

# Group Presentation: The Collapse of Easter Island



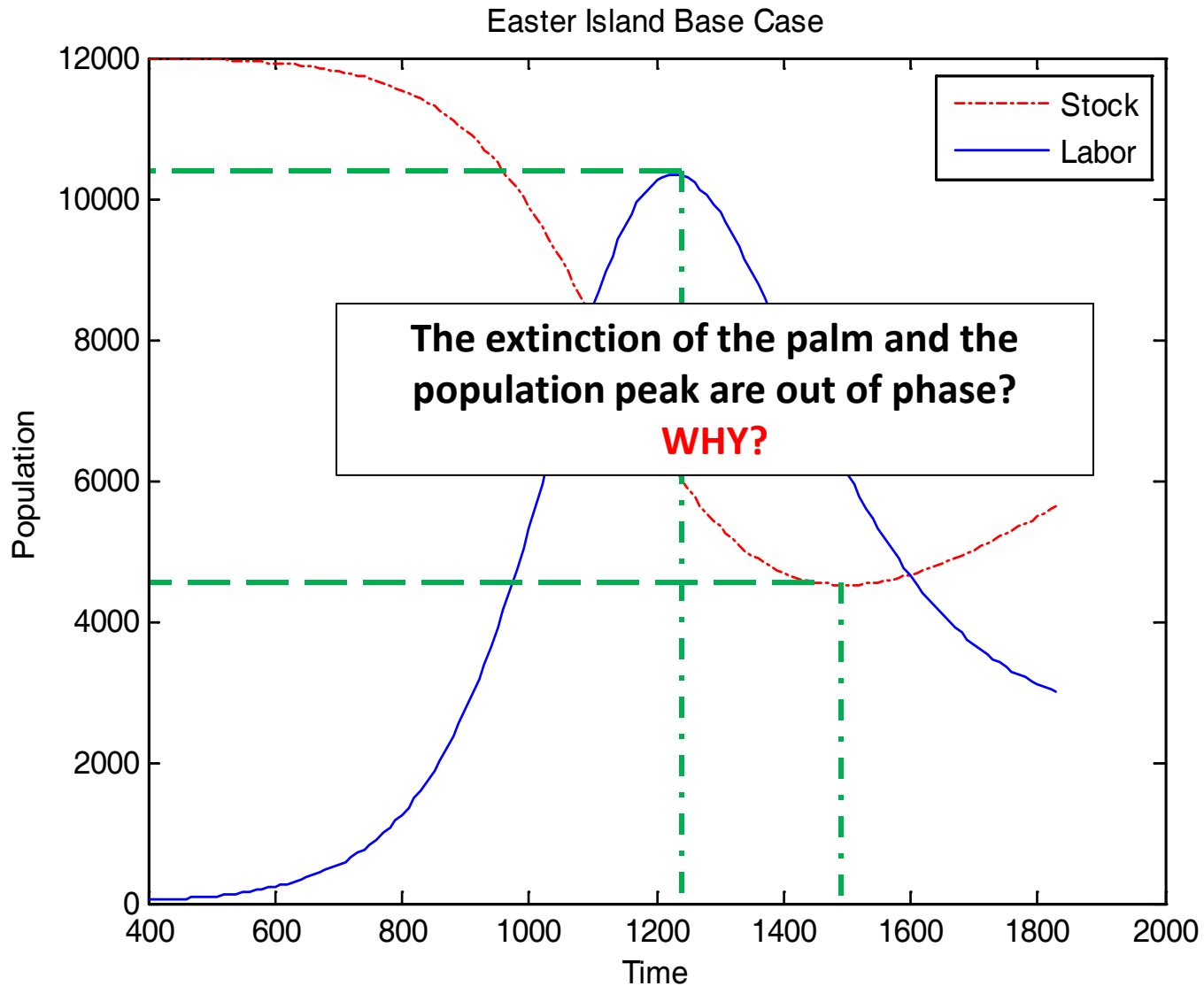
By Mara, Ethan, Brian, Serena and Emma

# Re-cap of Problem

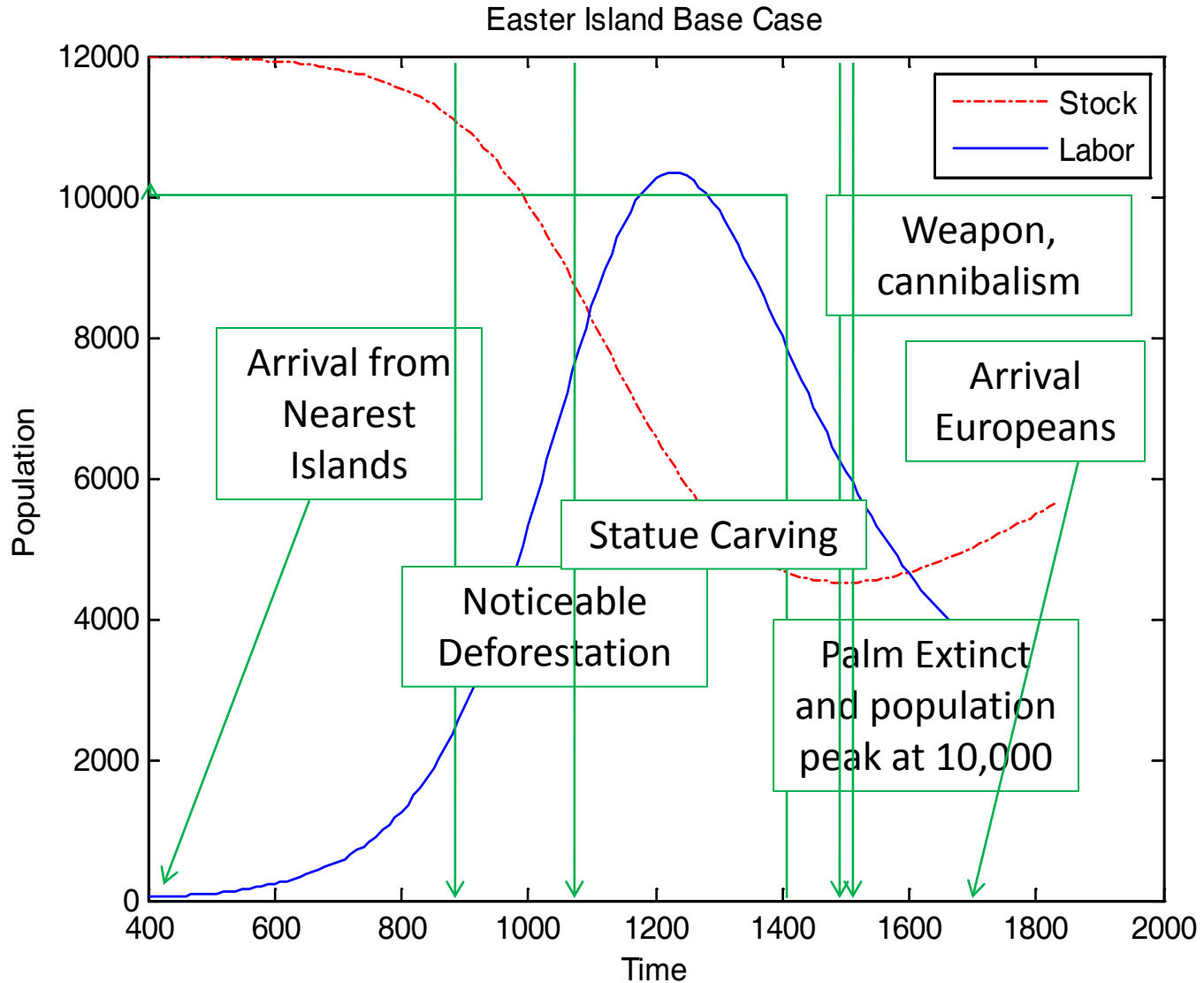
- Easter island is a classic example of human dependence on the environment.
- Shows how resource demands by population had irreversible consequences (rise and fall E.I).
- Brander-Taylor model used a Ricardo-Malthus model of open-access renewable resources.
- The model leads to a dynamical system similar to the Lotka-Volterra predator-prey model.



