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Impact of extreme weather events on the risk from West Nile virus in Illinois

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Mosquitoes as disease vectors

- *Culex spp.*:

- West Nile virus, St. Louis encephalitis virus, Filariasis

- *Aedes spp.*:

- Dengue, Yellow fever, Chikungunya, Zika virus

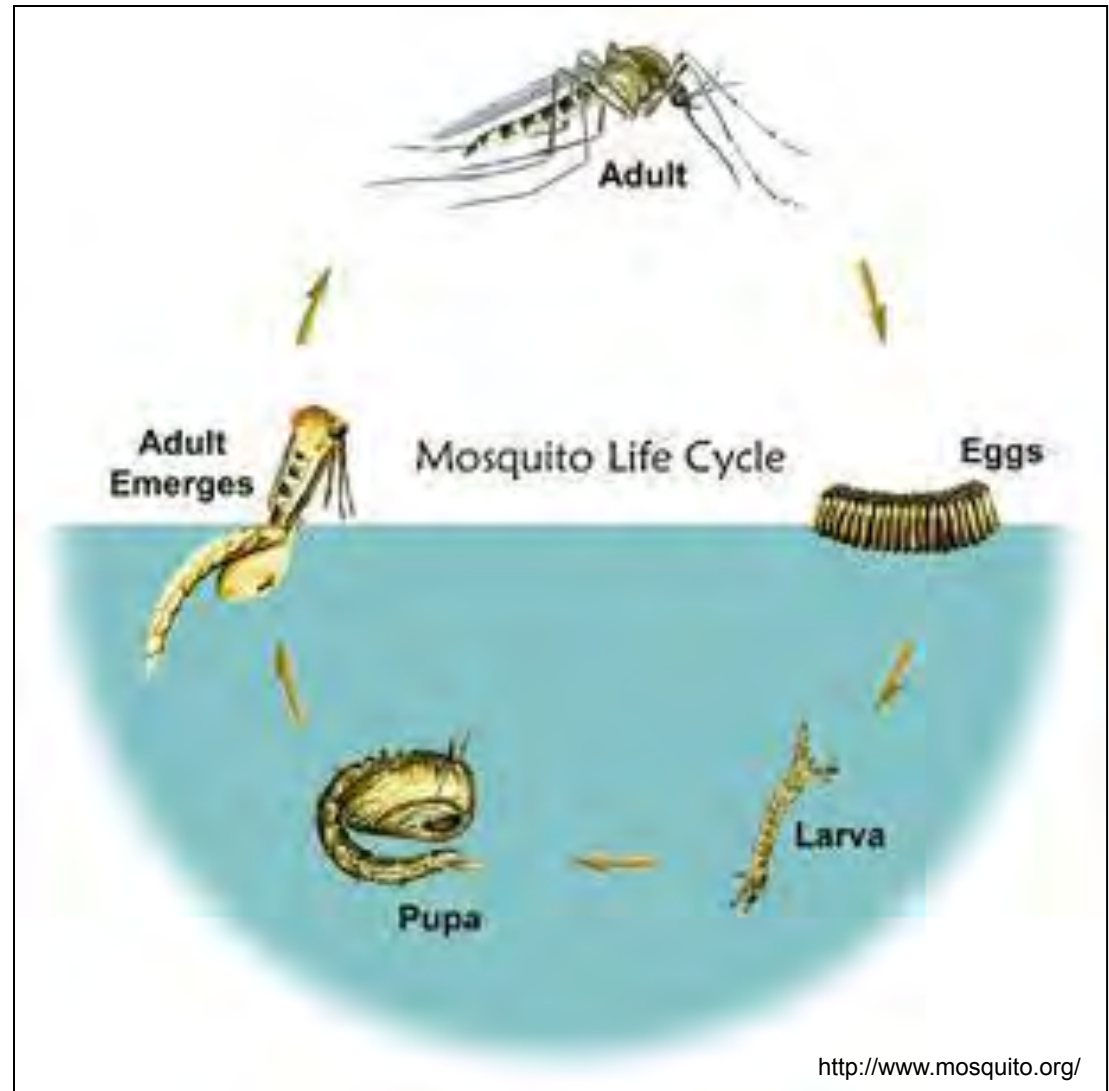
- *Anopheles spp.*:

