

# Temperature and Photoperiod Influences on BMSB phenology in North Carolina

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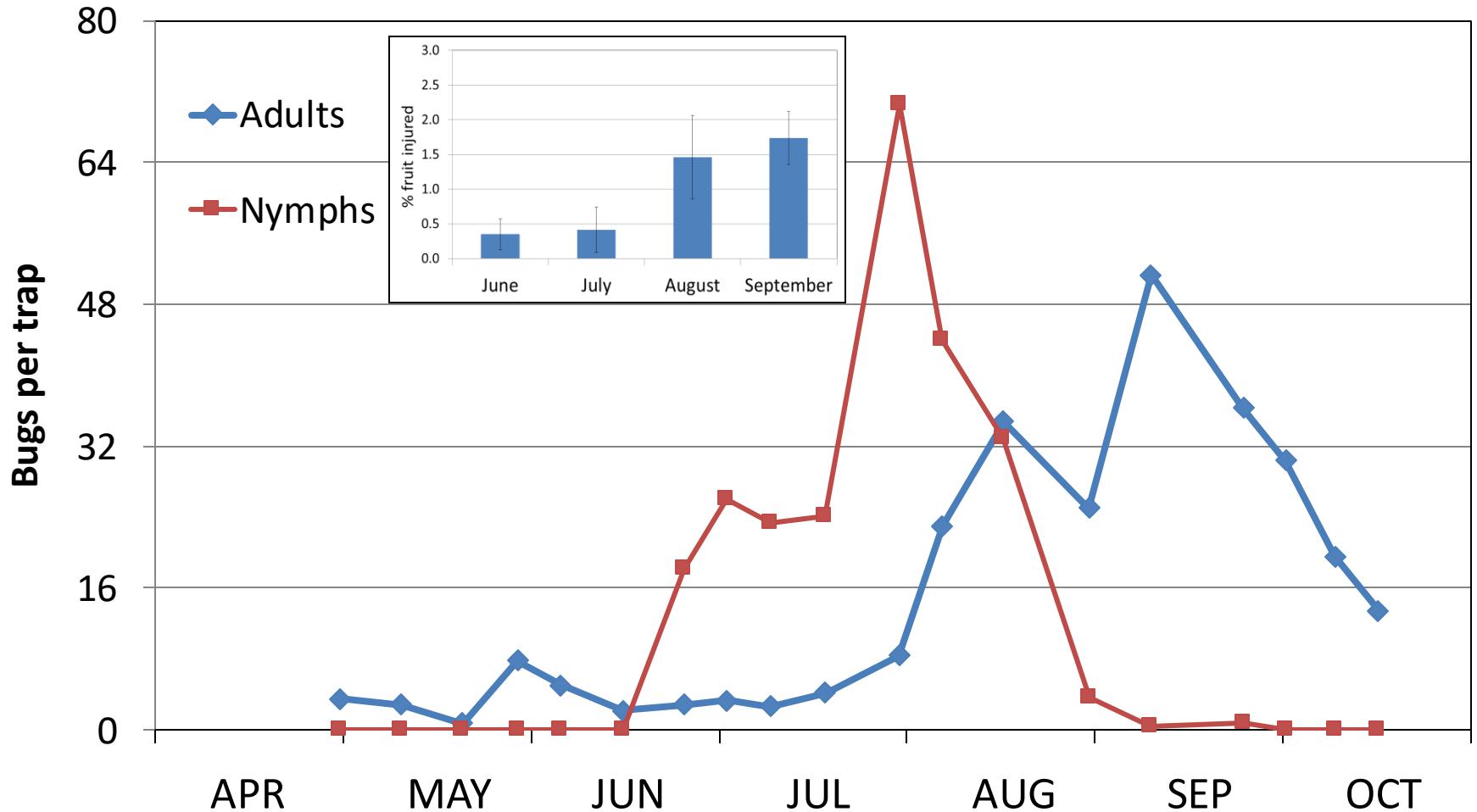
  

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# Reasons for Conducting Research

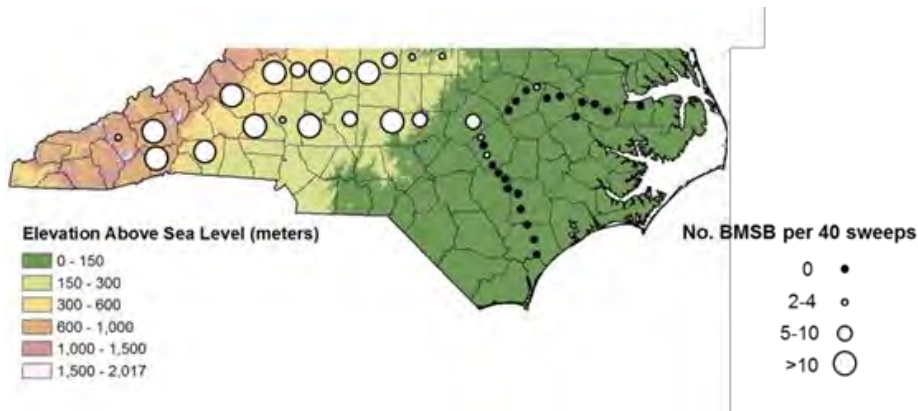
- Predict emergence of 1<sup>st</sup> generation adults
  - Most damaging to tree fruits
- Provide insight into population abundance differences between eastern and western NC
  - Well established in west
  - Difficulty establishing in east

