

Connecting parasite-infected crab data to shorebird mortality during El Niño seasons

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Introduction

- Pacific mole crabs serve as the primary intermediate host for Acanthocephalan parasites.
- Common food source for shorebirds and sea otters - linked to a number of mortality events.
- Parasite development and transmission may be strongly effected by weather patterns.
- Segregated the data from LiMPETS into El Niño/La Niña seasons to obtain parameters for the differential equation model.

Organisms

- Acanthocephalan parasites require multiple hosts to complete a life cycle.
- Burrowing time has been shown to increase when the crabs are infected with parasites¹, allowing for easier predation.
- Surf Scoters (*Melanitta perspicillata*) are a definitive host.
- California sea otters (*Enhydra lutris*) are a dead-end host.
- 13-16% of sea otter deaths are caused by this parasite².
- Consuming parasite-infected crabs are fatal for these predators because the parasites cause peritonitis.

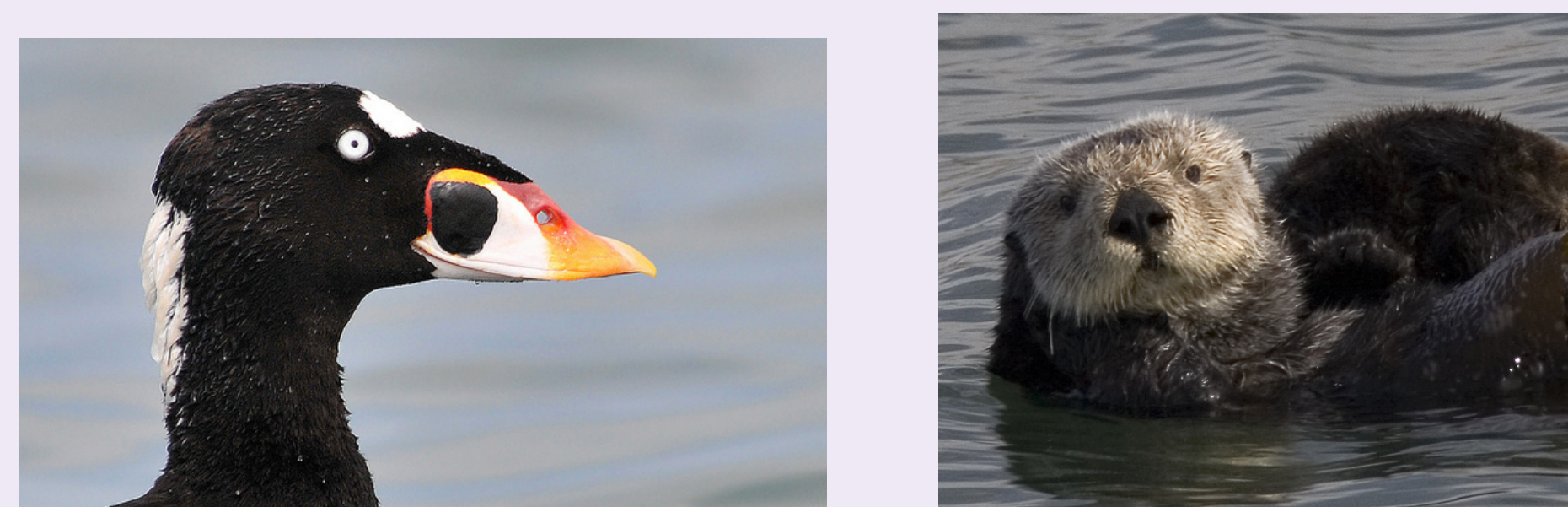


Figure 1: Surf Scoter (Left) and Sea otter (Right)

