

Effects of temperature and food availability on feeding behaviour in the sea cucumber *Cucumaria frondosa*

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Background

- *Cucumaria frondosa* – largest & most abundant sea cucumbers in the North Atlantic and Arctic oceans¹
- Commercially harvested in Maine and Atlantic Canada¹
- Benthic suspension-feeders². Tentacle insertion rate (**TIR**) = proxy for feeding rate
- **Goal:** to fill knowledge gaps relating to the ecophysiology of *C. frondosa*¹

Research questions

- How does **temperature** affect feeding behaviour?
- How does **food availability** affect feeding behaviour?

Methods

- Sea cucumbers from Halifax Harbour
- 10 inds. held in each of two 245L mesocosms
- Two independent experiments:
 - Increase **temperature** by 1°C every 3 days (5°C to 16°C)
 - Increase **phytoplankton concentration** by 10,000 cells ml⁻¹ every 3 days (2,000 cells ml⁻¹ to 50,000 cells ml⁻¹)
- Every 3rd day - Data collection
 - Videos of TIRs (**individual feeding**)
 - # of individuals feeding (**population feeding**)
 - Particle counts & water quality

Data analysis

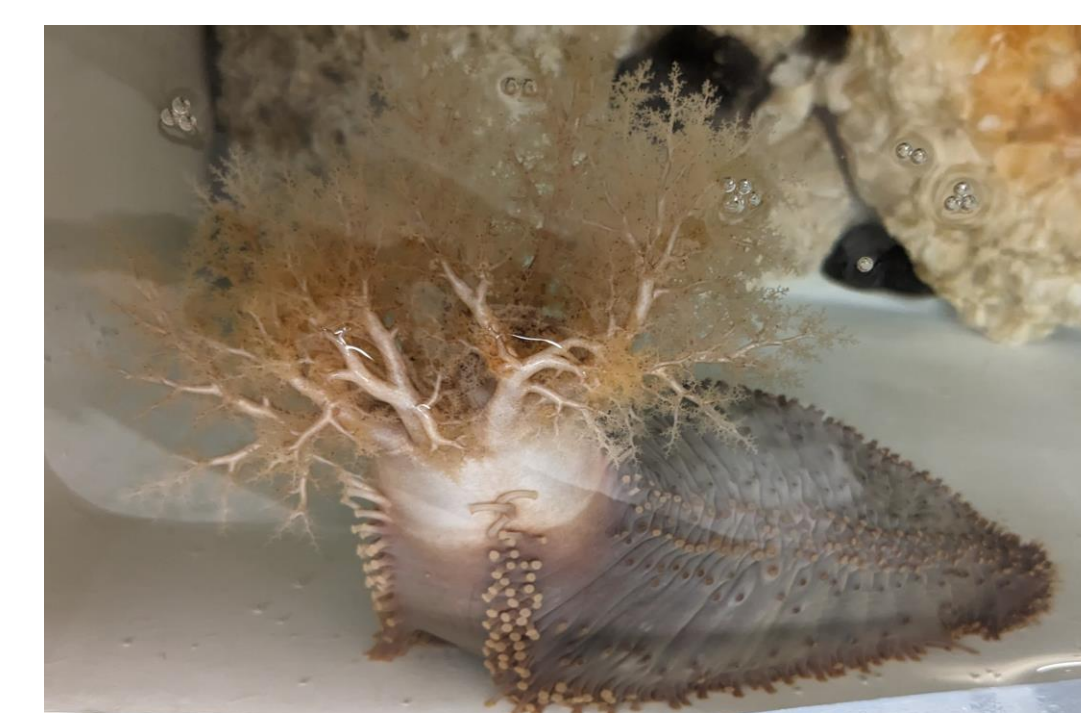
- Linear Mixed-Effect Modelling in R (*lm*, *lmer*, *nls*)
- Fit tested using Akaike Information Criterion