# Pheromone Trap Captures Western North Carolina

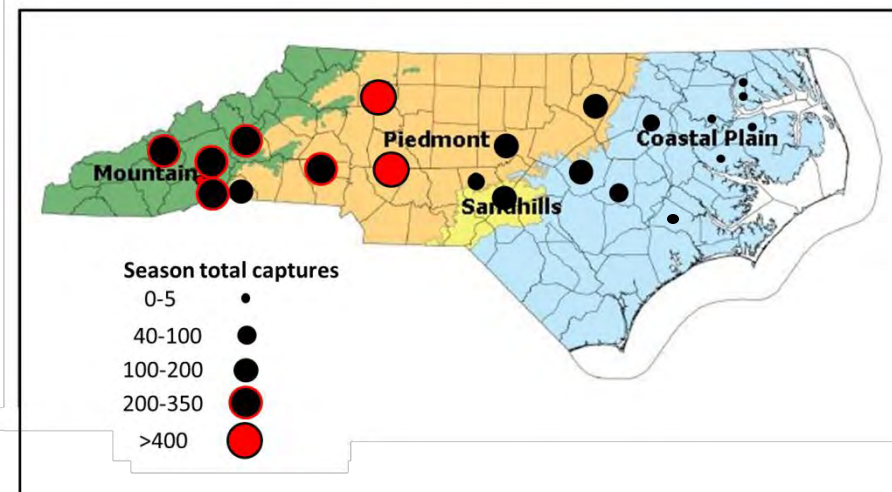


# BMSB Abundance Across NC/VA

2014



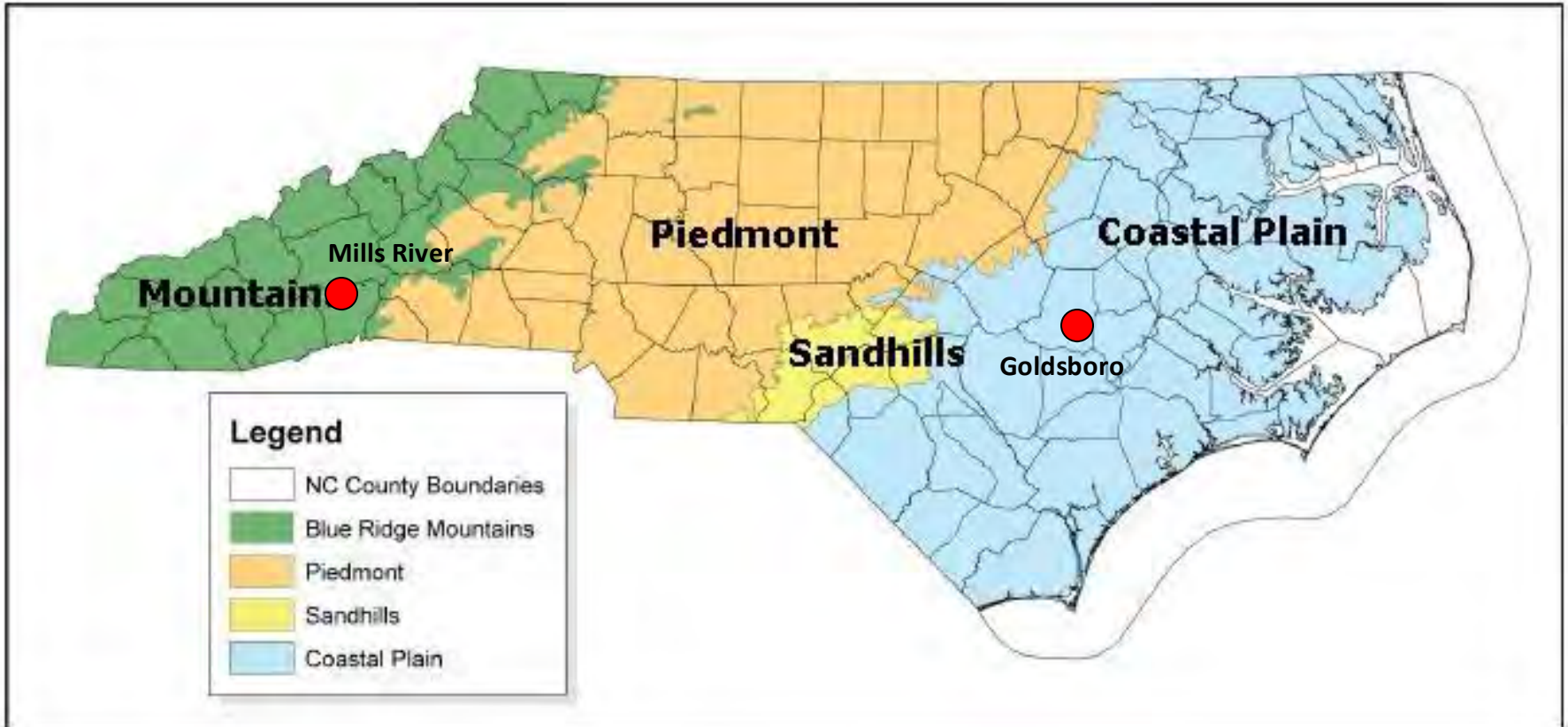
2019



# Partial Life Table Analysis

- Observed development of BMSB outdoors
  - Reproduction and development of successive generations beginning with overwintered adults
- Two locations
  - Mills River (Mountains)
  - Goldsboro (Coastal Plains)
- Two years
  - 2018 and 2019
  - January to December

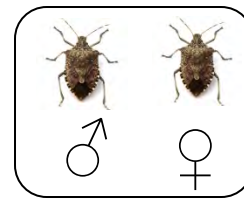
# North Carolina Ecoregions



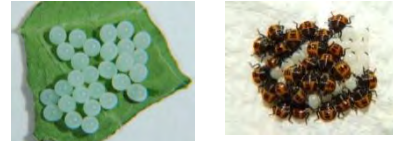
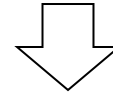


