

# 1.1.1 Voltinism

Peter W. Shearer, Ph.D.

Oregon State University

- Acknowledge Brent Short, USDA-ARS & Nik Wiman for creating most of these slides

- The frequency or number of annual broods
  - Univoltine: one generation per year
  - Polyvoltine: multiple generations per year

# Degree day model for BMSB

- Anne Nielsen, G. C. Hamilton & D. Matadha. 2008. Developmental Rate Estimation and Life Table Analysis for *Halyomorpha halys* (Hemiptera: Pentatomidae). Environ. Entomol. 37(2): 348-355.
  - Preoviposition period: 148 DD
  - Egg hatch: 126 DD
  - Egg to adult development: 538 DD
  - 15 °C base temperature, 33 °C maximum temperature

# Number of Generations in WV



- Designed to replicate field observations of development
- 5 male and 5 female overwintering bugs
  - Apr 14 and May 4, 2010
  - April 26, 2011
- Paulownia tomentosa*, nectarines, peas, soybeans, green beans, tomatoes and/or peppers.
- Bagged pairs of adults on *Paulownia* – triggered by observation of egg masses in field
  - May 21, 2010
  - May 23, 2011
- Removed adults when eggs laid
- Followed development and recorded temperature daily

# Results from 2011

Biological Period	Calendar Date	Accumulated DD	Total DD
Overwintered Adults in Cage	April 26	180.81- 189.06	
Eggs Deposited	June 2-3		
Eggs Deposited	June 2-3	582.76-656.27	
Summer Generation Adults Present	July 27-August 2		<b>762 - 845</b>
Summer Generation Adults Present	July 27 – August 2	80.51-95.86	
Eggs Deposited	August 1 - 9		
Eggs Deposited	August 1 - 9	553.38-562.42	
Second Generation Adults Present	<b>October 11-18</b>		<b>633 - 658</b>

# Voltinism Expansion 2012



# Modifications

- Examination of capacity
- Egg masses from laboratory colonies
- Ovarian development can occur at 13-15 h day length; 14 h reported most often
  - 14 h selected as starting point
    - » Watanabe et al. (1978), Watanabe (1979, 1980), Yanagi and Hagihara (1980)

# Mills River, NC Voltinism 2012

Biological Period	Calendar Date	Mean Degree Days $\pm$ SE (Range)
<b>First Generation Dev.</b>		<b>542.2 <math>\pm</math> 0.49 (541.7-542.7)</b>
Eggs placed in field cages	May 13	
Egg hatch	May 24-25	
First generation adults	July 17	
<b>Second Generation Dev.</b>		<b>448.9</b>
Eggs placed in field cages	July 26	
Second generation adults	August 29	



# Kearneysville, WV Voltinism 2012

<b>Biological Period</b>	<b>Calendar Date</b>	<b>Mean Degree Days <math>\pm</math> SE (Range)</b>
<b>First Generation Dev.</b>		<b>542.39 <math>\pm</math> 50.64 (449.26-623.45)</b>
Eggs placed in field cages	May 8	
Egg hatch	May 14-May 23	
First generation adults	July 5-July 18	
<b>Preovip. Period Summer</b>		<b>64.25 <math>\pm</math> 15.48 (48.77-79.73)</b>
<b>Second Generation Dev.</b>		<b>550.22 <math>\pm</math> 91.42 (458.8-641.63)</b>
Eggs deposited	July 16-July 31	
Second generation adults	Sep 13-Sep 14	

# Highland, NY Voltinism 2012

---

Biological Period	Calendar Date	Mean Degree Days $\pm$ SE (Range)
<b>First Generation Dev.</b>		<b>579.06 <math>\pm</math> 75.42 (503.65-654.48)</b>
Eggs placed in field cages	May 4	
Egg hatch	May 11-May15	
First generation adults	July 23-Aug 8	
<b>Second Generation Dev.</b>		
1 <sup>st</sup> instars	Aug 8	
Second generation adults	No data	

