Volunteer Monitoring of Australian Rocky Reef Communities

Pilot study

Report to the Commonwealth Environment Research Facilities program, Department of the Environment, Water, Heritage and the Arts

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SUMMARY

The volunteer monitoring of Australian rocky reef communities project commenced in December 2007 with funding from the Commonwealth Environment Research Facilities (CERF) program, an Australian Government initiative supporting world class, public good research. The project's goal is to develop and resource a network of skilled recreational divers who can rapidly and cost-effectively assess the state of the inshore marine environment at the continental scale using standardised methods. The first year of this project was seen as a pilot study, with the primary aims of providing clear evidence that the recreational dive community and relevant coastal managers are enthusiastically engaged in the project, and that immediately useful data are generated. Initial aims of the project were to assess two central assumptions:

1. If appropriately trained and resourced, the most enthusiastic and knowledgeable recreational divers can undertake routine investigation of the marine environment to a level equivalent to a scientifically-trained diver.

2. A large proportion of the best recreational divers are willing to assist scientific studies, and will maintain enthusiasm through the long-term, if provided appropriate technical, financial and logistic support, and they receive feedback and recognition for their efforts.

Confirmation of these assumptions requires demonstration that the concept and methods proposed are appropriate for establishing a long-term program for providing scientific quality sub-tidal monitoring biodiversity data to marine resource managers.

During the first 10 months, the project has been highly successful in achieving the goals of the pilot study and has met or surpassed all milestones. Appropriate staff were appointed, a steering committee established, a long term institutional home found, and a website and database developed. Most importantly, 52 skilled and enthusiastic recreational SCUBA divers have been trained in standardised sub-tidal biodiversity survey techniques and more than 280 surveys subsequently completed by

divers in their own time, thus providing substantial support to the two original assumptions.

The appropriateness of the methods for both the training of divers and biodiversity monitoring, and the quality of the data produced, were demonstrated through statistical analysis of the data collected by volunteers. Analyses of data collected during training show that survey counts from skilled and committed volunteers are comparable to those produced by experienced scientists. Some volunteer divers produce good quality data immediately, while most require no more than six training dives to produce data useful for scientific analysis (depending on the individual and the complexity of local marine life).

Analysis of volunteer data collected in and near Marine Protected Areas (MPAs) demonstrate that volunteers can contribute to robust and meaningful analysis of the condition of reef communities. A continental-scale assessment of the effects of MPAs revealed clear differences in sites within no-fishing zones (Sanctuary Zones) and fished reference sites. Sites in Sanctuary Zones right around southern Australia had significantly greater numbers of large fishes and estimated total biomass of fishes than nearby unprotected reference sites. Fish biomass was also related to the distance to the nearest Sanctuary Zone boundary. Biomass significantly declined away from sites located furthest inside sanctuary zones to zone boundaries to fished sites distant from sanctuary zones.

One notable outcome was a strong relationship found between the ratio of fish biomass inside compared to outside Sanctuary Zones with the number of years since protection. The effects of protection from fishing apparently continue to increase with time after MPAs are declared, with the largest effect size observed in areas that have been protected for almost 40 years. This result has clear implications for the management of Marine Protected Areas globally, providing the first evidence of such patterns over a continental-scale based on standardised empirical methods. It also contrasts with outcomes of a widely-cited meta-analysis that suggested that effects of MPAs stabilise within 1-2 years of protection. Such meta-analyses are likely biased through selective reporting of results in journals.

Other scientific outcomes demonstrated by the project during its 10 month existence include information on range extensions for fish and invertebrate species, as confirmed by photographs taken by volunteer divers during surveys. Also, a University of Tasmania honours student, Elizabeth Oh, has started a research project based on the CERF digital image database. She is using photo-quadrat images taken by divers along transects to quantify changes in the percentage cover of macroalgae and sessile animals associated with different levels of human disturbance in south-eastern Tasmania, including impacts of salmonid fish farms.

