Concept Plan SP 2024-001

Understanding the drivers of hypoxic events and impacts to the coral communities in Bill's Bay, Ningaloo Marine Park

BCS Marine Science

Project Core Team

X X **Supervising Scientist** Claire L Ross
Data Custodian Claire L Ross

Project status as of Jan. 30, 2024, 2:50 p.m.

X X New project, pending concept plan approval

Document endorsements and approvals as of Jan. 30, 2024, 2:50 p.m.

X X
Project Team granted
Program Leader granted
Directorate required

Understanding the drivers of hypoxic events and impacts to the coral communities in Bill's Bay, Ningaloo Marine Park

Program

BCS Marine Science

Departmental Service

Service 7: Research and Conservation Partnerships

Background

Coral reefs are diverse and complex ecosystems that provide a wide range of important ecological and economic benefits. However, coral reefs are under increasing pressure worldwide due to ocean warming and ENSO-driven marine heatwaves, which to date have caused extensive coral bleaching and mortality. Coral communities in Western Australia have not been immune, with significant coral bleaching occurring on multiple occasions in marine parks across the state. More recently, hypoxia (detrimental low O_2) has rapidly been gaining increasing attention for its role in the localised degradation of tropical coral reefs. Acute hypoxic events that cause localized mass mortality are particularly concerning as they can result in wide-ranging losses of biodiversity and ecosystem functioning. In Bill's Bay, located within the World Heritage listed Ningaloo Marine Park, hypoxic events are known to have caused severe mortality of fish and coral communities on several occasions over the past three decades. These events have generally coincided with the annual mass coral spawning event whereby coral spawn slicks are trapped close to shore. Spatial patterns in water circulation have previously been found to influence the vulnerability and recovery of adult coral communities in Bill's Bay to past coral spawning related hypoxic events and other environmental disturbances. However, relatively little is known about what coral species or colony sizes are most affected by acute deoxygenation events, how the coral communities are changing, and how this varies spatially within a reef system. Moreover, the oceanographic drivers of acute hypoxic events through time and the influence of hydrodynamics on coral recovery mechanisms post-disturbance are not yet well understood, making it challenging to predict when these events may occur in future and determine what the long-term impacts will be on the reef ecosystem. While the coral communities in Bill's Bay have recovered from natural disturbances in the past, they are now faced with high disturbance regimes that are amplified by climate change. Thus, there is a need to elucidate the drivers of hypoxic events and to understand the impacts to the coral communities and the mechanisms that may facilitate recovery.

Aims

The specific aims of this project are to: 1) investigate the abiotic conditions that drive acute hypoxic events in Bill's Bay using numerical modelling and predict how they might be exacerbated in the future under ongoing climate change, 2) quantify the impacts of the 2022 hypoxic event on coral communities compared to previous events and assess coral recovery through time, and 3) determine how patterns in coral recruitment and juvenile abundance vary across a hydrodynamic gradient and how this may influence recovery processes.

Expected outcome

Overall, the findings of this study will provide a framework to predict or forecast hypoxic events in the future and will identify the processes of recovery and how this may be facilitated by water movement within Bill's Bay. Information collected as a part of this project will a) inform the ongoing monitoring of coral communities in relation to identifying relevant pressures in Ningaloo Marine Park, b) inform the development of appropriate management strategies to build resilience in coral communities in the face of pressures from climate change that are largely beyond the scope of local management action, and c) inform management strategies to provide opportunities for a high quality visitor experience and minimize impact through management and communication/interpretation.

Strategic context

The objectives of this project will advance our knowledge in areas that have been identified as high priority research for management, including the response of tropical coral reef communities to disturbance and the persistence of corals under extreme environmental conditions (Kendrick et al., 2016). The proposed study

would support the on-park management objectives of Exmouth District in relation to coral communities in Ningaloo Marine Park. For example, this proposal aligns with management plan strategies to monitor coral cover, composition, and condition as a high priority and to undertake research to improve knowledge of the pressures acting on coral communities as per the Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area, 2005-2015 to: 1) Undertake research to assess the potential impacts of climate change on Ningaloo Marine Park over the next 50 years, with particular emphasis on the coral reef communities, and 2) Strategically monitor the recovery of the coral reef communities in Bill's Bay in response to mortality from bleaching or other damage. In addition, this project addresses specific Departmental strategies and objectives as outlined in the DBCA Strategic Directions and Plan 2022-25: 1) Use world-recognised science to build and share biodiversity knowledge to support evidence-based management, and 2) Undertake research and monitoring to address gaps in biodiversity knowledge to support conservation and recovery of key species and ecological communities and inform management of ecosystems.

Expected collaborations

This project will be a collaboration between the Marine Science Program in BCS and regional marine park staff based in the Exmouth district, and staff at the University of Western Australia (Prof Ryan Lowe and Dr Michael Cuttler), including co-supervision of a UWA PhD student (Sean Bensadon).

Proposed period of the project

July 1, 2023 – June 30, 2026

Staff time allocation

to | X | X | X |

Role	Year 1	Year 2	Year 3
Scientist	0.2	0.2	0.2
Technical	0.05	0.05	0.05
Volunteer	0.1	0.1	0.1
Collaborator	0.05	0.05	0.05

Indicative operating budget

to | X | X | X |

Source	Year 1	Year 2	Year 3
Consolidated Funds (DBCA)	7,000	5,000	
External Funding	3,000		