

# Evolution of emergence strategies

How organisms combine cues to make decisions

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December 5, 2016

# Table of Contents

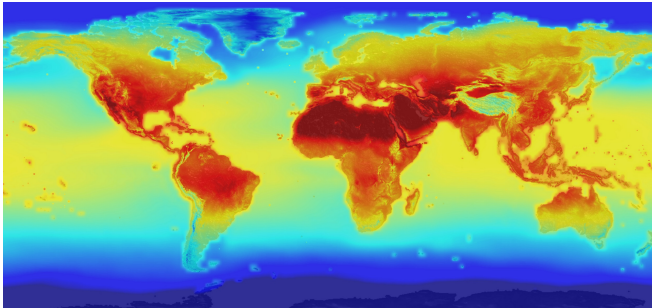
1 Introduction

2 Simulation

3 Predictive Framework







# Goals

- Provide base-line model for multiple-cue decisions
- Develop predictions for the use of phenological cues

# Table of Contents

1 Introduction

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# Basics

Let's start by imagining a very simplified system:

- Organisms decide when to emerge/germinate based on trait values and environmental cues



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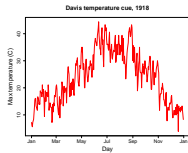
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- Organisms collect resources ( $\sim$ fitness) based on abiotic conditions for a set duration after emerging (10 days)

# Basics

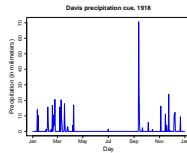
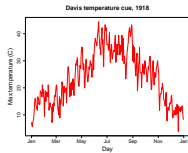
Let's start by imagining a very simplified system:

- Organisms decide when to emerge/germinate based on trait values and environmental cues
- Organisms collect resources ( $\sim$ fitness) based on abiotic conditions for a set duration after emerging (10 days)
- Lottery model reproduction: parents produce offspring proportional to resources gathered, each offspring has equal chance of filling one of the  $N$  'slots' for adults in the next generation

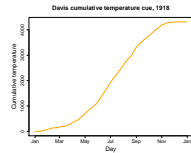
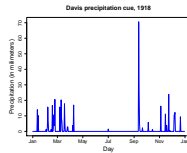
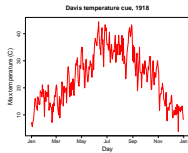
# Emergence Cues



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# Emergence

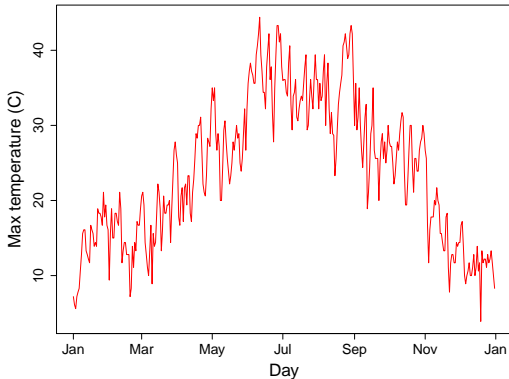
Every day, organisms combine environmental cues and traits to get an 'E' value:

$$E = \frac{\text{photoperiod cue}}{\text{photoperiod trait}} + \frac{\text{temperature cue}}{\text{temperature trait}} + \dots$$

If  $E > 1$ , organism decides to emerge!

# Trait interpretation, simple example

Davis temperature cue, 1918

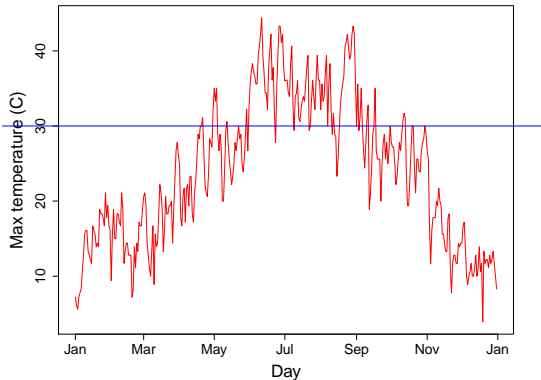


$$E = \frac{\text{temperature cue}}{30}$$

Temp cue = 30,  
other cues not in  
use.