Acanthocephalan Life Cycle

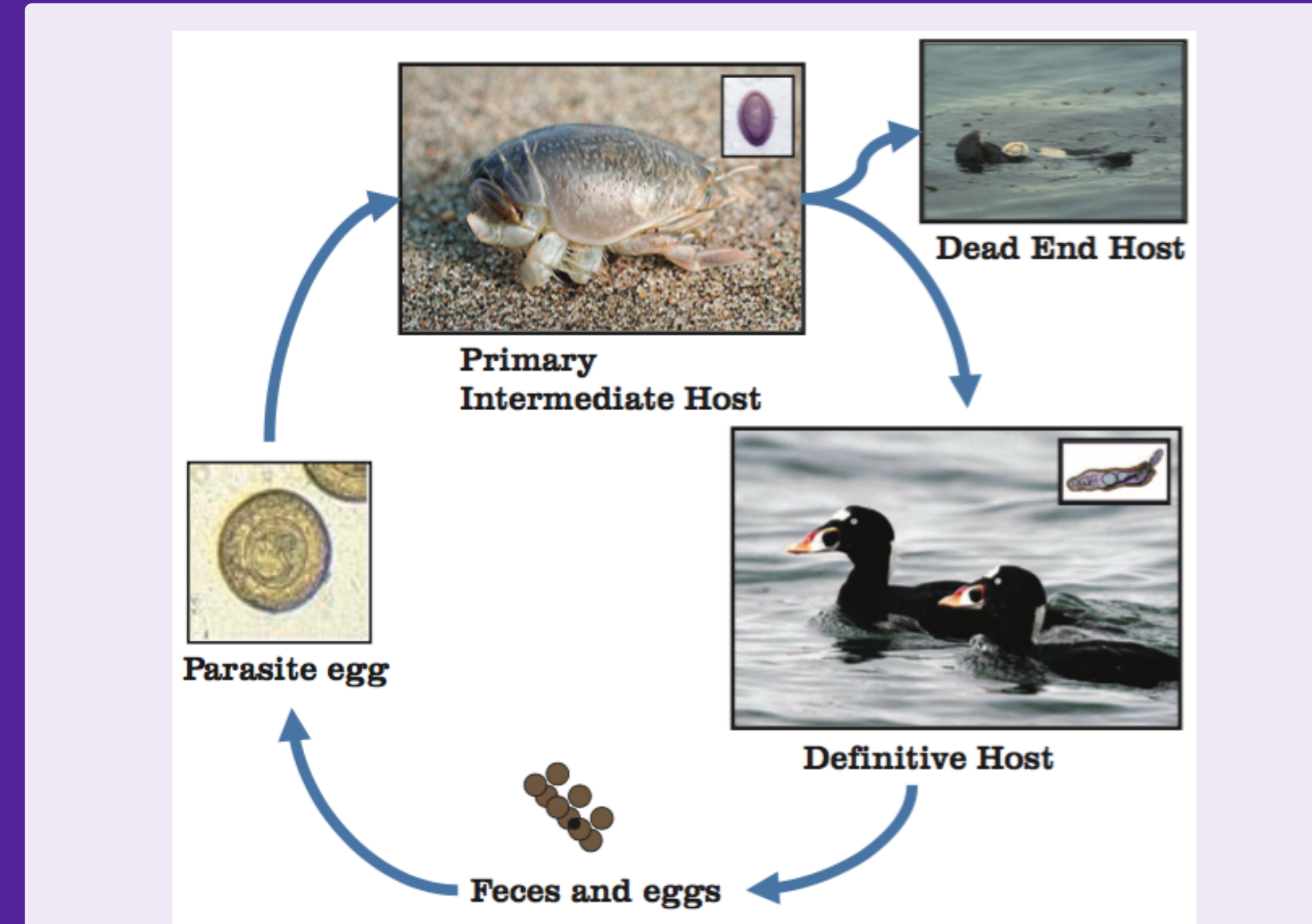


Figure 2: Model of Acanthocephalan life cycle

El Niño/La Niña Seasons

- Seasons with less than 0.5 °C higher or lower than the average temperature are normal.
- Results in above-average and below-average water surface temperatures.
- This phenomenon has significant influence on increased parasite-host interactions³.