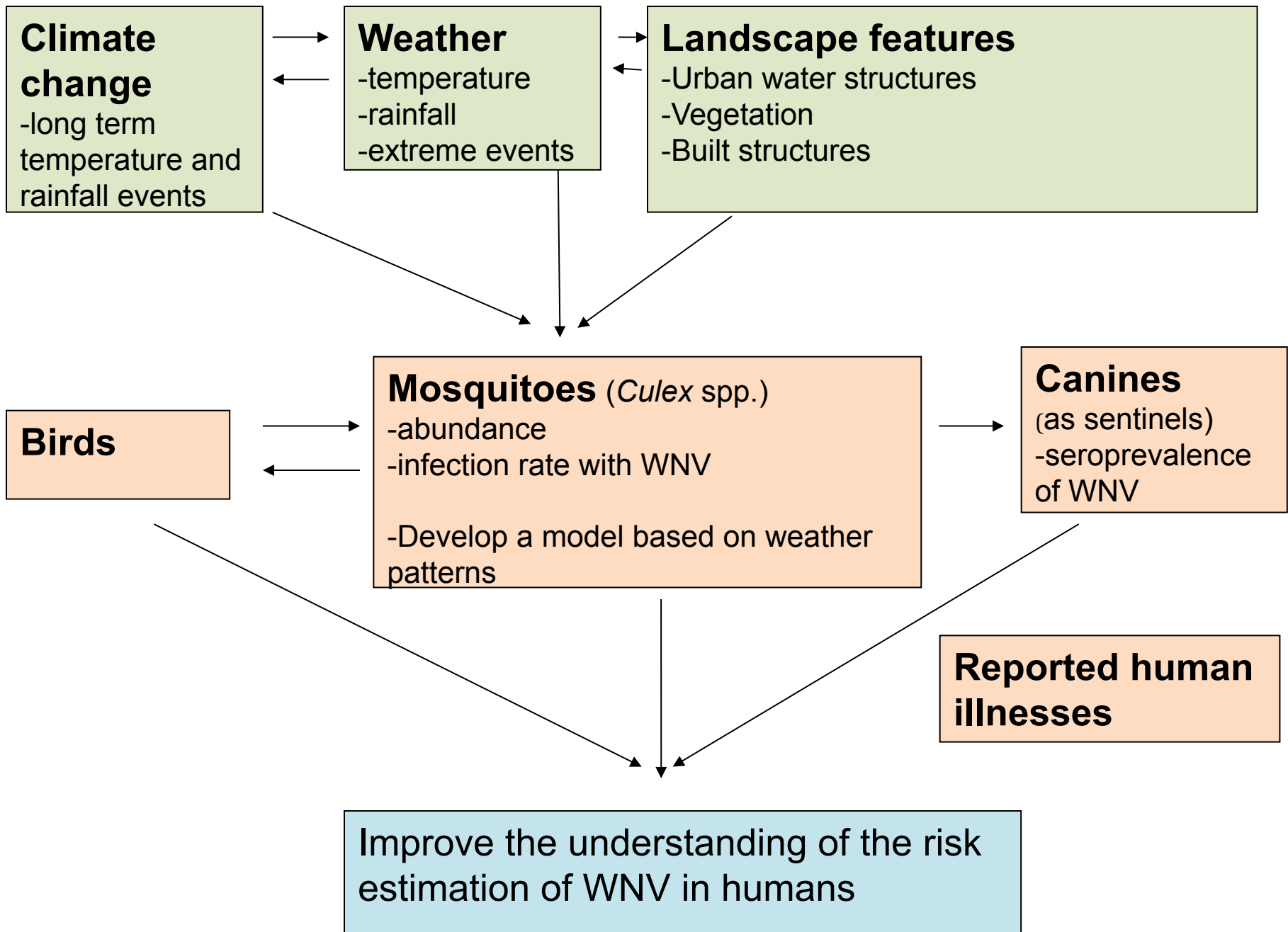
- Malaria



Mosquito lifecycle

- Four stages: Eggs, Larvae, Pupae and adult
- First 3 stages aquatic, adult terrestrial
- Temperature and rainfall affects mosquito lifecycle





Specific research objectives relative to climate change

1. What was the magnitude and timing of weekly or daily rainfall events in northeastern Illinois over the past 10 years during peak mosquito season?
2. How and when do large rainfall events affect the adult mosquito population?
3. How do average weekly temperature and rainfall affect mosquito **abundance** based on historic data?

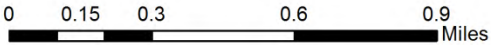
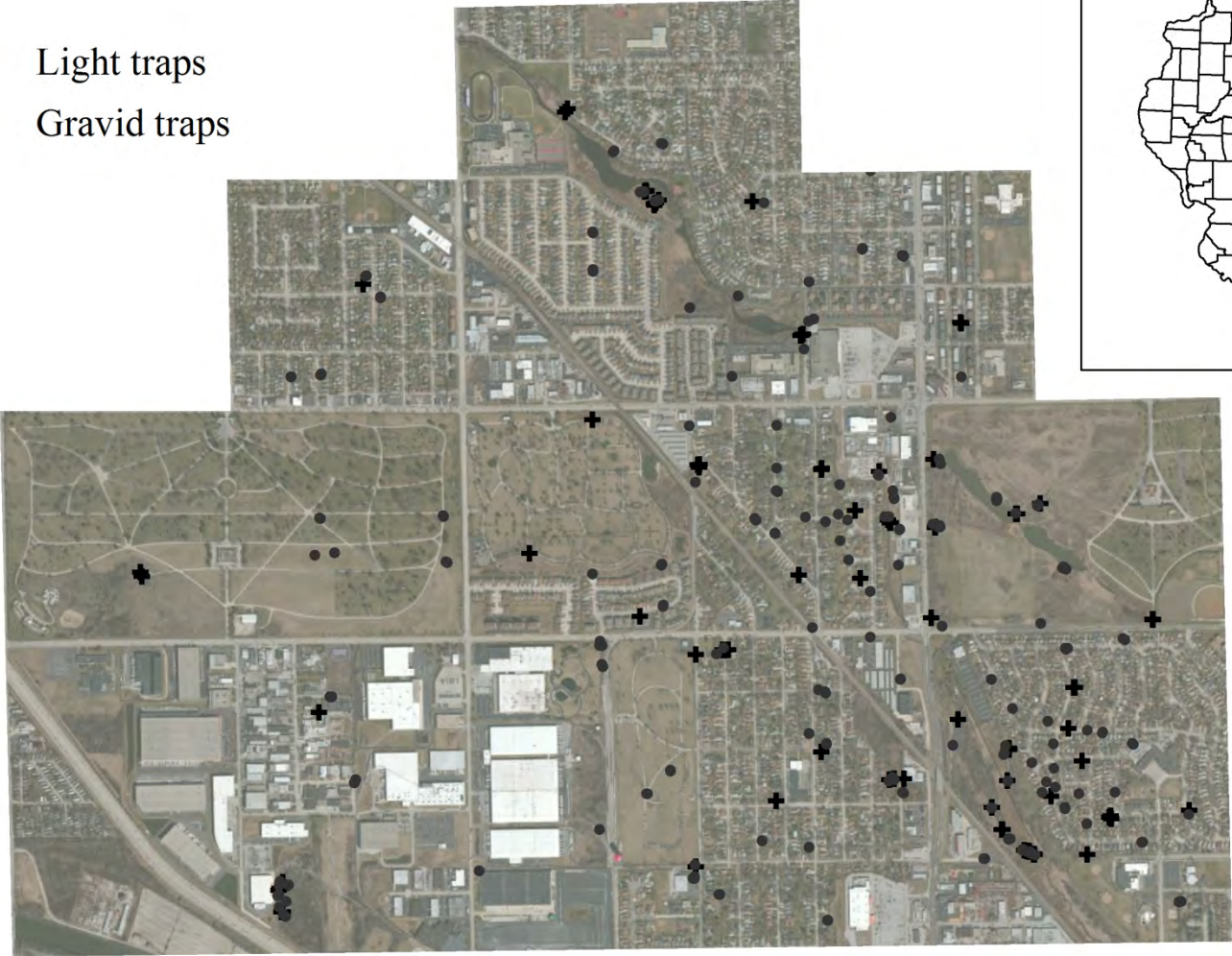
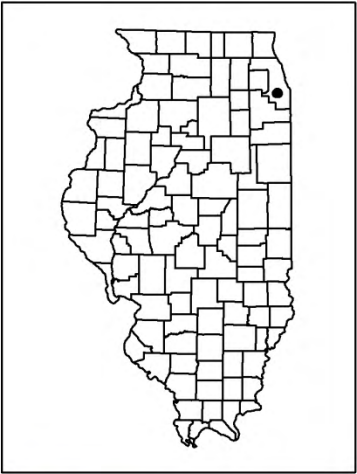
Approach

- **Mosquito data:** Abundance data collected over 2009 to 2012.
- **Weather data:** Obtained from nearby weather station (Midway airport).
- **Analyses**
 - Descriptive analysis of the NOAA weather patterns (from Chicago Midway).
 - Multivariable statistical analysis using mosquito abundance per trap night as the outcome variable and with weather variables as the predictor variables.
 - Akaike information criteria was used to select the best fit model.