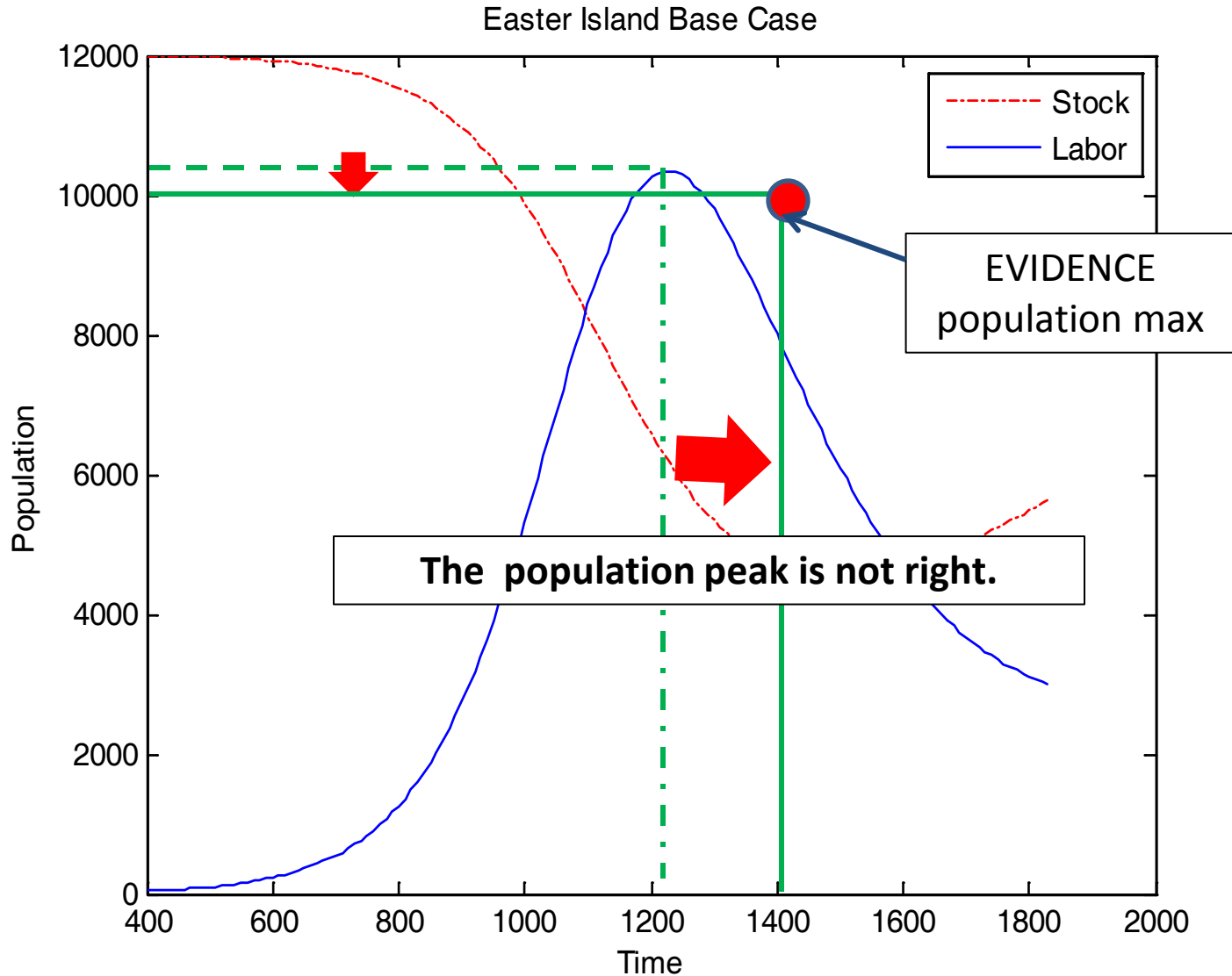
# Brander-Taylor (Ricardo-Malthus)



