

Western Bean Cutworm Flight Pattern

Structural Equation Modeling (EDSP 971)

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Outline

- Motivation
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- Spaghetti Plot
- Latent Growth Model
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Motivation

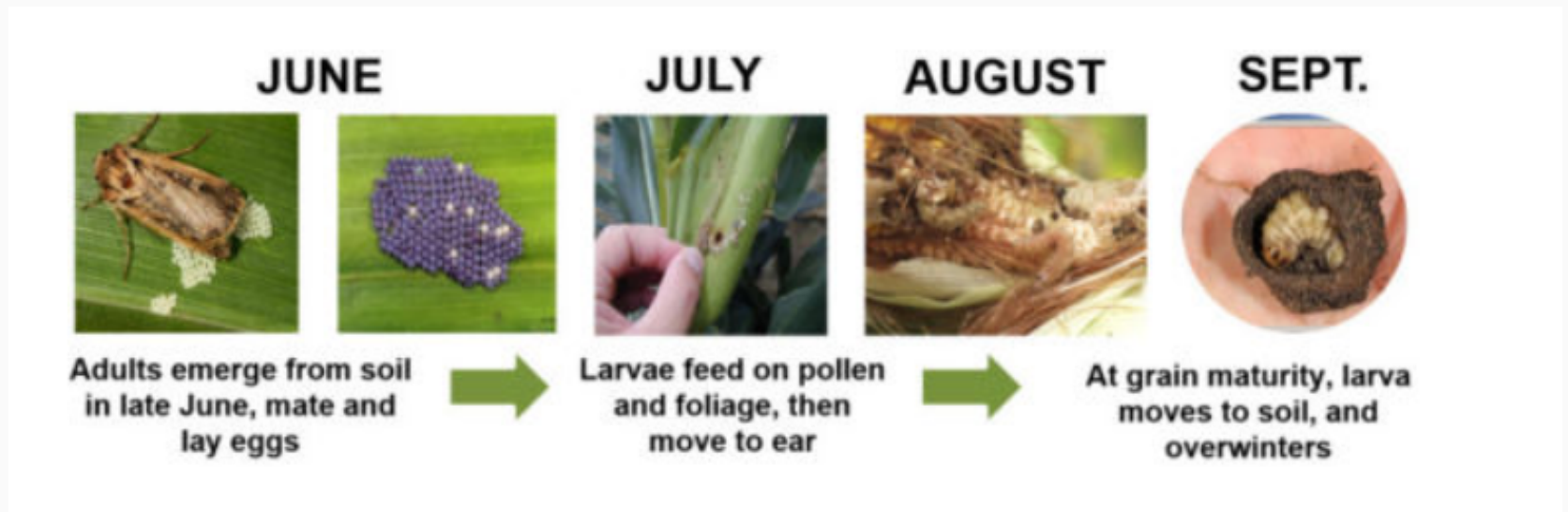
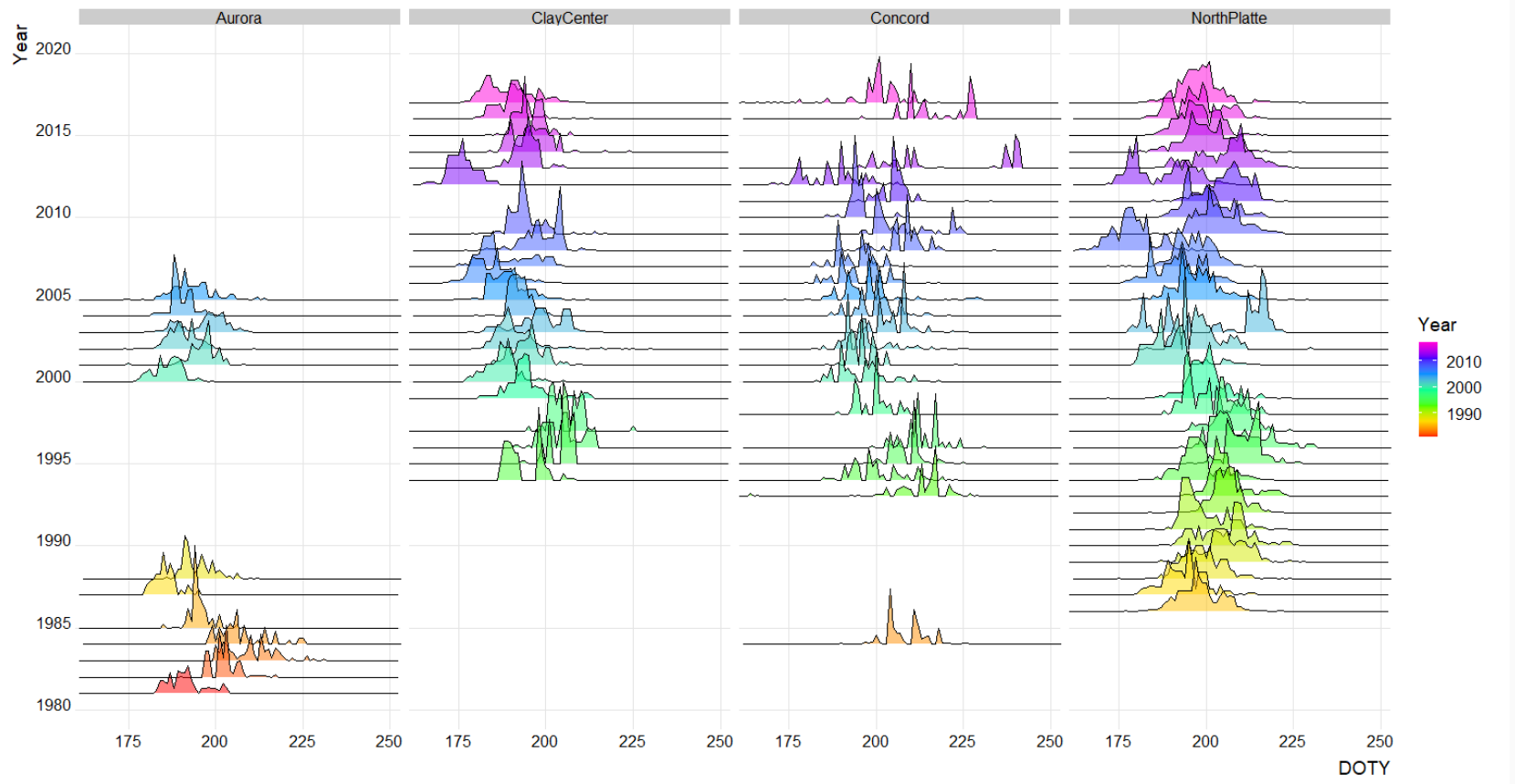


