Concept Plan SP 2009-002

Spatial and temporal patterns in the structure of intertidal reef communities in the marine parks of south-western Australia

BCS Marine Science

Project Core Team

X X **Supervising Scientist** Alan Kendrick
Data Custodian

Project status as of June 30, 2023, 12:02 p.m.

X X Update requested

Document endorsements and approvals as of June 30, 2023, 12:02 p.m.

X X
Project Team granted
Program Leader granted
Directorate granted

Spatial and temporal patterns in the structure of intertidal reef communities in the marine parks of south-western Australia

Program

BCS Marine Science

Departmental Service

Service 6: Conserving Habitats, Species and Communities

Background

None

Aims

1. The ecology of temperate intertidal reef platforms

As the inter-face between marine and terrestrial environments, wave-cut intertidal reefs are a harsh environment, and the distinctive composition of temperate intertidal reef communities reflects both the ability of organisms to tolerate a relatively wide range of physical conditions and the consequences of biological processes such as recruitment, competition and predation (Dakin & Bennett 1987, Edgar 2001).

The pronounced vertical distribution of intertidal organisms typically relates to their capacity to tolerate relatively predictable tidal cycles of exposure, inundation and wave action. Hence, species diversity on the high intertidal is low and typically restricted to desiccation-resistant molluscs (such as *Austrolittorina _and _Nodilittorina),* while organisms of particular abundance on the rarely exposed reef crest (such as *Haliotis roei)* are more robust to the effects of high wave energy (Edgar 2001, 2008). On the broader reef platform, even small variations in height relative to the tide datum can lead to significant differences in environment conditions caused by varying degrees of tidal exposure. Hence, organisms are commonly also patchily distributed across the seemingly minor depressions, rock-pools and ridges that occur on most reef platforms (Britton et al. 1988). In addition to tidal influences, intertidal reef habitats are also subject to less predictable episodic disturbances from, for example, strong wave action, sand deposition and relatively extreme temperatures (Dayton 1971), which may result in localised or widespread mortality among intertidal organisms (Hodgkin 1959a, Leviten & Kohn 1980, Kohn 1993). Such disturbances can act to maintain community heterogeneity across a range of scales (Lubchenco & Menge 1978). The biological communities of shoreline platform reefs may also be influenced by terrestrial factors, such as freshwater aquifer discharge, particularly if these sources are polluted (Johannes 1980).

Complex biological processes such as recruitment, competition, herbivory and predation also strongly influence the structure of intertidal communities (Dayton 1971, Lubchenco & Menge 1978). While larval recruitment to reef platforms may vary depending on life-cycle traits (such as direct or pelagic larval development), the availability of space and competition between organisms for space are major factors that structure intertidal reef communities. Early life stages of many organisms, for example, may require suitable settlement habitat (Raimondi 1990), while some species are competitively dominant over others (Dayton 1971). Intra-specific competition among cohorts may also affect community composition (Boventura et al. 2003). The potential dominance of competitively successful species may in turn be restricted by herbivory, predation or disturbance events.

Direct human interactions can also impact on intertidal reef habitats, which are often easily accessible from the shore. Such impacts may comprise the trampling of organisms by repeated access or their removal by collecting (Robinson 2005). Platform reefs support some important recreational and commercial fishery species, such as Roe's abalone Haliotis roei while other species may be taken for bait or by shell collectors (Keough et al. 1991, Hancock & Caputi 2006).

2. Intertidal reefs in temperate Western Australia.

While wave sculpted intertidal platform reefs are a feature of many temperate Australian rocky shores, their presence and structure depends on the wave exposure and the underlying geology (Dakin & Bennett 1987). Hence, while such platform reefs are relative uncommon along WA's predominantly granitic south coast, they are a common coastal feature of the 'warm' temperate zone extending from Shark Bay to Cape Leeuwin where coastal features are dominated by the softer Tamala limestone.

Mainland and island intertidal reefs of this region typically comprise a flat reef platform backed to landward side by an undercut cliff (Figure 1), while isolated patch reefs typically comprise only the reef flat. The platform width varies markedly; those at Rottnest Island commonly exceed 50 m in width and are typically wider than

those on the adjacent mainland. The reef platforms vary in structure from being relatively level to very irregular due to the presence of gutters and rock-pools, and their elevation in relation to tide datum may vary considerably. The seaward platform edge is frequently raised into a distinct rim beneath which the reef falls away in a vertical or undercut face to the seabed below.