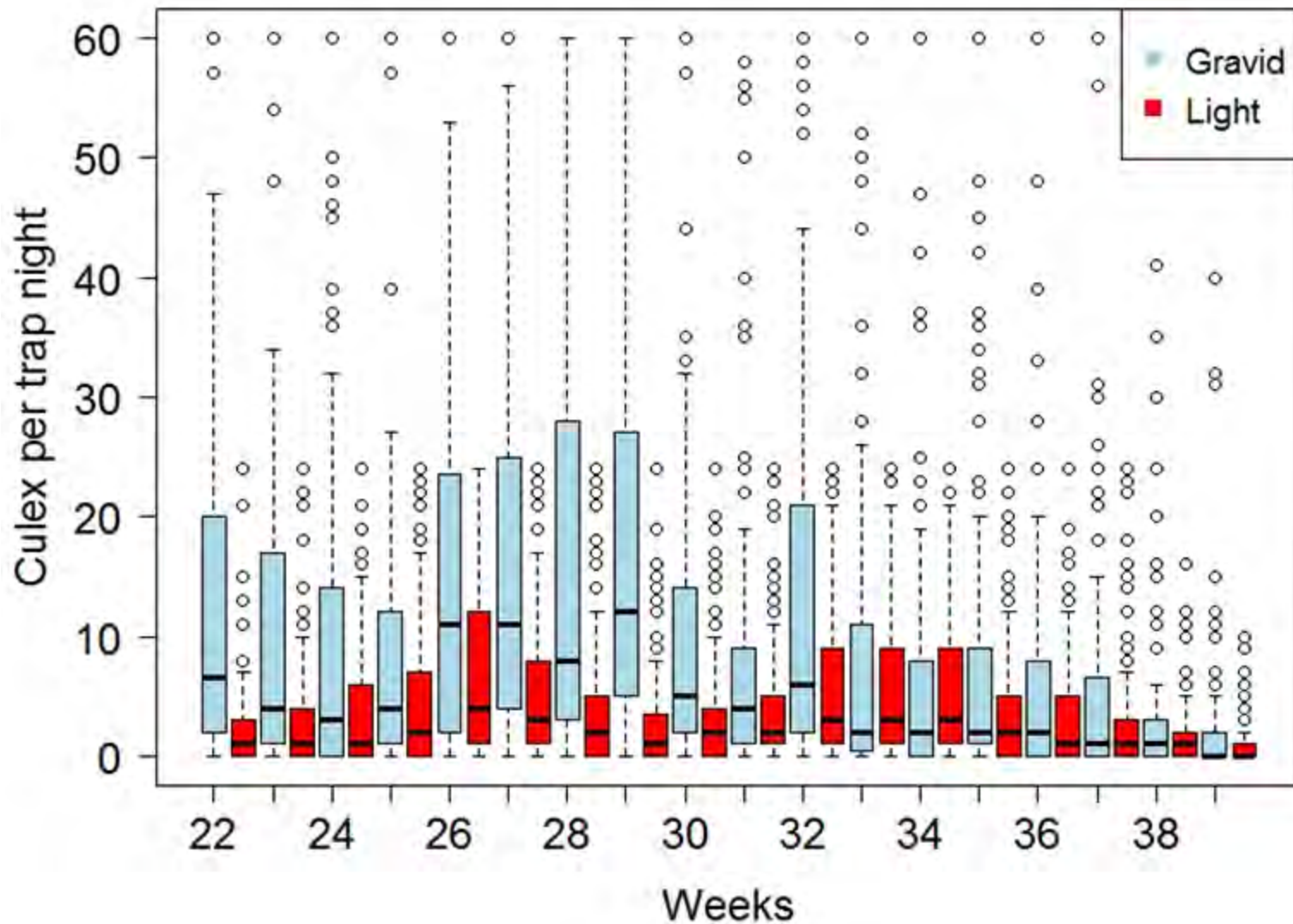
Study area: Oak Lawn / Alsip, Illinois



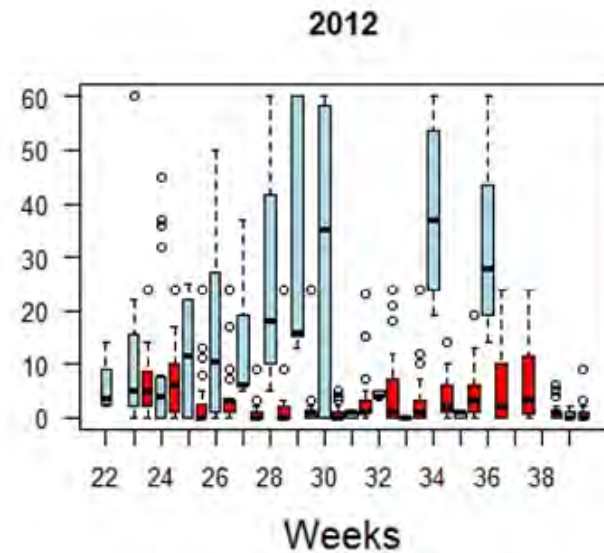
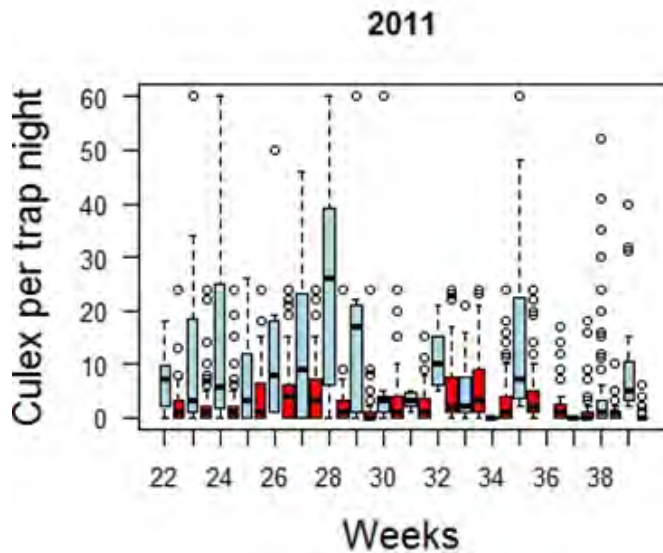
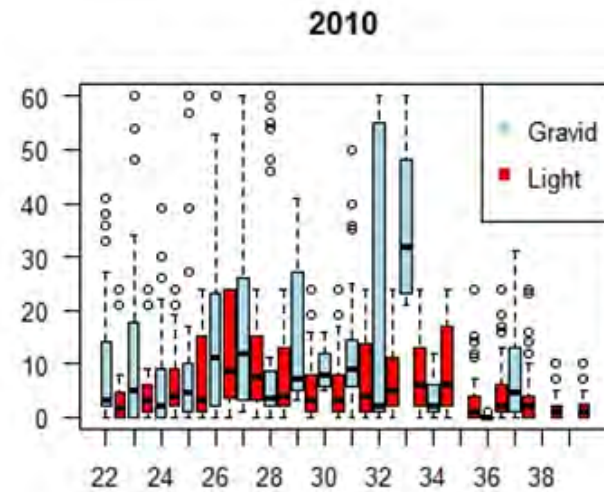
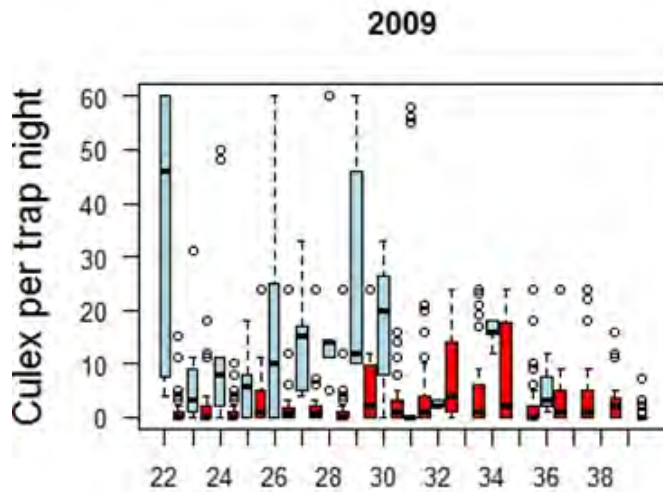
- Light traps
- + Gravid traps



