PROJECT TITLE: Integrating multi-species connectivity patterns in marine conservation.

DTP Research Theme(s): Living World
Lead Institution: University of Bristol
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Project keywords: Connectivity, marine conservation, genomic, landscape genetics

Coral reefs are highly diverse ecosystems and implementing conservation measures that suit all species can be challenging.

Coral reefs are naturally patchy environments. Maintaining connectivity between reefs is important to sustain healthy reefs.

Project Background
Almost every marine organism has an obligate pelagic larval phase lasting days to weeks and connectivity between discrete populations depends on their successful migration. Since coral reefs are naturally patchy environments, connectivity between seemingly isolated reefs underpins their resilience to disturbance and is central to the management of these fragile ecosystems. Measuring connectivity between reefs, identifying the factors driving these patterns and its demographic consequences is therefore vital to understand how species will respond to habitat loss, exploitation, and management actions. However, there is a distinct lack of robust information on the processes driving connectivity in marine environments or how to integrate varying connectivity patterns in marine conservation. In this project you will use available genomic data from several species of fish, corals, and a shark to investigate trends in the genetic structure, diversity, and connectivity among isolated coral reef atolls in the Coral Sea Marine Park, Australia. You will develop expertise in measuring and modelling genetic connectivity and contribute to the growing discipline of seascape genetics. The project will inform guidelines to integrate multi-species connectivity patterns in marine conservation planning.

Project Aims and Methods
An emergence of novel approaches to track pelagic larvae from source to sink has supported modern guidelines in spatial marine conservation planning and the design of marine protected areas globally. However, increasing environmental pressure on marine ecosystems is leading us to consider how species are responding to environmental change and whether current management strategies are sufficient to sustain healthy ecosystems.

The rapid proliferation of next generation sequencing technologies has prompted the development of novel analytical approaches for understanding how species interact with their environment and the eco-evolutionary processes that determine the future health of species in fragmented habitats such as coral reefs. This project will investigate how patterns of genetic connectivity vary between species across the same seascape to highlight the features influencing genetic variation within and between populations. This project will inform multi-species guidelines for marine conservation.

The project will use existing data from fish, corals, and a shark collected from the Great Barrier Reef and Coral Sea Marine Parks. The large geographic scale of this region, its well-defined oceanographic regimes, strong environmental gradients, and fragmentated populations make it ideal to assess spatial patterns of genetic variation in a marine seascape. Specifically, the project aims will be to:

1. Resolve genetic connectivity using available genomic data for fish, corals, and a shark.
2. Use methods of landscape genetics and graph theory to isolate the effects of ocean currents on connectivity patterns.
3. Determine critical regions that maintain network connectivity and assess the suitability of an existing network of marine protect areas across multiple species.

Candidates will be encouraged to contribute toward the design of the project and bring their own ideas.

Candidate requirements
Candidates are expected to hold (or be about to obtain) a minimum upper second-class honours degree (or equivalent) in a related area. Candidates with experience in bioinformatics and competence in the R statistical language are encouraged to apply. We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

Project partners
This project will be conducted in partnership with Prof Jamie Stevens, University of Exeter, who has more than 20 years of experience in researching genetic connectivity in a range of marine organisms in both temperate and tropical environments. The successful candidate will receive project guidance and participate online in the weekly population genetic seminars held at Exeter.

Training
Candidates will be provided with training in the analysis of genomic data and statistical genetics, with opportunities to attend international conferences and workshops.

Background reading and references
Manel S *et al.* (2003). Landscape genetics: combining landscape ecology and population genetics. *Trends in Ecology and Evolution* 18, 189-197.

Jones GP, *et al.* (2009). Larval retention and connectivity among populations of corals and reef fishes: history, advances and challenges. *Coral Reefs* 28, 307–325.

Payet SD, *et al.* (2022). Demographic histories shape population genomics of the common coral grouper (*Plectropomus leopardus*). *Evolutionary Applications* 15, 1221-1235.

Useful links
http://www.bristol.ac.uk/biology/courses/postgraduate/

Bristol NERC GW4+ DTP Prospectus:
https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/
 Please note: If you wish to apply for more than one project please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

The application deadline is Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.

For more information about the NERC GW4+ Doctoral Training Partnership please visit
https://www.nercgw4plus.ac.uk.

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