Paternal identity influences response of *Acanthaster planci embryos* to ocean acidification and warming.

[1]Kate Sparks, [2]Shawna Foo, [3]Sven Uthicke, [4]Maria Byrne and [1]Miles Lamare

[1]Univ. Otago Dept Marine Science, Dunedin NZ; [2] Univ. Sydney School Anatomy and Histology, Sydney AUS; [3] Australian Institute of Marine Sciences, Townsville, AUS; [4] Univ. Sydney School of Medical Sciences, Sydney, AUS

AIM: To determine the adaptive capacity of *A. planci* to combined ocean acidification and warming.

ABSTRACT

- '**Outbreaks**' of *A.planci* are increasing in frequency – driven by food availability and warm ocean?
- **Quantitative Genetics** (QG) used to assess adaptive capacity within the population from Cairns, Queensland, AUS.
- **FOUND**: Temperature a barrier to developmental success
- **FOUND:** Sire identity important for adaptation to ocean acidification, warming
- **FOUND:** positive genetic correlation between performance at high temperature and high pCO_2

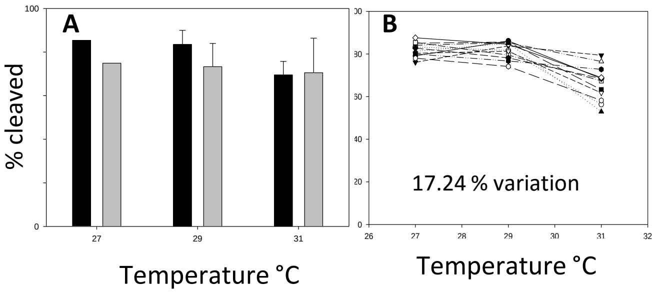
INTRODUCTION

- *A.planci* population on the Great Barrier Reef, AUS (GBR) fluctuates an 'outbreak' cycle.
- Increasing food availability + warmer temperatures as a co-factor = high survival in one year and increased population sizes
- Leads to reef destruction, biodiversity losses

METHODS

- North Carolina II breeding design (QG protocol)
- 24 half-sib families scored for development under high temp. (+2°C) and pCO_2 (900ppm)
- Calculated genetic variance, response ratios, reaction norms
- Statistical effects tested using PERMANOVA

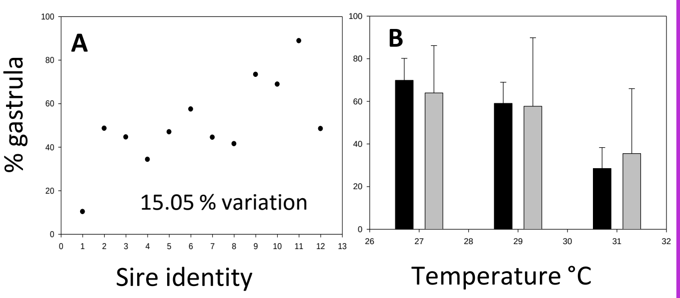
RESULTS – 16-CELL EMBRYO



A= Normal development at 16-cell stage**.** Left side: mean development across all families. B= reaction norms for male genotypes across temperature treatment. Error bars: 1SD. N=75

Sire x temperature accounted for 17.24% of variation among offspring and interacted with both temperature and pCO_2 to influence development. **Dam identity not significant.**

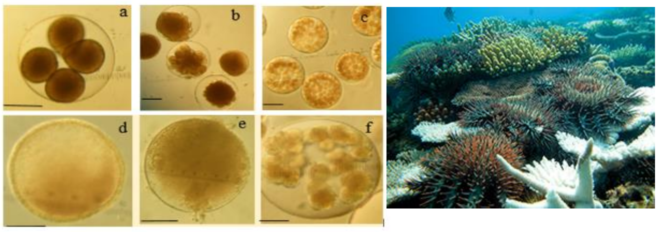
RESULTS - GASTRULAE



A= Sire identity accounted for 15.05% of variation at gastrulation. Dam identity not significant.

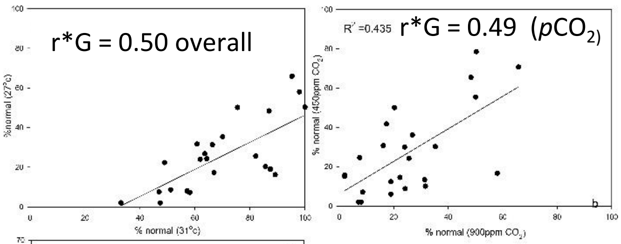
B= Mean development at gastrulation (all genotypes). **High temperature and pCO_2 interacted to reduce development success.**

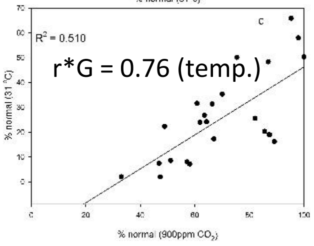
RESULTS – DEVELOPMENT TO GASTRULATION



Developmental morphology in *A.planci* a) normal 4-cell embryo; b) abnormal blastulae; c) morulae; d) normal blastulae; e) abnormal blastula showing outer wall rupture; f)abnormal blastula showing internal rupture and asymmetry; g) adult *A.planci* (photo courtesy AIMS). Bar = 50µm

RESULTS – ADDITIVE GENETIC VARIANCE





Positive genetic correlations for the gastrulation trait and temperature (r*G=0.76) ; and pCO_2 (r*G=0.49)

CONCLUSIONS

- We conclude that ***A.planci* can adapt to moderate acidification and warming** in the near-future.
- **Sire identity influences offspring genotype** in response to warming and acidification.
- **Range shifts** may open up new areas to this predator as individuals with high thermal tolerance are selected for.
- Maternal identity not important for offspring tolerance, suggest genetic component (not provisioning)
- **Positive genetic correlations** = no constraint on adapting to both high temp. and high pCO_2