# Fall BMSB Collection and Preparing Overwintering Boxes

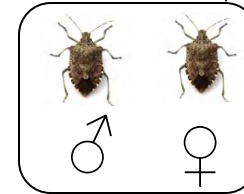




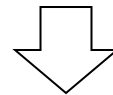
Overwintered  
Adults



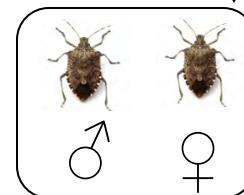
**f<sub>1</sub>** Eggs  
nymphs



**f<sub>1</sub>** Adults



**f<sub>2</sub>** Eggs  
nymphs



**f<sub>2</sub>** Adults

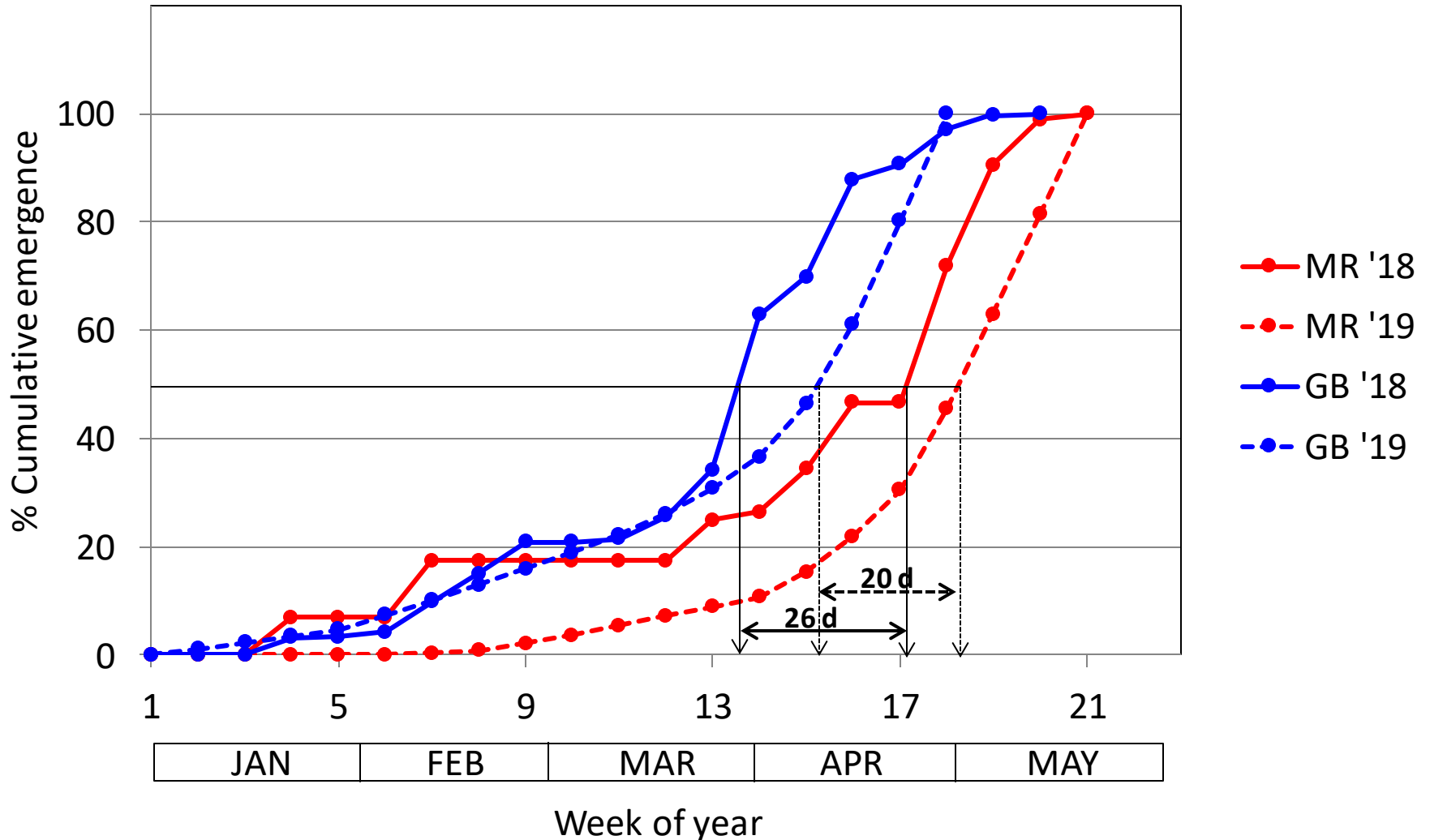




# Key Factors Affecting Phenology

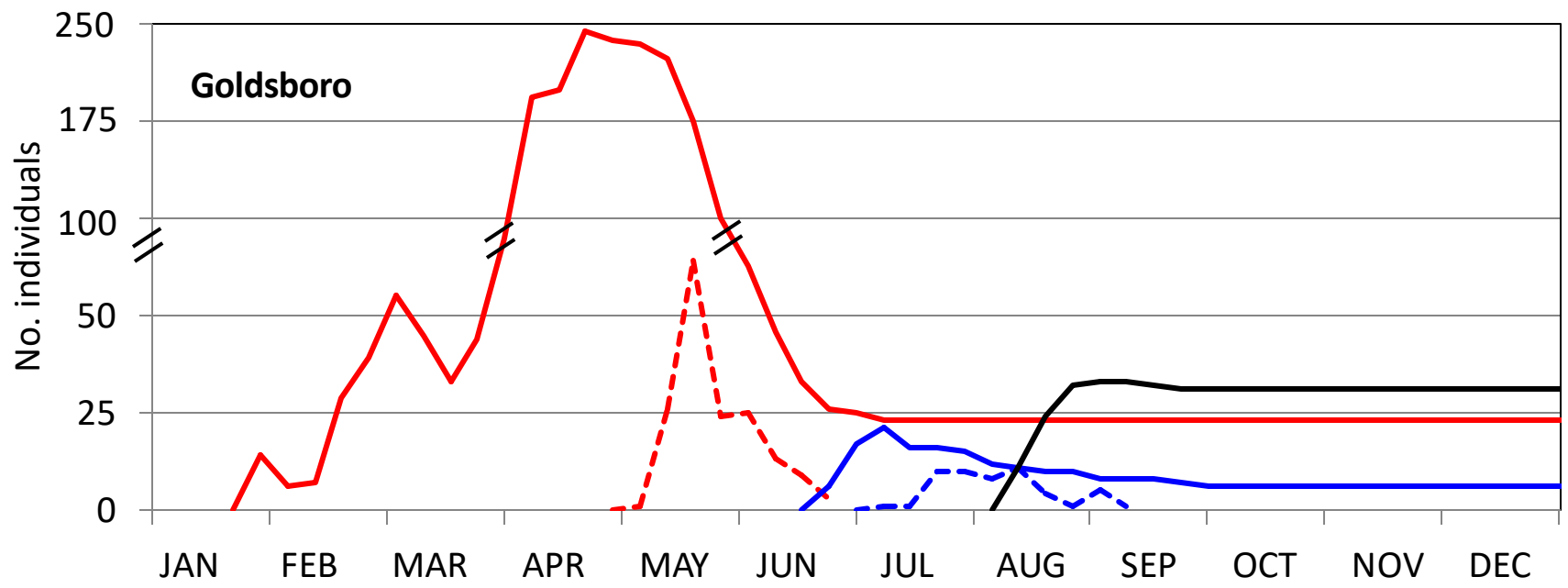
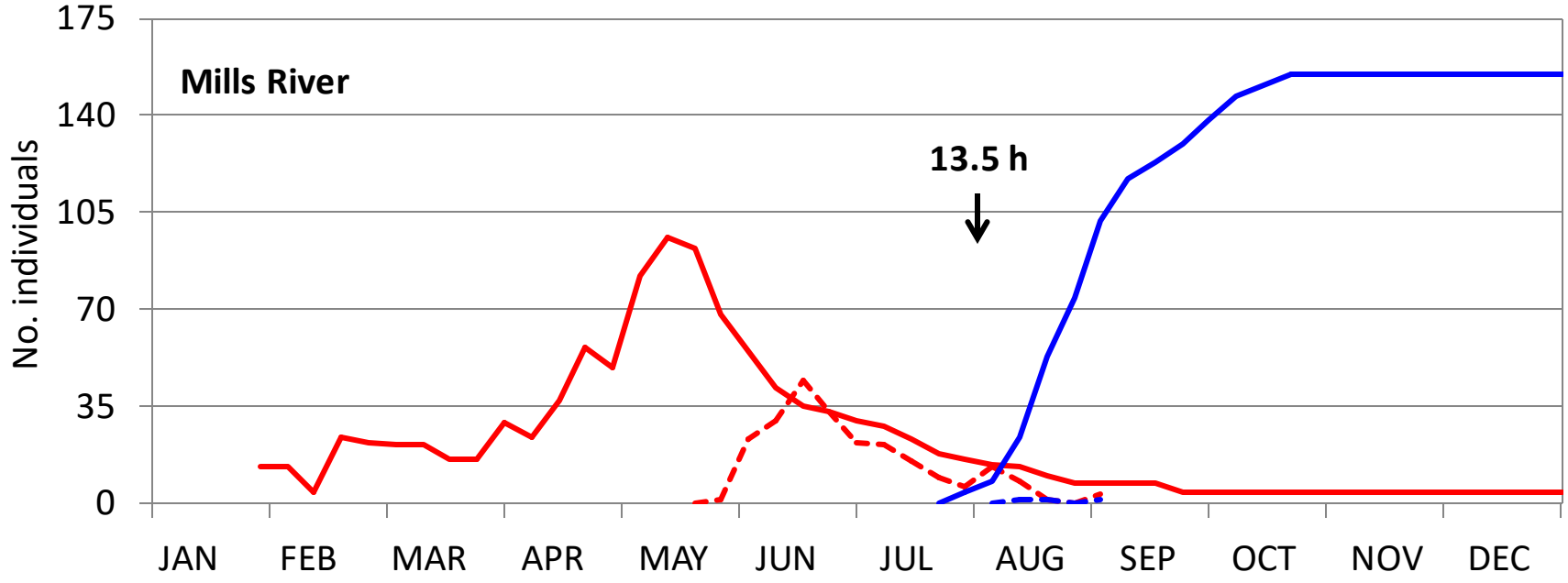
- Developmental rate (Nielsen et al. 2008)
  - 14.2 (lower) and 35.6° C (higher)
  - Development from egg → adult required 540 DD
- Post diapause reproduction (Nielsen et al. 2017)
  - Females overwinter unmated (reproductively immature)
  - Reproductive development triggered by photoperiod cue of 12.7 hr
  - Reproductively mature females appear at 150 DD
- Induction of reproductive diapause
  - <13.5 to 14 hrs day length
  - Fujiya et al. 1979; Watanabe 1979

# Cumulative Emergence of BMSB Adults from Overwintering Boxes



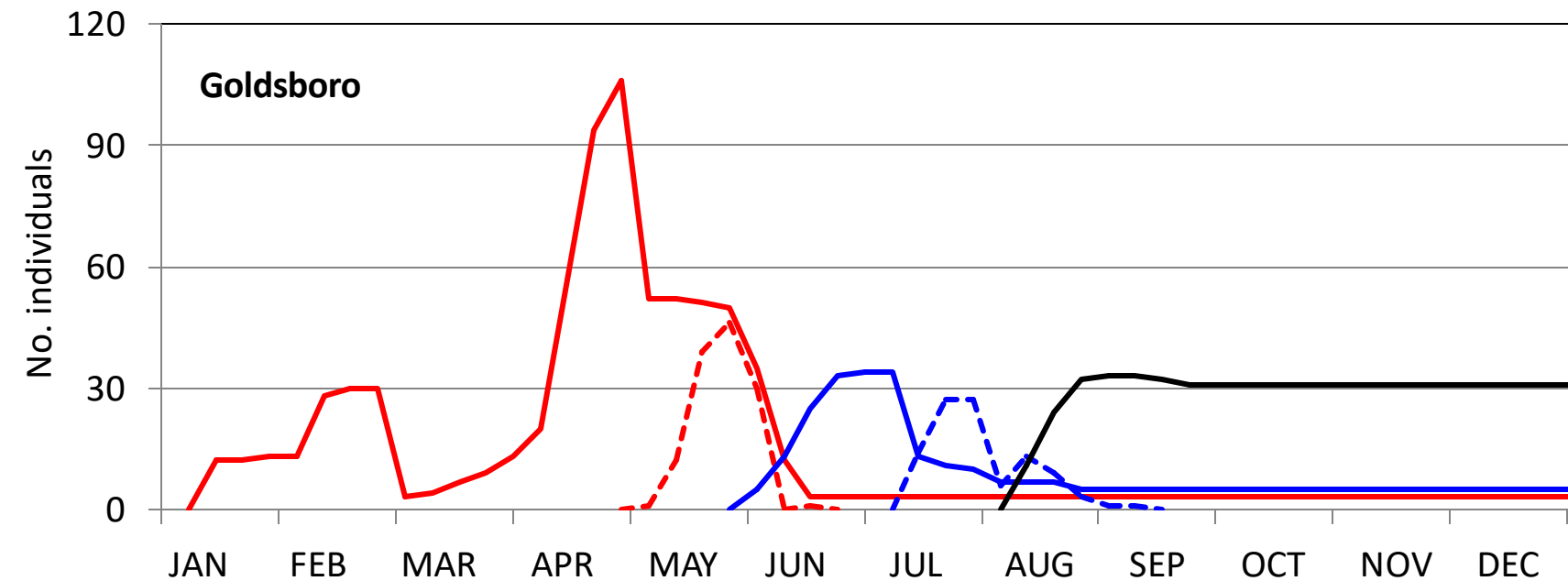
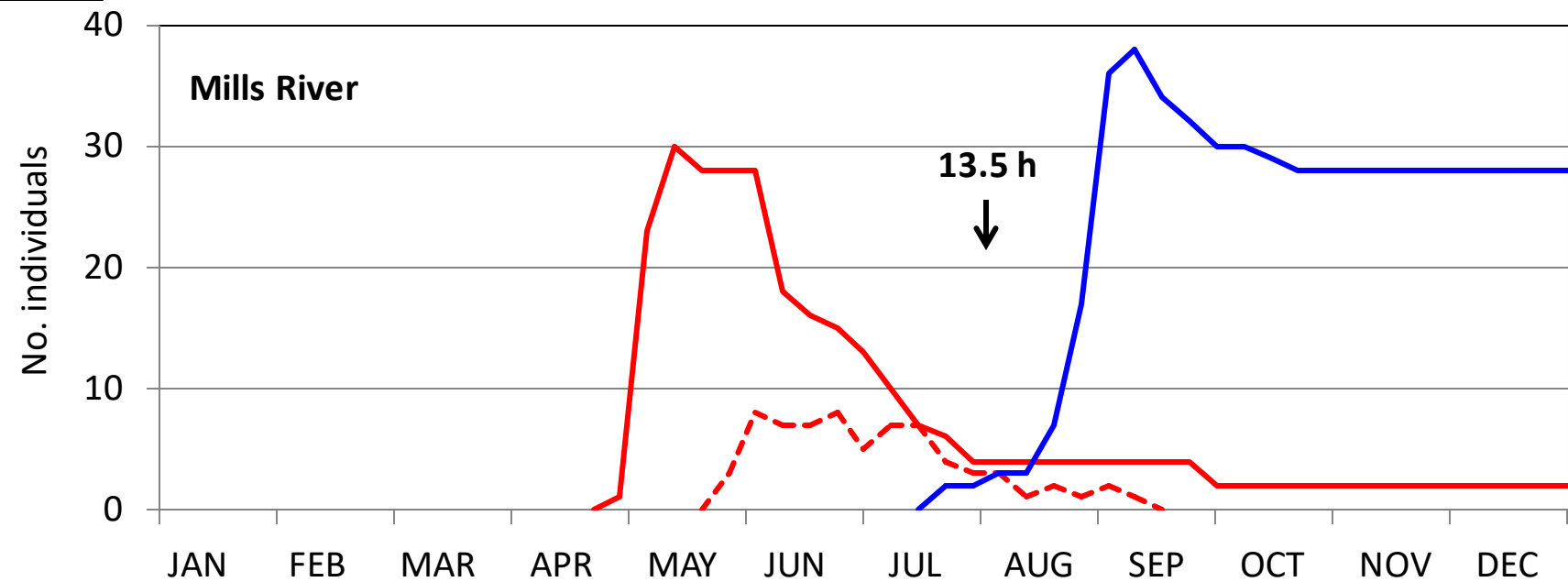
2018

