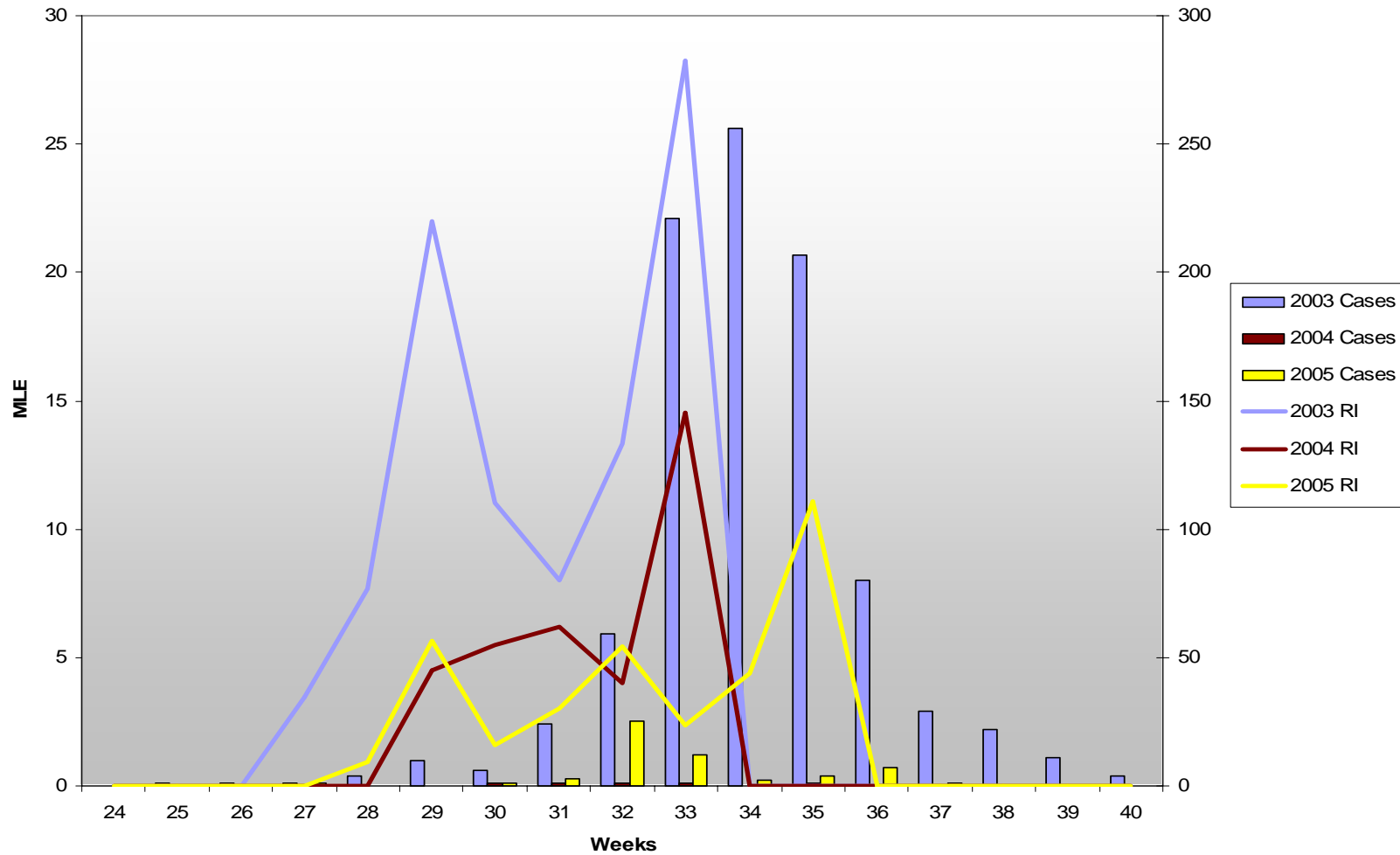
# MLE Comparison 2003-05 - Saskatchewan

## Province wide MLEs