Image Source: Pioneer. (2019, May 9). Western Bean Cutworm. Retrieved from https://www.pioneer.com/us/agronomy/western_bean_cutworm_cropfocus.html

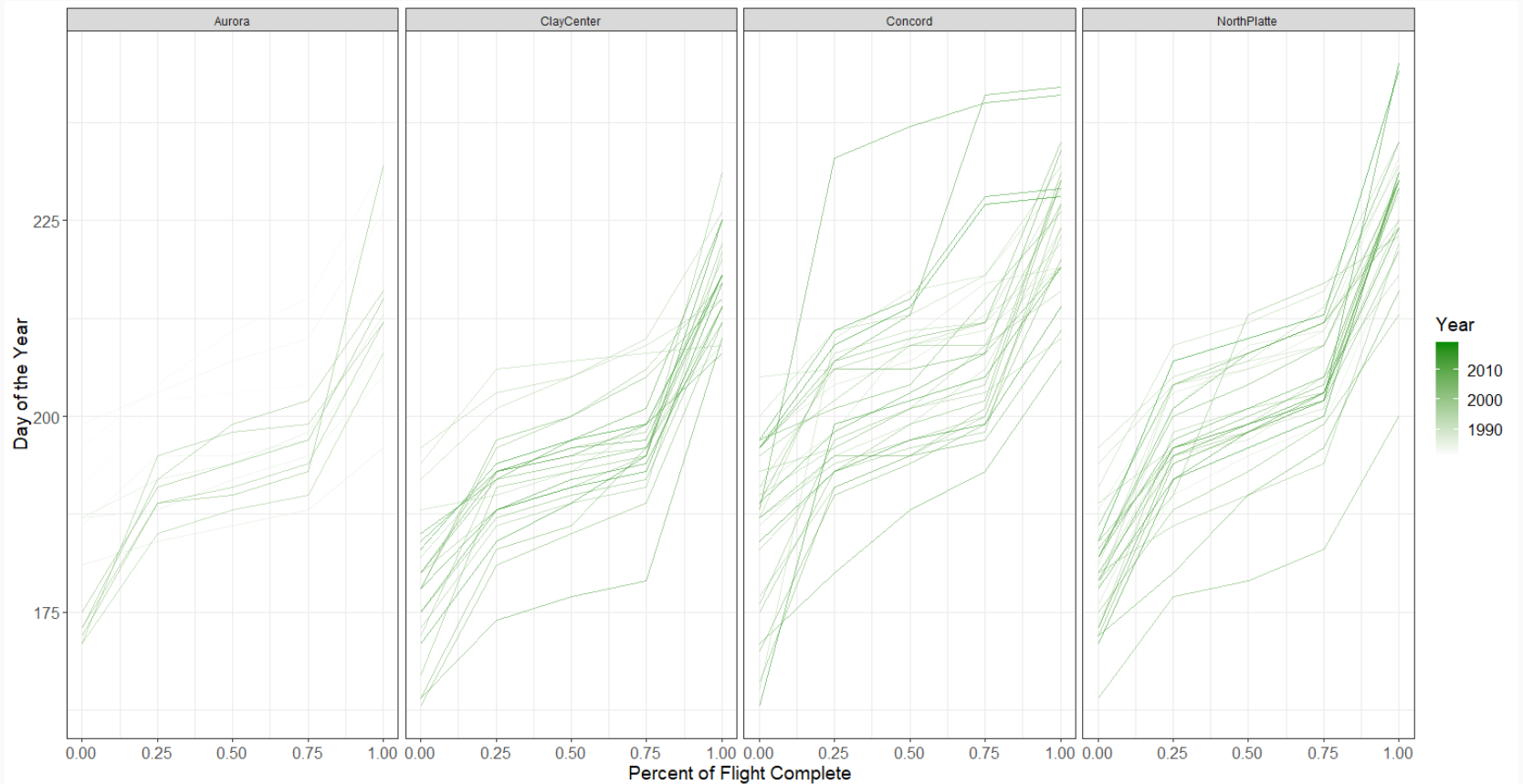
Data Visualization



Data

- Site (Aurora, Clay Center, Concord, North Platte)
- Year (1980 - 2020)
- DOTYfirst - DOTYlast (*Time Component*)
- Covariates
 - Total Moths
 - Peak Moths
 - Peak/Total Moths Ratio
 - Average Temperature (Summer)
 - Total Precipitation (Summer)

