Monitoring marine biodiversity, invasive species and debris in the Batemans Marine Park

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Abstract

The long-term sustainability of our marine environment relies largely upon effective and therefore informed management of competing interests, as well as the local community's sense of ownership and appreciation for the ocean and their passion to conserve its unique biota.

In two ongoing projects, volunteer SCUBA and snorkel divers from the Nature Coast Marine Group Inc. (NCMG - see www.ncmg.org.au) are gathering data that will facilitate monitoring changes in biodiversity over time, as well as identifying invasive species and assessing the marine debris load at selected rocky reef sites in the Batemans Marine Park. The SCUBA divers use a proven visual census survey methodology developed by the Reef Life Survey Foundation (RLSF – see www.reeflifesurvey.com). Snorkel divers use a modified version.

The data provide critical information to assist managers of the Batemans Marine Park (BMP) to make informed decisions about management strategies. The data also contribute to the global RLSF database, which includes data on marine biodiversity from thousands of transects around the world.

The projects also help educate the local community in the sustainable use of our marine resources, providing an investment in the protection of our marine environment for future generations, through producing videos, media releases and generating content for fortnightly columns in two local newspapers.

The SCUBA project was partly funded by the Commonwealth government's Caring for Our Coasts program, through the Southern Rivers Catchment Management Authority (SRCMA). The snorkel project was initially funded by the Commonwealth government's Caring for Our Country program.

Results are discussed.

Introduction

Australia is party to international agreements to conserve biodiversity, including as a signatory to the 1992 UN Convention on Biodiversity. In turn, state and territory governments have obligations to implement networks of marine reserves. In the case of NSW, it is intended to establish a marine park in every bioregion. Currently there are 6 marine parks established (including Lord Howe), with two bioregions still unrepresented in the NSW marine parks system (Hawkesbury and Twofold).

NSW marine parks are managed by the NSW Marine Parks Authority (MPA). The MPA is required to conserve biodiversity for future generations and maintain ecological processes, and where consistent, to provide for sustainable use and facilitate appreciation.

Hence NSW marine parks are zoned for multiple uses, so that, for example, recreational fishing is allowed throughout most of a declared marine park, with smaller areas zoned as sanctuaries. An important role of the MPA is to gather data so that changes following declaration and zoning of each park can be monitored; particularly changes in biodiversity, species abundance and biomass in protected areas (i.e. sanctuary zones), compared to those areas not afforded such protection.

There are a variety of monitoring methods and programs operating in NSW marine parks. However, monitoring is expensive and some methods such as diver surveys are labour intensive and require intensive training and expertise. To overcome some of these limitations, in some areas the MPA has teamed with local volunteer organisations to survey marine life to gather data that can be used by scientists. Such programs have the added benefit of involving the local community and facilitating a sense of ownership and appreciation for the marine environment.

NCMG and RLSF are both non-government incorporated associations. NCMG is based in the Eurobodalla area of the NSW south coast, and was formed in 2006 to actively promote the protection and understanding of coastal, estuarine and marine environments in the Eurobodalla. Its aims include educating the community and participating in scientific research. It comprises volunteers, and its activities (other than research) are funded through members' fees.

RLSF was initiated through a Commonwealth-funded pilot project in 2007, and was subsequently incorporated and became an Australian Registered Environmental Organisation in 2011. RLSF aims to conserve biodiversity and sustainably manage marine resources by producing high quality survey information, using recreational divers in partnership with management agencies. It is directed by a stakeholder advisory committee comprising scientists, managers of agencies with marine responsibilities, and volunteer divers, and receives support from the University of Tasmania in the form of database management and technical support. Members' fees provide a small part of its income compared to funds from grants.

NCMG obtained a grant from the Caring for our Coasts program, through the SRCMA, to survey sites in the BMP in 2011 and 2012, using the RLSF methodology (permissible because the NCMG program managers are also highly experienced members of RLSF).

This paper deals with the application and results of the SCUBA survey program, together with the application and results of a joint NCMG/MPA snorkel survey program, which has been running for 5 years, and was originally funded through another grant under the Caring for our Country program.

