Research finds reef fish can adjust for gender as oceans warm

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Using a multigenerational experiment UTS research has shown for the first time that when reef fish parents develop from early life at elevated temperatures they can adjust their offspring gender through non-genetic and non-behavioural means.

The study, published in *Global Change Biology*, demonstrates that the

mechanisms involved in restoring offspring sex ratios across generations are switched on during early development of the parents and do not simply occur as a result of adults being exposed to higher temperatures.

"Understanding the ability of species to respond and cope with rising environmental temperature is key to predicting the biological consequences of global warming," said lead author and UTS Chancellor's Postdoctoral Research Fellow Dr Jennifer Donelson.

The ability to compensate for the gender bias caused by rising temperatures is an important trait that could help constrain the impacts of ocean warming on reef fish populations and other species. However the research also suggests that when developmental temperature is too hot there is a limit to this "transgenerational plasticity".

"The research findings are significant because global warming poses a threat to species with temperature-dependent sex determination (TSD), such as reptiles and fish, potentially skewing the sex-ratio of offspring and, consequently, breeding individuals in a population," Dr Donelson said.

"It's well known that gender bias away from the optimal sex ratio of juveniles, that is roughly equal numbers of males and females, can have significant consequences for population success.

"A reduction in the proportion of females in the population could be especially damaging because population growth rate is often constrained by female fertility."

The researchers showed that even relatively small increases in developmental temperatures, just 1.5 degrees Celsius above average summer temperatures, can reduce the proportion of female offspring by more than 30 per cent. However the female sex ratio of offspring was

restored when parental fish were reared at this temperature for their entire life and for two generations.

"However, only partial improvement in the sex ratio occurred at 3.0 degrees Celsius above average conditions, even after two generations, suggesting a limitation to transgenerational plasticity when the developmental temperature is too hot," Dr Donelson said.

"Previous research has focused on the changes to the timing of breeding and mothers behaviourally altering the location of their nest to compensate for warming. The novelty of our study was using a multigenerational (three generations) rearing design to ask questions about non-genetic and non-behavioural parental effects to sex determination," Dr Donelson added.

"Just precisely how our study species, the Spiny Chromis coral reef fish, engineer these amazing adjustments is unknown and is something we are now investigating. What we do know however is that oceans are warming and emerging research is showing the importance of transgenerational plasticity in reducing the negative impacts of climate change on species with TSD."

The research was conducted in collaboration with Dr Philip Munday from the ARC Centre of Excellence for Coral Reef Studies at James Cook University.

More information: Jennifer M. Donelson and Philip L. Munday (2015) "Transgenerational plasticity mitigates the impact of global warming to offspring sex ratios," *Global Change Biology*. onlinelibrary.wiley.com/doi/10 … 1/gcb.12912/abstract

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