

4.3.5 Baseline biodiversity monitoring in the proposed Jurien Bay Marine Park, Survey 3

PI and Co-PI names Affiliation(s)

Dr Graham Edgar	University of Tasmania Tasmanian Aquaculture & Fisheries Institute GPO Box 49, Hobart, TAS, 7001 Email: g.edgar@utas.edu.au
Dr Neville Barrett	University of Tasmania Tasmanian Aquaculture & Fisheries Institute GPO Box 49, Hobart, TAS, 7001 Email: g.edgar@utas.edu.au
Kevin Bancroft	Department of Conservation and Land Management Marine Conservation Branch 47 Henry Street, Fremantle WA 6160 Email: kevinb@calm.wa.gov.au
Dr. Russ Babcock	CSIRO Marine and Atmospheric Research PO Box 5, Wembley WA 6913 Email: russ.babcock@csiro.au

Introduction

Concurrent with the implementation of a network of Marine Protected Areas (MPAs) in Western Australia is the need for effective monitoring programs to assess the ability of MPAs to achieve management aims. Only by studying changes that occur in MPAs following protection can we assess the true value of MPAs as baseline reference areas for quantifying ecosystem effects of fishing in the coastal zone, and the success of current conservation and fisheries management strategies. Potential benefits of MPAs include those related to protection of spawner biomass and conservation of critical habitats.

In order to properly determine whether changes observed within MPAs are the result of protection rather than natural variation in space and time, scientifically-credible baseline surveys within and adjacent to proposed MPAs are needed prior to protection from fishing, with subsequent survey of locations at biologically meaningful time intervals. Ideally, baseline surveys should be conducted over several years to assess the scale of inter-annual variability before the MPA is declared.

In the present project, we undertook quantitative surveys of fishes, macroinvertebrates and algae on reefs in the Jurien Bay Marine Park (JBMP) in October/November 2003. These surveys represent a baseline data set, given that JBMP was declared on 31 August 2003 but fishing restrictions had not been gazetted nor sanctuary or scientific reference zones marked in the field in 2003.

The JBMP area surveyed is centred around the towns of Jurien and Cervantes and extends for approximately 80 km of coastline to a distance of 5 km offshore. The MPA is characterised by an extensive offshore development of limestone pavement, structured reef, seagrass beds, sand banks and islands that provide a protective barrier from the prevailing swells and seas. Wave height generally declines substantially eastward of a series of reefs running north-south at a distance of 5-7 km offshore. The inner three kilometres of coastal waters essentially form a protected lagoon with water depths <5 m and isolated structured reefs outcrop from sand and seagrass. The most highly protected management zones within the MPA comprise 7 sanctuary zones (4% of the area) and 3 scientific reference areas where commercial lobster fishing and shore-based line fishing are allowed but other extractive activities prohibited (17% of the area).

Underwater visual censuses of fish, large mobile invertebrates and macroalgae were undertaken at 7 to 9 sites within each of the major management zone types (general use, sanctuary and scientific reference area). Surveys utilised similar techniques to those currently used for MPA monitoring in Tasmania, New South Wales and Victoria as part of a continental-scale study of the effectiveness of marine protected areas (MPAs). The survey methodology covers several assemblage types, having been designed to maximise quantitative information collected on a variety of species in the limited diving time available. This methodology should not only detect changes in heavily exploited species, but also any cascading ecosystem effects of fishing as well as patterns of long-term change in the region.

Aims/objectives

The objective of the project was to provide baseline data on the biodiversity of marine habitats within various management zones in the proposed Jurien Bay Marine Park. This information will be consistent with and supplement biodiversity information collected in two previous surveys undertaken by the University of Tasmania's survey team.

Discussion

Baseline surveys conducted in the Jurien Bay Marine Park have provided a broad-scale description of inter-site and inter-annual variation in communities of reef fishes, large mobile invertebrates and cover-forming plants and animals. The selection of 7-9 sites within each management zone should be sufficient to detect biologically meaningful change for the species examined – a doubling in population numbers for common species or an increase of ≈ 3 species in number of species richness per transect. From the results of the Tasmanian MPA study (Edgar and Barrett, 1999), and a workshop examining MPA monitoring techniques (Barrett and Buxton, 2002), it appears that six sites would be the accepted minimum number of “replicates” per treatment for an effective monitoring program.