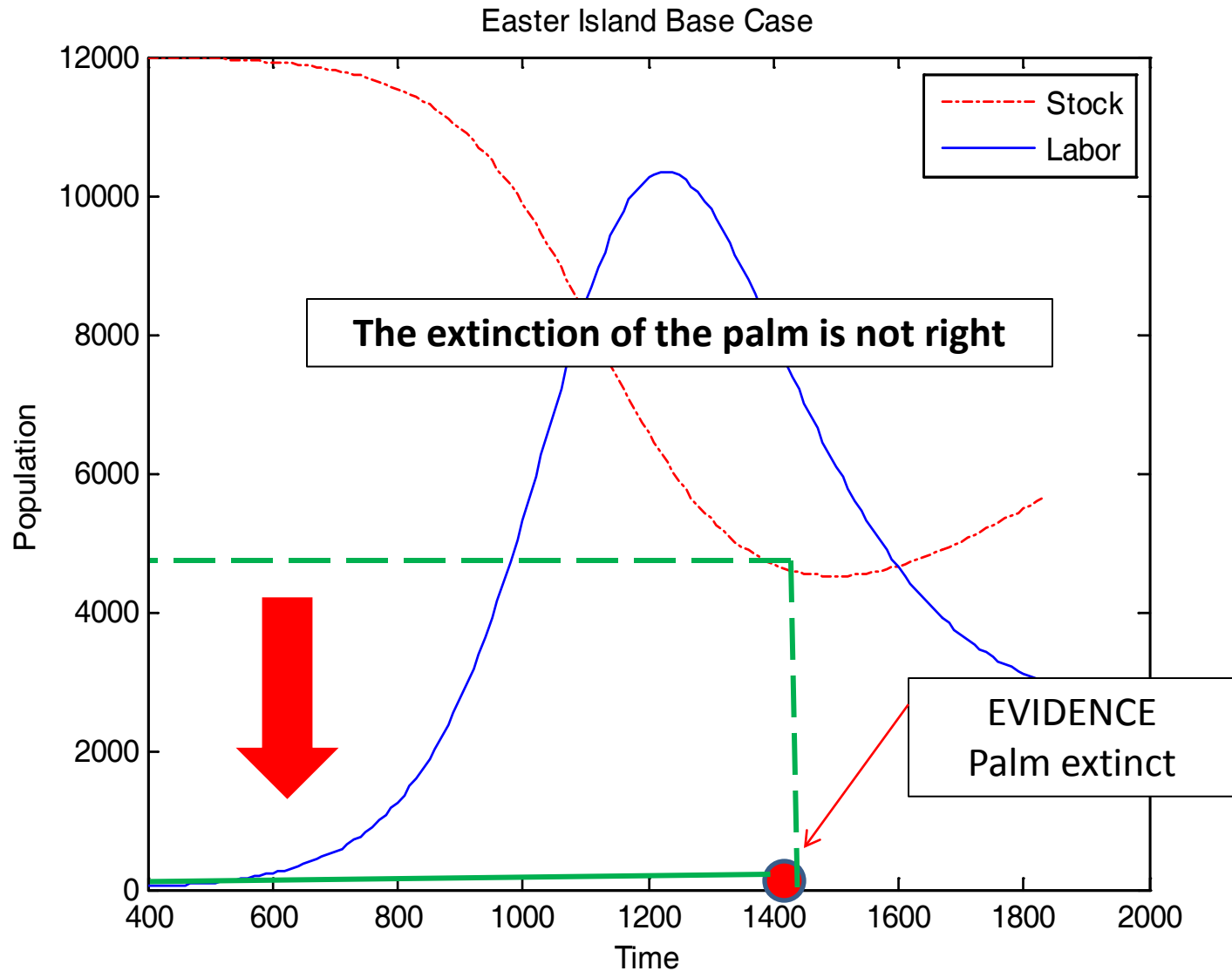
# Brief History



# Brander-Taylor (Ricardo-Malthus)



# Brander-Taylor (Ricardo-Malthus)



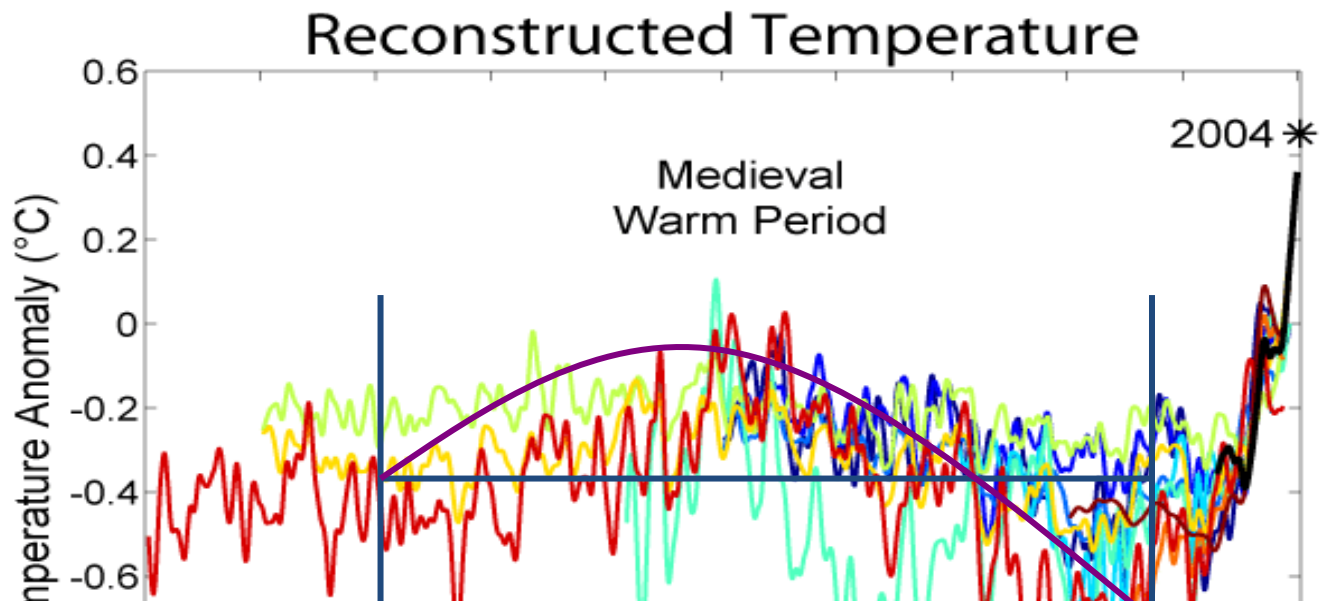
# So.....what are we investigating

- Is the model wrong?
- Is there more to the story?
  - Did climate change influence the rise and fall of Easter island? In what way?
  - Did competition between agriculture and palm contribute to the rise and fall?