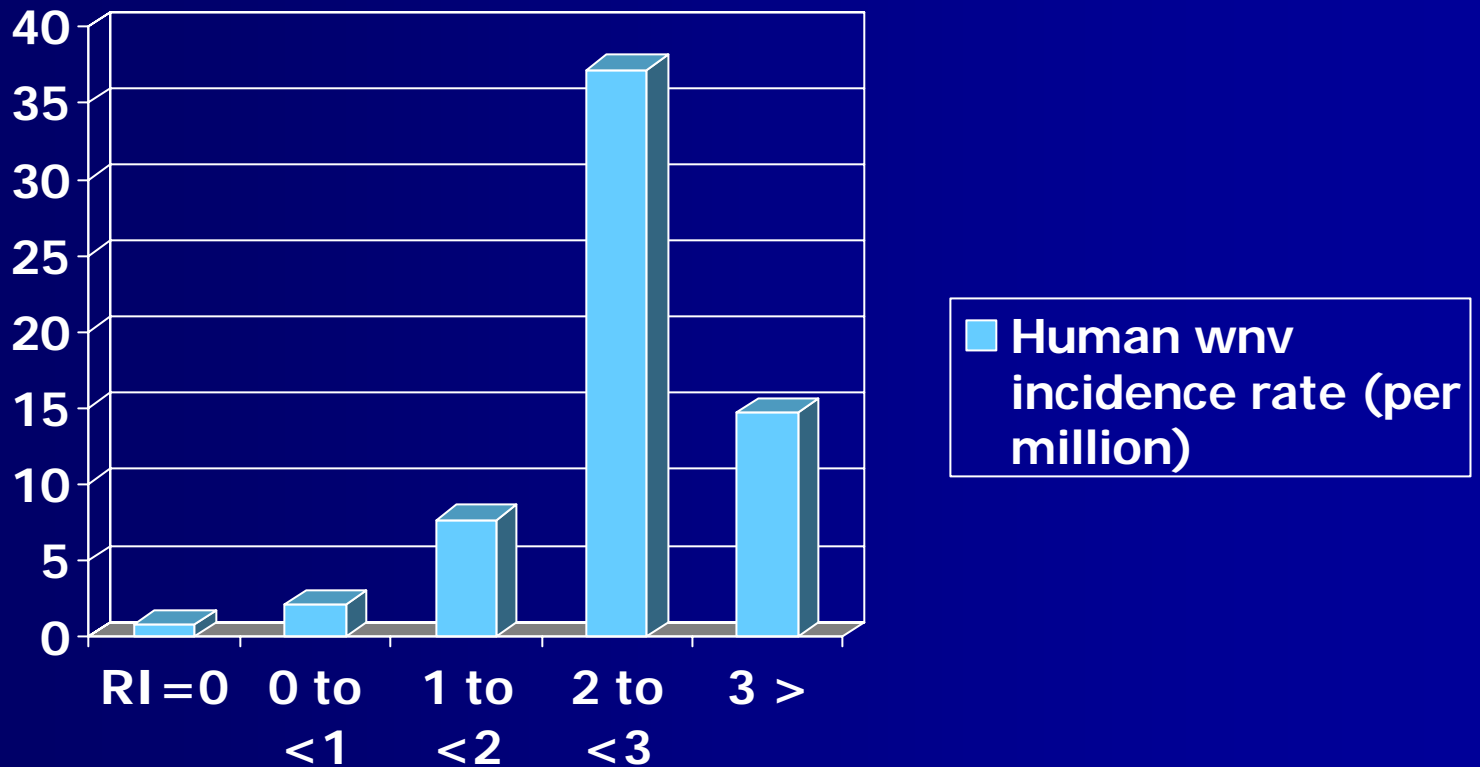


# Risk Index Comparison 2003-05 - Saskatchewan

2203-2005 cases and risk index (estimates 2003)



