Diurnal variation in the corrosiveness of sediments and its effects on a hard shell clam

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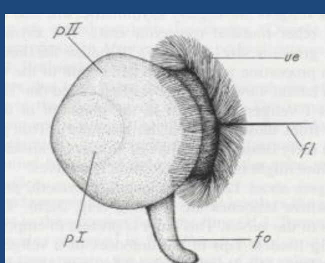
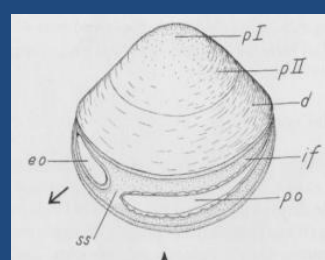
Mercenaria mercenaria, the hard shell clam

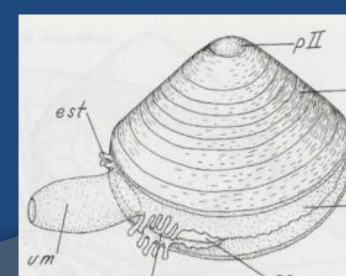
- Marine bivalve that builds a calcium carbonate ($CaCO_3$) shell
- The pediveliger stage (late larval) is an active feeding swimmer
- Metamorphose to juvenile stage finds habitat in the upper sediment layer
- Upon settlement a new layer of shell growth and intensive organ development occur
- Effective shell building dependent on non-corrosive sediment conditions



~0.2mm Pediveliger (larval)



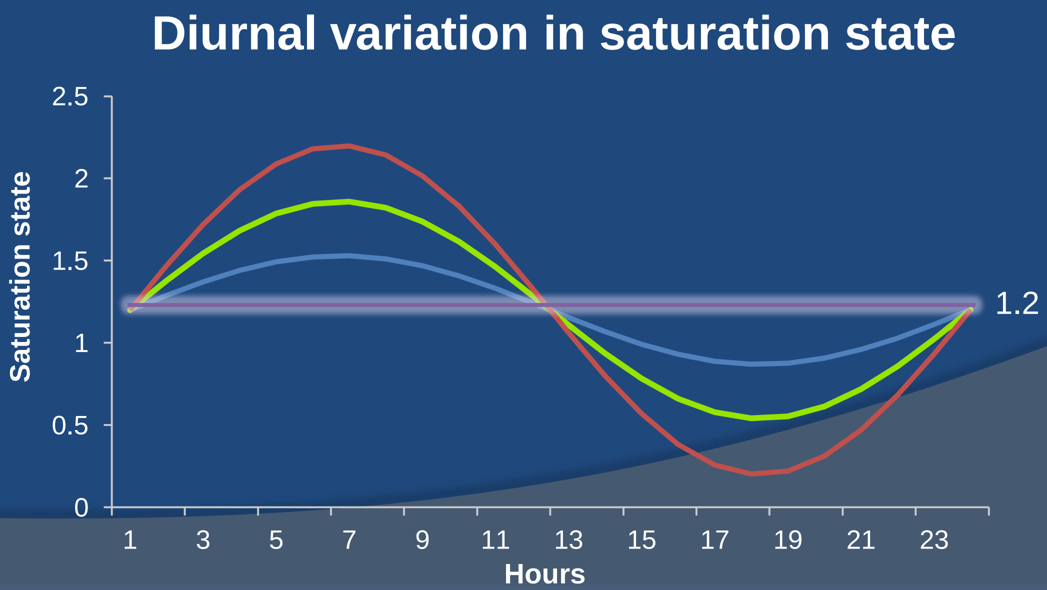
~0.2mm+ Dissoconch I (juvenile)



~1.0mm+ Dissoconch II (juvenile)

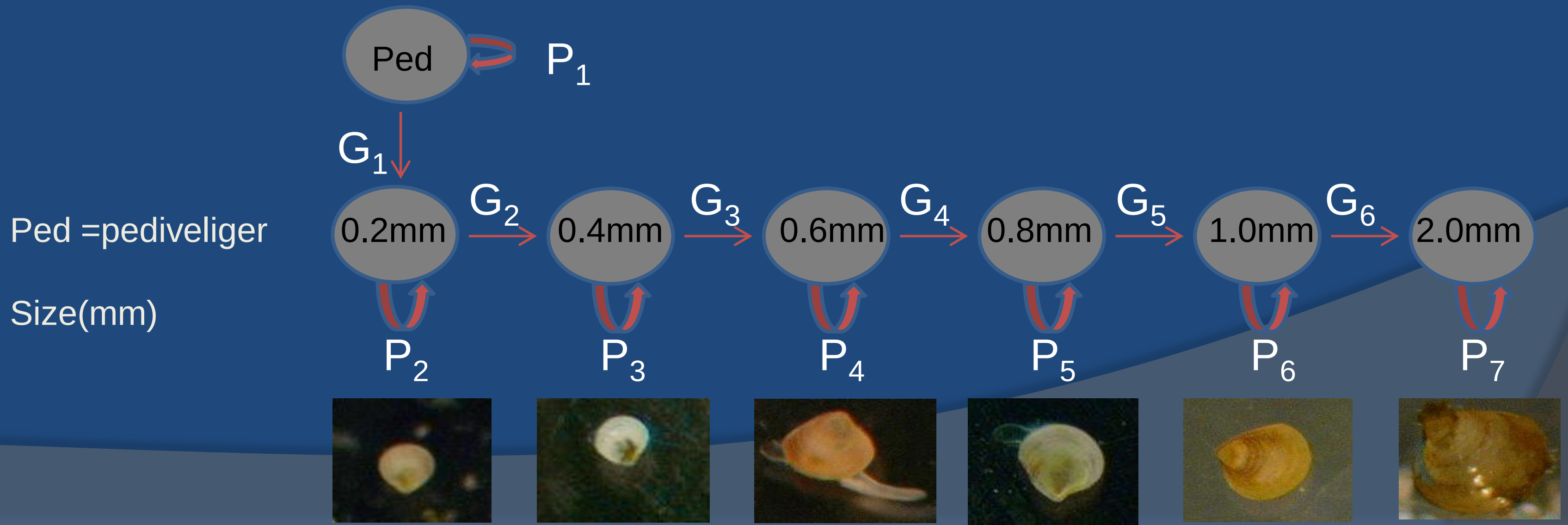
Saturation state and diurnal variability