Spaghetti Plot



Latent Growth Model

```
lgcMod <- 'Start =~ 1*DOTYfirst + 1*DOTY25pct + 1*DOTY50pct + 1*DOTY75pct +
          Length =~ 0*DOTYfirst +    DOTY25pct +    DOTY50pct +    DOTY75pct +

          DOTYfirst ~~ c(rA, rCC, rC, rNP)*DOTYfirst
          DOTY25pct ~~ c(rA, rCC, rC, rNP)*DOTY25pct
          DOTY50pct ~~ c(rA, rCC, rC, rNP)*DOTY50pct
          DOTY75pct ~~ c(rA, rCC, rC, rNP)*DOTY75pct
          DOTYlast  ~~ c(rA, rCC, rC, rNP)*DOTYlast

          DOTYfirst ~ 0*1; DOTY25pct ~ 0*1; DOTY50pct ~ 0*1; DOTY75pct ~ 0*
          Start  ~ c(iiA, iiCC, iiC, iiNP)*1
          Length ~ c(isA, isCC, isC, isNP)*1
          Start  ~~ 0*Length

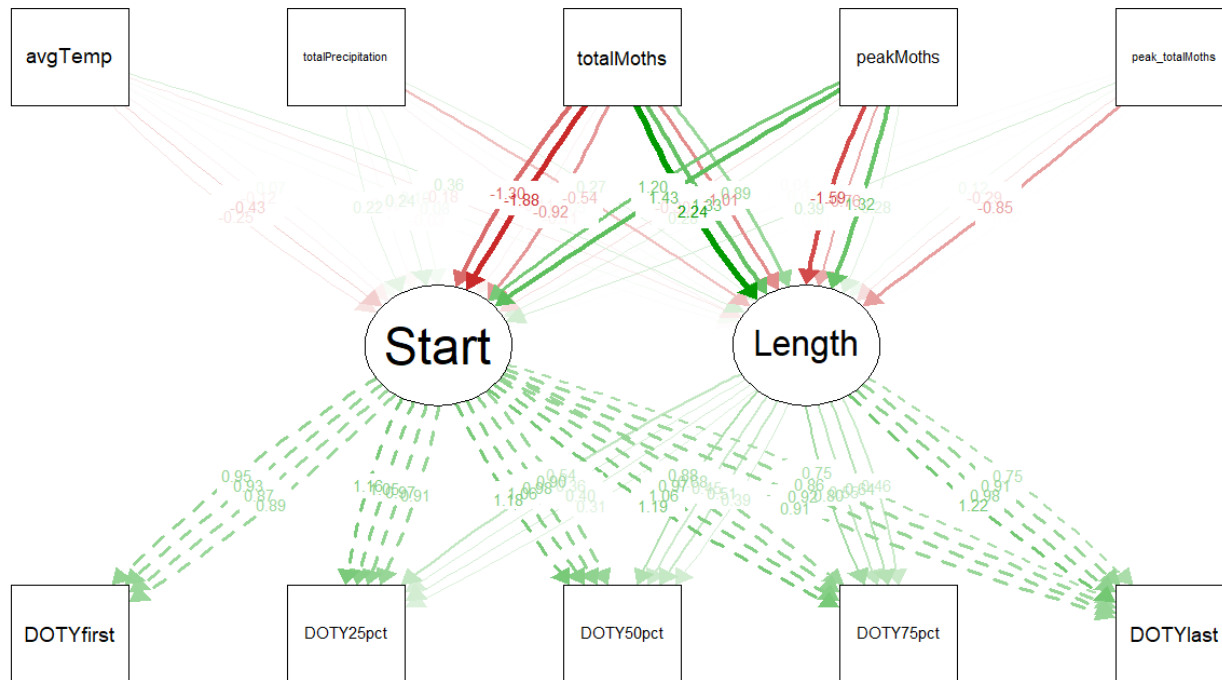
          Start  ~ avgTemp + totalPrecipitation + totalMoths + peakMoths +
          Length ~ avgTemp + totalPrecipitation + totalMoths + peakMoths +
          ,
```

Latent Growth Fit 😐

```
lgcFit <- cfa(lgcMod,  
             data = wbcDat_LGC,  
             std.lv = F,  
             group = "Site",  
             check.gradient = FALSE)
```