---

May

June

July

Aug

Sep

Oct

WV



Eggs

1<sup>st</sup>

2<sup>nd</sup>

3<sup>rd</sup>

4<sup>th</sup>

5<sup>th</sup>

Adults

Eggs

2<sup>nd</sup> gen. nymphs

Adults



NC



Eggs

1<sup>st</sup>

2<sup>nd</sup>

3<sup>rd</sup>

4<sup>th</sup>

5<sup>th</sup>

Adults

Eggs

2<sup>nd</sup> gen. nymphs

Adults



# Comments/Concerns from 2012

- Two complete generations documented in Mills River, NC and Kearneysville, WV
- Two generations in Highland, NY.
- High nymphal mortality and/or disappearance
  - Geneva, NY
- One report of unsuccessful mating in field cages
- Potential predation in cages: beetles, ants?
- Need for standardization of monitoring and resources across states

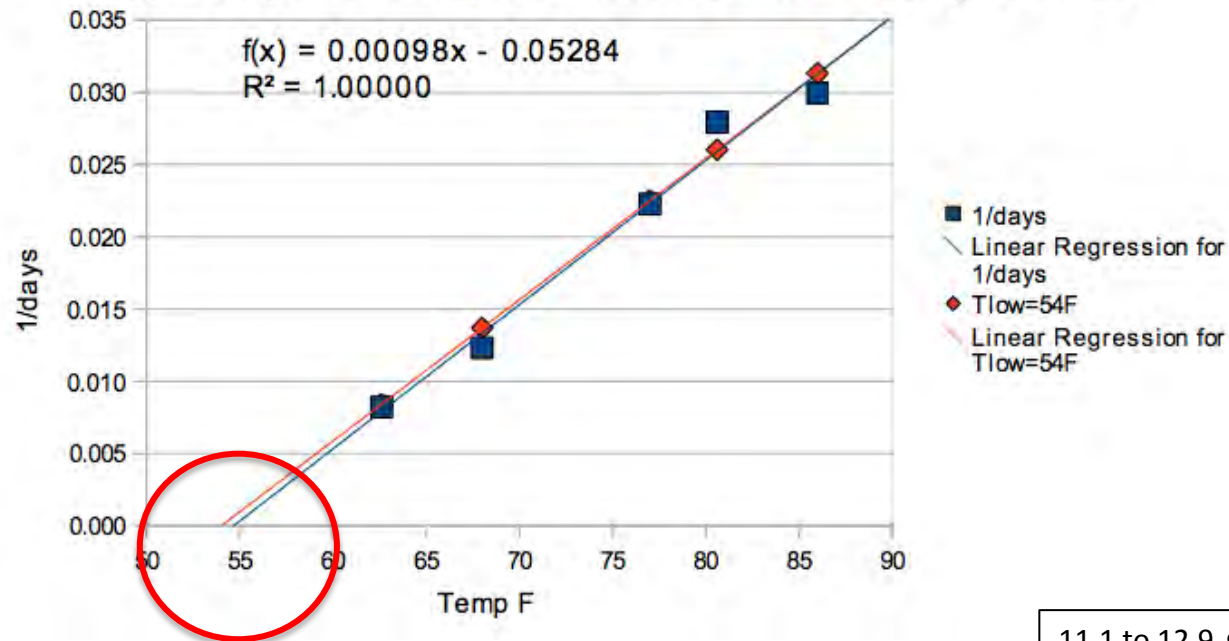
# A few observations from Oregon

	Lower	Upper
Nielsen	59F (15C)*	92 F (33.3C)
IPPC	54F (12.2C)*	92 F (33.3C)

\* Egg hatch occurred at 15C

\* IPCC model fitted to Nielsen et al data:

