Position Description

1. General Information

Name of the position	**Coral reef fish ecology**
Foreseen enrolment date	1 October 2023
Position is funded by	• COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • École Pratiques des Hautes Études, CRIOBE (EPHE) • James Cook University (JCU)
Research Host	École Pratiques des Hautes Études, CRIOBE
PhD awarding institutions	École Pratiques des Hautes Études, CRIOBE & James Cook University
Locations	Primary: Moorea, French Polynesia Secondary: Townsville, Australia
Supervisors	Associate Professor Suzanne C. Mills (CRIOBE) Associate Professor Jennifer Donelson (JCU)
Group of discipline	Ecology, Marine Biology, Physiology, Behavioural Ecology

2. Research topics (only one of these projects will be funded)

Project 1: *Impacts of run-off events on coral reef fish communities*

Humans are affecting marine ecosystems through activities including agricultural and urban development, dredging, catchment modification, and deforestation, all of which, impact coastal marine ecosystems through inputs of sediment, nutrients, pollutants, and freshwater. While inputs of suspended sediment from terrestrial sources is an important natural process that connects terrestrial and marine systems through the influx of particulate and dissolved matter, elevated inputs of sediments and nutrients can have negative impacts on marine ecosystems. This is because elevated sediment and nutrient inputs increases turbidity, decreases light attenuation, reduces visibility, and can also cause mechanical damage or stress. As such, increased suspended sediment and freshwater run-off can affect coral reef fish at both the individual and the community level: individuals may be directly impacted through changes to sensory capacities impacting intra- and inter-species interactions and/or mechanical damage to gills which may cascade up to impacting the abundance and diversity of fish on coral reefs both directly and indirectly through habitat quality and species composition.

This project will advance our knowledge of how sedimentation and run-off impact coral reef fish communities by exploring whether shifts in community composition are related to taxonomy, functional group or level of site fidelity

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(e.g. site-attached species: i.e. associated with coral and anemone hosts e.g. Pomacentridae - anemonefish, damselfish) versus highly mobile species (e.g. Pomacentridae i.e. Sergeant-majors). Furthermore, we will use state-of-the-art Virtual Reality to investigate whether species' absences are related to behavioural interactions between individuals of the same species via changes in social and/or sexual behaviour, as well as interactions between different species via changes in predator-prey interactions in the presence of suspended sediments. In addition, this study will investigate the threshold levels of turbidity that various species avoid both in the field and in a laboratory setting. For many species moving to avoid run-off in nature means leaving the safety of their coral or anemone host. Thus, avoidance can depend on the costs, risks and benefits of doing so. Consequently, this work will determine the physiological impacts of suspended sediment *in situ,* which has previously not been investigated.

Supervisors: Associate Professor Suzanne C. Mills (EPHE, CRIOBE), Associate Professor Jennifer Donelson (JCU)
Non-academic supervisor: Francis Murphy (Executive Director Tetiaroa Society FP)
Collaborators: Manuel Vidal (Aix-Marseille Université), Associate Professor Megan Head (ANU)

Research Fields: Sedimentation, Reef fish, Coral Reef Ecology, Community Ecology, Behavioural Ecology, Sexual Selection, Physiology, Movement Ecology

Project 2: *Thermal regulation in coral reef fish*

Global phenomena such as climate change imposes considerable local environmental changes. In particular, many coral reef ecosystems are degraded and at risk of shifting into undesirable algal- dominated states. Therefore, it is critical and timely to understand how coral reef species respond to, and cope with the multiple stressors associated with environmental change. Recent global thermally-induced coral reef bleaching events, due to both average climate warming and marine heatwaves, underline the severity of climate-driven impacts on coral reef ecosystems. The frequency, severity, and duration of heatwaves and bleaching episodes are expected increase in the coming decades.

While behaviour is often suggested as the first line response that animals use to respond to changes in environmental conditions, whether reef fish can use behaviour to buffer and avoid negative effects of ocean warming is poorly understood. For example, to avoid the negative physiological consequences of elevated water temperatures, juvenile fish may alter settlement from usual areas to avoid non-optimal temperatures during a heatwave, instead settling in otherwise undesirable areas but avoiding thermal stress. Whether these initial life choices carry-on to impact growth, development and fitness, remains untested, but it is likely there will be physiological and ecological costs.

This project will combine laboratory and field-based studies to determine the behavioural plasticity of species in response to water temperature. Thermal preference is believed to indicate the wholistic optimum temperature for an individual and includes the thermal performance of various traits which may not have the same thermal optimum (e.g., growth vs reproduction). This work will start by determining the thermal preferences of a range of reef fish species from site-attached species that are often associated with coral and anemone hosts (e.g. anemonefish, damselfish, cardinalfish, hawkfish) to mobile species (e.g. parrotfish, wrasses, butterflyfish). Subsequently, comparison of species living in the same and distinct reef areas will be made to test the hypothesise that species living in similar conditions with similar ecology will have similar thermal preference. Also we expect that due to developmental plasticity, thermal preferences of site-attached species will relate to the thermal conditions experienced (range, average, most frequent temperatures) at sites. Field based investigations will determine to what extent fish can use behavioural thermoregulation to maintain body temperatures within their optimal range. This will involve mapping the thermal micro-climates of the reef at scales relevant to the focal species. For site attached species like anemonefish, this only includes a relatively small area within and around their host anemone, while for mobile reef fish that can have home ranges of a hectare or more their potential to thermally regulate is expected to be much larger. Finally, by combining behavioural and physiological data (metabolic rates), the real current days costs of daily life considering the realised benefits of behavioural thermoregulation can be determined, as well as the expected future metabolic costs under various projected warming scenarios.