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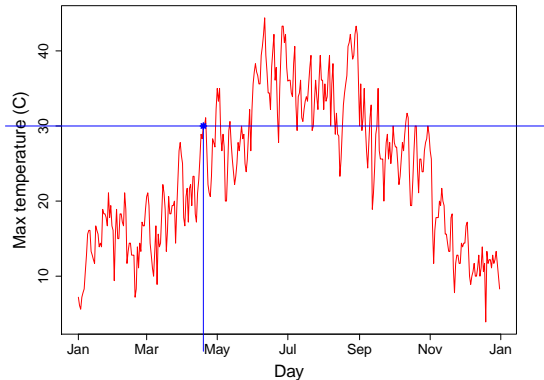
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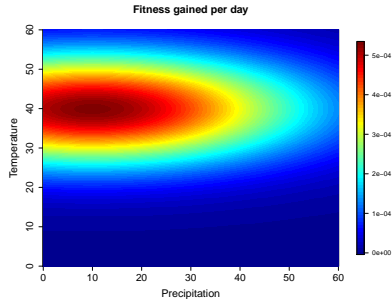
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# Fitness

- After emergence, collect resources each day (for 10 days)
- Daily resources based on temp and precip

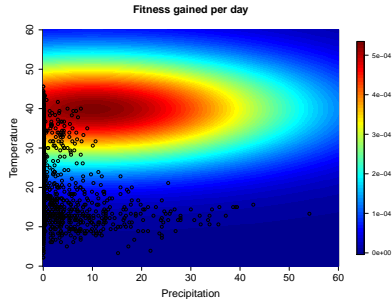
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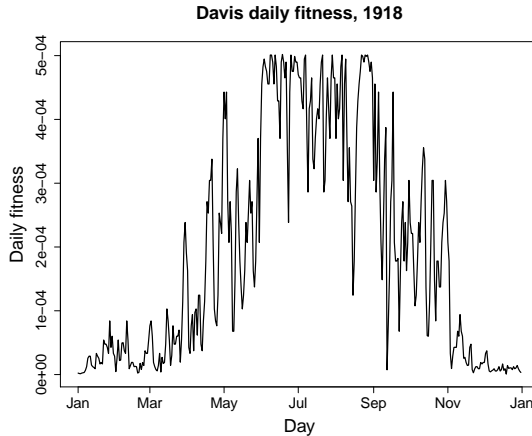


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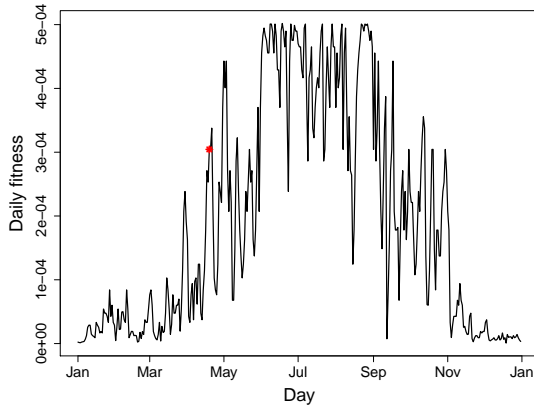


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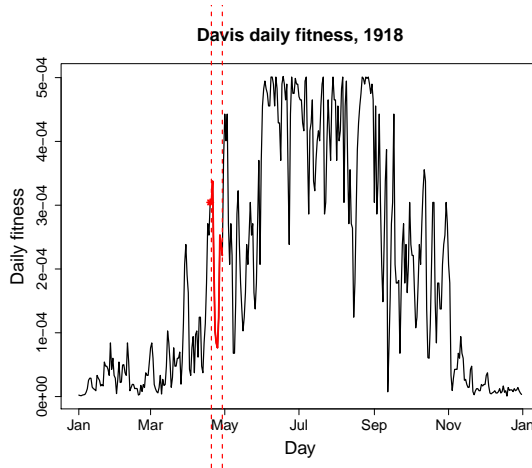


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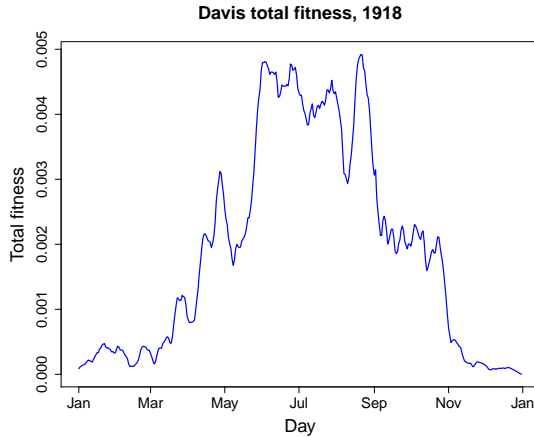
**Davis daily fitness, 1918**