Closed

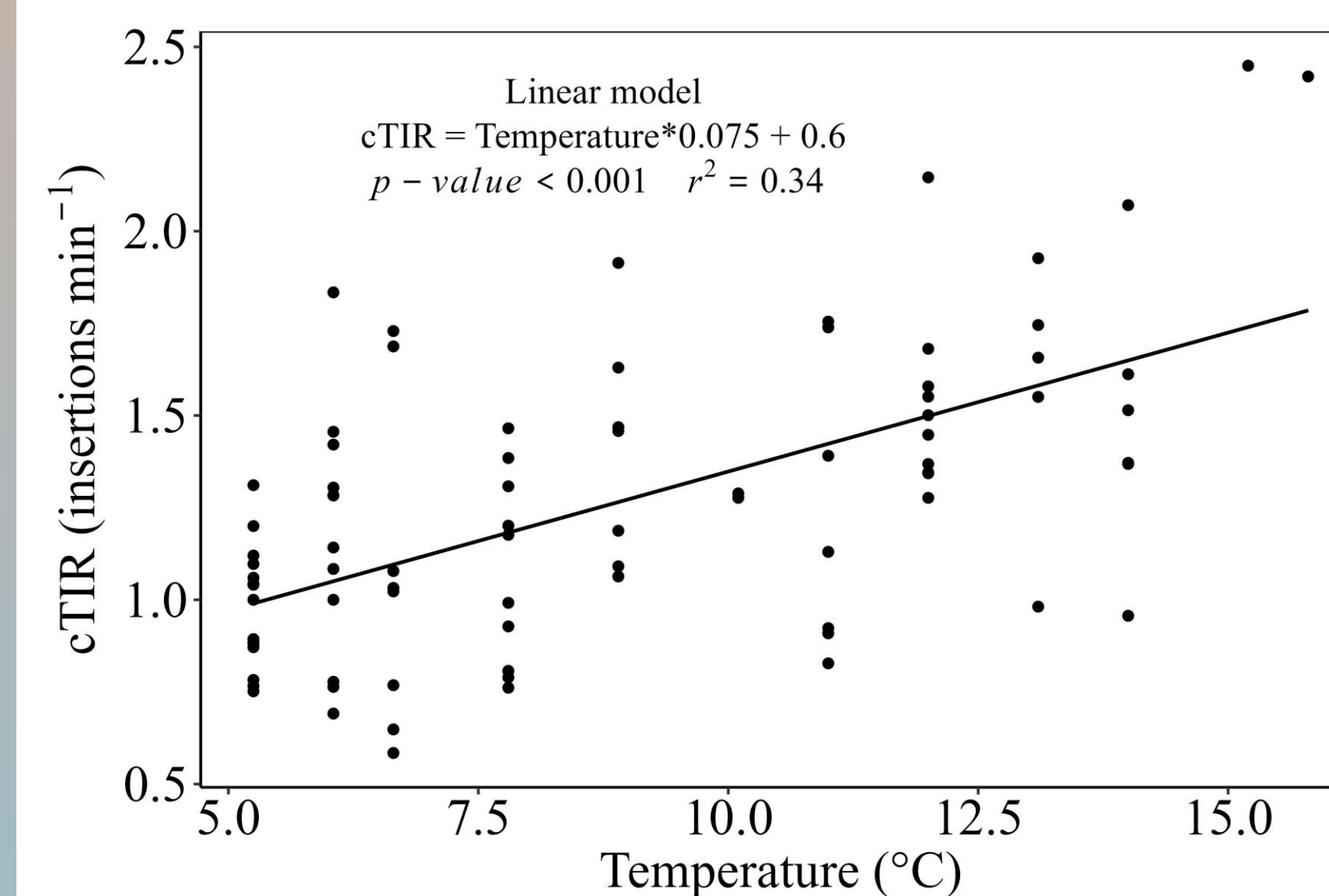


Partially open

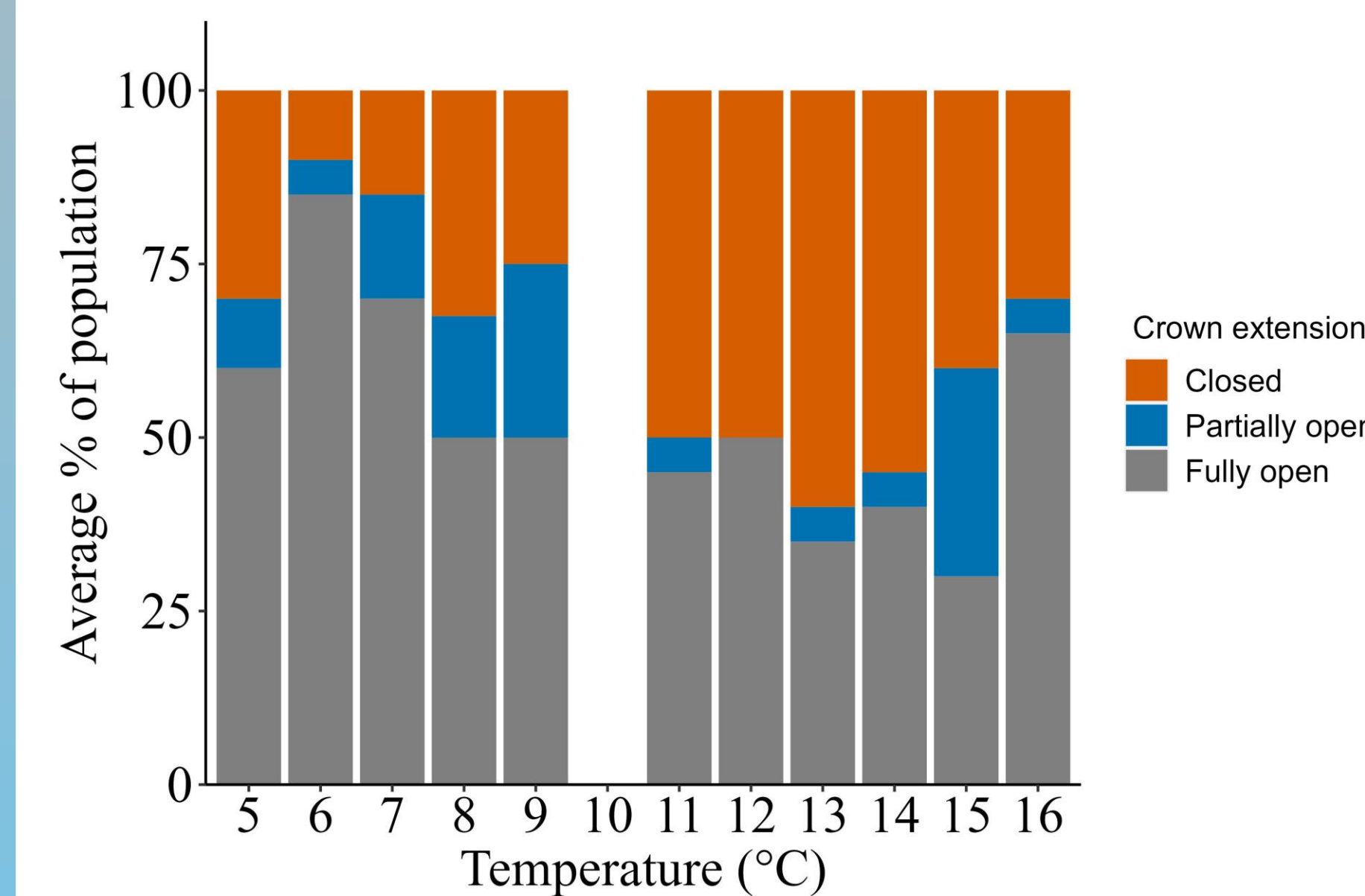


Fully open

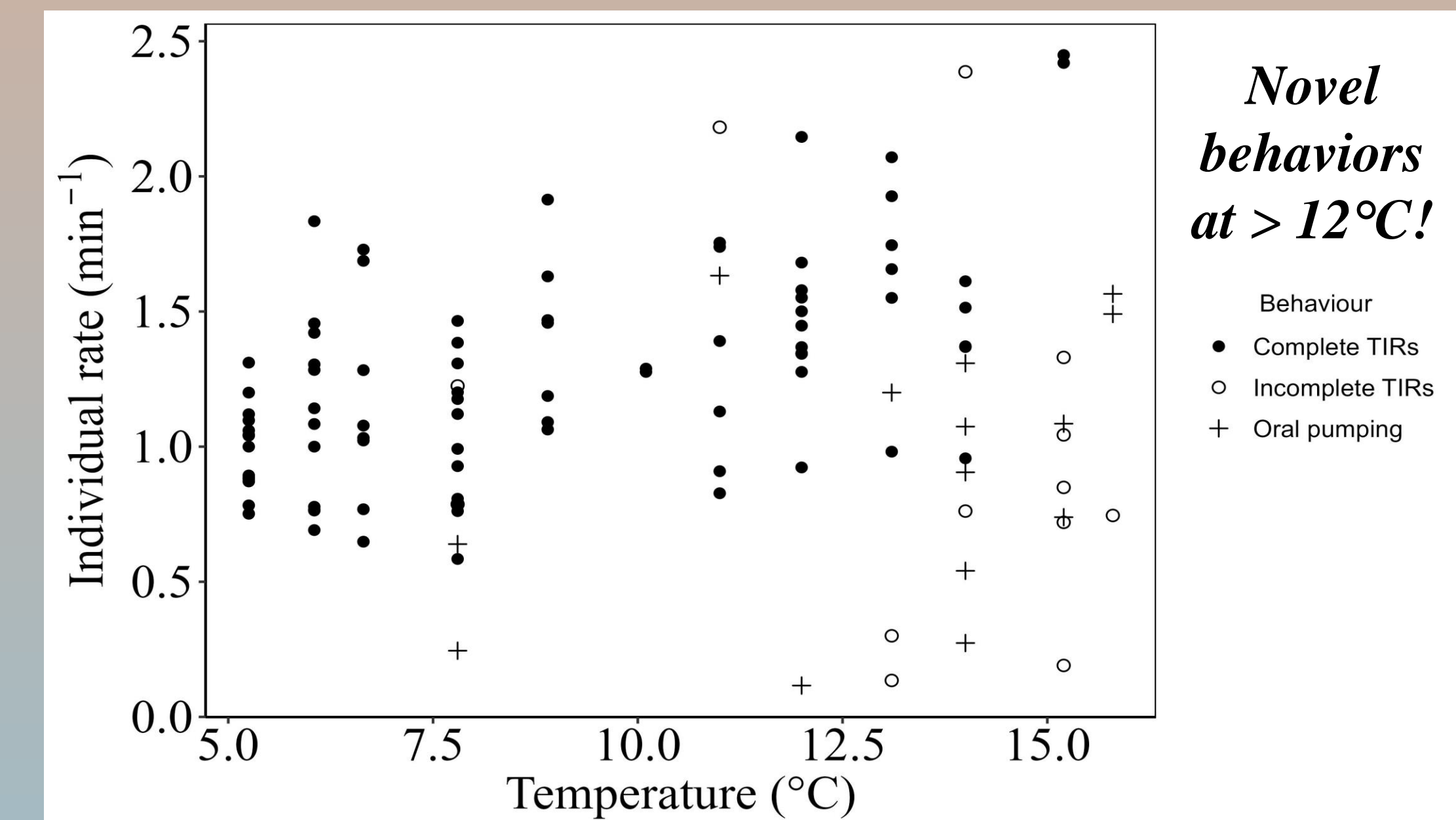
Results: Temperature



- ↑ Temperature => ↑cTIR (complete insertions)
- ↑ Temperature => more frequent iTIR (incomplete insertions) + OP (oral pumping)



- ↑ Temperature = ↓ % population feeding
- 15-16°C: several individuals open but not feeding



Discussion

Complete insertions



Low

Incomplete insertions (Failed feeding attempts?)