Temporal (weeks combined) distribution of *Culex* mosquito abundance 2009- 2012



Temporal (annual weekly) distribution of *Culex* mosquito abundance 2009- 2012



Effect of average weekly weather variables on Weekly *Culex* abundance estimates

Culex abundance in light traps were associated with:

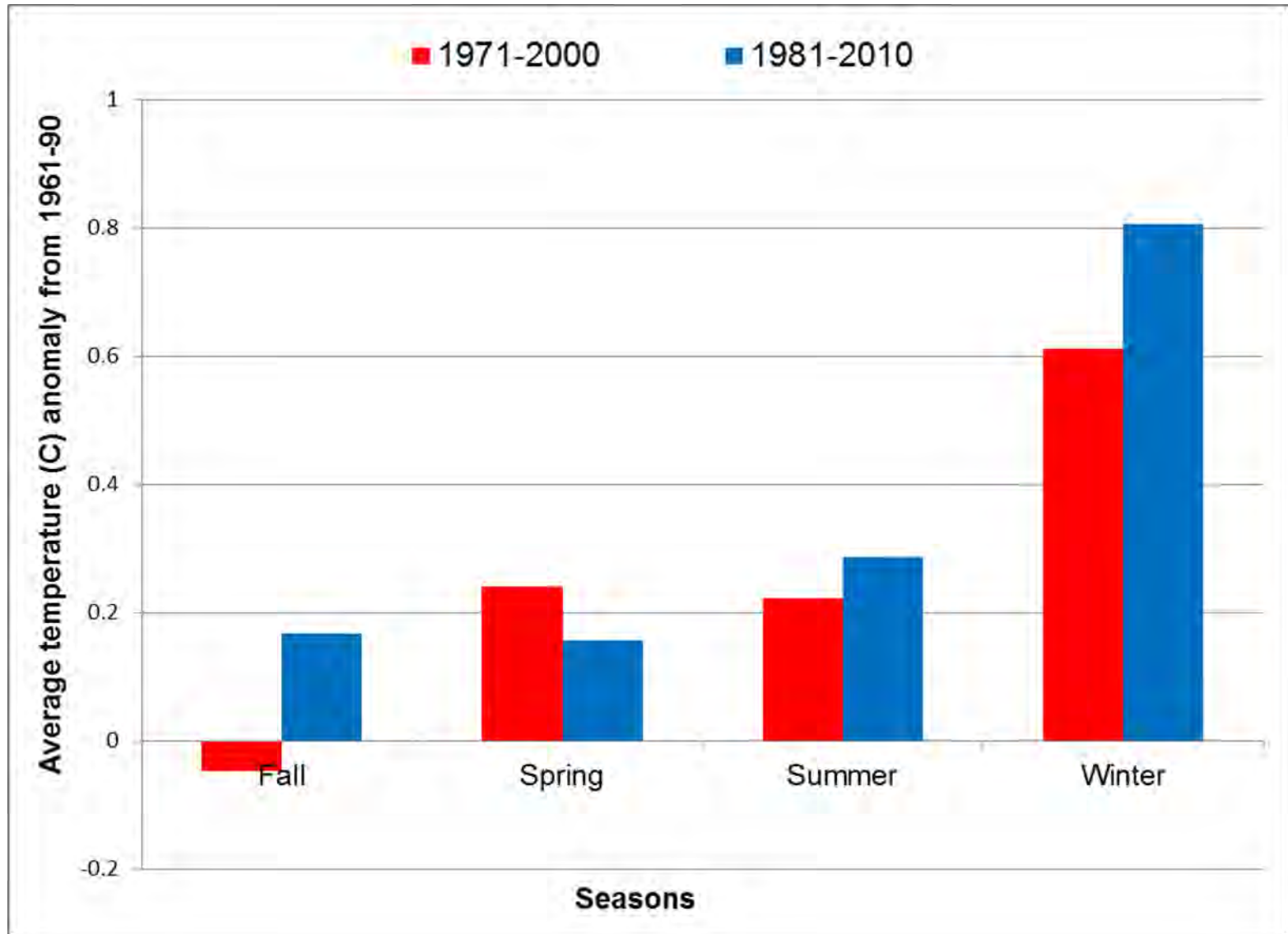
- Average weekly temperature of the same week (+)
- Precipitation one, two and four weeks earlier (+)
- Maximum average wind speed of the same week (-)

Culex abundance in gravid traps were associated with:

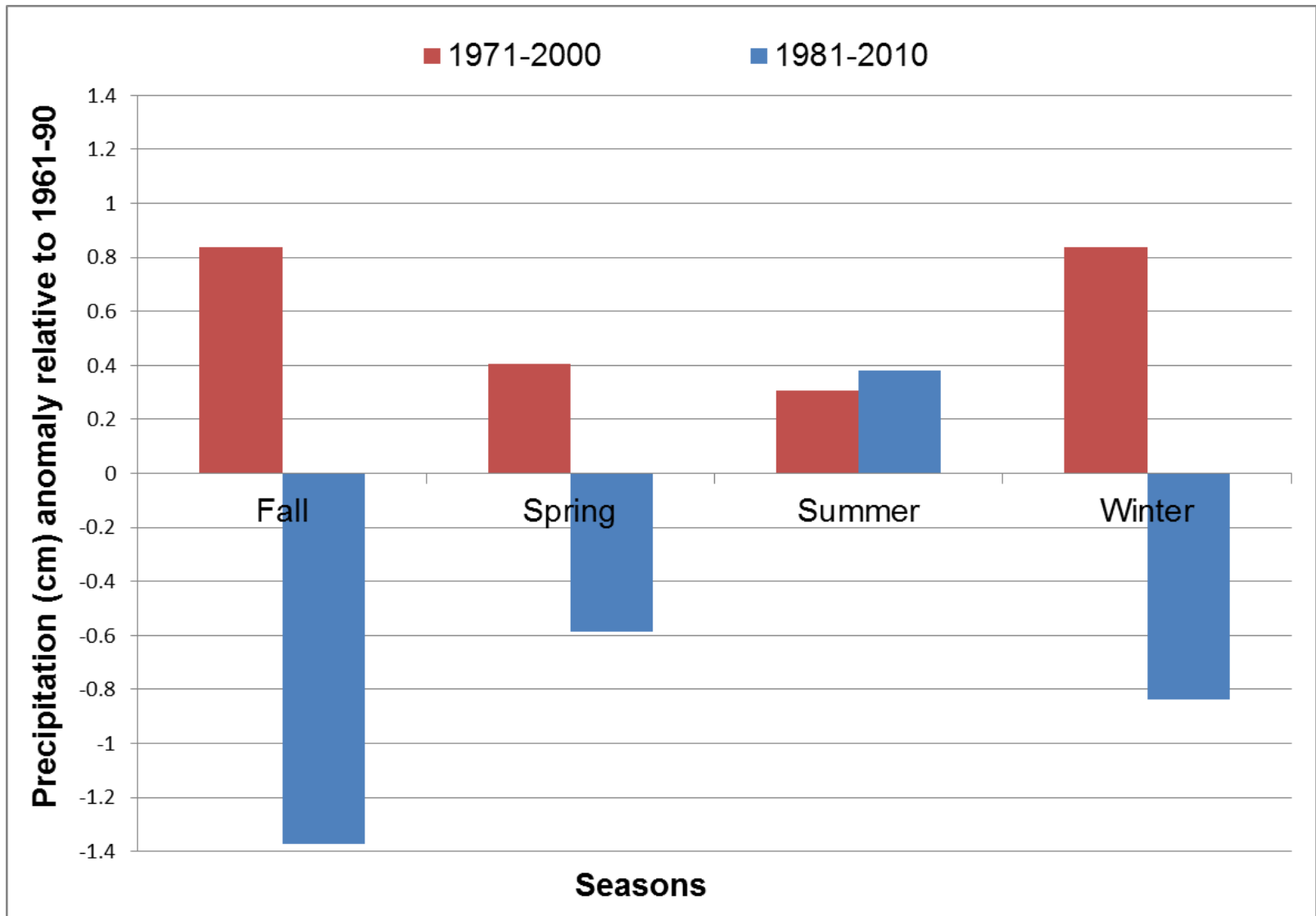
- Average weekly temperature of the same week (+)
- Average weekly temperature of four weeks before (-)
- Precipitation two and four weeks earlier (+)