The project has now also accomplished the most important steps towards ongoing sustainability once the three-year funding cycle associated with CERF is completed. *Reef Life Survey* (RLS), a newly-formed organisation of volunteer divers, has been established within an existing NGO, People and Parks Foundation, to facilitate the aims of the CERF project through the long term. RLS aims to link divers, managers and scientists in marine conservation activities through survey and analysis of reef communities using scientifically rigorous techniques. Involvement of People and Parks Foundation in the CERF project generates many benefits, including liability insurance for volunteer divers at no cost to CERF or the University of Tasmania.

The CERF project has also been supported by Stefan Töpfer, CEO of Winweb International Ltd, a web design company that has provided considerable technical expertise in setting up a website at no cost to the project, and by Barry Andrewartha, publisher of *Dive Log Australasia* and *Sport Diving*. With respect to financial sustainability, grant applications have also been submitted by RLS to AusAID and Caring for our Country for projects to extend the geographical scope of the project to the Asia-Pacific region and to expand training capacity within Australia, respectively. RLS is also a major participant in a grant proposal to Caring for our Country for surveys of reef communities using CERF-trained volunteer divers at Lord Howe Island and Norfolk Island.

Specific milestones of the pilot year of the CERF project have been achieved as follows:

Appointment of staff – A Junior Research Fellow (Dr Rick Stuart-Smith) was appointed in December 2007 as a program coordinator, under the supervision of Assoc. Prof. Graham Edgar. He has effectively organised and coordinated all of the training programs and survey trips, attended and presented at scientific conferences and community group meetings, and analysed training data. A technical officer, Ms Antonia Cooper, was also appointed in March 2008 as a database coordinator. She has assisted in the development of a database and has checked and uploaded all data and undertaken day to day liaison with the volunteer divers, as well as assisting on some of the training/survey trips.

Meeting of stakeholders and formation of Steering Committee – An initial meeting was held in September 2007 with representatives of major stakeholder groups, resulting in the successful development of a strategy and the formation of a Steering Committee. The CERF Steering Committee comprises marine management representatives from the Commonwealth Government and Tasmania, Victoria, New South Wales, South Australia and Western Australia, plus scientists and community dive group representatives. The Committee meets on a monthly basis to discuss the direction of the project and address specific issues as they arise.

Identification and training of at least 31 recreational divers - Fifty-two suitable recreational divers were selected and trained during the pilot study, which included 5 training courses and 4 survey/training trips. Analysis of data generated has shown that the training was successful in achieving a high level of competence amongst the recreational divers, with 85% of the divers reaching a level that could be considered equivalent to a trained scientific diver after 6 training dives.

Functioning data base system operating – A Microsoft Access database was developed to store and manage the biodiversity data collected by volunteers, with a range of in-built checks to minimise the potential for mistakes as data are entered into the database. Original Excel spreadsheets and hard-copies of divers' data have also been kept as a back-up and evidence of the data as originally collected and entered by the volunteers.

Website developed and live – A website was developed that allows the general public to find out more about the project, and facilitates access to relevant information and resources for trained and interested divers. When fully developed, it will also provide managers and NGO's (and the public) with regional reports on reef condition. The website is now live, and is undergoing continual improvement. See: www.reeflifesurvey.com

A scientific journal publication drafted – A paper using volunteer-collected biodiversity survey data for assessing continental-scale effects of Marine Protected Areas has been drafted for submission to an international, peer-reviewed journal.

Results presented at conferences and community group meetings – Information on the training of volunteers in the initial courses and general information on the existence and goals of the project have been presented at the Australian Marine Science Association/New Zealand Marine Science Association joint conference in Christchurch, NZ, the Coast to Coast 2008 conference in Darwin, and the CERF conference in Canberra. Additional presentations have been made to the Australian Marine Science Society SA annual conference in Adelaide and students undertaking the Scientific Diver course at the University of Tasmania. The project has also received considerable media interest, including supporting articles written for popular dive magazines by enthusiastic divers participating in the program. Two newsletters outlining the details and progress of the Reef Life Survey program were also produced and circulated to volunteer divers, steering committee members and other people and organisations involved.