# Hypothesis 1: Climate influence

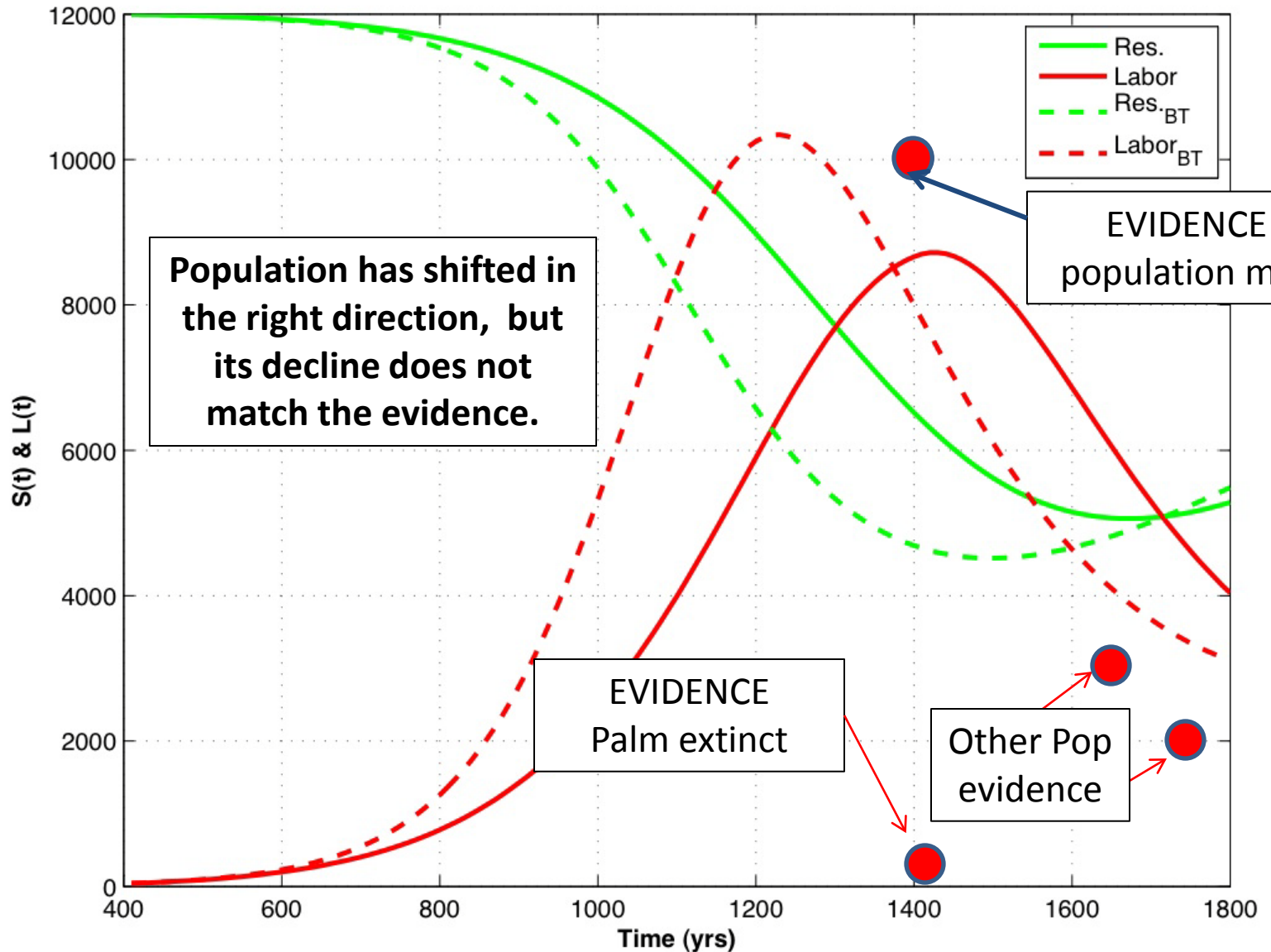
Did the medieval warm period perturb palm growth on Easter island?



**Concept:** The temperature change during this period reduced the resource use efficiency.



# Climate influence on palms



# Hypothesis 2: Competition from Agriculture

Did the agriculture resource affect the palm resource?