# Manitoba Rural WNV Human Incidence Rate (per million N=28) vs. Risk Index



# Parameters for Decision- Making in 2005

# Considerations for Adult Mosquito Control

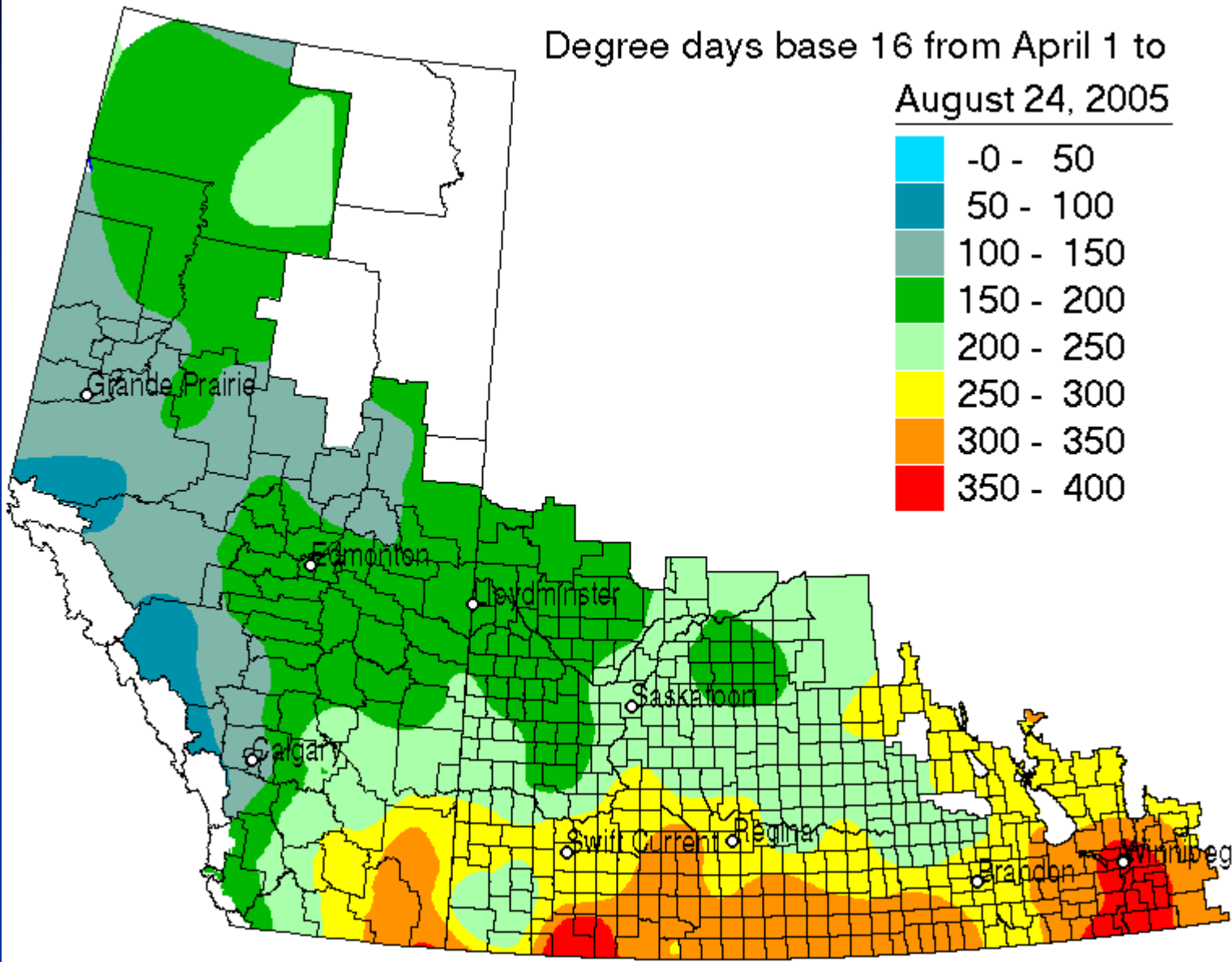
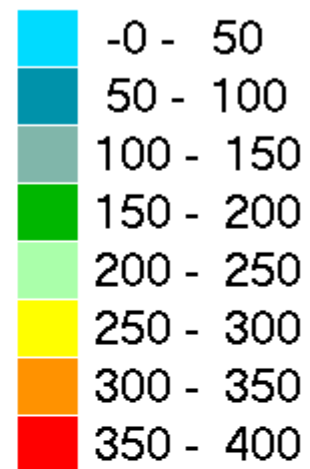
- Determination of the health risk posed by WNV in the province is based on:
  - risk index \*
  - *Culex tarsalis* generation & age
  - human population at risk
  - time of year
  - past and predicted weather conditions

\* A risk index value of 1.00 or higher does not necessarily trigger an adulticiding operation. However, when the risk index reaches this level other relevant ecological and physical data should be examined closely

# Situation in Manitoba in Early July 2005

- Large numbers of *Culex tarsalis* present
- 2nd generation *Culex tarsalis* were emerging – likely live for at least 3 weeks
- Multiple positive mosquito pools
- Manitoba was experiencing hot, humid conditions in early July
- Weather conditions had been optimal for mosquito development (larval) and adult activity
- Evidence of amplification of the virus in birds in Winnipeg
- Large human populations at risk

Degree days base 16 from April 1 to August 24, 2005



# Threshold for Action

- A 50% or greater probability of preventing one serious human case of WNV in a community, based on an estimation of the effective weeks of adult mosquito control, (due to time of year and biology of mosquito life cycle) assuming 50% effectiveness in reducing mosquito numbers.

## Example of using risk index reduction to guide decision-making for adult mosquito control

- Risk index = 1.3; pre-spray WNNS rate = 1.3 cases per million person weeks at risk
- Assume 50% reduction in mosquito count for one week; post-spray risk index = 0.65; post-spray WNNS rate = 1.0 cases per million person weeks at risk
- Relative WNNS rate reduction =  $(1.3-1.0)/1.3 = 23\%$
- Absolute WNNS rate reduction =  $1.3 - 1.0 = 0.3$  cases pmwar

Pop 500,000

- Cases prevented by one week of control =  $.0000003 * 500,000 = .15$
- Number of weeks of control to prevent one case (“NNT”) =  $1 / .15 = 7$

Pop 50,000

- Cases prevented by one week of control =  $.0000003 * 50,000 = .015$
- Number of weeks of control to prevent one case (“NNT”) =  $1 / .015 = 70$

# Acknowledgements

## Manitoba Health

- Dr. Susan Roberecki
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## Saskatchewan Health

- Erin Laing
- Rob Anderson