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Supervisors: Associate Professor Suzanne C. Mills (EPHE, CRIOBE), Associate Professor Jennifer Donelson (JCU)
Non-academic supervisor: Francis Murphy (Executive Director Tetiaroa Society FP)
Collaborators: Professor Shaun Killen (University of Glasgow), Associate Professor Ricardo Beldade (Pontifica Universidad Católica de Chile), Dr Rebecca Fox (Department of Climate Change, Energy, the Environment and Water)

Research Fields: Behavioural thermoregulation, Coral Reef Fish, Metabolic Rates, Fish Ecology, Behavioural Ecology, Physiology, Community Ecology

Project 3: *The biology and ecology of rabbitfish*

The rabbitfish (Siganidae) are a group of coral reef fish that are gregarious, charismatic, important for ecosystem function, and are an important fishery and protein source in many Indo-Pacific nations. As a shallow water, territorial reef fish, rabbitfish are also highly vulnerable to the impacts of climate change. The aim of this project is to improve our understanding of the impacts of environmental stressors on the biology and ecology of rabbitfish.

Although rabbitfish are an iconic member of many coral reef communities little is known about their biology and ecology. For instance, it is known that numerous species live in pairs as adults - yet it is unknown why. Do pairs consist of same or opposite sex fish? Are they for breeding? Do they help to avoid predators while foraging? Do they prevent territory take-over? The fact that males and females in this species look very similar, makes it difficult to answer these questions.

Likewise, it is known that rabbitfish regularly migrate to deeper water during summer months, presumably to breed. However, it is not known where they go or what happens when they get there. Do fish from different populations mix at these spawning grounds? Do fish mate with their pair, or with others? Having the answers to questions like these are essential for understanding how fish will respond to climate change because they help us understand the adaptive potential of populations and the ability of individuals to move between habitats.

To answer these questions, we will establish a genetic library of fish from three different sites spanning the length of the Great Barrier Reef and from three different sites spanning French Polynesia. This will form the basis of a long-term monitoring study of these sites and will ensure that we cover populations that experience different temperature regimes. To develop our database, we will map the territories of rabbitfish pairs at each study location in each geographical zone, capture pairs of fish, photograph them, take morphological measurements, blood samples for hormonal analyses and collect genetic samples prior to releasing the fish at their site of capture. We will use hormonal measures to determine the sex of fish. We will also look at their genetic relatedness and determine population structure. We will develop a non-invasive individual identification method based on unique face markings of rabbitfish. Once this method is established, we will be able to identify individual fish from photographs taken by snorkelers and divers visiting our study sites. We will set up an online platform where divers and snorkelers can submit their photos along with information about date, location, water conditions. This will allow us to track individual fish through time thus providing data on fish movement patterns, social interactions and lifespan across a range of ecological setting. This data may be linked with genetic data to allow detailed analysis of the genetic underpinnings of the patterns observed from monitoring.

Supervisors: Associate Professor Suzanne C. Mills (EPHE, CRIOBE), Associate Professor Jennifer Donelson (JCU), Associate Professor Megan Head (ANU)
Non-academic supervisor: Francis Murphy (Executive Director Tetiaroa Society FP)
Collaborator: Dr Rebecca Fox (Department of Climate Change, Energy, the Environment and Water)

Research Fields: Pair bonding, Coral reef fish, Fish Ecology, Behavioural Ecology, Genetics, Endocrinology, Citizen Science, Migration, Territoriality

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3. Employment Benefits and Conditions

École Pratiques des Hautes Études, CRIOBE (EPHE) offers a 36-months full-time work contract (with the option to extend up to a maximum of 48 months). The total working hours per week is 35h.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a gross annual salary of 28,380 EUR. Of this amount, the estimated net salary to be perceived by the Researcher is 1,900 EUR per month. However, the definite amount to be received by the Researcher is subject to national tax legislation.

Benefits include

- Access to all the necessary facilities and laboratories at CRIOBE (in Moorea and Perpignan) and JCU.
- Tuition fee waiver at both PhD awarding institutions.
- Yearly travel allowance to cover flights and accommodation for participating in AUFRANDE events.
- 10,000 EUR allowance to cover flights and living expenses for up to 12 months in Australia.
- 25 days paid holiday leave.
- Sick leave.
- Parental leave.

4. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to AUFRANDE's conditions.

EPHE

Applicants must hold a Research master's degree or a diploma of equivalent level.

More Information: https://www.ephe.psl.eu/formations-conferences/doctorat

JCU

To be eligible to apply for entry to a Doctoral program, an applicant must demonstrate the capacity to undertake research at the Doctoral level by attaining at least one of the following:

a) a Bachelor's degree with at least Second Class, Division A (Honours) in a degree program that included a total of at least a semester of supervised project work, the results of which contributed to the Honours grade;

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b) a postgraduate qualification which included: (a) supervised research component(s) of at least one semester or equivalent and resulted in the production of output(s) graded at the equivalent of Distinction or better, and (b) at least one research methods subject;

c) a Research Master's degree, where at least two thirds of the degree consisted of a supervised research component and resulted in the production of a thesis or equivalent;

e) a combination of qualifications, research training and experience, considered equivalent to the above by the Dean of the College to which the Candidate is applying, e.g., senior authorship of at least one peer-reviewed publication plus completion of an appropriate research methods subject.

All applicants must meet the IELTS Band 2 English Language Requirements or equivalent as defined by the University.

More information: https://www.jcu.edu.au/graduate-research-school/how-to-apply

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