INTRODUCTION

The marine environment is suffering from a variety of human impacts, most notably climate change, over-fishing, discarded rubbish, chemical pollution, sedimentation, bleaching and introduced pests. The big problem faced by managers trying to deal with these impacts is that it is very difficult to know where conservation intervention is most useful because little reliable information exists on the nature and true scale of these threats.

Current efforts to protect biodiversity through the establishment of representative networks of marine protected areas (MPAs), in particular, require two specific levels of biological information – data on local biodiversity values and trends (including for threatened species), and information on the effectiveness of the different options or strategies to protect these biological communities, given their characteristics and the threats of greatest relevance. The reality is that managers only rarely possess adequate information on local biodiversity, and they never have requisite information gained from broad-scale research to implement the most appropriate strategy with respect to local circumstances.

Thus, there has been a consistently heavy reliance on habitat mapping and modelling efforts to provide management with relevant "biological" information with which to assist in determining the appropriate number, locations, sizes and boundaries of MPAs. These components (habitat mapping and modelling) are necessary and can substantially reduce the amount of biological data required, but should never be used in isolation from quantitative empirical biological data (Edgar et al. 2008), particularly as they almost always neglect threatened and rare species, and complex ecological interactions and stochastic processes, which cannot currently be effectively modelled.

Local-scale biodiversity information is required to know what requires protection and how species and ecosystems are distributed in space, yet knowing what is in greatest need of protection and what may effectively be protected by different management actions requires data over broader spatial and temporal scales. Funding realities and

lack of trained personnel make it unlikely that needed data will be obtained over appropriately-large geographic scales through the foreseeable future.

We suggest that the most practical option for extending Australia's capacity for sub-tidal monitoring to the continental spatial scale through the long-term is through utilising the skills and time of the most committed and capable recreational SCUBA divers. Avian monitoring and research has long relied on the skills and commitment of amateur bird watchers (e.g. Harrison 1992, Greenwood et al. 1995). Increasing use is also now being made of volunteer-collected data for marine environments (e.g. Mumby et al. 1995, Darwall & Dulvy 1996, Pattengill-Semmens & Semmens 1998).

This project aims to provide training and assistance to a national network of committed recreational SCUBA divers, to enable broad-scale, cost-effective monitoring of Australia's economically and socially valuable sub-tidal reefs. This one-year CERF pilot study specifically aimed to demonstrate that such a model based on volunteers would work and that the data collected by trained recreational SCUBA divers would be of sufficient quality to conduct robust and meaningful analyses of spatial and temporal patterns in reef communities. A continental-scale analysis of MPAs was performed using data collected during the pilot year in order to demonstrate scientific application of volunteer-collected data. The specific research goal was to describe differences between MPAs and adjacent fished reference areas with respect to the species richness, biomass and density of fishes and invertebrates. MPA-related differences in fish biomass that are associated with the period of MPA protection were also quantified.

OUTLINE OF METHODS AND PROGRESS

Formation of CERF Steering Committee and development of long-term program

Following an initial meeting of major collaborating partners in late 2007, a Steering Committee was formed that comprises state marine management representatives, scientists and community dive group representatives. The members are:

- **Alan Jordan** *Representative of NSW state management agencies.* NSW Marine Parks Authority, Port Stephens, NSW. Manages scientific research within the NSW marine protected area system. Recently replaced Tim Lynch as NSW representative. Email: alan.jordan@environment.nsw.gov.au
- **Andrew Green**: *Representative of volunteer diver organisations*. Major coordinator of the Nature Coast Marine Group, Congo, southern NSW. Also one of our most active volunteers. Email: agreen@acr.net.au
- **Andrew Zacharek** *Representative of Commonwealth Government*, Department of Environment, Water, Heritage and the Arts. Based at the Temperate Marine Conservation Branch of the Marine Division, Hobart. Email: andrew.zacharek@environment.gov.au
- **Graham Edgar** *Principal Investigator on CERF grant and Director of program.* Associate Professor, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. Over 30 years experience in marine environmental research. Email: gedgar@utas.edu.au
- **Ian Shaw** *Representative of volunteer diver organisations*. Major coordinator of the Solitary Islands Underwater Research Group. Knowledgeable volunteer diver and contact for community groups in central and northern NSW. Email: c/o reeflife.survey@utas.edu.au
- **Kevin Bancroft** *Representative of WA state management agencies.* Department of Environment and Conservation, WA. Marine biodiversity research scientist in Western Australia. Email: kevinb@calm.wa.gov.au
- **Neville Barrett** *Representative of scientific interests.* Tasmanian Aquaculture and Fisheries Institute. Marine biodiversity research scientist in Tasmania with over 20 years experience, particularly in field survey techniques associated with marine parks. Email: neville.barrett@utas.edu.au
- **Peter Mooney** *Representative of Tasmanian state management agencies.* Tasmania Parks and Wildlife Service. Director of the Tasmanian Government's Parks agency. Email: Peter.Mooney@parks.tas.gov.au
- **Rebecca Koss** *Representative of volunteer dive organisations.* Sea Search Vic. Project officer of marine volunteer program and Victorian community group contact. Email: rkoss@parks.vic.gov.au

- **Rick Stuart-Smith** *Research Fellow coordinating Reef Life Survey program and CERF grant.* Tasmanian Aquaculture and Fisheries Institute. Marine biodiversity research scientist. Email: rstuarts@utas.edu.au
- **Scoresby Shepherd** AO *Representative of scientific interests.* South Australian research and Development Institute. Marine biodiversity research scientist with over 40 years experience. Email: Shepherd.Scoresby@saugov.sa.gov.au

The Steering Committee has met at approximately monthly intervals to discuss plans, issues and priorities for the project. It has been highly effective in both directing effort and decisions at local levels within each state, as well as providing overall balanced input into the project at the national level. Steering Committee members have shown an exceptional level of support for the project, taking time out from busy schedules to participate in meetings, interact through regular email correspondence, and in most cases participate in field activities. Minutes of all Steering Committee meetings have been recorded and are available.

The Steering Committee decided that the formation of an associated volunteer program was needed to implement the goals of the project through the long-term. Consequently, a program called *Reef Life Survey* was developed, with its steering committee members currently the same as those who oversee the CERF project.

Reef Life Survey falls as a program within the People and Parks Foundation (PPF), a national non-profit organisation based in Victoria that was established "to improve the physical, mental and social health and well-being of people, and to ensure the sustainability of parks, both terrestrial and marine". The mission of PPF is to develop innovative programs that increase people and parks interactions across Australia and internationally. PPF seeks to build strategic partnerships with park management agencies, educational institutions and research organisations across Australia and overseas and is thus well suited as a long-term home for the *Reef Life Survey* program. PPF has Deductible Gift Recipient (DGR) status, allowing tax deductible donations to

the program, and insurance that covers liability issues associated with volunteer diver training and field surveys, at no cost to the CERF project.

Methods for monitoring sub-tidal reefs

CERF volunteer divers are trained in visual census methods that are slightly simplified in relation to, but that generate data directly comparable with, methods applied in long-term scientific monitoring programs across southern Australia (Edgar and Barrett, 1997; Edgar et al., 1997). Visual transect methods are employed by marine researchers globally to quantitatively assess the densities of major taxonomic groups in sub-tidal reef habitats. They are highly repeatable, cost-effective, and can be applied in most habitat types. The method used in this program is based around SCUBA divers laying a 50 m transect line along a defined depth contour as depicted graphically in Figure 1. Fish abundance, macroinvertebrate abundance, and macroalgal and sessile animal densities are then separately surveyed along the transect line.