Acant-Crab-Scoter Model

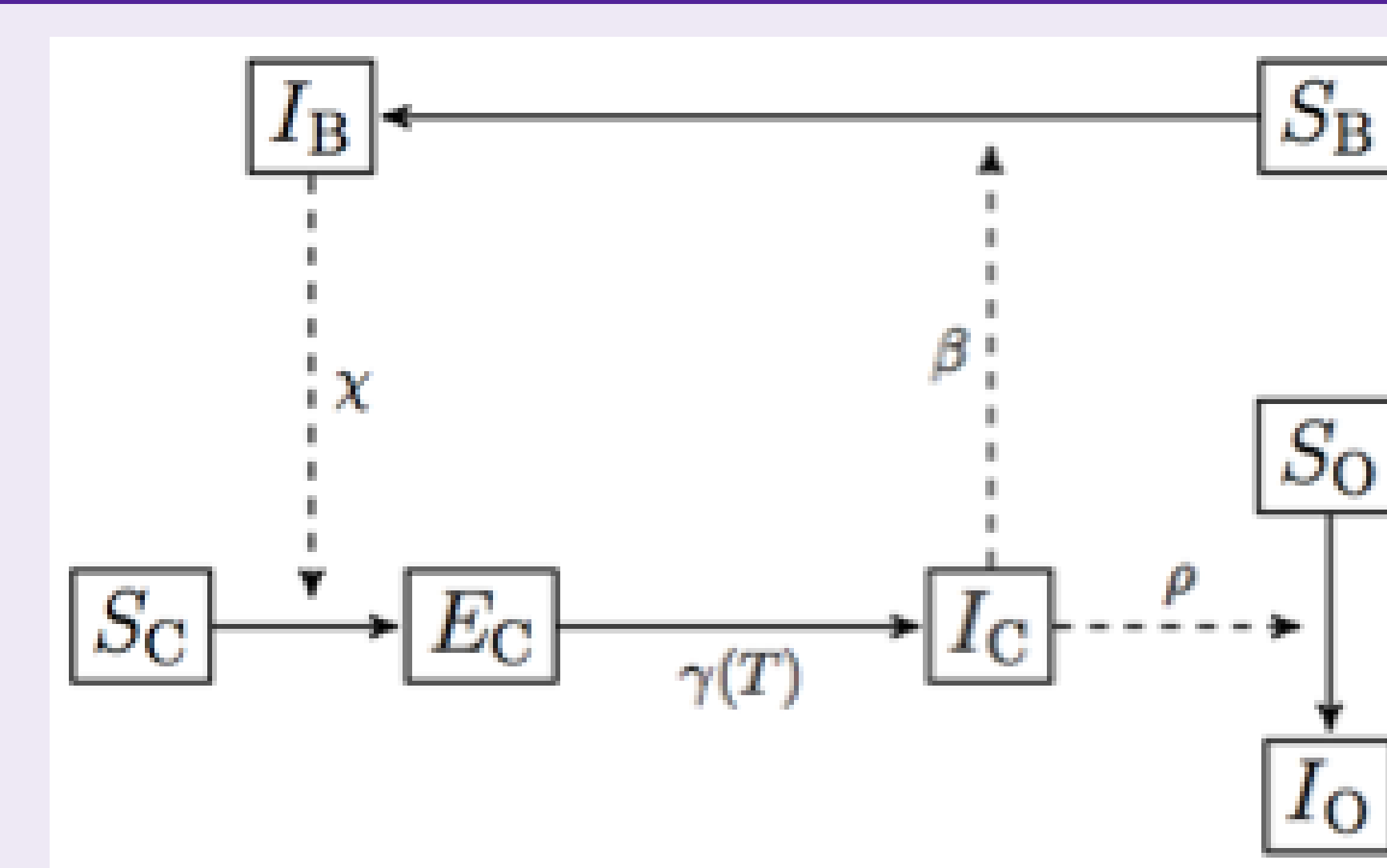


Figure 3: Model of Parasite-Host interactions

LiMPETS

- Long-Term Monitoring Program and Experiential Training for Students is a citizen science program.
- Data is collected at multiple locations along the California coast.
- Regular monitoring allows for quick observation of ecosystem unbalances.
- This report used LiMPETS data on parasite prevalence in mole crabs in the Ocean Beach area of San Francisco.

