Parks Victoria Research Partners Panel
Project Summary Report

Statewide Assessment of Victorian Marine Protected Areas using Existing Data

Parks Victoria and Deakin Univiersity

Background

Along the 2,000 km Victorian coast, Parks Victoria manages a system of 13 marine national parks and 11 sanctuaries, which make up approximately 5.3% of Victoria's state waters. These were declared to be a comprehensive, adequate and representative sample of the state's marine habitats and environmental conditions and was based on the best available knowledge at the time. Since their designation, a large amount of data has become available, including information on seafloor habitat, surveys of biological communities, and satellite and modelled oceanographic data. This newly available information provides an opportunity to better assess the efficacy of Victoria's marine national parks and sanctuaries (MPAs) and inform their management. Using data collected by multiple methods and groups from 1998 to 2019 across the entire coastal zone of Victoria, we assessed how different habitats, environmental conditions and patterns of connectivity are represented across Victoria's MPAs. We also investigated relationships between key fish, macroinvertebrate and macroalgal species, habitat types and environmental conditions to identify important drivers of species abundance within marine parks and changes over time. Lastly, we compared Victorian MPAs for their effectiveness based on criteria known to have a major influence for protecting biodiversity.

Aims

This report aimed to:

- use bathymetry data to determine how well different habitats are represented and replicated across the Victorian MNPs.
- incorporate habitat maps (which used a combination of ground truth data including towed video, baited remote underwater video systems (BRUVS), remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and diver observations) produced for the Victorian Environmental Assessment Council (VEAC) to determine how well biotopes are represented across Victoria
- use sea-surface temperature (SST) and hydrodynamic information to assess the representation of oceanographic characteristics across the Victorian MPAs and trajectories of change across the time series to determine which MPAs are experiencing changing oceanographic conditions, potentially putting them at risk
- use outputs from connectivity models to assess how well connected the MPAs are to each other and suitable habitats outside the MPAs to determine whether MPAs are serving as sources and/or sinks for a variety of life history traits present in the Victorian state waters
- use a collated time series of biological data for subtidal reefs (data collected by Subtidal Reef Monitoring Program (SRMP) and Reef Life Survey (RLS) programs) and a machine learning approach to determine how fish, invertebrate and macroalgae communities are changing through time while accounting for variations in habitat, oceanography and degrees of connectedness inside MPAs and their associated biological regions
- use BRUVS data from across the state to develop fish species and fish community distribution models and predictive maps to help to determine where hotspots for fish diversity and

Relevant parks and ecosystems

All Victorian Marine National Parks and Marine Sanctuaries

More information

Contact Parks Victoria on 13 1963

Publications and presentations

Young, MA, Porskamp, P, Critchell, K, Treml, E, Ierodiaconou, D, Pocklington, JB, Sams, MA (2022) Statewide assessment of Victorian marine protected areas using existing data. Parks Victoria Technical Series 116, Parks Victoria, Melbourne.

species abundance are across the state, allowing assessment of representativeness of critical fish habitat within the MPA network.

- assess and rank Victorian MPAs for effectiveness based on whether they meet 4 criteria known to have a critical influence on biodiversity protection: level of human impacts (using the proximity of an MPA to population and ports as a proxy); how well enforced the MPA is, size of the MPA, relative biodiversity in the MPA and how isolated the MPA is based on habitat and depth barriers derived from the seafloor mapping data.

Results

The major habitat types and biotopes found across Victoria were represented within MPAs overall. Subtidal rocky reef habitats and their associated biotopes tended to be over-represented inside MPAs across the state, while sediment habitats and their associated biotopes tended to be under-represented. This is not always the case, though, with some over-representing sediment habitats, especially those encompassing deeper depth ranges like Wilsons Promontory Marine National Park (MNP). Some rarer biotope classes like rhodolith beds and non-reef epibiota were not well represented inside.

Oceanographic and environmental conditions were well represented in marine national parks, but marine sanctuaries tended to capture areas of higher energy (higher wave orbital velocities and currents speeds) due to their shallower depths. Overall, the larger marine national parks more adequately captured the oceanographic and environmental conditions in each region than the smaller marine sanctuaries.

