

# Adaptive Physiology at a Local Scale: Implications for Species Distributions under Climate Change

Richard Stafford<sup>1</sup>, Terence PT Ng<sup>2</sup>, Gray A Williams<sup>2</sup> and Mark S Davies<sup>3</sup>  
rstafford@bournemouth.ac.uk

## Introduction

- Physical and biological conditions on rocky shores vary over small spatial scales (~100s m)<sup>4</sup>
- For gastropods, it can be difficult to disperse over these distances as adults, but highly likely during their planktonic phase<sup>5</sup>
- Acclimation may occur over the life time of an organism
- Assessing physiological response so different levels of physical and biological stress provide a measure of within lifetime response to local conditions
- Understanding plasticity and adaptability of marine organisms will refine predictions of how they will respond to climate change.

## Methods

- Four sites were selected on Hong Kong Island (Figure 1)
- Simple, *in situ* field measurements were taken to determine the physical and biological characteristics of these sites
- These included aspect, crevice and rockpool cover, number of grazers, number of habitat facilitators etc
- These measurements represented physical stress (temperature and desiccation) and biological stress (intra- and interspecific competition) which limpets were exposed to at each site
- Significantly different stress profiles were determined through a bootstrapped PCA process for each site<sup>6</sup>
- To measure physiological adaptation, the detachment temperature of limpets (*Cellana grata*) was measured for limpets collected from each site (in the lab, within 90 mins of collection)

**Figure 1.** (Right) Locations of four sites on the Shek O peninsula of Hong Kong Island



**Figure 2.** (Below) *Cellana grata* on a physically stressful shore (site 1)

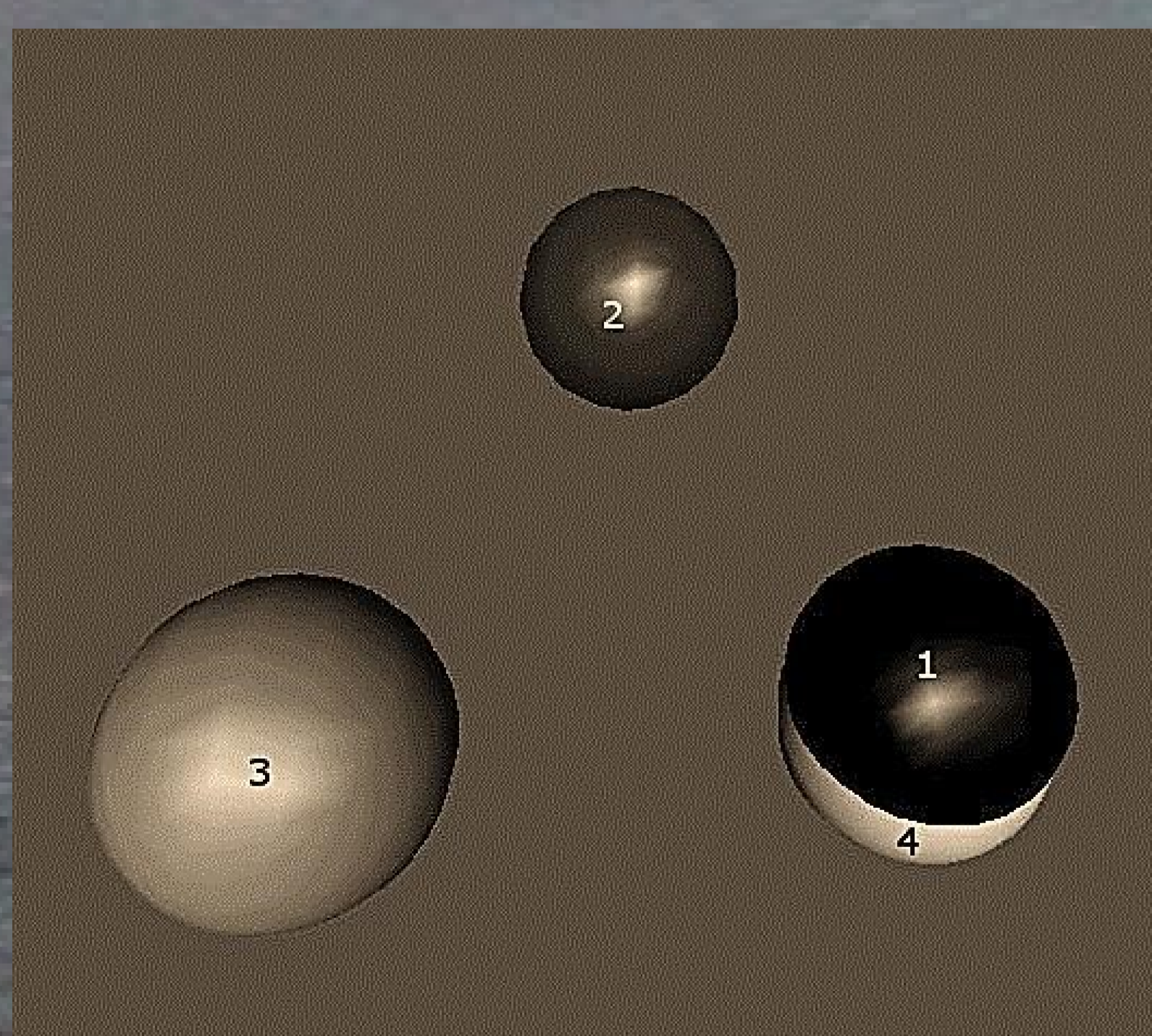


## Results

- Significant differences occurred between stress profiles at different sites (Figure 3).
- Detachment temperatures also differed significantly between different stress profiles (Figure 4).
- Those sites with higher proportions of physical stress had higher detachment temperatures