Nevertheless, the sampling design could be improved by increasing the number of sites investigated in sanctuary zones. We recommend that two additional sites in sanctuary zones be monitored in future surveys to provide a fully balanced design with nine sites in each zone. The relatively low number of sites currently sampled in sanctuary zones reflects a slight change in zone boundaries from those proposed when the initial survey was undertaken. Additional sites would best be located in the large sanctuary zone block immediately south of Jurien Bay township, providing that reefs of sufficient depth and extent can be found amongst the predominance of shallow sand and seagrass in this block. Given the importance of following trends in rock lobster abundance, we also recommend that the total area surveyed for rock lobsters in future years is doubled by counting animals present on both sides rather than one side of the transect line.

Ideally, surveys should be repeated each year following enforcement of the MPA zoning scheme, at least for the first few years until population responses start to stabilise. In addition to its MPA value, a long-term data set possesses a variety of other uses, including as a tool for tracking regional changes in biodiversity associated with climate change or invasive species. Because a wide range of species have been surveyed, the experimental design should have sufficient power to detect ecosystem shifts as well as changes in the abundance of target fishery species.

Comparison of the overall relationship between sites based on assemblage data indicates that, while there is some degree of variation between sites within each zone category, the management zones broadly overlap and therefore future comparisons between zones are valid using current sites and experimental design. Our surveys were confined to moderately-sheltered inshore reefs of the region because sanctuary zones are all located in this ecosystem type. We note that, because sanctuary zones do not encompass any offshore reef habitat, the full range of ecosystem types within the JBMP remains to be adequately protected. We therefore recommend that a sanctuary zone be extended to include the outer reef, and that the monitoring program is extended to at least three outer reef sites in different zones.

Summary and Conclusions

Quantitative data are now available on densities of fishes, macroinvertebrates and plants on lagoonal reefs in the Jurien Bay Marine Park. Relative to variation between sites, the flora and fauna at different sites generally exhibited a low level of change between years for sites with data collected previously. With the exception of somewhat anomalous sites in the north near Fishermans Island, the biotic composition of sites was interspersed with respect to the three major MPA management zones – sanctuary, scientific reference and general use, with no zone possessing a predominance of one particular biotic assemblage type. Thus, data collected encompassed the range of variability within zones, allowing rigorous comparative analysis of change through time. Because a wide range of species have been examined, ecosystem shifts as well as changes in the abundance of target species should be detectable following the protection of areas from fishing.

The selection of between 7 and 9 sites within each management zone appears to provide sufficient replication to detect biologically meaningful change for the species examined. Nevertheless, to restore a fully balanced design following slight changes to the management zone locations originally proposed, we suggest that an additional two sites in sanctuary zones are monitored in future. Additional sites should be located in the large sanctuary zone immediately south of Jurien Bay if reefs of sufficient size to encompass 200 m long transect lines can be found in that area, which is presently unmonitored. We also recommend that (i) at least one sanctuary zone should be extended to the outer reef region to protect the full range of biodiversity within JBMP, (ii) monitoring should be undertaken at sites on the outer reef, and (iii) the number of 50 m x 1 m transect blocks monitored per site be increased from 4 to 8 for rock lobsters.

Analysis of the baseline data set indicated no significant differences between zones in number of fishes, macro-invertebrate or plant taxa per 50 m transect. Once fishing restrictions pertaining to different management zones are adequately enforced, surveys should be repeated on an annual basis until differences between zones stabilise. Such a monitoring scheme would provide time-series information on trends in the abundance of species of interest in different management zones, information on indirect impacts of both rock lobster fishing and general recreational and commercial fishing on ecosystems, and regional changes associated with such factors as climate change.

References

- Barrett, N.S., Buxton, C., (2002). Examining underwater visual census techniques for the assessment of population structure and biodiversity in temperate coastal marine protected areas. *Tasmanian Aquaculture and Fisheries Technical Report Series 11*, 1-114.
- Edgar, G.J., Barrett, N.S., (1999). Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. *J. Exp. Mar. Biol. Ecol.* 242, 107-144.

List of publications and/or outcomes to date

- Edgar, G., Barrett, N., and Bancroft, K. (2003) Baseline surveys for ecosystem monitoring within the Jurien Bay Marine Park 1999-2003. *Tasmanian Aquaculture and Fisheries Institute Internal Report*, Hobart, 29 pp.