Methodology

SCUBA survey sites

For the funded portion of the project, site selection was agreed between MPA, RLSF and NCMG and included 8 SRCMA priority sites. There are 21 sites, 18 of which are in the BMP; plus two just to the north of the northern BMP boundary, and one to the south of the southern boundary. Eleven of the 21 sites were initially chosen so as to complement the sites for the longer-running snorkel survey program. Ten of the 21 sites have also been surveyed previously under other programs. GPS coordinates are used to identify the sites. Depths vary, but most are at 5m.

The sites were surveyed once in 2011 and once in 2012. Weather conditions were very poor for the autumn periods used in both years, resulting in a longer than desirable time frame to survey all the sites.

Data gathered from a further 16 BMP sites (total 37) were already available and have been included in the analysis and results discussed below. The project is ongoing but will focus on the 21 agreed sites for at least the next two years.

RLSF SCUBA visual census methodology (RLSF, 2012)

A 50m transect tape is laid to follow a pre-determined depth contour, starting at or near the boat anchor. A diver swims parallel to the tape on the deep side, identifying, counting and recording (in 5 cm size classes) all fish seen in a 5m wide band on that side (Block 1, Method 1). The swim and count is repeated on the shallow side (Block 2, Method 1). The diver next searches and identifies / records all mobile invertebrates and cryptic fish in a 1m wide band on the deep side of the tape (Block 1, Method 2). This is repeated on the shallow side (Block 2, Method 2). Marine debris is also recorded during the Method 2 search, according to pre-determined categories. Invasive species would be recorded under Method 1 or Method 2, as applicable. Finally, the diver takes a photo of the bottom adjacent to the tape every 2.5 metres (Method 3 photo quadrats).

The entire process is repeated at each site to provide two full transects comprising four blocks of fish and invertebrates, to provide adequate replication. The methodology is designed to survey rocky reefs, which should comprise at least 90% of the transect (minimise sand or seagrass to < 10%). Underwater photography is critical in that a diver must draw, describe, or preferably photograph a fish or invertebrate they cannot identify at the time, for later identification.

Snorkel survey sites

Site selection was agreed between NCMG and MPA. There are 12 sites. Three are outside the BMP as above (i.e. non-park / non-sanctuary). Three more are island sanctuary sites. Three are other sanctuary zone sites in the BMP, and the remaining three are non-sanctuary zone sites in the BMP.

The sites have been surveyed twice yearly for up to 5 years. An MPA vessel allows access to the three island sites; the remainder are accessed form the shore.

NCMG/MPA snorkel survey methodology

The snorkel methodology has been derived from the RLSF methodology. A 30m tape is used. Depths are limited to ensure easy searching by snorkelers; generally less that 3m, but transects must still be below low tide level (indicator: no *Hormosira* should be found on transect). There is a single Method 1 fish count, with a diver recording fish in a 5m band, swimming ahead of another diver laying the transect tape, to minimise disturbance of fish used to being hunted. All species are identified, counted and recorded, but lengths are not recorded. Method 2 comprises a single 1m wide search on the deep side of the tape, recording all mobile invertebrates. Method 3 is a simple point count at 1m intervals on the tape, recording the bottom cover using several defined categories of algae; plus barrens, bare rock, sand etc. The process is repeated at each site to give 3 x 30m transects, randomly placed.

Data for both methods are checked for quality control and entered into an Excel spreadsheet. Data are analysed statistically by trained scientists using a variety of multi- and univariate methods.

Results

SCUBA survey program

Overview

- Range of fish species recorded per block: 7-20
- Range of invertebrate species recorded per block: 2-11
- Most abundant fish: Mado, One Spot Puller, Yellow Tail Scad, Smallscale Bullseyes, Sweep, Hula Fish
- Most abundant invertebrates: Tent Shells, *Centrostephanus rodgersii*; then (an order of magnitude less) *Turbo torquatus* & *Heliocidaris sp.*
- As expected at this early stage in the BMP's history, there are very few statistically significant differences in species richness or abundance between sanctuary zones and non-sanctuary zones.
- The data can be considered to be near baseline data, as far as monitoring changes following zoning is concerned.

