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Senior Research Associate – Further Information – Behaviourally-mediated shifts in reef fish communities following severe disturbance (NERC Grant)

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The Project

Lancaster Environment Centre (LEC) is seeking to appoint a Senior Research Associate in ecology. The project involves a Partner at James Cook University in Australia, enabling collaborative opportunities.

Individual behaviour has strong potential to impact species richness, composition, abundance and interactions in ecological communities, particularly interference behaviours that mediate resource access amongst individuals (Grether *et al.*, 2017). Nonetheless, the underlying mechanisms that determine *how* individual behaviour scales up to impact ecological communities are unresolved. The project will **develop a mechanistic understanding of species responses to disturbance events by establishing how individual behaviour scales up to impact ecological communities**, exploiting the recent global coral bleaching event as a natural experiment. Such large-scale replication of an acute disturbance event allows understanding to move beyond site-specific studies, to identify consistent ecological responses to disturbance.

Butterflyfishes (*Chaetodon* spp.) are an iconic genus of coral reef fishes with approximately 50 species that rely on corals as a food resource and engage in aggressive resource defence behaviour. The PI's research has shown that after the mass coral mortality caused by bleaching, aggression amongst individuals of these fishes decreased by two-thirds across the Indo-Pacific (Keith *et al.*, 2018), yet was not accompanied by decreased butterflyfish abundance, consistent with previously documented time lags after disturbance. The rare global natural experiment, our existing data, and the fact that behavioural change has preceded any community-scale changes provides a unique opportunity to establish how aggregated individual behaviour scales up to impact populations and communities. Ecologists need to resolve this link to incorporate behaviour successfully and explicitly into predictions of biodiversity response to disturbance and subsequent recovery potential.

Specifically, this project **aims to develop and test robust predictions for how changes in aggression between individuals can alter species abundance, composition and richness within ecological communities following abrupt disturbance** on coral reefs. To achieve this, we will collect primary data on long-term impacts of disturbance on butterflyfish behaviour and community properties across 10 reefs in three regions of the Indo-Pacific (two that experienced mass coral mortality, one "control" that did not) and combine these new data with existing baseline and immediate (6-12 months) post-disturbance data to create a response trajectory. We will use **individual based models** to develop robust predictions for how behavioural change scales up to influence community properties and test these predictions by confronting the model with first-hand empirical data. This project will provide

the **first explicit test of how altered individual behaviour impacts community species richness, composition, abundance and interactions.**

Field work will involve two trips to each of three locations (i.e., six in total) over the course of the project to Iriomote, Japan; Anilao, the Philippines; Christmas Island, Indian Ocean. Each trip will last approximately two weeks. The project also involves two weeks in Townsville, Australia to collaborate with our project Partner, Prof. Morgan Pratchett.

Further reading:

Bonin, M. C., L. Boström-Einarsson, P. L. Munday and G. P. Jones (2015) The Prevalence and Importance of Competition Among Coral Reef Fishes. *Annual Review of Ecology, Evolution, and Systematics* **46**(1): 169-190

Connolly, S. R., S. A. Keith, R. K. Colwell and C. Rahbek (2017) Process, Mechanism, and Modeling in Macroecology. *Trends in Ecology & Evolution* **32**(11): 835-844.

Grether, G.F., Peiman, K.S., Tobias, J.A. & Robinson, B.W. (2017) Causes and Consequences of Behavioral Interference between Species. *Trends in Ecology & Evolution*, **32**, 760-772.

Grimm, V., U. Berger, D. L. DeAngelis, J. G. Polhill, J. Giske and S. F. Railsback (2010) The ODD protocol: A review and first update. *Ecological Modelling* **221**(23): 2760-2768.

Keith, S.A., Baird, A.H., Hobbs, J.-P.A., Woolsey, E.S., Hoey, A.S., Fadli, N. & Sanders, N.J. (2018) Synchronous behavioural shifts in reef fishes linked to mass coral bleaching. *Nature Climate Change*, **8**, 986-991.

Maher, C. R. and D. F. Lott (2000) A Review of Ecological Determinants of Territoriality within Vertebrate Species. *The American Midland Naturalist* **143**(1): 1-29.

Peiman, K. S. and B. W. Robinson (2010) Ecology and Evolution of Resource-Related Heterospecific Aggression. *The Quarterly Review of Biology* **85**(2): 133-158.

The Department

The vibrant, friendly and growing LEC REEFS research group comprises >16 researchers (further info <http://lec-reefs.org/>) and sits within Lancaster Environment Centre (LEC). LEC forms one of the largest and most prestigious groups of interdisciplinary environmental researchers in the world, with over 200 staff, and research and teaching that span the Environmental, Biological and Social Sciences. LEC was formally constituted on 1st August 2008 through the merger of three successful university departments (Environmental Science, Geography and the non-Medical parts of Biology) and now operates as a fully integrated university department on a single site. It is the largest department in Lancaster University and a key player in the strategic development of the institution and the Faculty of Science and Technology. The co-location of the NERC Centre for Ecology and Hydrology on the Lancaster campus as part of the LEC complex adds critical mass in environmental research capacity enabling staff from both organizations to work closely together in a formal collaboration. LEC currently admits about 240 undergraduate students and 100 postgraduate (MSc/PhD) students each year and teaches across a wide range of degree schemes. We are committed to family-friendly and flexible

working policies on an individual basis. The department holds an Athena SWAN Bronze Award, which recognises and celebrates good employment practice undertaken to address gender equality in Higher Education and research.

The University

Lancaster is the Times University of the Year, is consistently ranked in the top 10 universities of the UK, and is in the top 1 percent of the world ranking (QS). The university continues to grow its reputation for teaching and research excellence both nationally and internationally. Established in 1964, Lancaster currently has over 12,000 students and has had £450 million invested in the campus over the last ten years. The University boasts an idyllic campus that combines city, coast and countryside all into one. The campus setting conveys a tranquil ambiance whilst offering such a range of facilities it can almost be called a small town in its own right. More recently, Lancaster University has developed a portfolio of teaching partnerships overseas, as part of its global outreach internationalisation strategy.

The City and the Region

The main campus lies 3 miles outside the City of Lancaster and is easily accessible via road, rail and bicycle. The city centre is just 15 minutes away by bus, and was recently ranked one of the top 10 most vibrant cities in the UK thanks to its arts scene and student population. The City of Lancaster also enjoys a long and diverse history dating as far back as 1193, and has a well-maintained iconic city centre and medieval castle. The campus is just 30 miles south of the beautiful Lake District and about the same distance from the Yorkshire Dales. It is very well connected by road and rail, with Manchester (and its international airport) just over an hour distant, while the train journey to London takes under two and a half hours.

Further information

Informal enquiries to Dr Sally Keith, Lancaster Environment Centre, sally.keith@lancaster.ac.uk