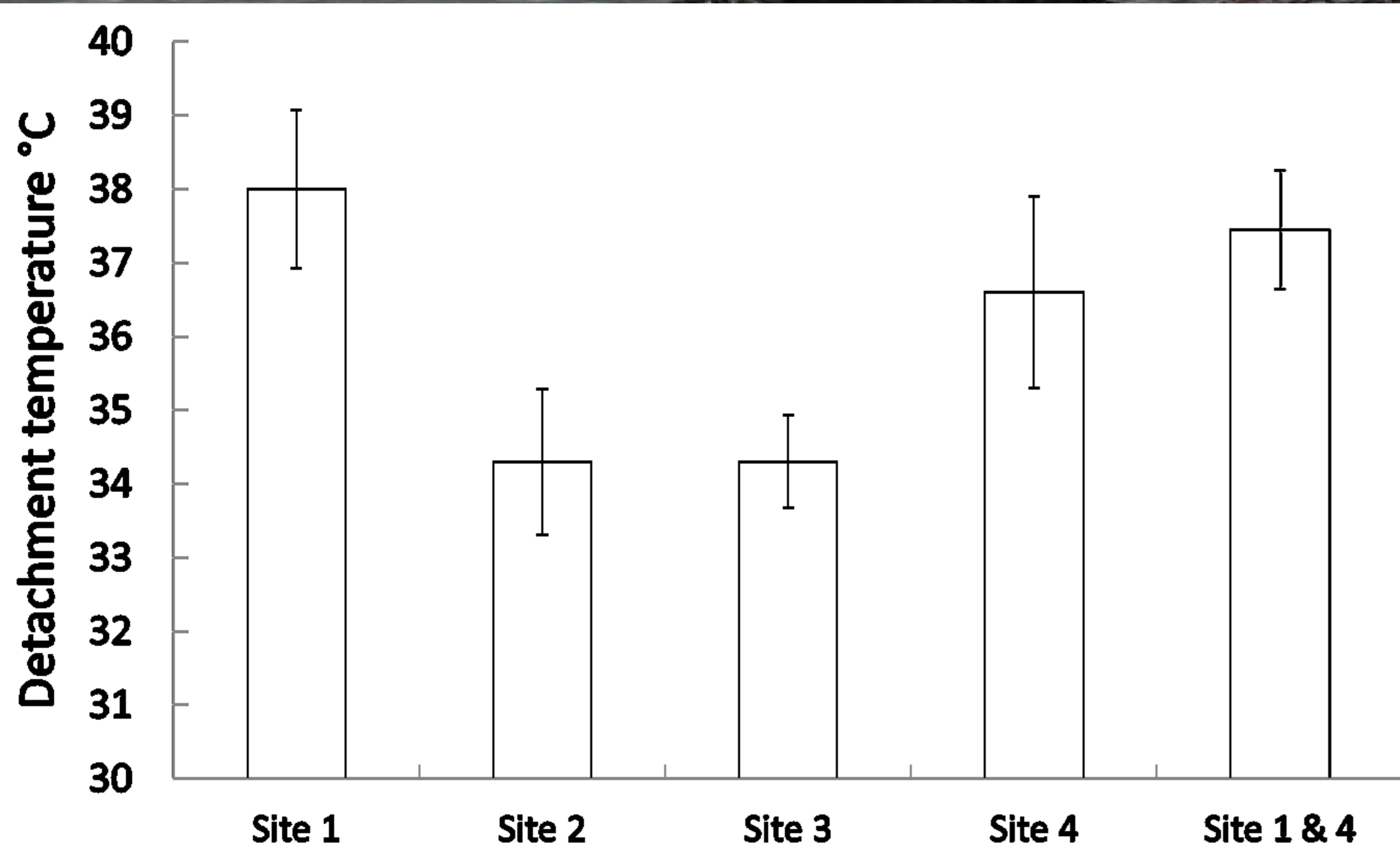
## Discussion

- Cellana grata* appears to adapt to localised conditions during its lifetime
- Uniform physiology across a range is unlikely to occur in many species which inhabit diverse ranges of habitats<sup>7</sup>
- Understanding the interplay between stress levels and localised adaptation will allow predictions of 'refuges' for species under climate change
- Determining areas with the highest levels of physical stress at present may also allow insights into how species can or can not adapt to future levels of stress more generally



**Figure 3 (Left).** Bootstrapped PCA of the physical and biological conditions at each of the four sites. Overlap of spheres indicates no significant difference in stress profiles between sites.

**Figure 4 (below).** Detachment temperature of limpets from each site, and from sites 1 and 4 combined, as no significant difference occurred between these sites



## Notes and References

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- Swire Institute of Marine Science, The University of Hong Kong
- Faculty of Applied Sciences, University of Sunderland
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Background image – view from site 3. North facing with more crevices, lower wave action and higher number of competing grazers than indicated in Figure 2