Results

- Graphs were obtained using a differential equation model in the mathematical software, Mathematica.
- Parameter estimation done for transmission rates for El Niño and La Niña seasons
- Observed differences in the infected crab population during El Niño and La Niña seasons
- Greater infected crab-Surf Scoter transmission rate during El Niño seasons (greater β value)

Conclusion

- Infected population of crab generally lower in La Niña seasons
- Since the transmission rate is greater, the shorebird mortality rates are also greater in El Niño seasons, as infection is fatal
- However, less data available from LiMPETS during La Niña seasons

Further Research

- Sea otter-parasite interactions relieving shorebird-parasite interactions.

Acknowledgements

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References

- ¹ Kolluru, G et al. (2011). Parasite infection and sand coarseness increase sand crab (*Emerita analoga*) burrowing time. *Behavioural Processes*, 88(3): 184-91.
- ² LiMPETS. (2017). Acanthocephalan Parasites: Fact Sheet.
- ³ Mouritsen, K and Poulin, R. (2002). Parasitism, climate oscillations and the structure of natural communities. *OIKOS*, 97(3): 462-68.

Numerical Solutions in El Niño/La Niña Years

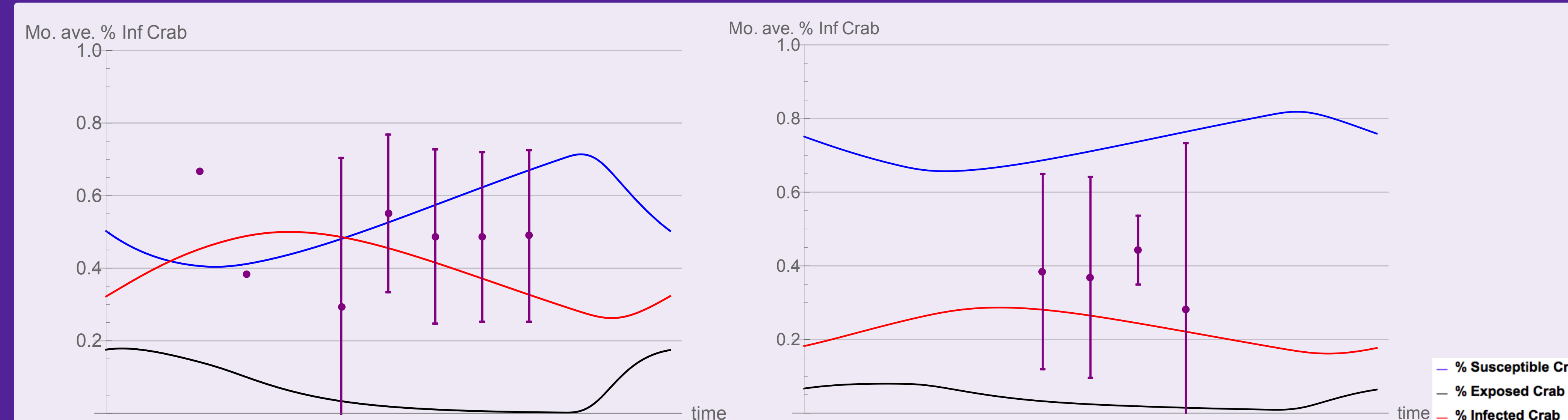


Figure 4: Monthly percentage of infected crabs in El Niño (Left) and La Niña (Right) seasons