Historical NOAA weather data analysis for Chicago Midway

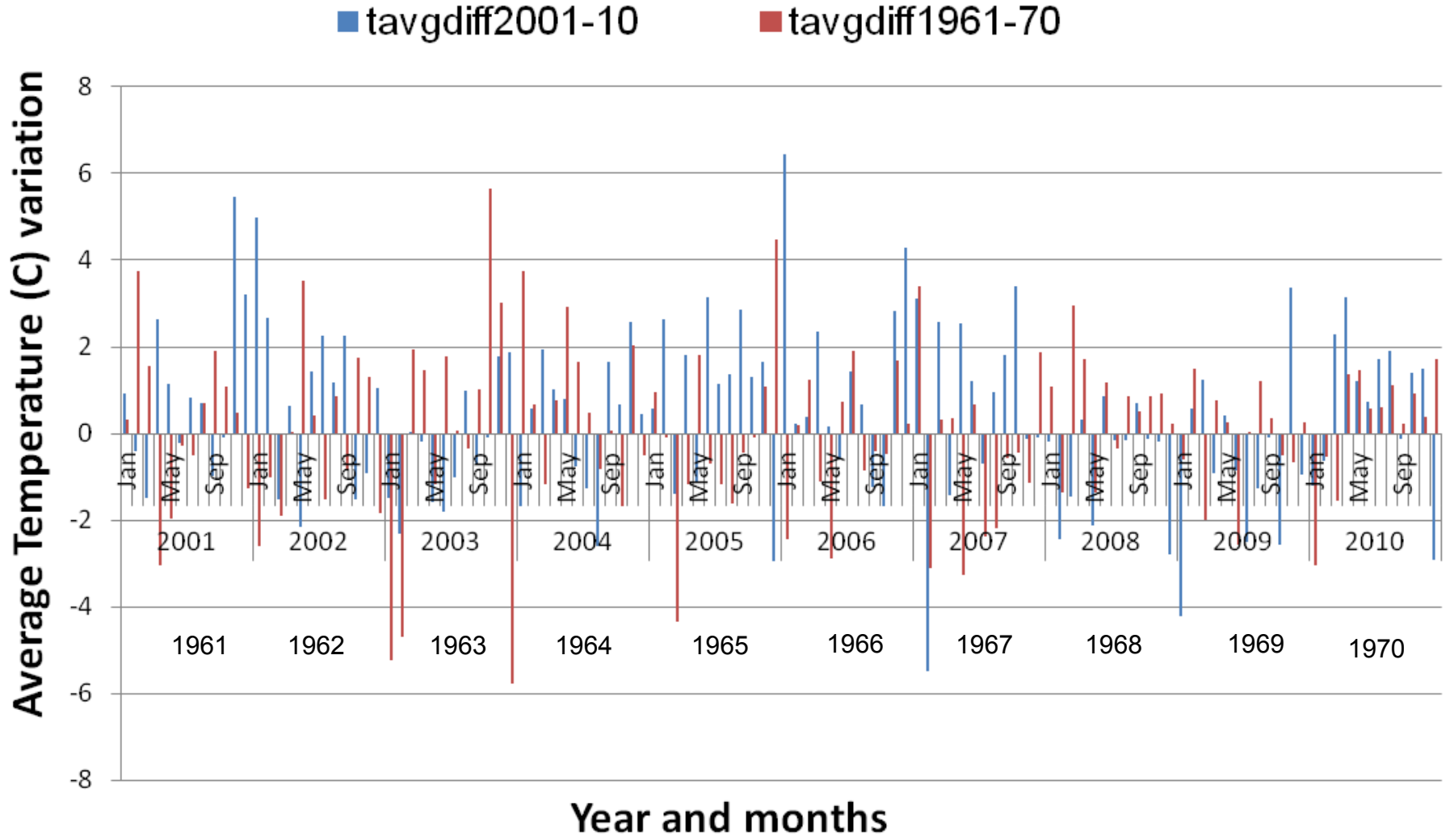
Seasonal average temperature anomaly relative to 1961-90