# Fitness



# Fitness



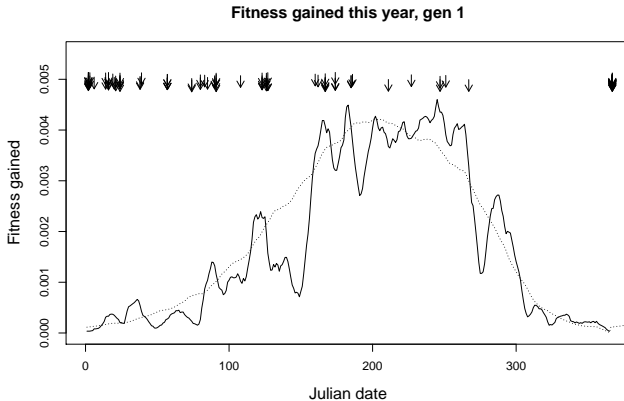


# Reproduction: Lottery Model

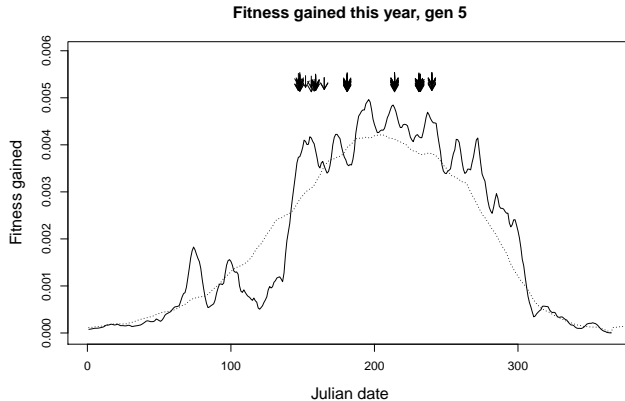
- Fixed population size for all generations
- Assign offspring randomly proportional to fitness
- Offspring traits = parent + mutation (asexual)