**Concept:** As population increased, agriculture competed with palms for space.

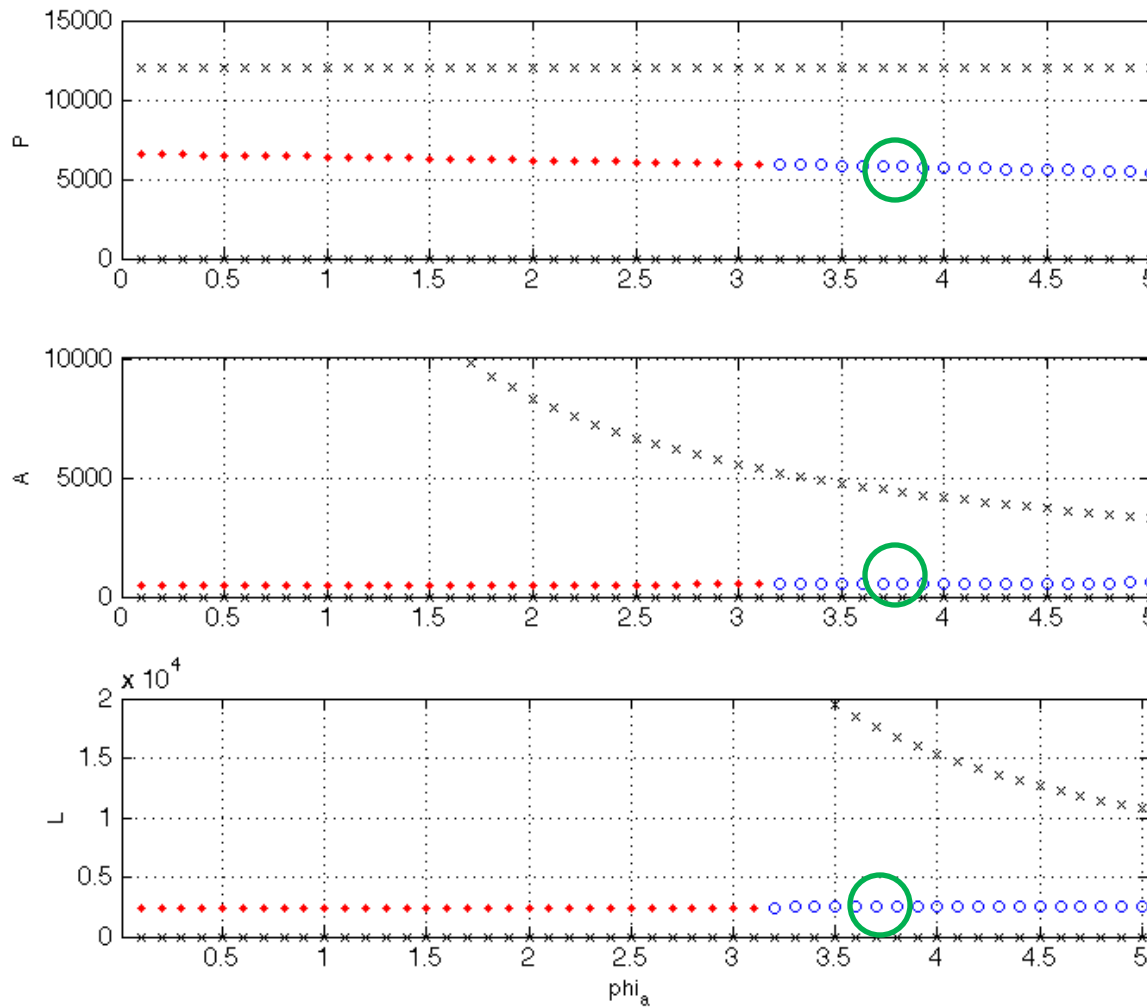


$$\frac{dP}{dt} = r_P P \left(1 - \frac{P + \gamma_P A}{K}\right) - \alpha_P L P$$

$$\frac{dA}{dt} = r_a L \left(1 - \frac{A + \gamma_a P}{K}\right) - \alpha_a L A - \mu A$$