— OW Adults    - - - F1 Eggs    — F1 Adults    - - - F2 Eggs    — F2 Adults



2019

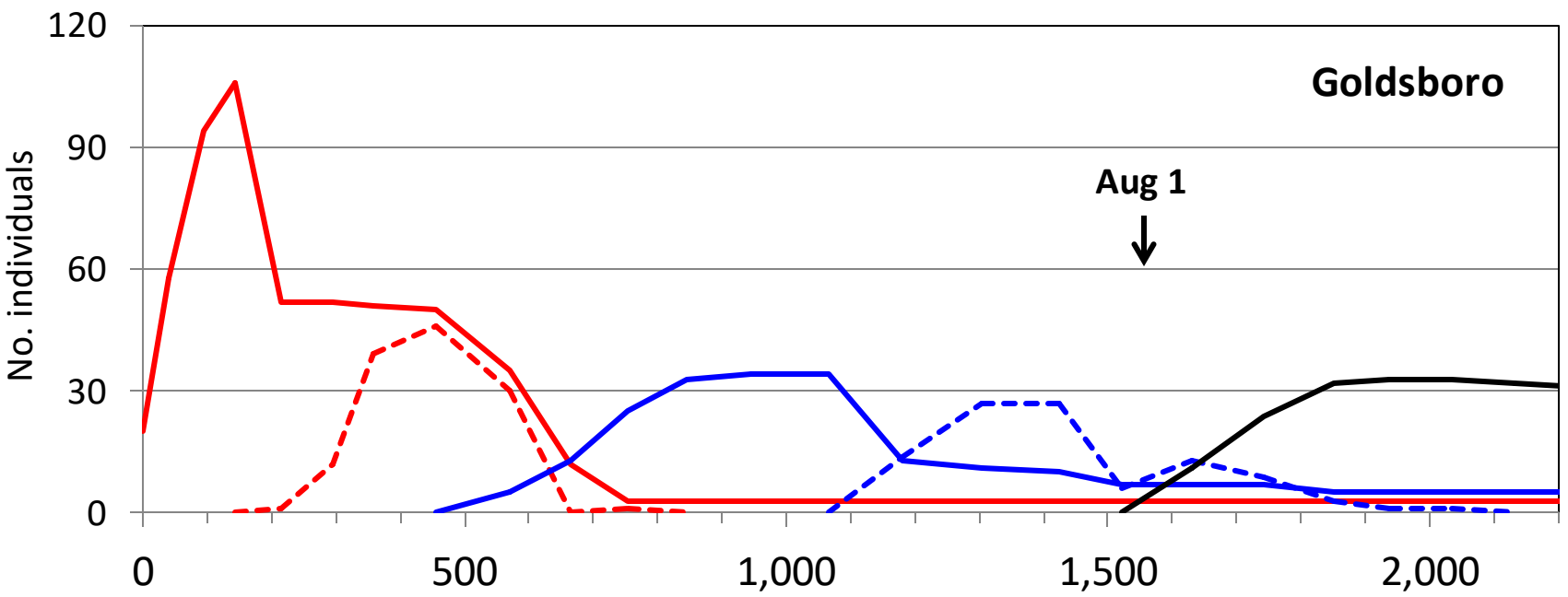
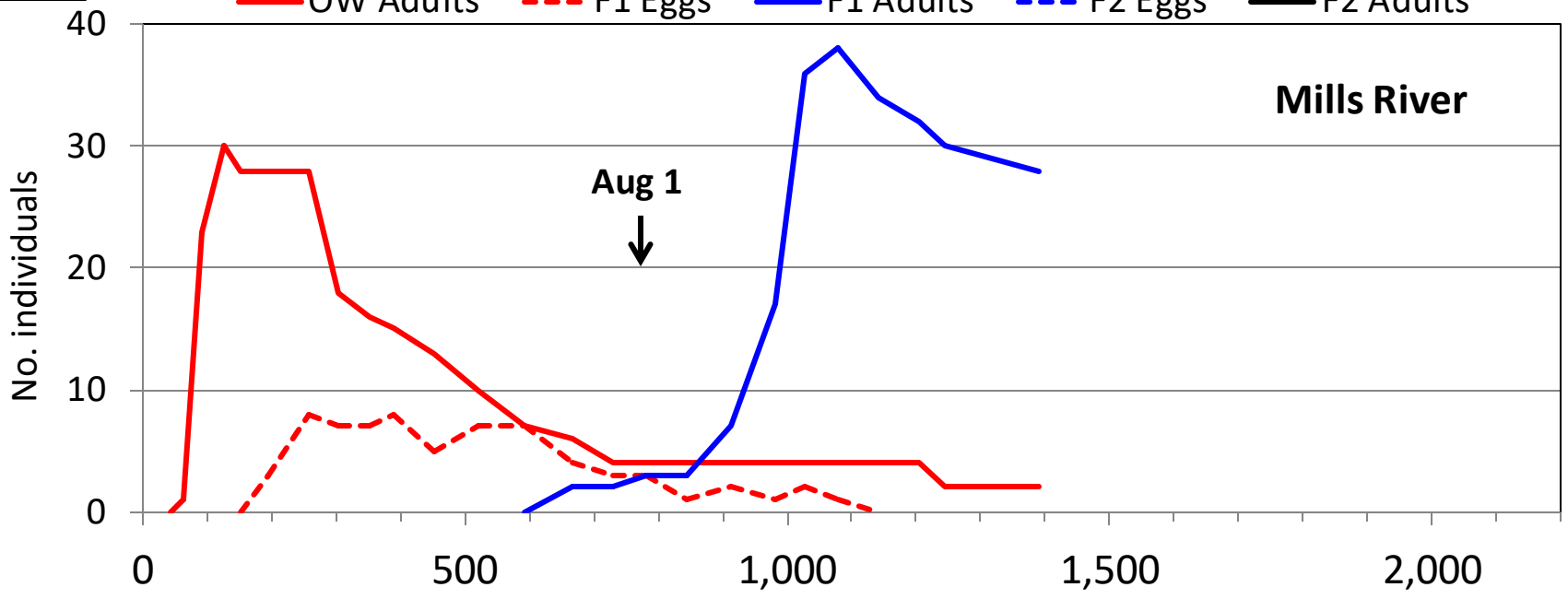
— OW Adults    - - - F1 Eggs    — F1 Adults    - - - F2 Eggs    — F2 Adults