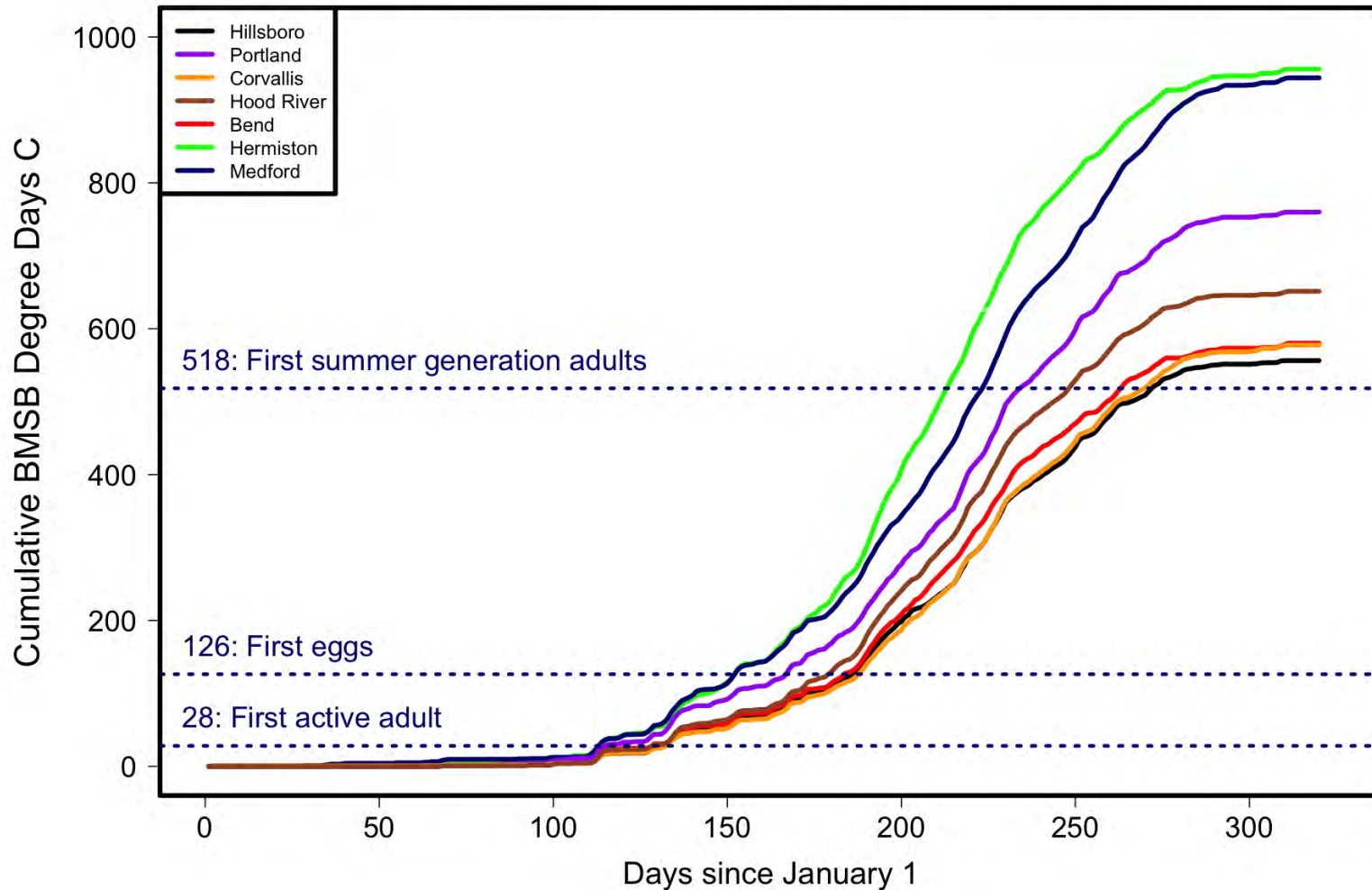
Egg+Nymphal Development with fitted model using  $T_{low}=54F$



11.1 to 12.9 °C (Kiritani 1997)