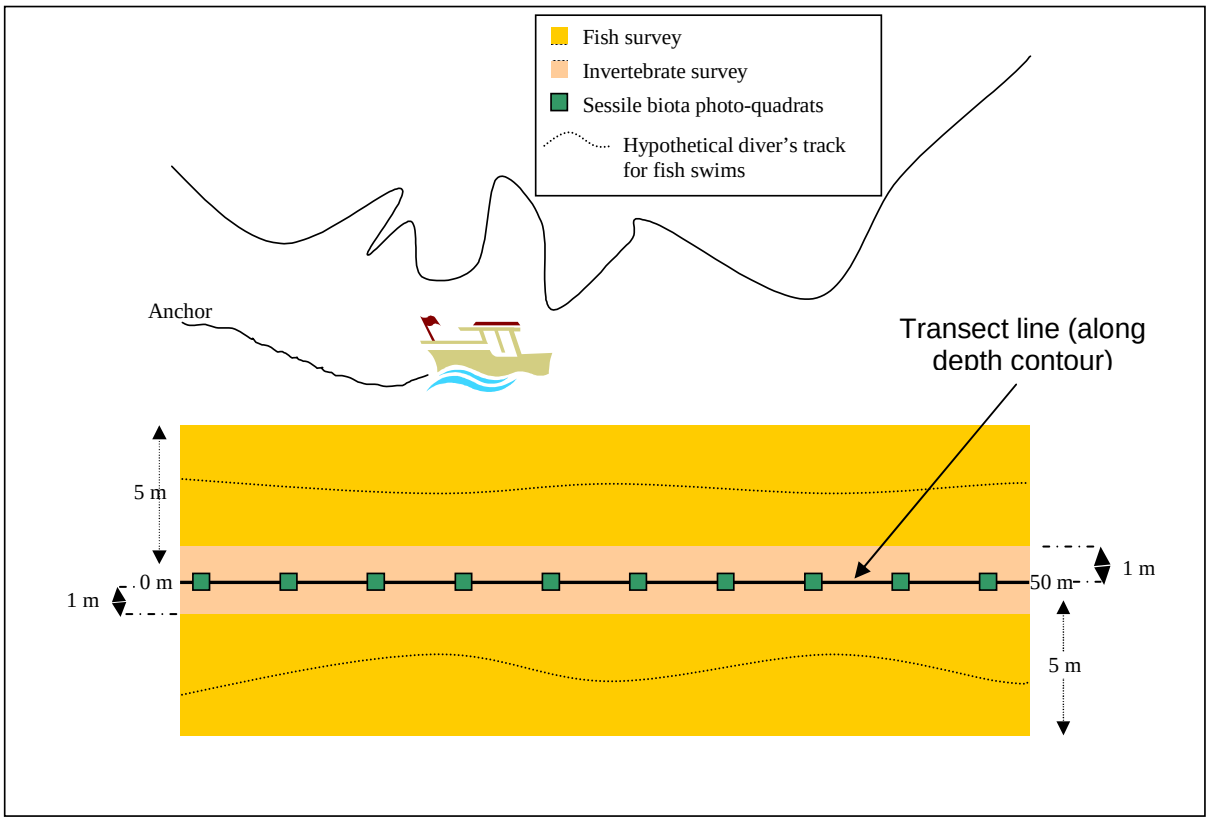

Figure 1. Stylised representation of survey technique.

Fishes are surveyed in two 5 m wide blocks either side of the transect line. The number and estimated size-category of all fishes sighted within these blocks is recorded as the divers swim slowly along. The size-classes used are 25, 50, 75, 100, 125, 150, 200, 250, 300, 350, 400, 500, 625 mm, and above. Lengths of fish larger than 500 mm are estimated to the nearest 125 mm and individually recorded.

Mobile macroinvertebrates and cryptic fishes are surveyed in two 1 m wide blocks on either side of the transect line. The diver brushes aside the algal canopy where necessary to search all exposed surfaces of the substratum for non-sessile invertebrates as well as small benthic fishes, which may be missed during the fish survey.