Picture here

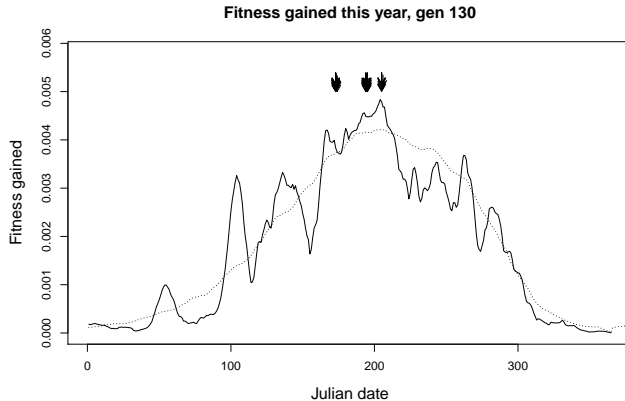
# Simulation results



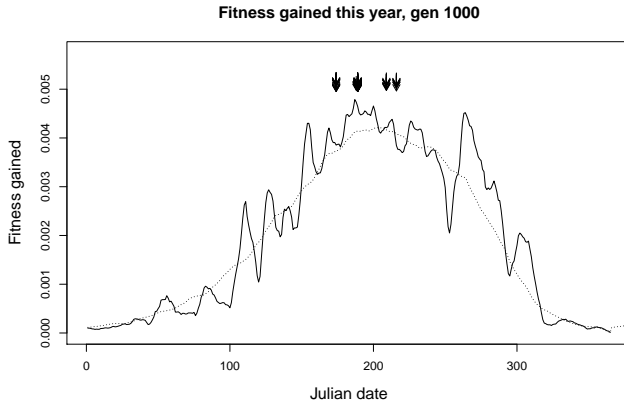
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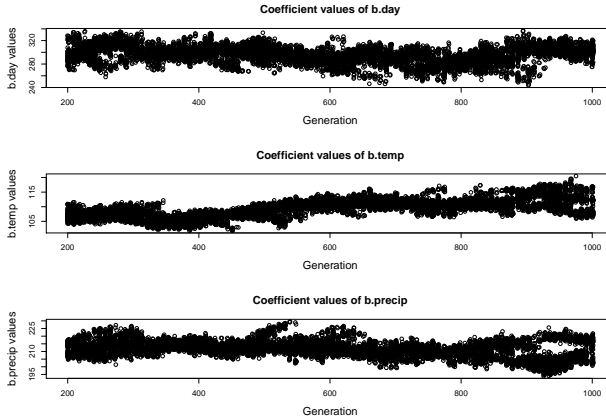
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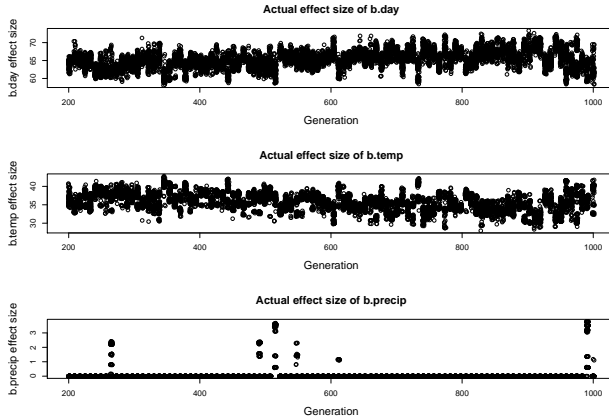
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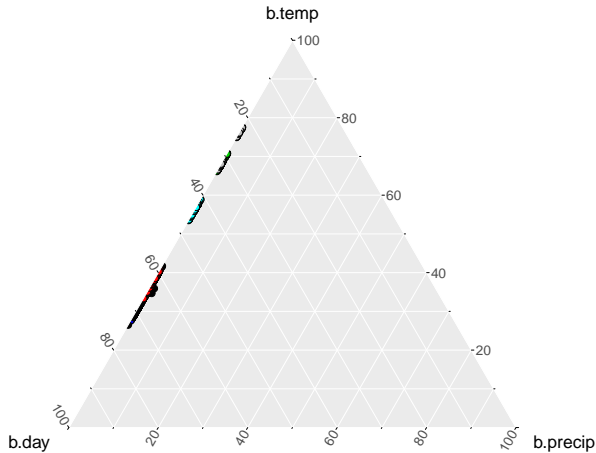
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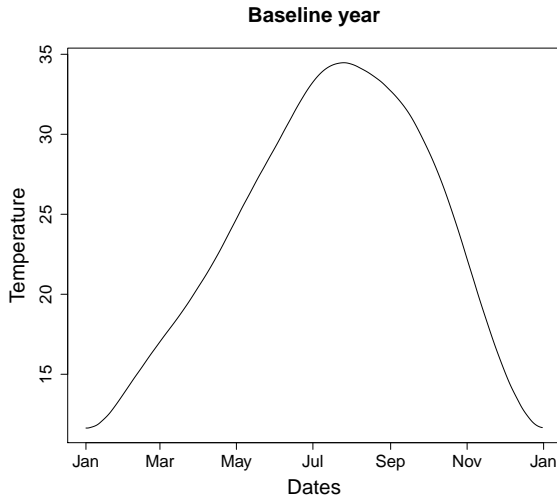
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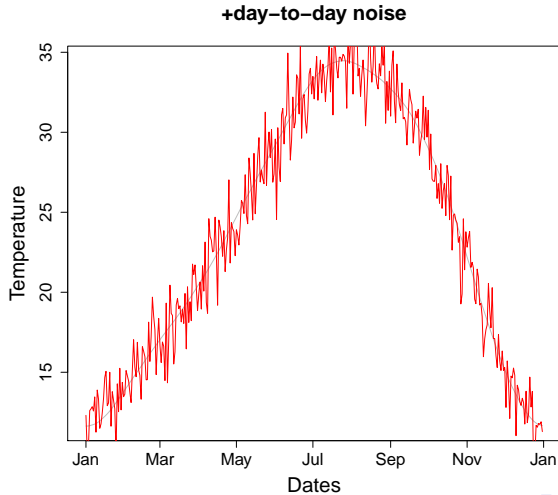
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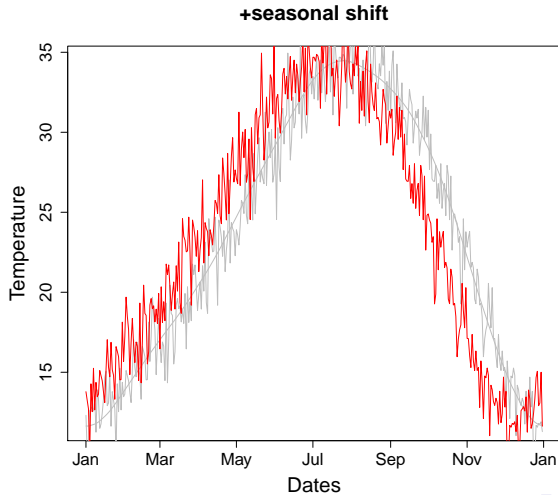
# Baseline year



