



Variation in Response to Temperature among N. American Monarch Butterflies: Evidence for Local Adaptation

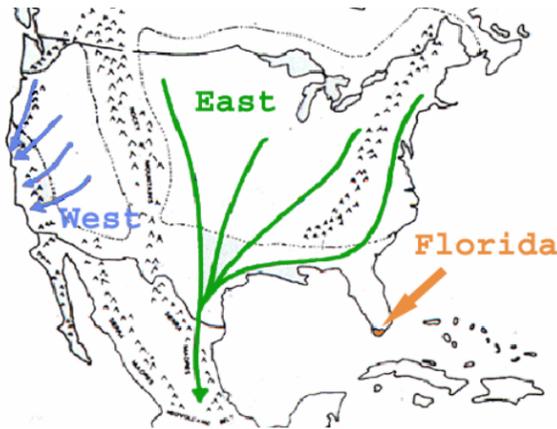


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Background

Key Questions

Results



- How does temperature affect monarch survival, development time, and pupal mass?
- Do populations differ in their response to temperature and is there evidence of local adaptation?
- **Predictions:**
 - Eastern and western monarchs will have a wider tolerance for temperature and perform better under colder conditions
 - Florida monarchs will have a close association with warmer temperatures
 - Siblings will respond similarly
- **Assumptions:** Faster development, increased survival, and higher mass all increase fitness

- Monarchs found in tropical and temperate climates
- 4 US populations: eastern, western (temperate), S. Florida, Hawaii (tropical)
- Potential differences between populations unknown
- Existence of commercial industry involving shipment of monarchs across the country necessitates further research
- Temperature affects larval development - cold causes slower development, hot causes rapid development
- Optimum temperature is approximately 26°C
- Either hot or cold deviations increase mortality

Methods

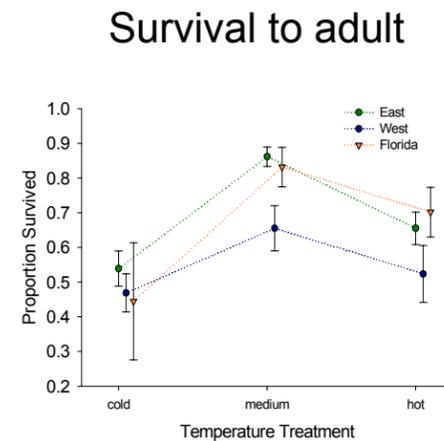
- 3 treatments: Hot (33°C), Medium (26°C), Cold (19°C)
- Offspring taken from 5-12 females/population; 40-50 larvae taken per female and divided among treatments on hatch day
- All larvae raised in treatments until eclosion

Data Recorded:

Survival: day 3,6,9 pupation, adulthood

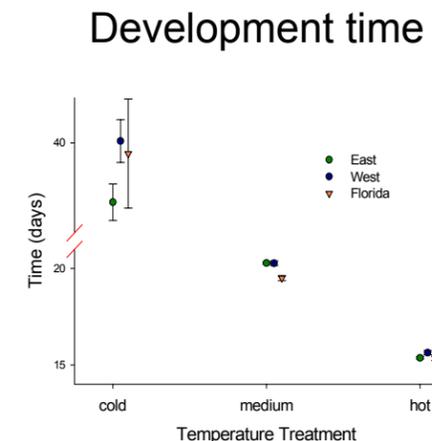
Mass: pupal and adult

Development time: to pupation and eclosion



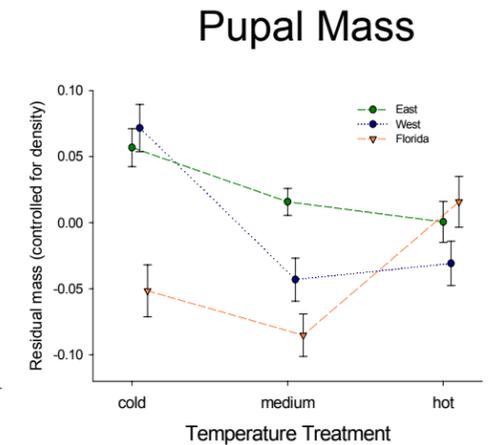
Survival

Survival was highest in the medium treatment overall
Western monarchs had lowest survival comparatively



Development

Monarchs grew fastest in hot; slowest in cold
Westerns slowest in all treatments
Hot and Medium: Florida fastest, Cold: Eastern fastest
Speed of development depended on stage of lifecycle and source population



Pupal Mass

Overall, mass similar in medium and hot but larger in the cold
Florida monarchs were smallest on average
Eastern and Western: cold treatment monarchs were largest
Florida: hot treatment monarchs were largest

Conclusions

- Monarchs from different populations demonstrated different responses to temperatures
- Evidence of local adaptation and trade-offs in life history strategies
- Family-level effects significant, genetic variability in populations

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