Fig. 1. Average species richness

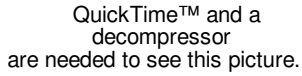


Fig 2. Average species abundance

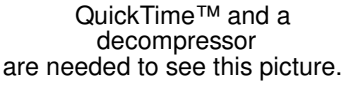


Fig 3. Abundance of selected invertebrates – exception is *Heliocidaris sp.*

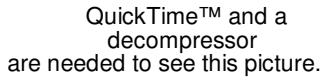


Fig 4. Abundance of selected fish species – exception is *G. tricuspidata*

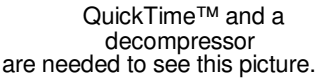


Fig 5. Abundance of selected fish species – exception is *C. spectabilis*

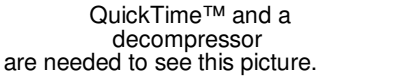
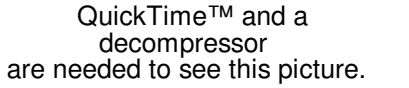


Fig 6. Entire fish community - SZ and non-SZ



Snorkel survey program

Overview

- Greater numbers of red morwong were recorded in sanctuary zones (responding positively to protection)
    - show site fidelity
    - numbers increase, then decline.

- Total abundance of all fish species is greater outside the BMP
    - driven by a small number of schooling species in barren habitats.

- Greater total numbers of abalone in sanctuary zones (responding positively to protection)
    - island sanctuary zones working especially well for abalone.

- Greater number of legal sized abalone in sanctuary zones (no significant difference in sub-legal sized abalone).

- Abundances of abalone show increasing trend.

- Greater numbers of urchins outside the BMP.

- Trend for *Phyllospora sp.* increasing in sanctuary zones
    - more urchin barrens outside the BMP
    - patterns probably existed prior to declaration of BMP.

Fig 7. Entire fish community. Fish community outside park ≠ elsewhere. Driven by abundant species, not types of species

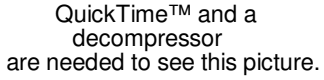


Fig 8. Abalone abundance is four times greater in island SZs

QuickTime™ and a
decompressor
are needed to see this picture.

Monitoring debris and invasive species

- Good news on invasive species! None were detected in either the SCUBA or snorkel survey programs on the rocky reefs sampled. However, invasive species are present in some of the estuaries and ICOLLs in the BMP.
- Debris counts were low to nil (debris was recorded on SCUBA surveys only). Most debris recorded comprised lost fishing gear (hooks, sinkers, line, traces etc.), with smaller numbers of rubbish items (bottles, cans, some plastic bags etc.).
- Sites were not chosen to represent heavily fished areas.
- The debris data have not yet been analysed in detail.

Discussion and conclusions

What does all this mean?

- The abundance of most species varies greatly across times & zones.
- Sanctuary zones encompass a broad range of habitats and species and represent broad scale diversity.
- There is a 'natural' patchy variation in species abundance and biodiversity that is spread across zones.

- There were no “negative” trends over the time periods studied.

- Snorkel surveys in shallow water appear to have detected possible early positive trends in sanctuary zones in some species and appear to be more effective than scuba surveys for detecting change in these species.

- Other studies show that transformation of sanctuary zones takes much longer than the survey periods in this study. According to Edgar et al, (2009):

> “Tasmanian reef communities within ‘‘no-take’’ marine protected areas (MPAs) exhibited direct and indirect ecological changes that increasingly manifested over 16 years, eventually transforming into communities not otherwise present in the regional seascape. Data from 14 temperate and subtropical Australian MPAs further demonstrated that ecological changes continue to develop in MPAs over at least two decades, probably much longer.”

Methodology and management issues

- The snorkel survey methodology is much more readily available to managers of agencies with marine responsibilities, due to the relaxed working environment, which allows an easy mix of staff and volunteer participation as required or desired.

- The snorkel survey methodology facilitates wider engagement of the community, due to the lesser skill set and fitness levels required.

- Participants in both snorkel and SCUBA survey programs would no doubt agree that counting invertebrates is much easier on SCUBA (more time to search / less chance of ‘losing your place’ underwater / easier to record findings as you go)!