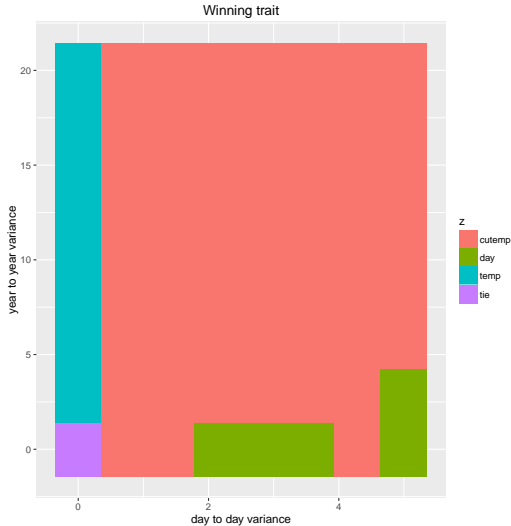
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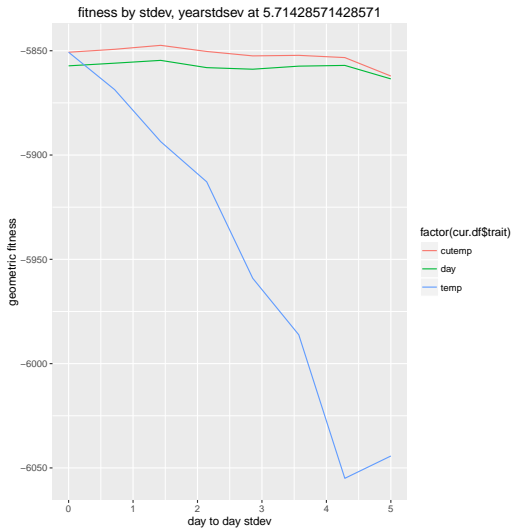
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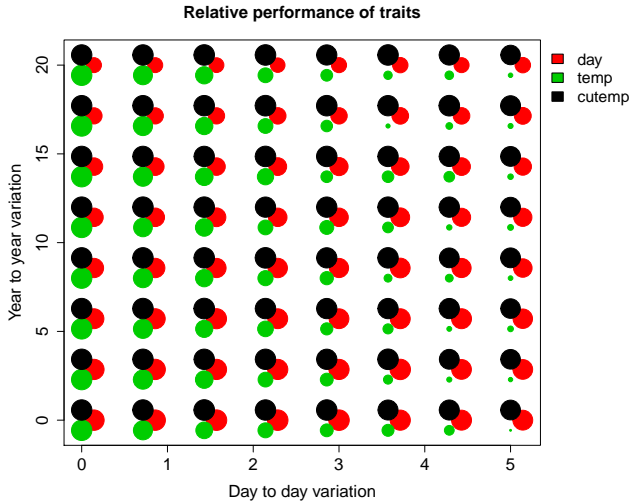
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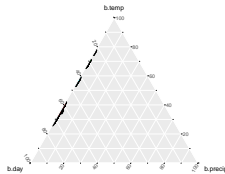
# Conclusion

$$E = \frac{\text{photoperiod cue}}{\text{photoperiod trait}} + \frac{\text{temperature cue}}{\text{temperature trait}} + \dots$$



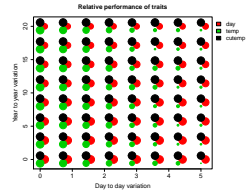
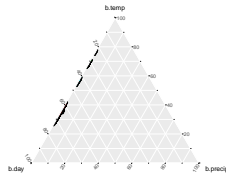
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# Questions or suggestions?