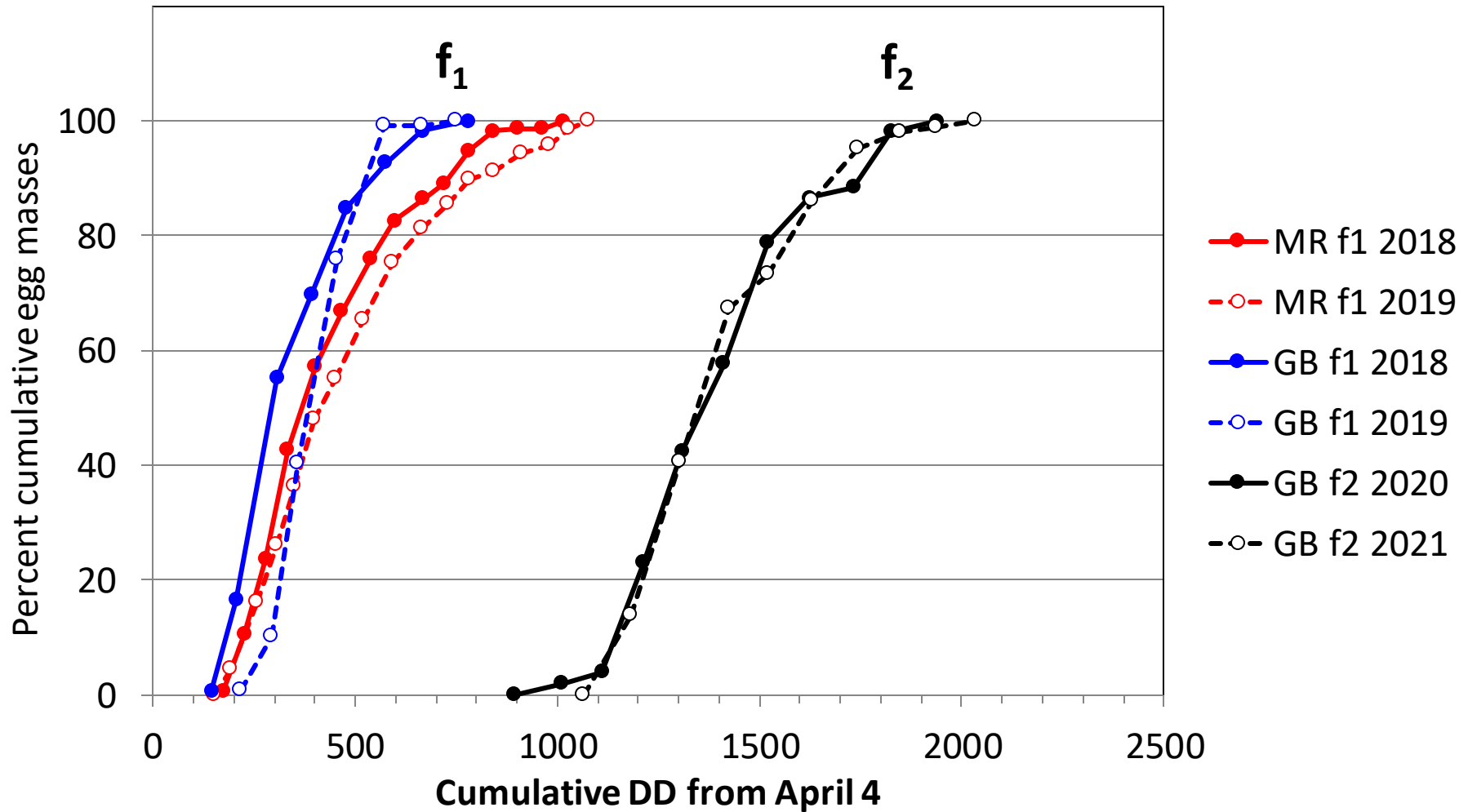


**2019**

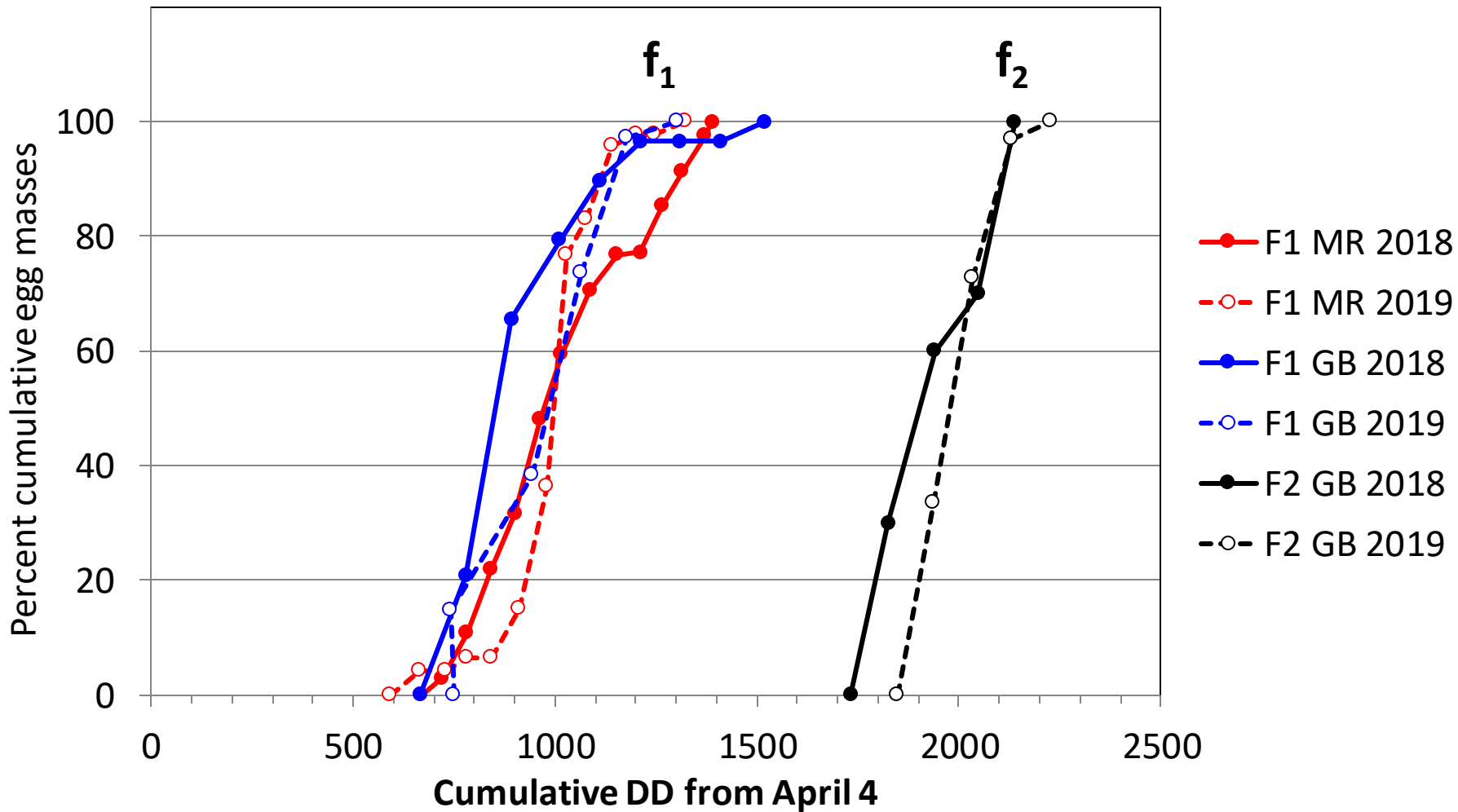
— OW Adults    - - - F1 Eggs    — F1 Adults    - - - F2 Eggs    — F2 Adults