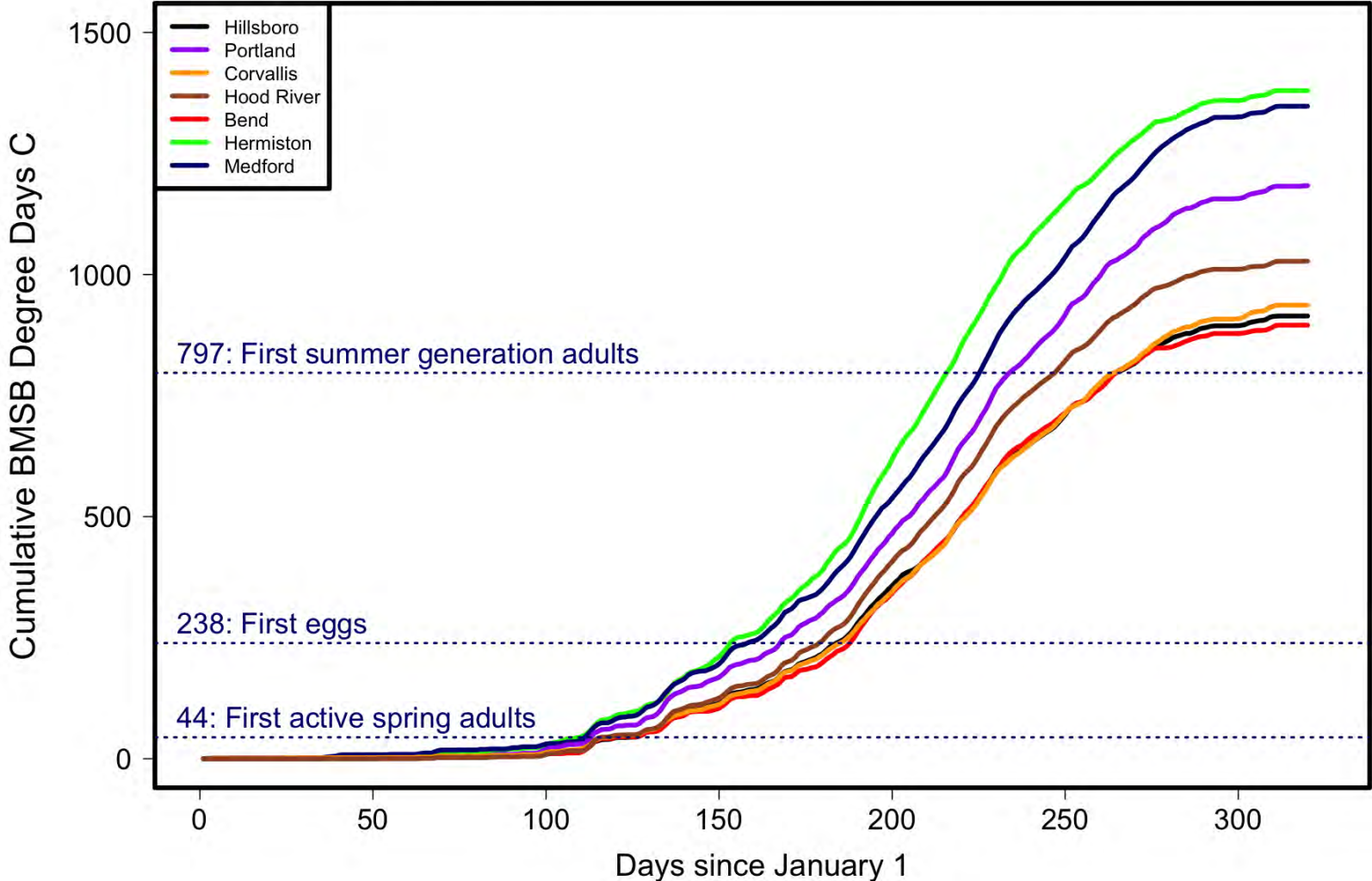
# Nielsen model

2012 Oregon Degree Day Accumulations,  $T_{low} = 15C$ ,  $T_{high} = 33C$



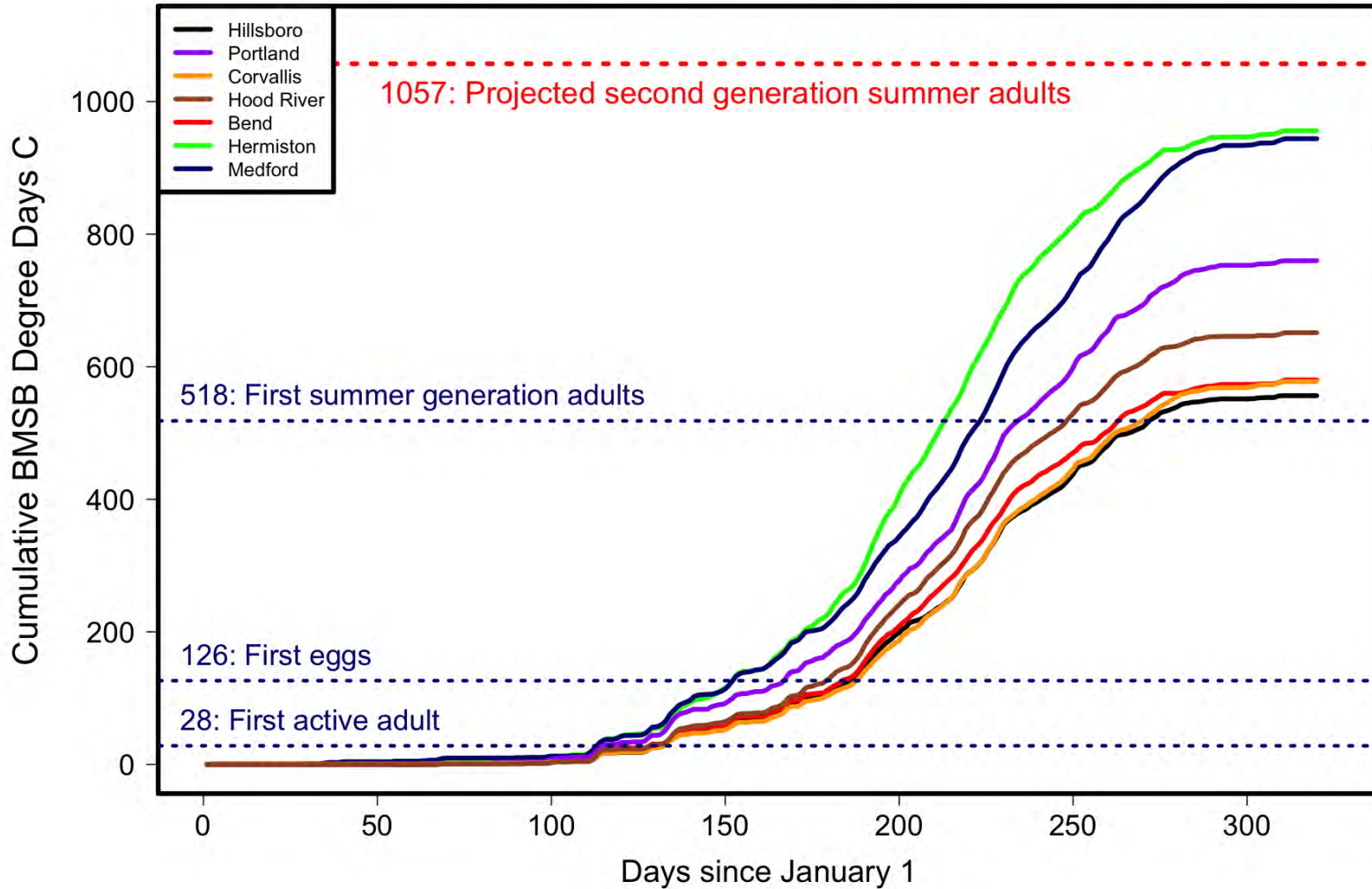
# IPPC model

2012 Oregon Degree Day Accumulations,  $T_{low} = 12C$ ,  $T_{high} = 33C$



# Nielsen model

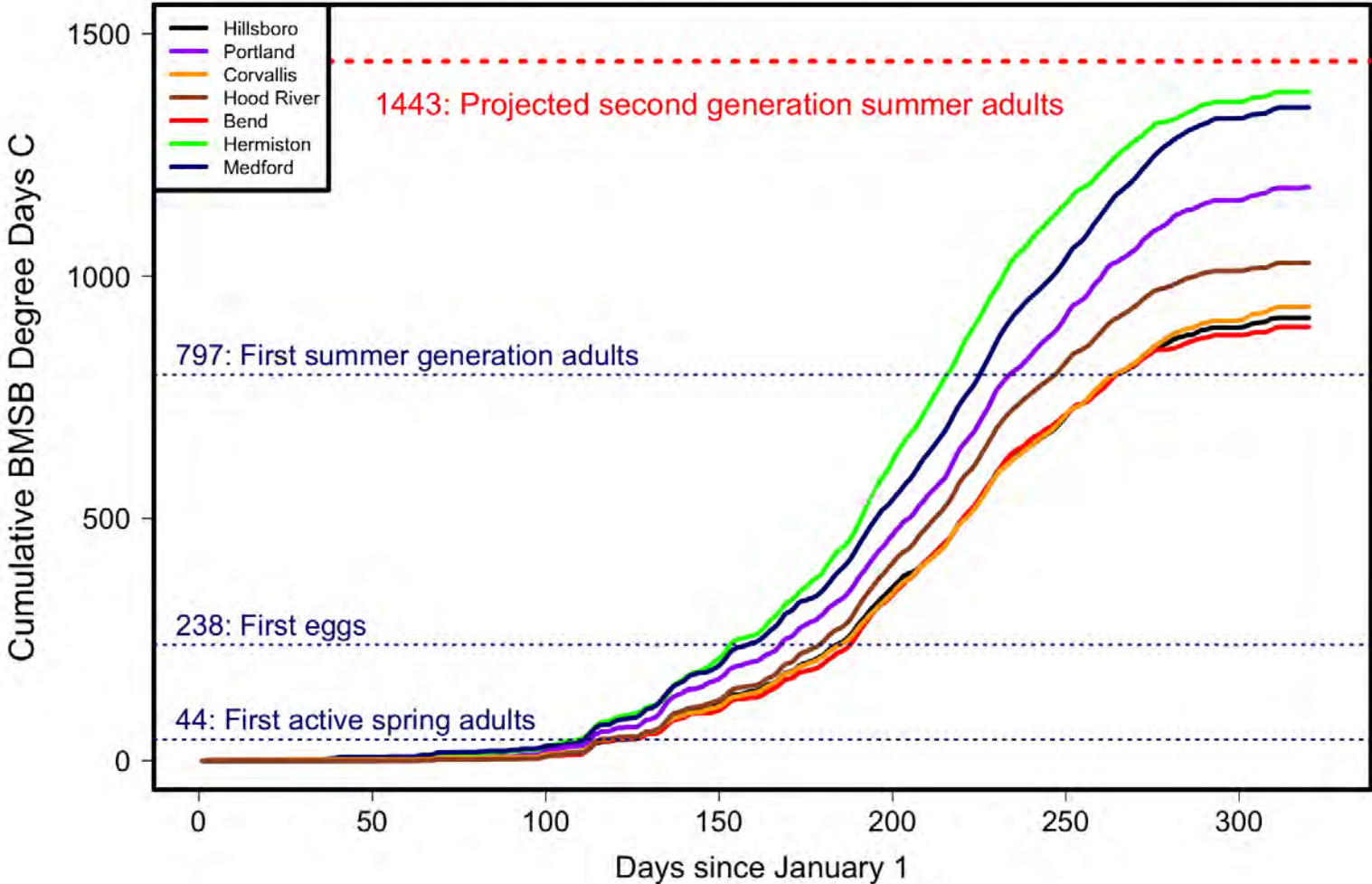
2012 Oregon Degree Day Accumulations,  $T_{low} = 15C$ ,  $T_{high} = 33C$





# IPPC model

2012 Oregon Degree Day Accumulations,  $T_{low} = 12C$ ,  $T_{high} = 33C$



# Voltinism – Oregon Conclusions

- Predicted and observed developmental periods agreed with IPPC model
  - However, develop periods will shrink with more precise sampling next season
    - Reports of earlier active adults
    - We missed first eggs
      - Hatched masses found

# Effect of latitude on day length

	Date of achieved day length		diff (d)
	13 h Light	14 h light	
Geneva, NY	7-Apr	29-Apr	22
Allentown, PA	9-Apr	4-May	25
Winchester, VA	10-Apr	6-May	26
Hendersonville, NC	13-Apr	16-May	33
diff (d)	6	17	11

# Thank you

- Questions?