$$\frac{dL}{dt} = L (bd + \Phi_P \alpha_P P + \Phi_a \alpha_a A)$$

# Bifurcation diagram



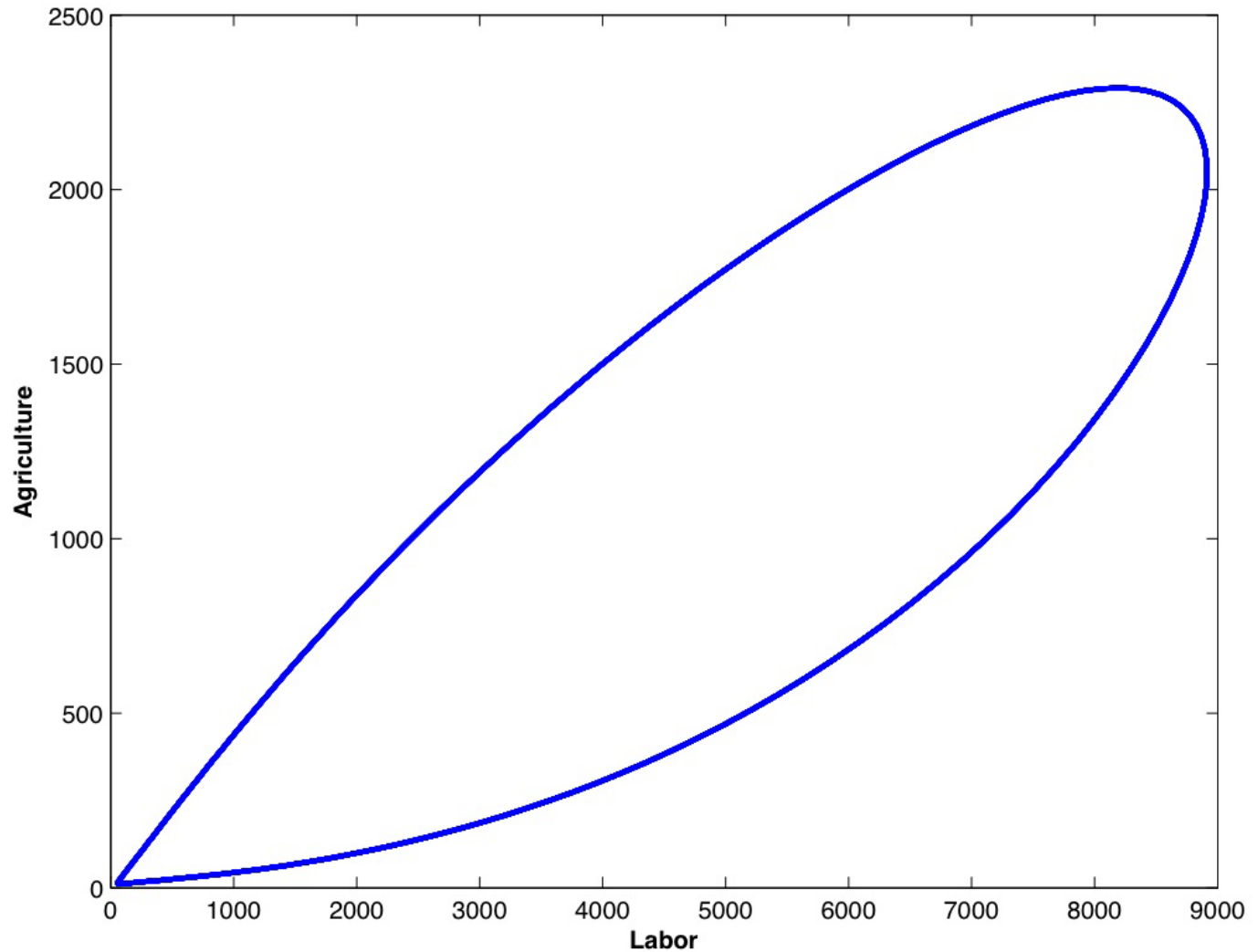
## Legend

○ Stable limit cycle

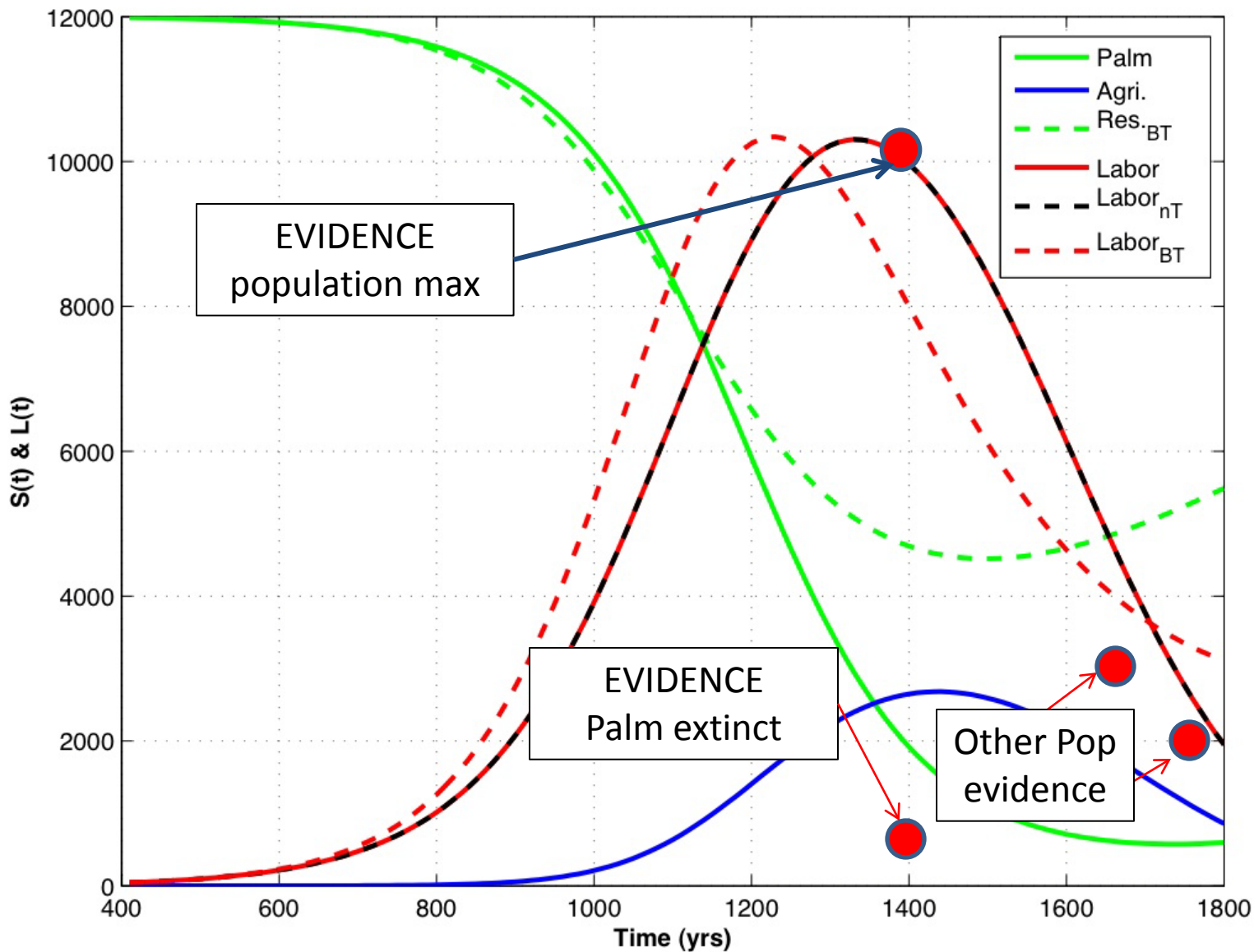
● Stable fixed point

✱ Unstable fixed point

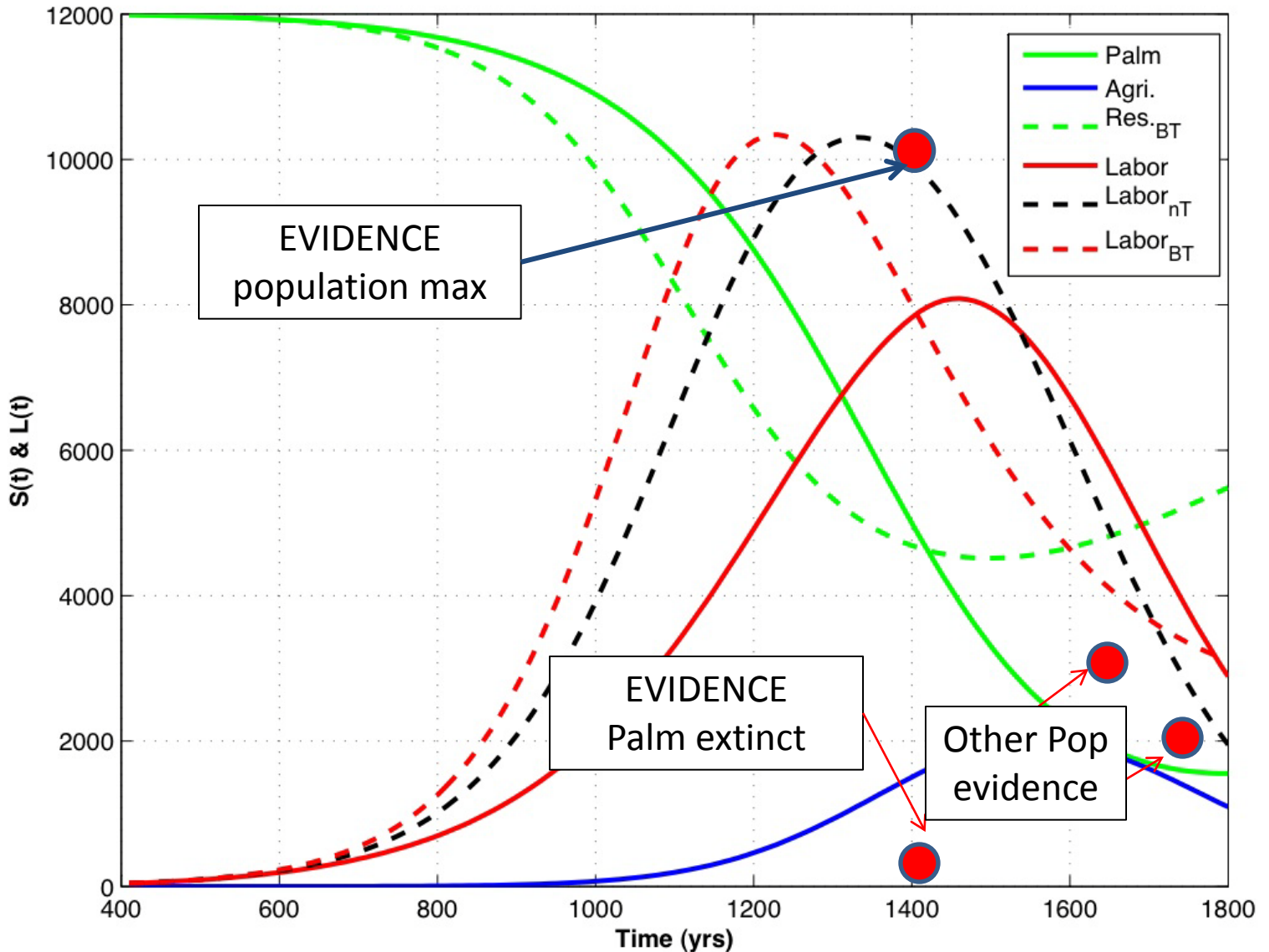
# Phase Space Trajectories



# Agriculture influence on palms



# Climate and Agriculture





# Conclusion

- Climate hypothesis does not match the evidence as well as the competition hypothesis.

## Future work

- More robust stochastic modelling



# Questions?