Connectivity models showed strong geographic patterns across the state. Larval settlement is higher in the west and east of the state compared to the central region, and self-recruitment was higher in the central part of the state and in MPAs in the far west. Central and eastern parts of the state had a higher number of connections between habitats. Patterns of connectivity for individual MPAs reflected connectivity patterns found for their surrounding regions

Using machine learning approaches we were able to effectively identify relationships between species and groups of species with environmental and habitat variables. Overall, cooler temperatures, lower wave energy, higher current speeds and more complex seafloor habitat supported the greatest abundance and diversity of species.

Combining BRUVS and habitat mapping data allowed for effective species distribution models to be produced for the whole state. Models for species richness and diversity performed well and had good predictive power, showing that richness and diversity hotspots occurred around reef habitat. Models for individual species had mixed performance and predictive power. Models for highly site-attached species tended to perform better than those for less site-attached species, but all models could be used to gain an understanding of the distribution of species inside and outside MPAs.

The assessment of MPA effectiveness found that fish species richness was higher inside MPAs than out. Larger less isolated MPAs supported a higher richness of fish, while fish richness declined in MPAs closer to human populations and ports. Invertebrate richness was also higher inside MPAs than outside but had a complex response to MPA size and reef area. The ecologically and commercially important species, Southern Rock Lobster (*Jasus edwardsii*) and Blacklip Abalone (*Haliotis rubra*) were found to have higher abundance inside MPAs than

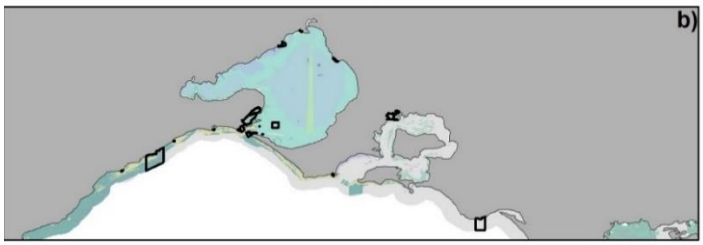
outside. High overall invertebrate richness is found in both small and large MPAs, while there is an initial increase in invertebrate richness as reef area increases followed by a flattening off.

Implications

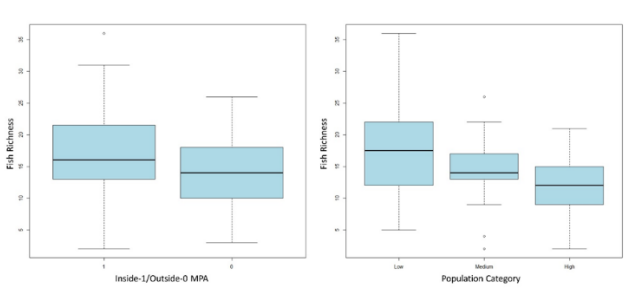
Information on how well represented habitats are within MPA's can be used to prioritise future management and responses to threats. For example, hotspots of richness and diversity were found around rocky reef, suggesting that the over-representation of reef found in MPAs is beneficial for preserving biodiversity. If protection of overall richness and diversity is a key management goal, then protection of rocky reef should be a management focus. If ensuring the protection of less well represented biotopes, such as rhodolith and epibiota in soft sediments, is a goal then greater management focus could be put towards them.

The relationships between species abundances and distribution and environmental variables identified through machine learning can be used to inform MPA management by providing information about the types of conditions that will best support a given species or group of species. Areas within MPAs supporting these conditions can then be targeted for management interventions (e.g., restoration or compliance and enforcement).

This study also highlights significant benefits of Marine National Parks, with higher fish and invertebrate richness inside MPA's than out, particularly in larger remote MPA's for fish and inside MPAs for economically and ecologically important lobster and abalone. This indicates that MPAs are protecting important source populations for these species. Smaller MPAs and MPAs closer to human populations and ports had lower richness of fish, suggesting that compliance and enforcement efforts will need to be greater for MPAs with these characteristics.



Biotope complex classification across the mapped areas of the Port Phillip Bay and Bass Strait.



Fish species richness was found to be higher inside than outside marine protected areas