# Cumulative Egg Masses vs Degree-Day Accumulations



# Cumulative Eclosion of BMSB Adults vs Degree-Day Accumulations

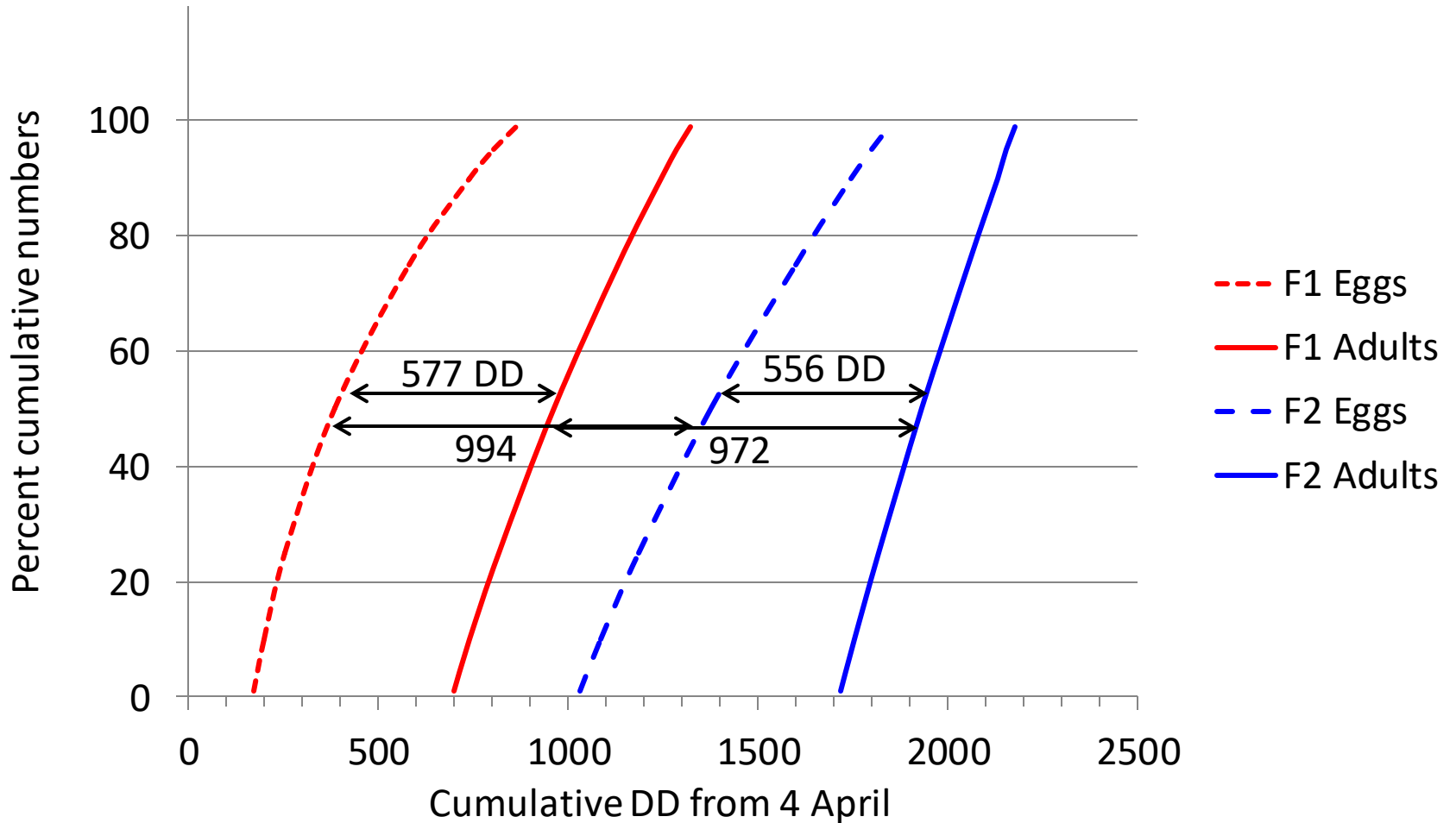


# Regression Equations for $f_1$ and $f_2$ Cumulative Oviposition and Adult Eclosion

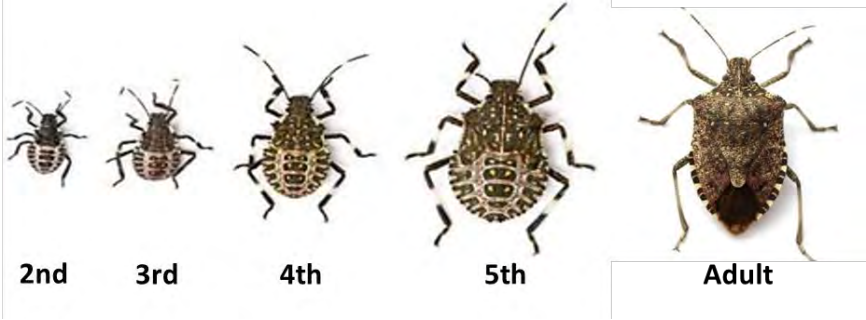
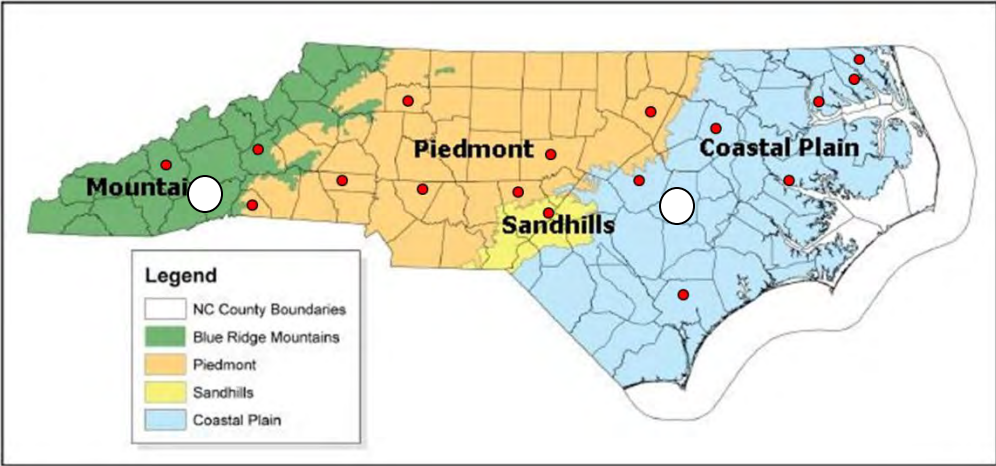
Gen.	Event	Equation	$r^2$
$f_1$	Oviposition (Mtn)	$y = 59.7\ln(x) - 309$	0.973
	Oviposition (East)	$y = 72.5\ln(x) - 373$	0.899
$f_1$	Adult eclosion	$y = 154.2\ln(x) - 1009$	0.876
$f_2$	Oviposition	$y = 168.1\ln(x) - 1165$	0.954
$f_2$	Adult eclosion	$y = 411.8\ln(x) - 3066$	0.894