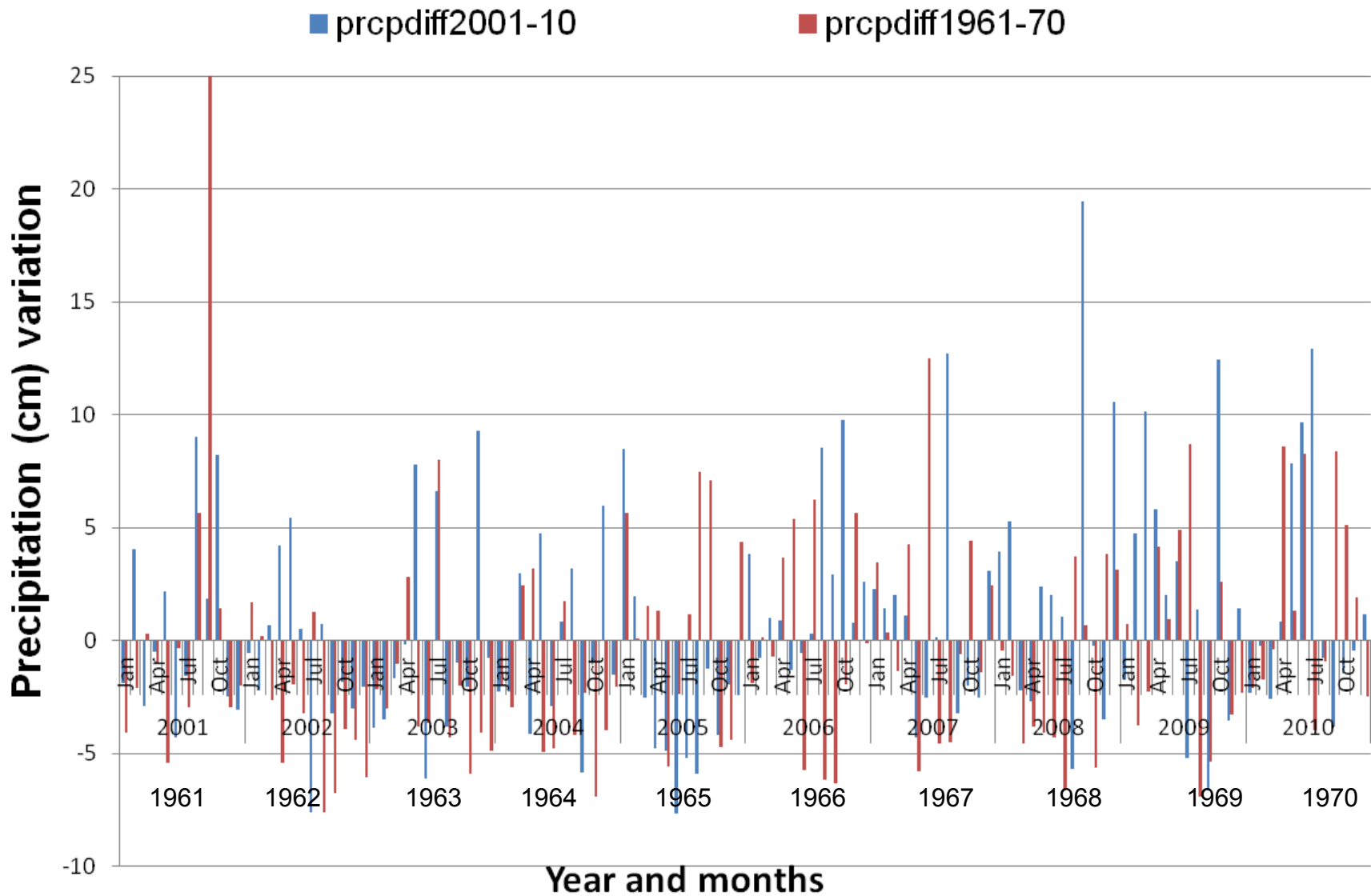
Seasonal precipitation anomaly relative to 1961-90