- The RLSF SCUBA survey methodology only suits a small number of volunteer recreational divers, due to the high degree of training required (in species identification, as well as survey technique), and level of dive skills. However, where a pool of such (motivated) volunteers exists, management agencies may encourage their participation in research activities, in order to supplement other sources of data for management purposes, by helping with project design and oversight, and assistance in kind with data analysis and writing grant applications to cover expenses.

- Potentially, the RLSF methodology and training program ensures that the highest quality data are obtained from volunteers, who in effect are ‘calibrated’ against trained scientists.

Highlights

- Efforts to identify unusual species. Volunteers have access to, and have consulted a range of professional scientists from RLSF, Northern Territory Museum,

Australian Museum and elsewhere. In some cases, museum staff consulted overseas-based world experts.

- The range of cryptic and endangered species observed and recorded. Some of these are rarely (if ever) seen by divers. For example, the Sand Diver (*Limncithys fasciata*) can be very abundant on transects but as it spends most of its time buried in sandy patches on the reef and is extremely cryptic, it could not be identified until pictures were finally obtained. Numerous species of Weedfish (e.g. *Heteroclinus sp.)* have also been recorded, but as these are also difficult to photograph and identify, records may be limited to genus, or in some cases, family level. Endangered black cod are occasionally sighted and recorded as with other species.

- Unfavourable weather has severely limited diving opportunities in the last two years. This extended the time period required to complete surveys of the 21 agreed sites, and necessitated exceptional effort by volunteers (up to 5 surveys per day) to complete the program in the limited opportunities available. Surveys were at times conducted in strong surge, low temperatures and low visibility. Practical considerations preclude surveying in less than 4 metres visibility.

Where to now?

- Continue monitoring! We need to collect enough data over a long enough period to detect and adequately reflect changes.

- Continue to monitor island sanctuaries separately (snorkel program). Island sanctuaries may provide additional protection from poachers, especially relevant to abalone numbers, where much poaching is shore-based.

- Each sanctuary zone will respond differently, so we need to consider each zone individually rather than averageup effects.

- We need to survey more heavily fished sites (especially in-shore) for debris (SCUBA program). We also need to analyse existing debris data, and over time, look for patterns, especially in sanctuary zones.

- Add debris categories to the snorkel survey methodology.

- Funds have been provided to continue the NCMG SCUBA survey program during 2013. Special projects to monitor grey nurse sharks and black cod have also been funded.

- The snorkel survey program will also continue, funded by NCMG members.

Postscript

After presenting this paper at the 21st Coastal Conference in Kiama, 6-9 November 2012, and attending many of the other presentations, it became clear that there were some further points that should be made. In particular, these two projects and the results show

that volunteers can meaningfully contribute to producing valid, useable scientific data. In the current cash-strapped times, this has obvious implications given the cost of scientific research and the possibility that volunteers might be able to help at minimal cost.

Indeed as keynote speaker Stephen Dovers said:

> "Long term monitoring is uncool…"

while noting the importance of such work. However, long term monitoring can be sexy to volunteers! If they can be successfully involved, they can free up 'real' scientists to do more of the 'rocket' science… And with an aging population, the pool of skilled people who want to make a difference and have the time and resources to become involved is only likely to increase.

Some suggestions for successfully involving volunteers:

- The projects need to be designed by scientists, with appropriate input from the volunteers.

- Scientists should find out about and make use of the special skills that volunteers can bring to projects. For example, volunteers may have expert photographic skills and sophisticated equipment – available at no charge!

- Volunteers need to know exactly what will happen to the data they help gather; and in particular, be certain that it will be used. This has not always been the case with data gathered by divers.

- Volunteers need to be properly trained by the scientists who will oversee the projects. There should be a ready line of communication between volunteers and project managers, for guidance and to answer any queries as they arise.

- Appropriate acknowledgements in the resulting scientific papers (and copies of the papers) confirm that the efforts of volunteers have been worthwhile.

- Volunteers who want to make the extra effort and study to become experts in their own right should be encouraged and mentored by scientists.

- If appropriate, it is always appreciated if a contribution can be made to the expenses incurred by the volunteers. This is not necessarily a financial issue, but indicates that their time does have a value.

References

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