3. Intertidal reefs of the Marmion and Shoalwater Islands Marine Parks

The Marmion Marine Park (MMP) and Shoalwater Islands Marine Park (SIMP) are located on the north and south Perth metropolitan coast, respectively. Covering coastal waters between Burns Beach and Trigg Island, the ca 9,500 ha MMP was created in 1987, while the ca 6,658 ha SIMP was created in 1990 over coastal waters from South Channel to Becher Point (CALM 1992, DEC 2007). Sanctuary zones were, however, only established in the SIMP as recently as 2007. The MMP and SIMP comprise a similar geomorphology dominated by sub-tidal and emergent limestone reefs and shallow sandy embayments (Searle & Semenuik 1985). Both marine parks support a diverse range of marine conservation values ranging from various marine habitats to threatened marine fauna. These marine parks are subject to high levels of recreational and commercial human activity due to their proximity to the Perth metropolitan area. Occurring along mainland and island shores and as isolated offshore patch reefs, significant areas of intertidal reef platform occur in both the MMP and SIMP.

Intertidal reef organisms of the Perth region have been studied since the early 1950s (Smith 1952, Marsh 1955, Hodgkin 1959b, Hodgkin et al. 1959). Since that time, most local research in this field has been concentrated at Rottnest Island, which supports large areas of intertidal reef (see Black & Johnson 1983, Wells et al. 1993a, 1993b). Studies in the 1980s on the intertidal reef fauna of the Perth metropolitan mainland derived from concern regarding exploitation of H. roei and planning for the then proposed Marmion Marine Park (Wells et al. 1987). A recent re-examination of intertidal reef invertebrates at Cottesloe, Waterman and Trigg on the northern Perth metropolitan coast concluded that no major changes in these communities had occurred since the 1980s (Wells et al. 2007). This study however, examined only three mainland reef sites, of which, two (Trigg and Waterman) were located within the MMP.

Management of intertidal reefs in the Perth region has increased significantly in recent decades through the creation of marine parks and reserves and enhanced fishery controls (CALM 1992, Hancock & Caputi 2006, DEC 2007). While the above studies provide a significant regional knowledge base, the broad spatial patterns of intertidal biodiversity across both the MMP and SIMP are not adequately understood. Particular gaps exist in knowledge of the intertidal communities of the SIMP and offshore platform reefs. This project will significantly expand on the knowledge generated by Wells et al. (1987, 2007) by increasing the number of sampling sites across both the MMP and SIMP and including offshore platform reefs. This study will determine relationships between the composition of these communities and the physical structure and location of the reefs. This study will focus on assemblages of algae, echinoderms, molluscs and barnacles, as these include major primary producers (ie algae), grazers (ie echinoderms and molluscs) and predators (ie molluscs) in these habitats. It is anticipated that this study will provide a basis for the design and implementation of comparative intertidal research in marine parks and reserves across WA.

4. Management relevance

This study will provide knowledge of how intertidal reef communities in the MMP and SIMP are structured in space and time. Such ‘inventory’ and/or ‘baseline’ information is required to determine the composition of these ecological values in relation to natural processes, and to benchmark their condition with regard to the impact of current and future anthropogenic impacts (Simpson 2007).

This study will address the following management questions:

- What are the patterns of intertidal biodiversity in the MMP and SIMP?
- Do areas of particularly high intertidal biodiversity exist, and where are they located?
- What natural and/or anthropogenic factors best explain the patterns of intertidal biodiversity in the MMP and SIMP?
- Do the current sanctuary zones provide adequate and representative protection for these communities?
- How should these communities be monitored?

Expected outcome

This project will:

- Provide a comprehensive understanding of the distribution and abundance of intertidal reef biota of both the MMP and SIMP at a scale commensurate with managing these habitats for biodiversity conservation;
- Provide an understanding of the natural and/or anthropogenic factors that contribute to patterns in the distribution and abundance of intertidal reef biota of the MMP and SIMP;
- Contribute to fulfilling by 2017 Science Division’s Key Strategic Goals of:

    - Completing seven targeted surveys of existing or proposed marine protected areas;
    - Implementing research programs on the biology and behaviour of key species and communities that are subject to recreation and tourism impact as a basis for minimising adverse impacts; and
    - Describe marine plants collected in association with research, survey and monitoring. (DEC 2008).

- Inform planning and management of the MMP and SIMP by identifying intertidal reef communities of particular conservation significance. This will enable planners and operational staff to prioritise management controls and effort in relation to intertidal reef communities, and provide quantitative information on MMP and SIMP intertidal reef communities to the MPRA audit process.
- Provide information for the development and implementation of intertidal reef monitoring across DEC's marine parks and reserves, and provide marine research and monitoring training to Swan Coastal District staff.
- Foster collaborations with tertiary institutes by developing and supporting student research projects relating to intertidal reef ecology.
- Contribute to a broader regional study of WA intertidal reef ecology to be implemented by DEC's Marine Science Program.

Strategic context

Expected collaborations

Proposed period of the project

None – None

Staff time allocation

to | X | X | X |

Role	Year 1	Year 2	Year 3
Scientist			
Technical			
Volunteer			
Collaborator			

Indicative operating budget

to | X | X | X |

Source	Year 1	Year 2	Year 3
Consolidated Funds (DPaW)			
External Funding			