# Predicted Cumulative BMSB Eggs Laid and Adults Eclosed in NC



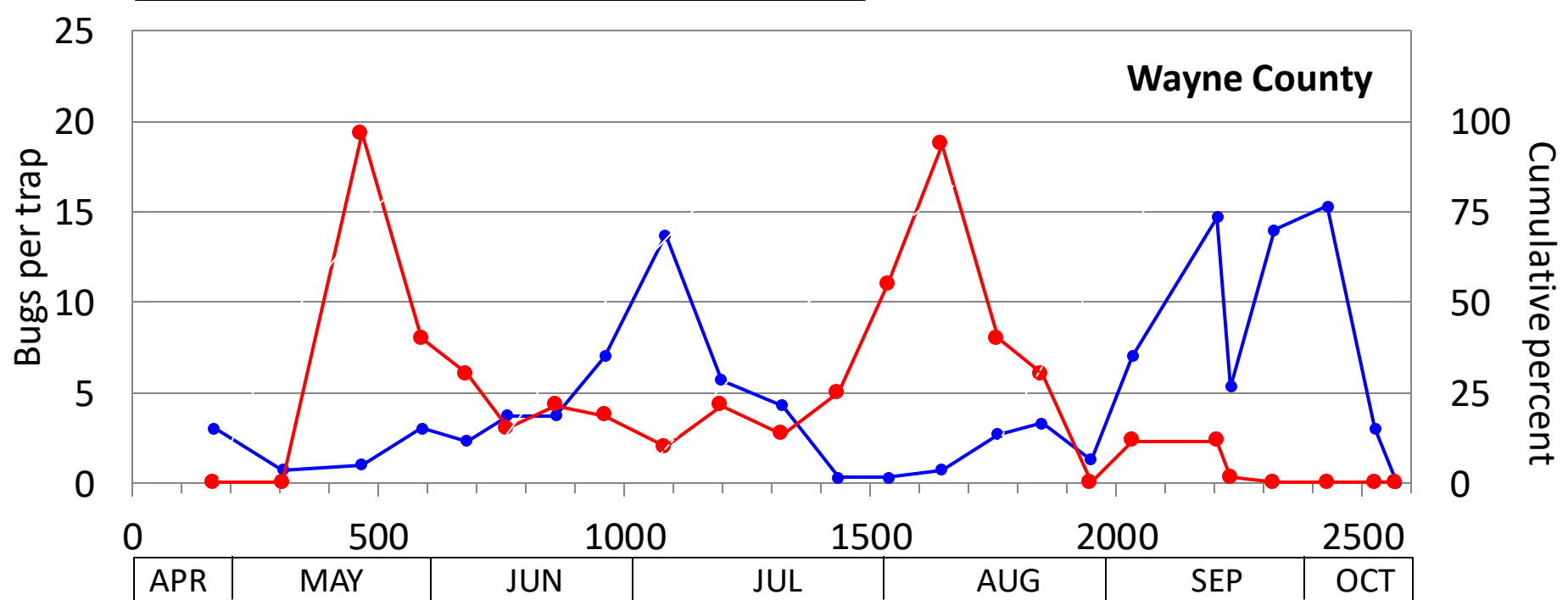
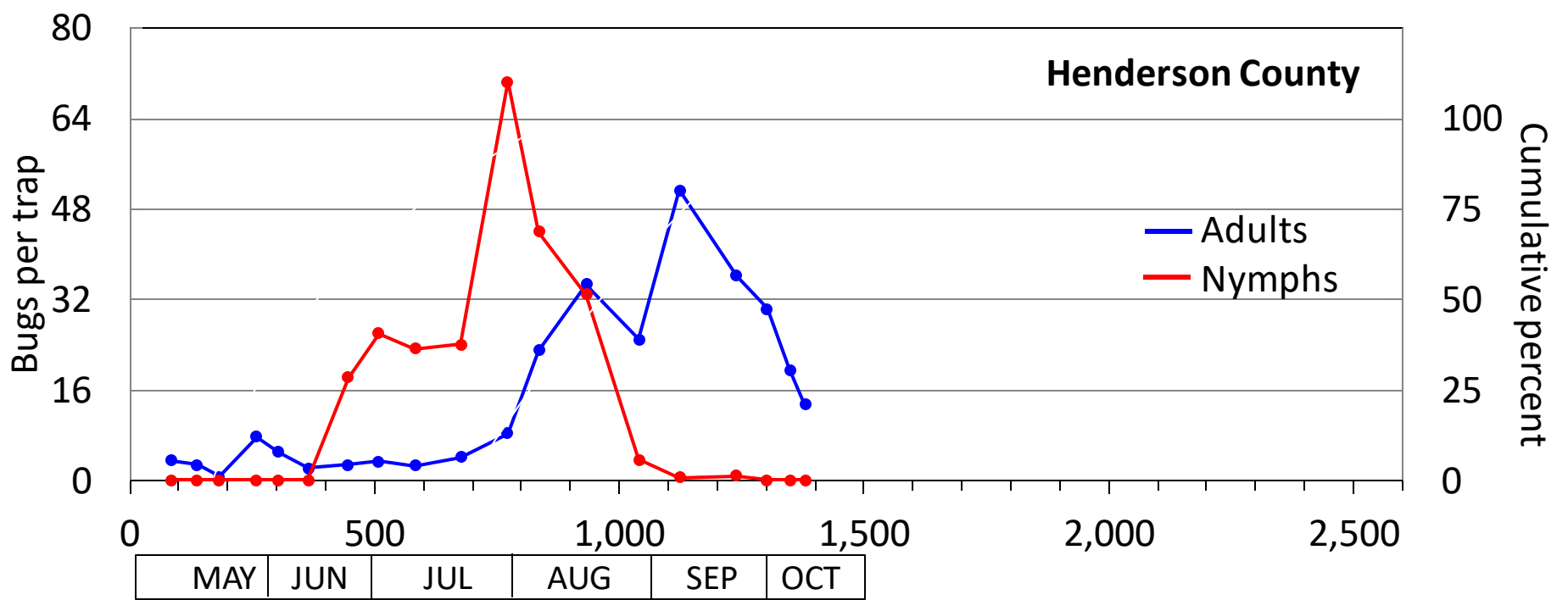
# BMSB Pheromone Trapping Network

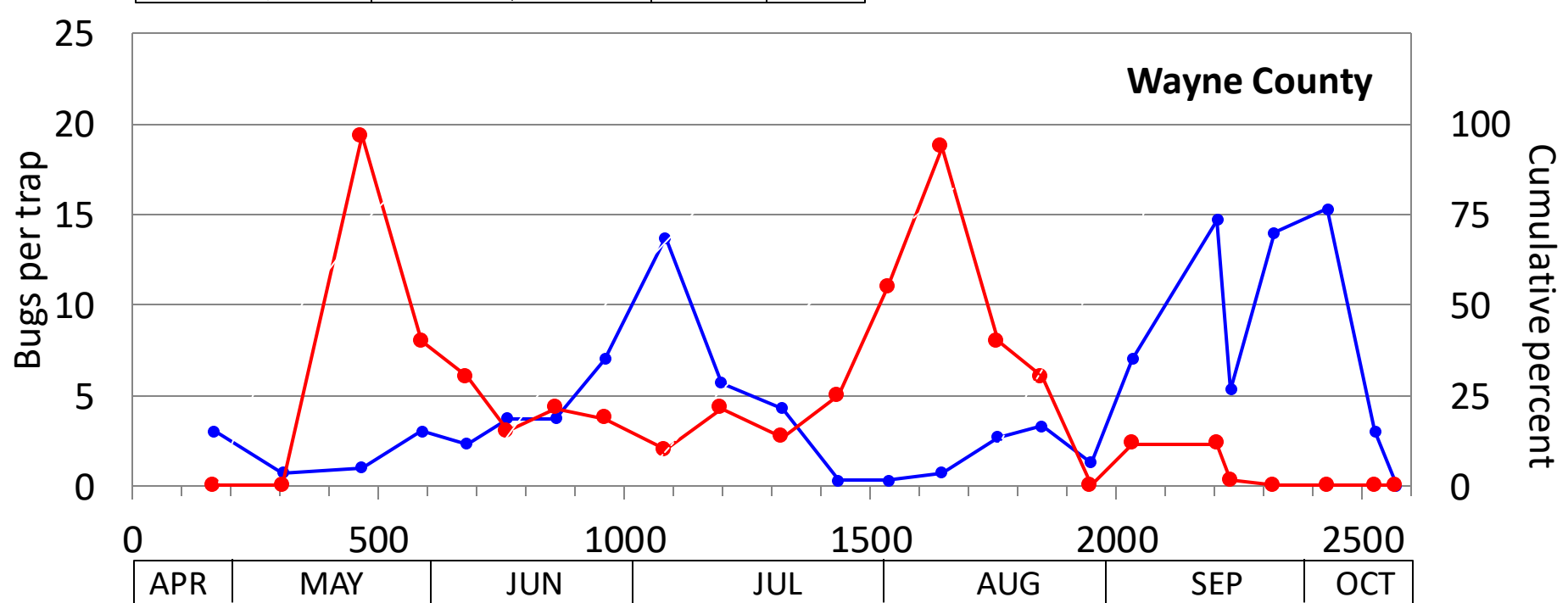
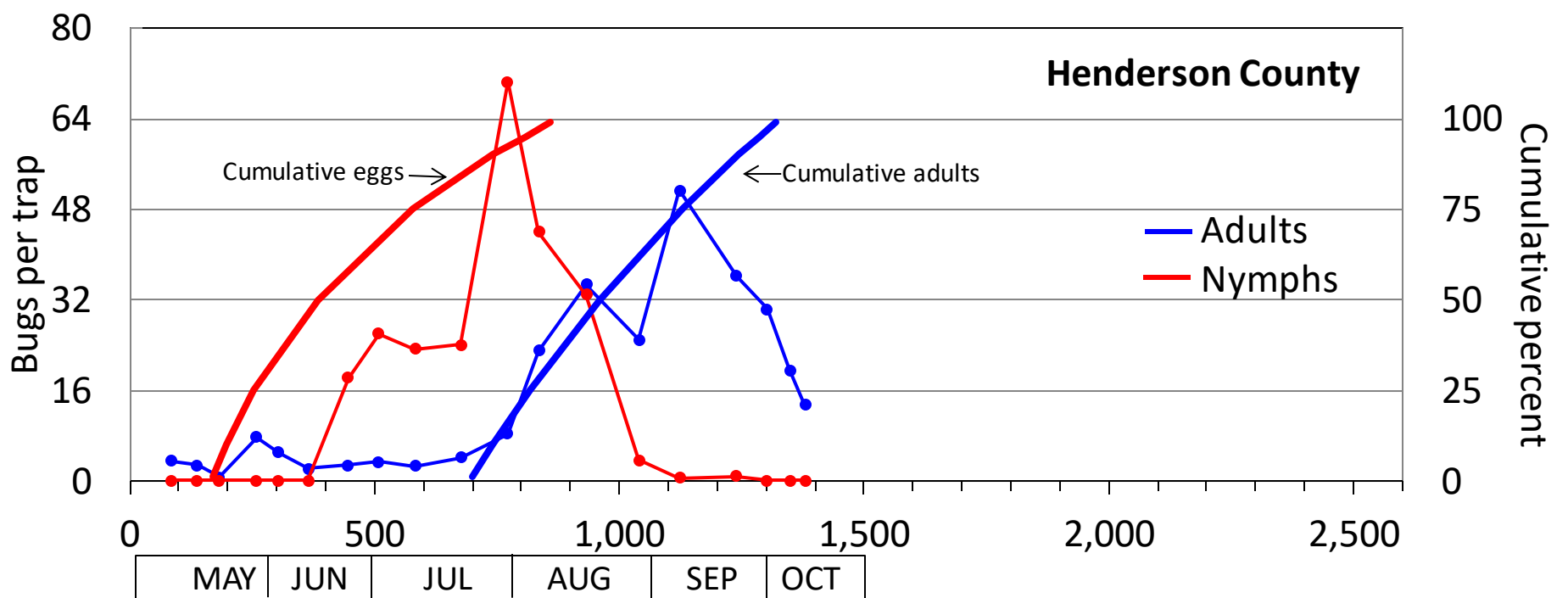