chisq	df	pvalue	cfi	rmsea	srmr
501.888	108	0	0.751	0.38	0.142

Final Path Diagram



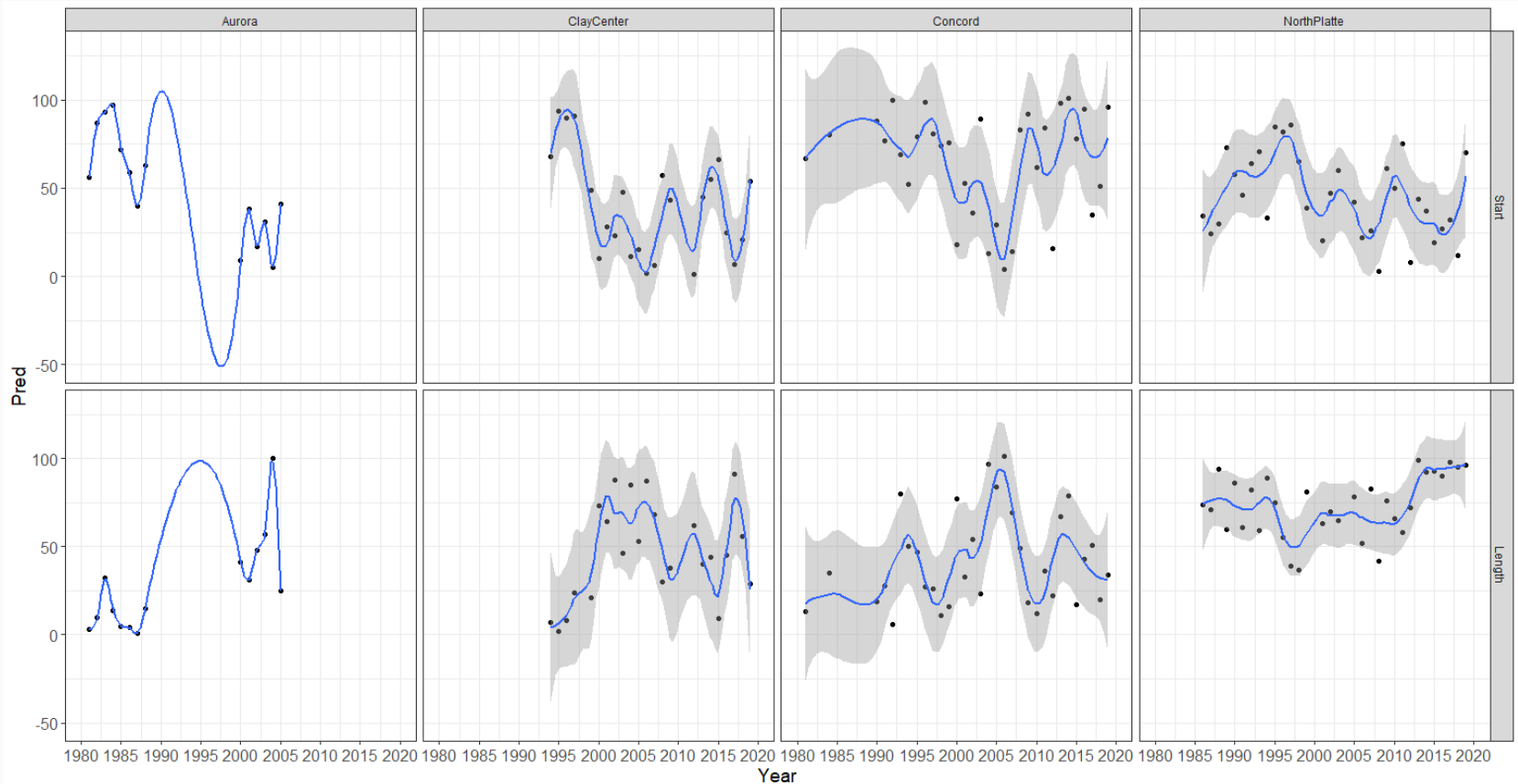
Results

Latent Means						
Group	LV	Est	SE	Z	Std. Est	Sig
Aurora	Start	162.48	98.57	1.65	19.91	
ClayCenter	Start	213.01	80.16	2.66	25.93	**
Concord	Start	344.16	53.77	6.40	37.60	***
NorthPlatte	Start	235.68	58.39	4.04	37.29	***
Aurora	Length	-133.61	98.72	-1.35	-12.17	
ClayCenter	Length	148.23	81.19	1.83	16.87	
Concord	Length	12.59	71.25	0.18	1.30	
NorthPlatte	Length	47.06	58.79	0.80	7.46	

Results

Latent Variances						
Group	LV	Est	SE	Z	Std. Est	Sig
Aurora	Start	28.24	11.88	2.38	0.42	*
ClayCenter	Start	34.79	11.47	3.03	0.52	**
Concord	Start	32.96	11.08	2.97	0.39	**
NorthPlatte	Start	28.71	8.20	3.50	0.72	***
Aurora	Length	18.57	12.17	1.53	0.15	
ClayCenter	Length	22.32	12.06	1.85	0.29	
Concord	Length	39.14	19.82	1.98	0.42	*
NorthPlatte	Length	15.25	8.60	1.77	0.38	

Year to Year Change



Conclusions

- The flight does not follow a linear relationship, most of the moths are captured in the middle of the flight with a few stragglers at the beginning and end.
- Based on the latent means:
 - Concord and North Platte tend to have later start dates.
 - Aurora has a shorter flight and Clay Center tends to have a longer flight.
- Based on the latent variances:
 - North Platte tends to have a more variable start date.
- The total moths for that flight are negatively associated with the start date and positively associated to the length of the flight.
- The peak moths are positively associated with the start date and for some locations, negatively associated with the length.
- According to farmers, the flight in North Platte has been lasting later in the season, based on the time series plot, we can see that the start date has been later and the length of the flight has been increasing over the most recent years.

References & Acknowledgements

- Da Luz, P. M. C., Swoboda Bhattarai, K. A., Montezano, D. G., Hunt, T. E., Write, R. J., & Peterson, J. A. (n.d.).
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- Western Bean Cutworm. (n.d.). Retrieved from <https://cropwatch.unl.edu/tags/western-bean-cutworm>
- Thank you to all of the people involved in collecting data in different locations over a period of more than thirty years.

Questions?