Annual average temperature anomaly relative to their 30-yr Normal

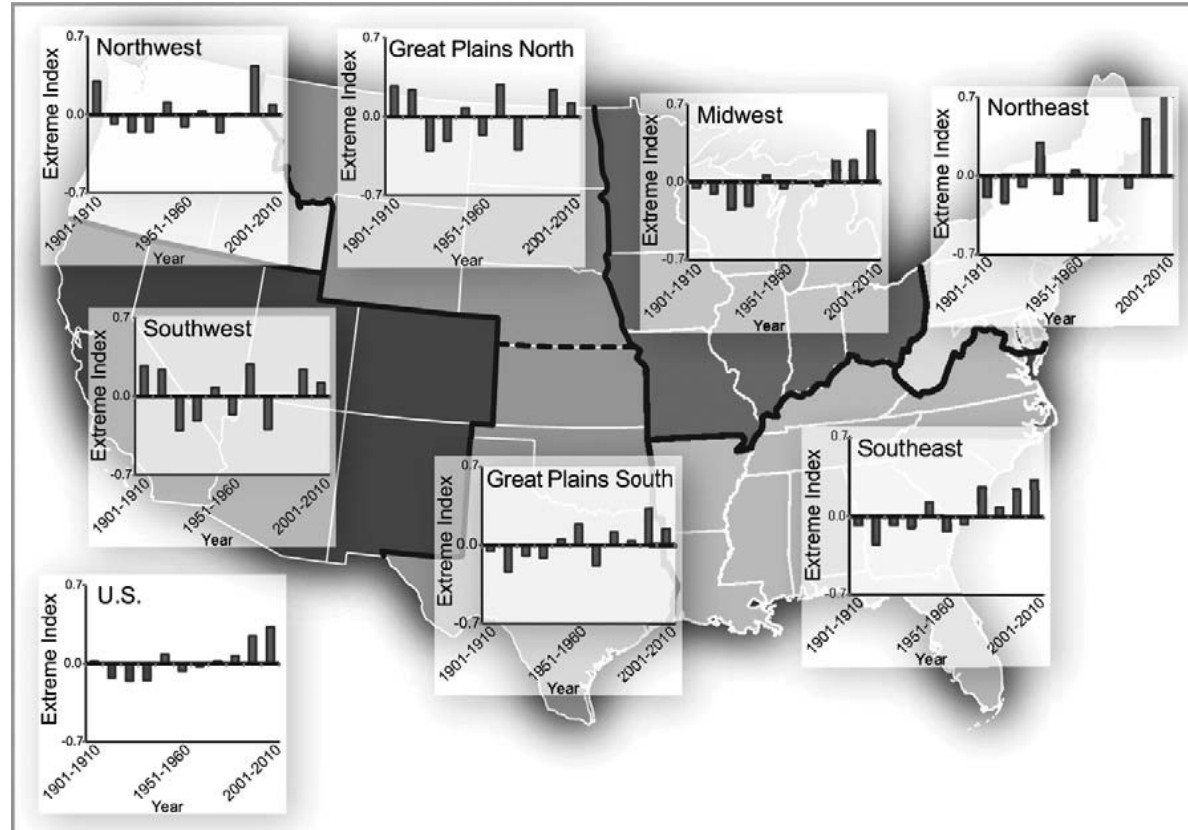


Annual total precipitation anomaly relative to their 30-yr Normal



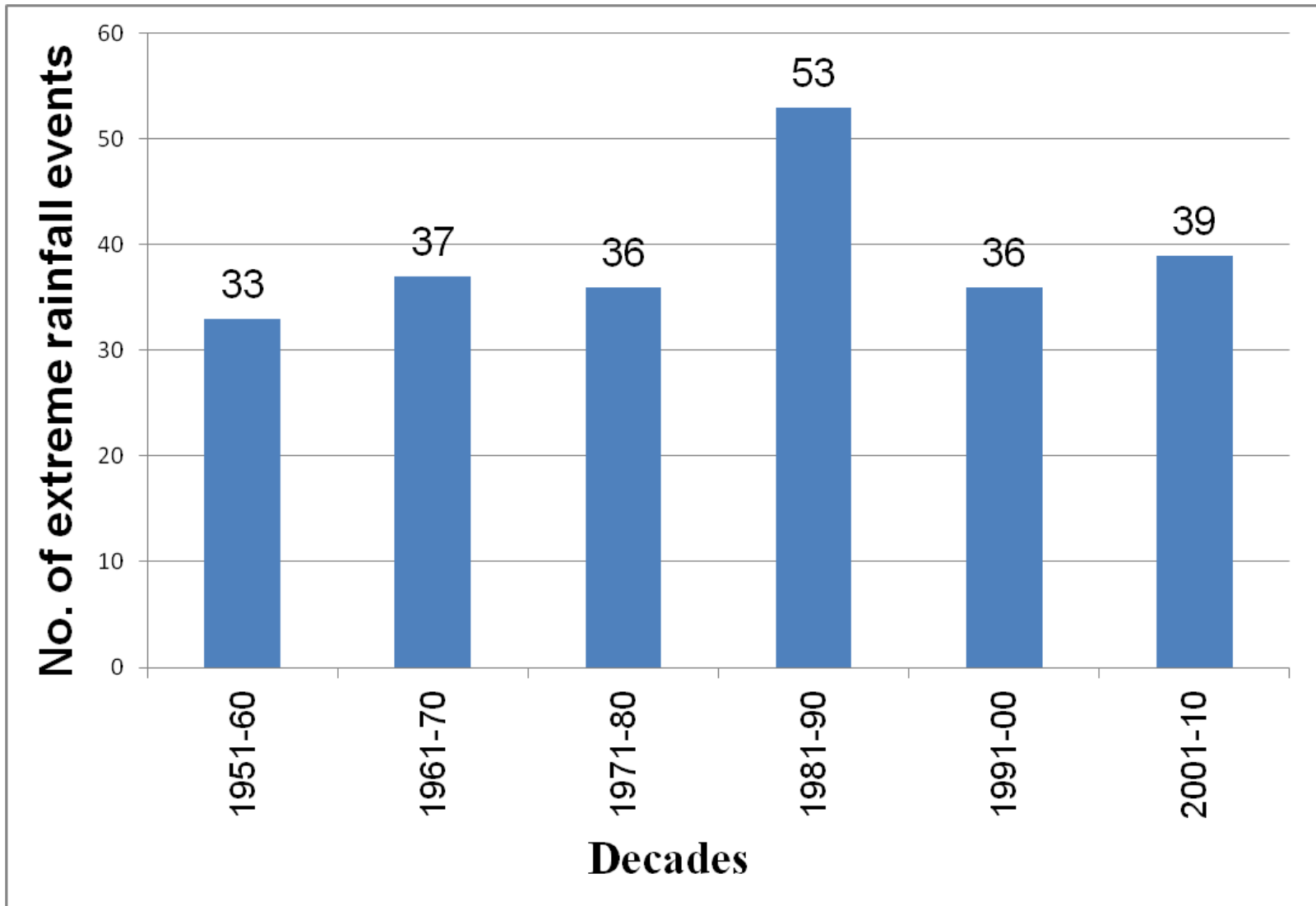
Extreme rainfall events

- **Extreme rainfall (High):** >3.5 cm in a single day (>99th percentile)
- **Low rainfall:** <1cm in a single day
- **No Rain**
- **Other:** other than above three conditions

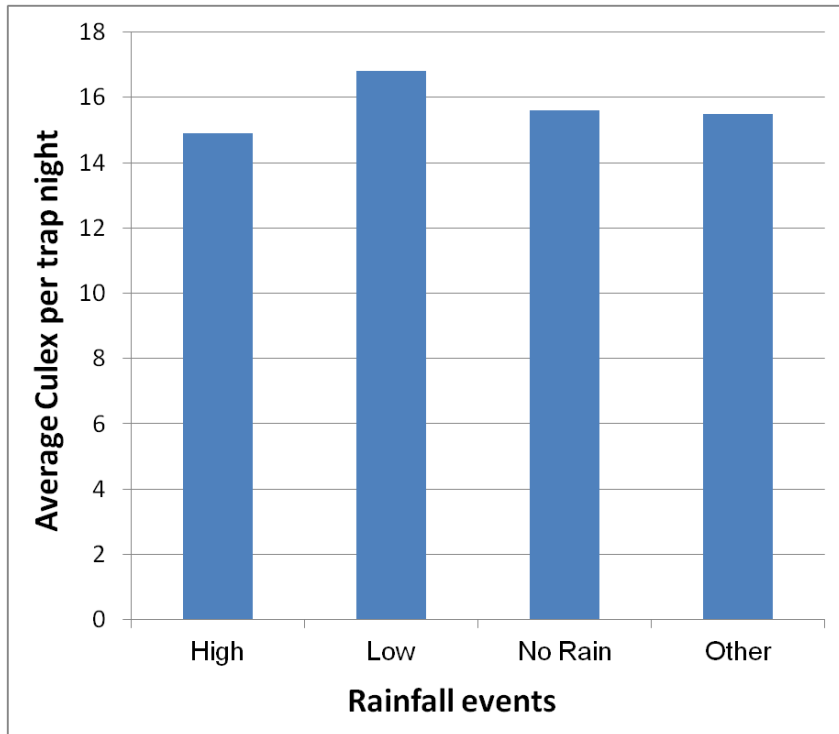


For Week: If any day within that week experienced an extreme event, that week is defined as extreme week. For all, all day within that week should have <1 cm rain

Extreme rainfall events (daily) in Midway

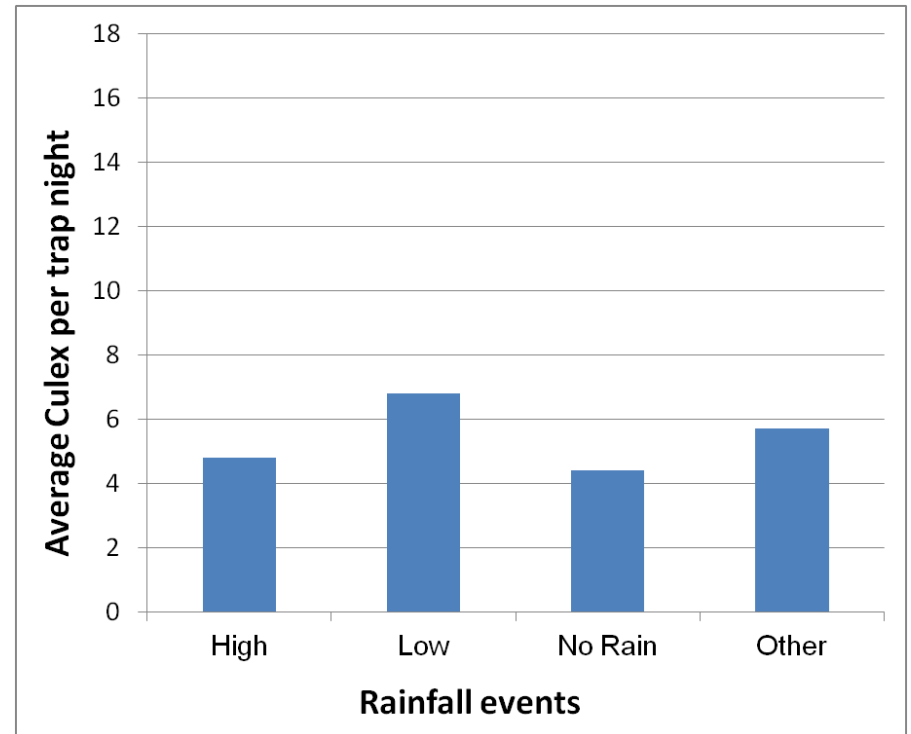


Extreme rainfall events and *Culex* abundance



Event	N	Mean	Std. de	Min	Max
High	6	14.9	6.5	8	25.5
Low	32	16.8	33.6	0.7	192.6
No Rain	5	15.6	10.9	4.7	29.7
Other	28	15.5	15.6	0.1	63.2