- Upper sediment layer is rich in organic matter (OM)
- Decomposition of OM leads to increased CO_2 production at sediment-water interface
- Increase CO_2 decreases CO_3^{2-} concentration
- Saturation state of $CaCO_3$ is a measure of corrosive conditions (<1)



Population model and associated parameters

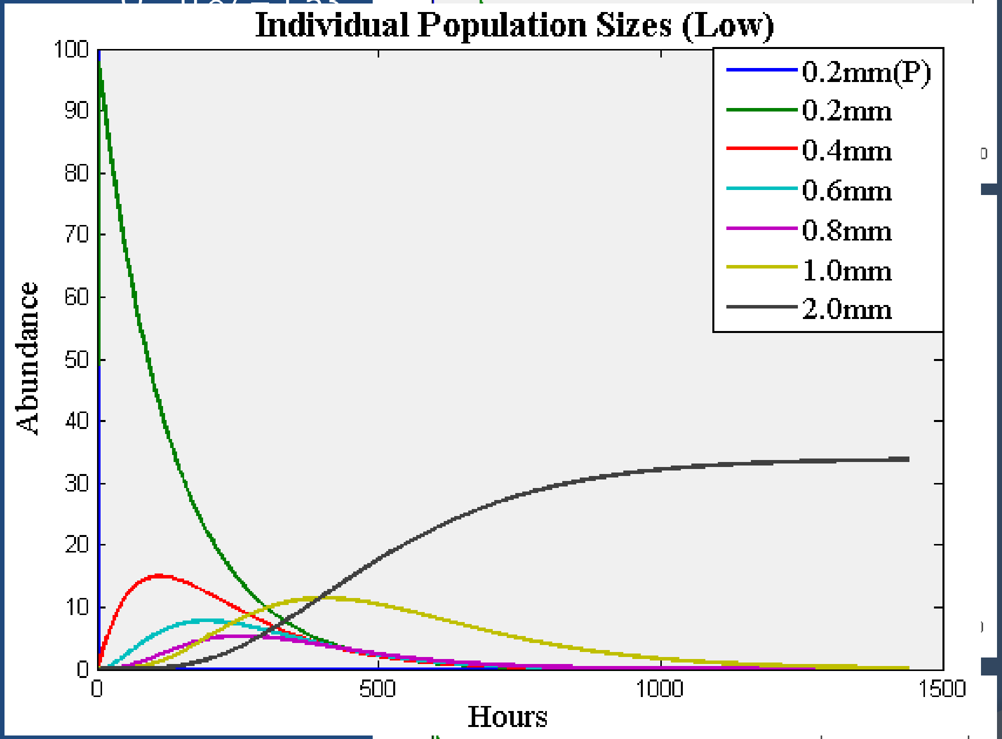
- A population model predicts a future population based on parameters set into the model
- Model Parameters: growth (G_x), survival (P_x) and saturation state (Ω)
- A low saturation state can inhibit shell formation and decrease survival and growth

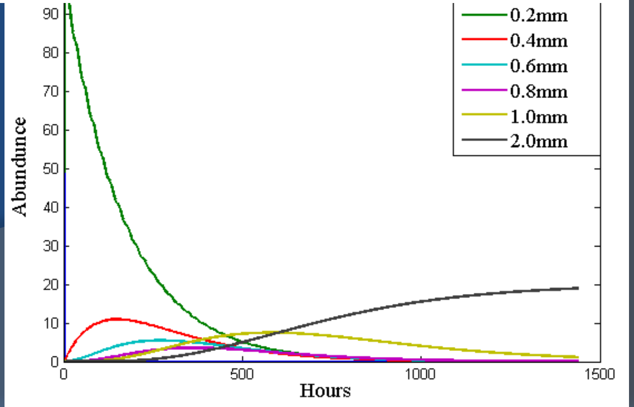


Varying degrees of saturation state: Model simulations

- Model runs for 60 days at an hourly time step
- Daily variation in saturation state, changing hourly
- 3 model simulations low, medium and high variability in Ω at same mean value
  - Starting population 100
  - Final population size (n)

Ω = 0.87 – 1.53





Ω = 0.20 – 2.20
n = ~19

Conclusions and future work

- Smaller class sizes are more susceptible to decreased saturation states
- Larger daily variation in saturation state results in a decreased population growth rate
- Higher mortality occurs with larger variations in saturation state
- Predation and settlement component will be added to the model
- A separate carbonate chemistry model will run in parallel with population model

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Increasing Diversity In Earth Sciences

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