Thermal stress

Oral pumping



High

- High interindividual variability
- 12°C: an ecologically relevant threshold?
- Rapid increase in TIR with food at low [food]

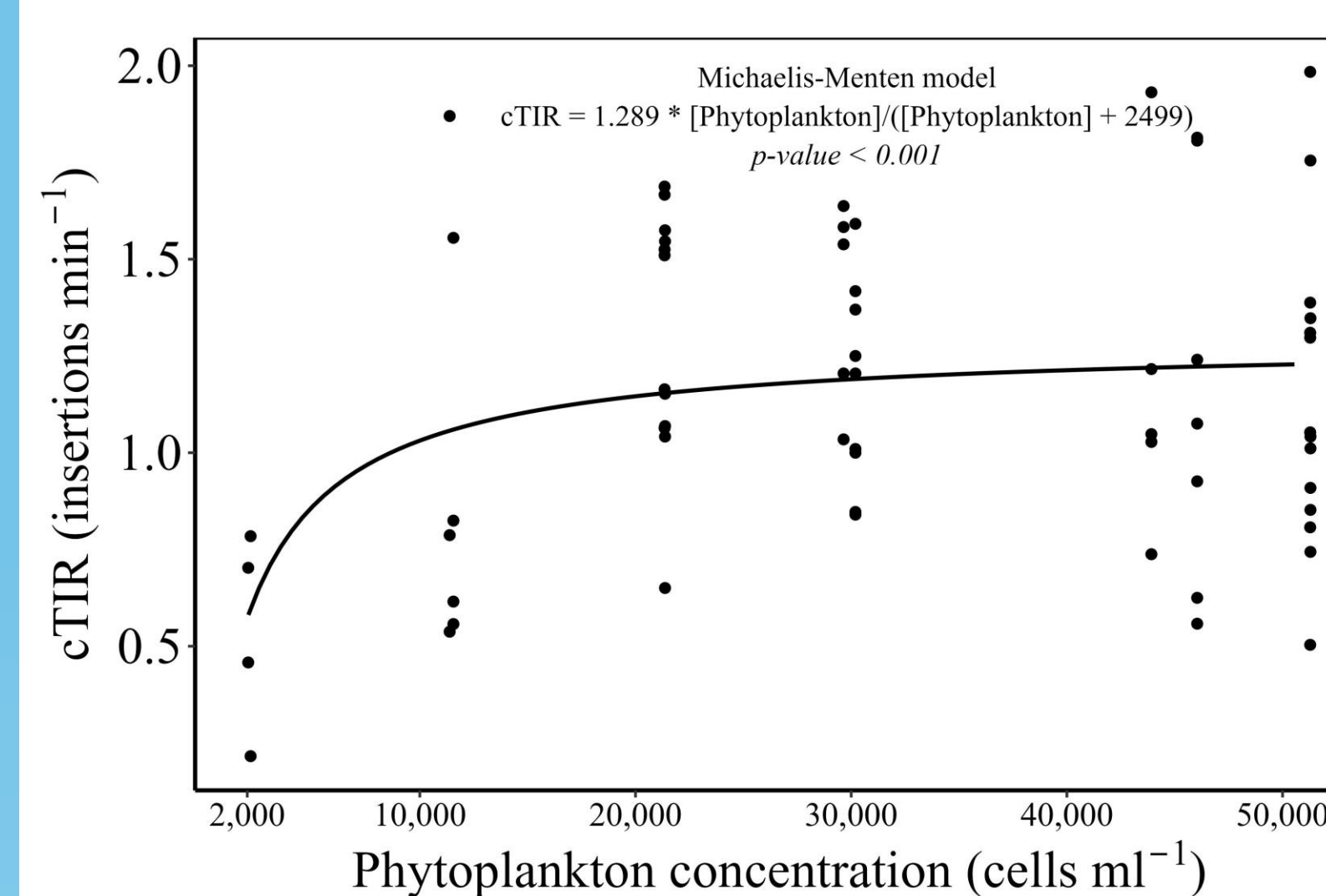
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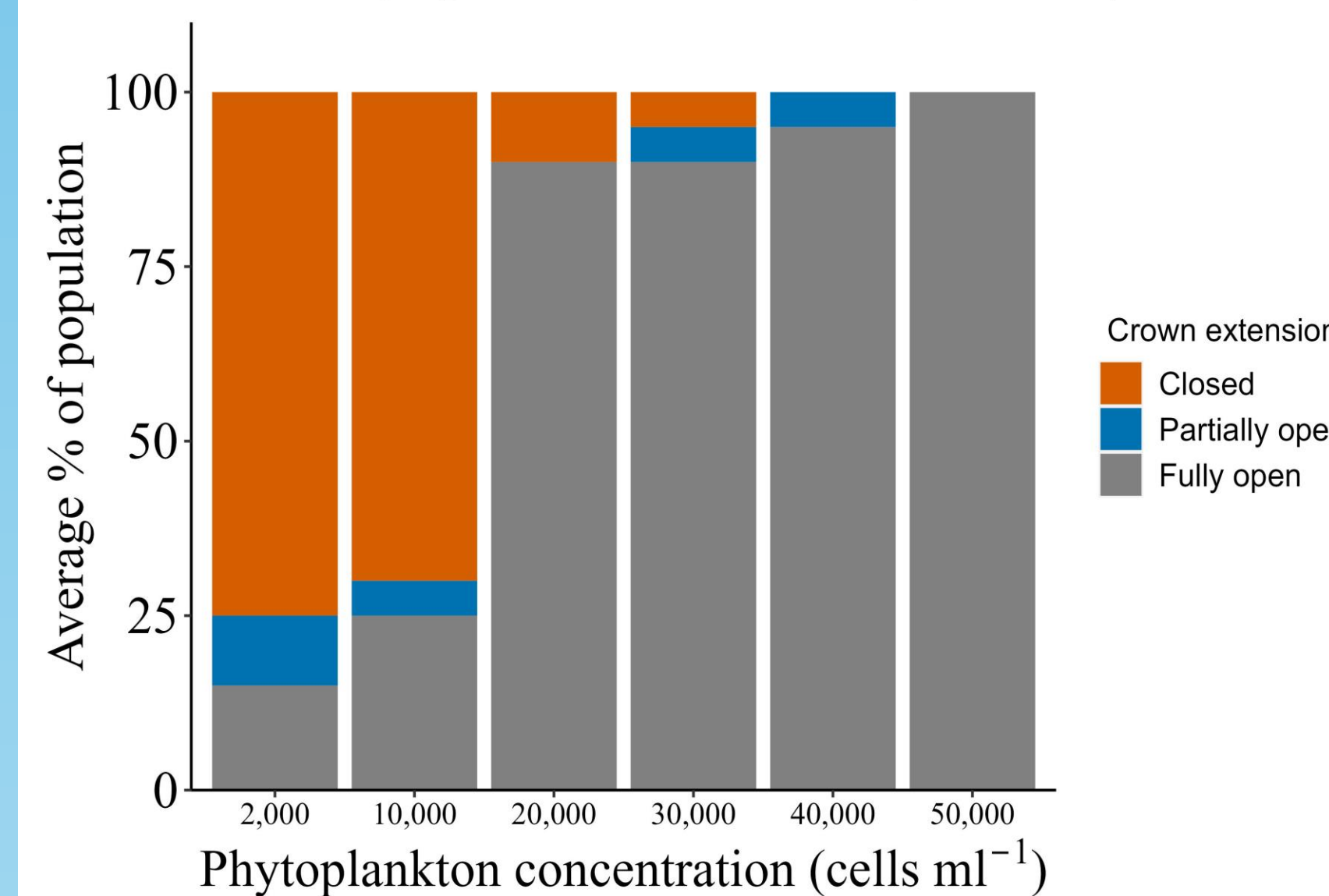
References

- Gianasi BL, Mercier A. et al. 2021. Current Knowledge on the Biology, Ecology, and Commercial Exploitation of the Sea Cucumber *Cucumaria frondosa*. Rev Fish Sci. 29(4):582-653.
- Singh R, MacDonald BA et al. 1999. Patterns of seasonal and tidal feeding activity in the dendrochirote sea cucumber *Cucumaria frondosa* (Echinodermata: Holothuroidea) in the Bay of Fundy, Canada. Mar Ecol Prog Ser. 187:133-145.

Results: Food availability



- ↑ [Phytoplankton] => ↑ cTIR
- Plateau at ~1.29 insertions min⁻¹ after ~ 20,000 cells ml⁻¹
- No OPs or iTIRs



- ↑ [Phytoplankton] = ↑ % population feeding
- All feeding at 40,000 cells ml⁻¹