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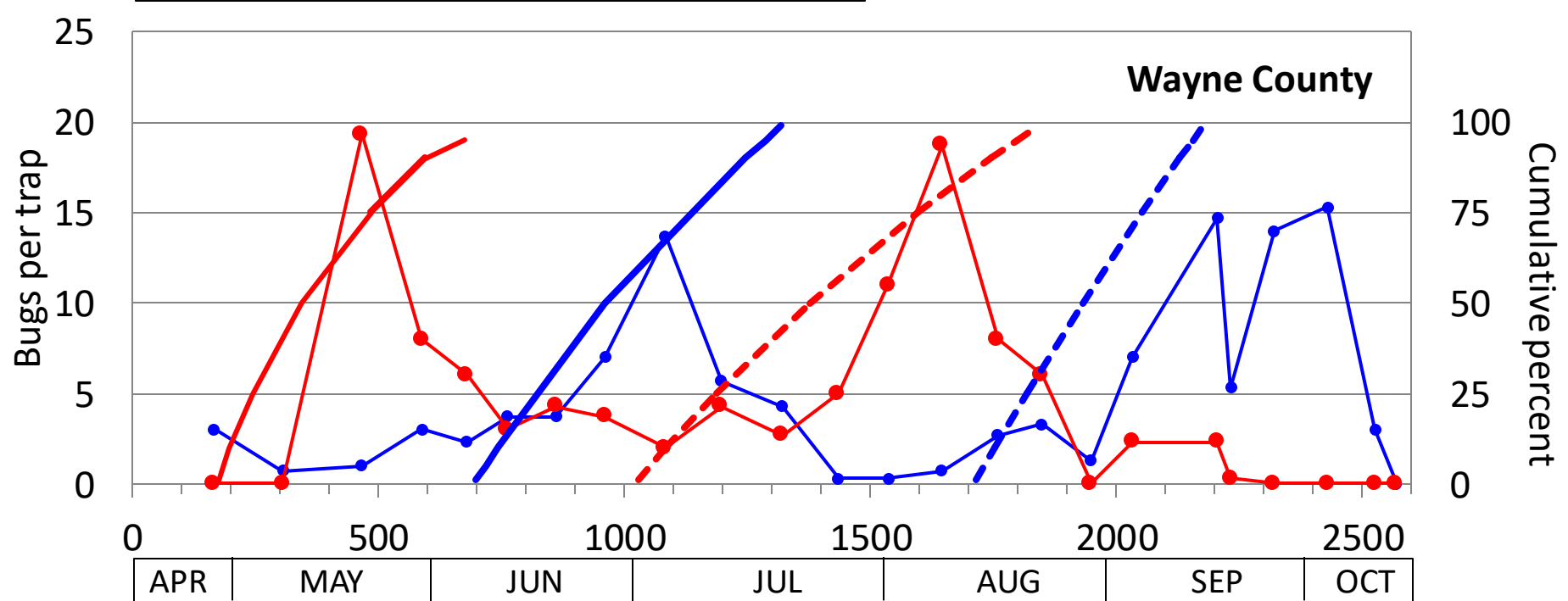
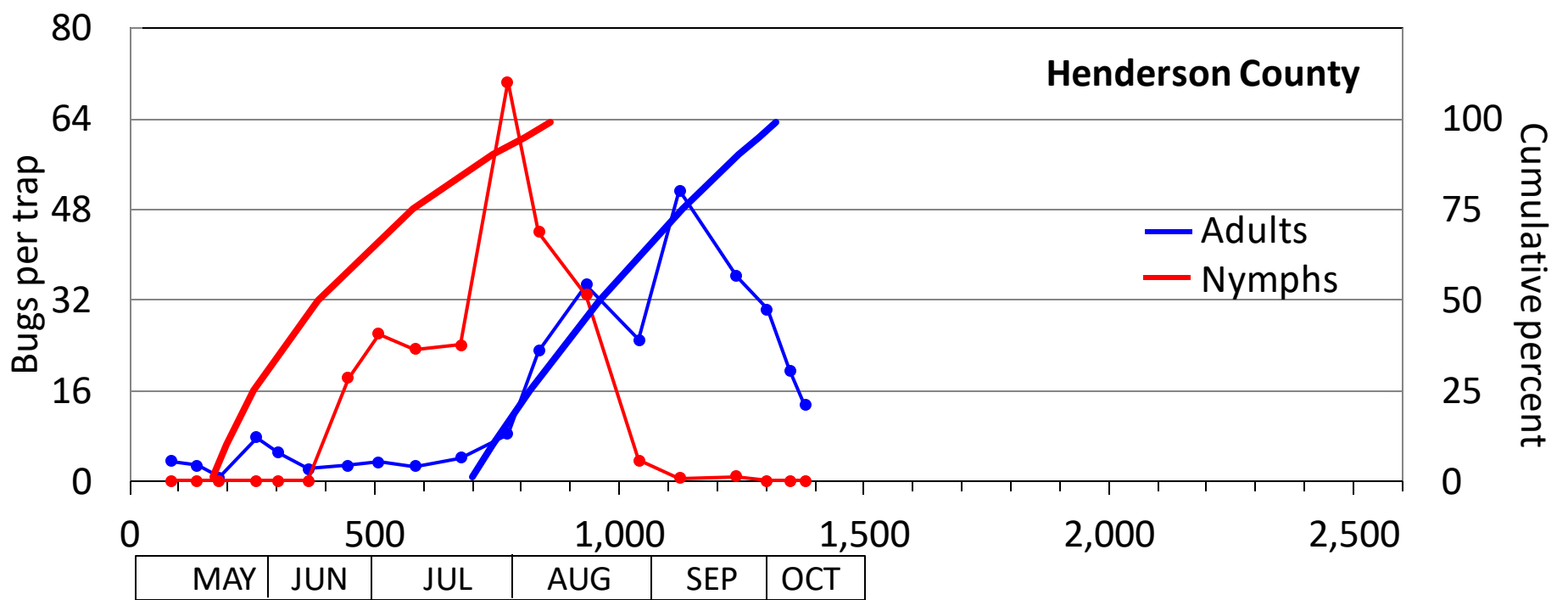


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# Summary

- Emergence of overwintering adults was not predictable, but only those emerging after April 1 reproduced.
- Cumulative oviposition and adult emergence of generations  $f_1$  and  $f_2$  were predictable based on DD accumulations from a biofix of 4 April
- Two generations only occur if a minimum of 1000 DD accumulate between April 4 and August 1.

# Why Does BMSB Perform Poorly in Coastal Plain vs Western NC?

- Warmer winter temperatures in coastal plains contributes to higher percentage of adults emerging before April, and hence fewer reproducing females than in the west.
- Overwintering  $f_2$  adult population in coastal plain completes development during July and Aug when temperatures often exceed 35-38°C

# Acknowledgments

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