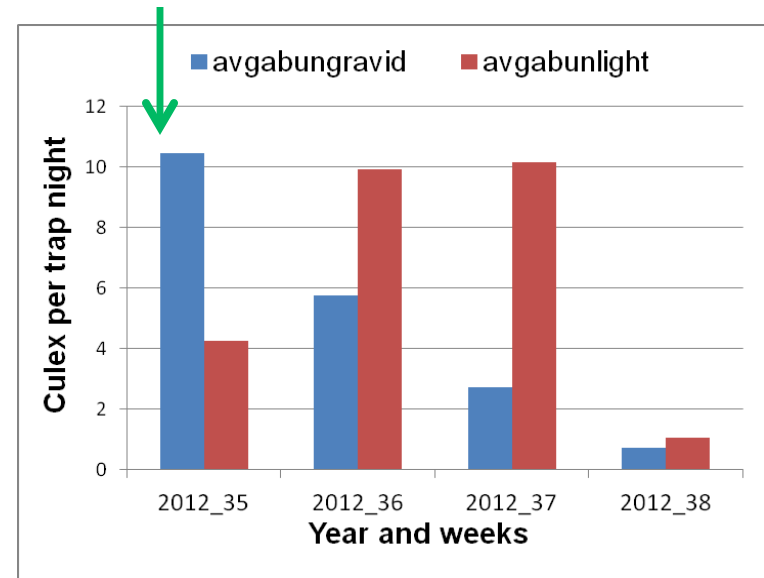
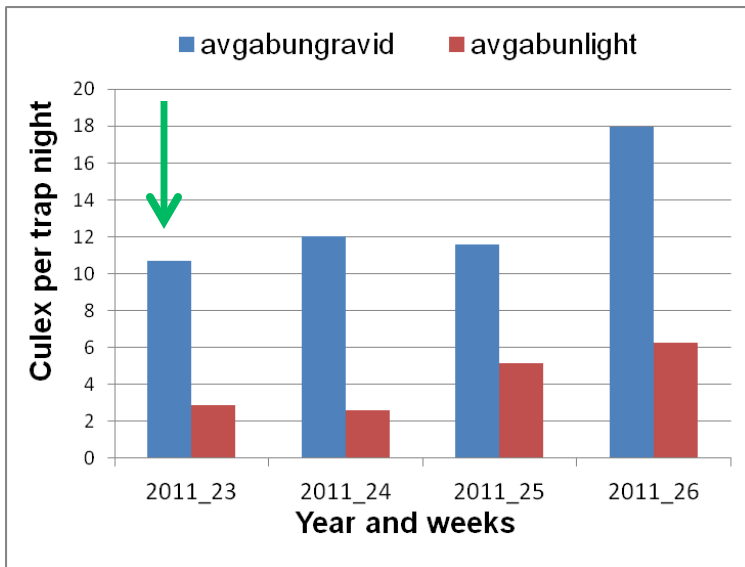
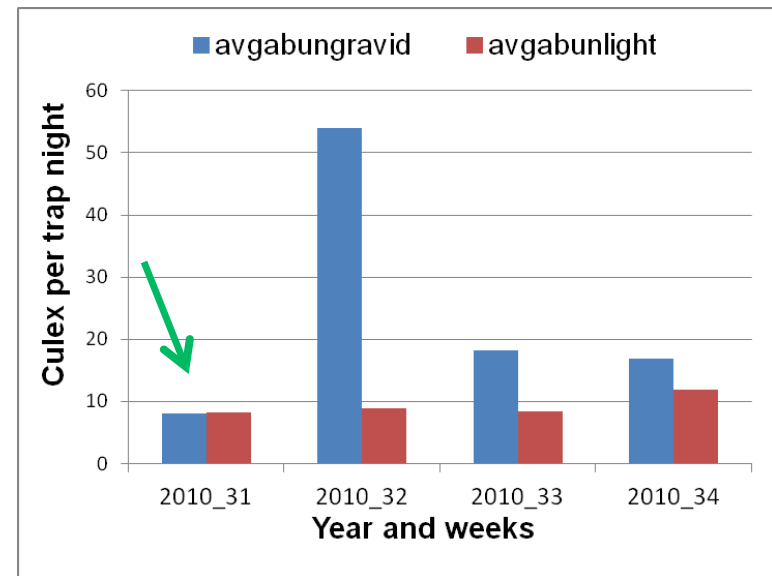
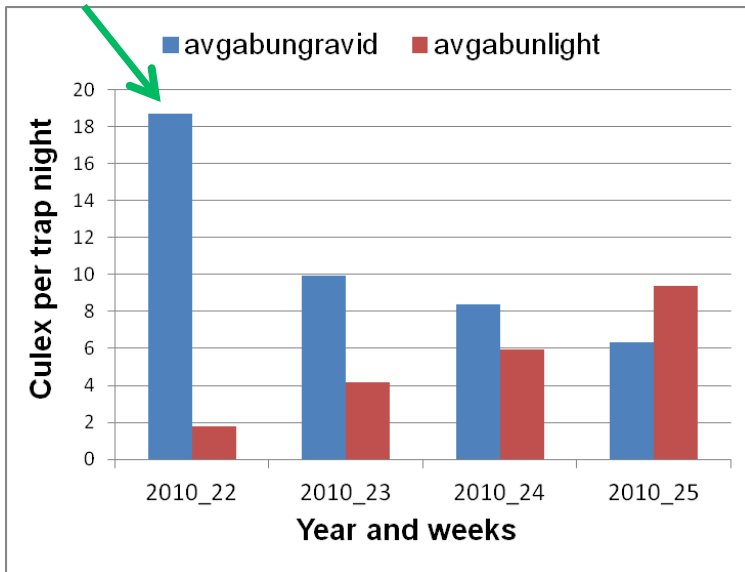
Gravid traps



Event	N	Mean	Std. de	Min	Max
High	6	4.8	2.3	1.8	8.1
Low	32	6.8	2.5	3.7	9.9
No Rain	5	4.4	3.3	0.8	13.1
Other	28	5.7	4.9	0.4	24.3

Light traps

Extreme rainfall events and *Culex* abundance following weeks



Conclusions

- Temperature and precipitation of the capture week and one to four weeks earlier played important roles in the temporal variation of *Culex* abundance in both light and gravid traps.
- Slightly lower number of *Culex* were captured on the week of extreme event.
- Temperature is going up; while precipitation is variable (summer precipitation going up) in Chicago area, which will influence the mosquito dynamics.

Acknowledgements

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THANK YOU