Digital photo-quadrats are taken at 5 m (or 2.5 m for cameras lacking a wide-angle lens) intervals along the transect line (i.e. 10 or 20 per 50 m transect) to allow percentage cover of sessile invertebrates and macroalgae to be later estimated using the appropriate computer software.

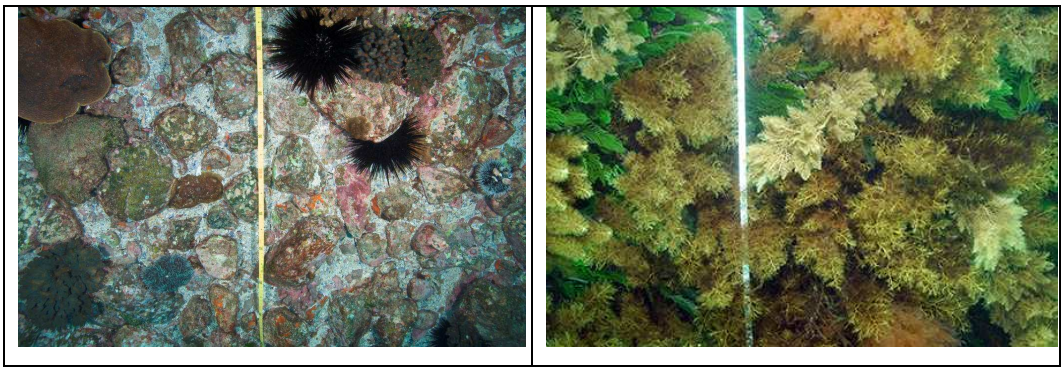

Plate 1: Examples of Photo-quadrats taken by volunteer divers.

Because of the relatively small cost and ease of use of many models now available, the vast majority of enthusiastic SCUBA divers now own a digital camera and underwater housing. The use of photo-quadrats to estimate bottom cover thus capitalises on the widespread availability and practicality of this equipment, and

means that algal or coral taxonomy skills are not required by every volunteer diver engaged in the CERF program. This represents a massive step forward in the capacity to collect large quantities of empirical data on macroalgal and coral cover, by utilising volunteers and not just the few scientists with the advanced skills required to identify these groups in the field.

Because of time and cost issues, photo-quadrats obtained by CERF volunteer divers are archived in a University of Tasmania database for study as required, rather than being analysed immediately. Thus, the database of archived photo-quadrats increases through the long-term, with images extracted and digitised for particular studies, such as analysis of changes in algal cover in sanctuary versus fished zones through time in a particular marine park. A University of Tasmania student, Elizabeth Oh, has started an honours project based on the CERF digital image database. She is digitising relevant photo-quadrats to assess human impacts on algal and sessile animal communities in south-eastern Tasmania, with particular emphasis on declining dominance of opportunistic algae (associated with eutrophication) with distance from salmonid fish farms.

We use Coral Point Count with Excel extensions (CPCe) software (Kohler & Gill 2006) to digitally quantify the percentage cover of different macroalgal and sessile invertebrate groups on images. A grid of 56 evenly spaced points is superimposed over each image, and the algal or invertebrate taxon laying under each of these points is recorded. CPCe then calculates mean percentage cover for each taxon within a defined set of images (i.e. those taken on a single transect line) and saves the data in a format suitable for addition to the Access database. Most photo-quadrats from surveys by training staff during the training courses (see below) have been processed using this program and procedure. The digitisation process is working smoothly, producing data in a format compatible with macroalgal data previously collected by scientific teams from MPA surveys around southern Australia.

Plate 2: RLS diver (Hisayo Thornton) undertaking a survey of an Abrolhos Island Reef

The methods used by the *Reef Life Survey* program (RLS) provide more detailed technical data than those used by other Volunteer-based reef monitoring programs, which most notably include Reef Watch SA, Reef Check International and REEF (the Reef Environmental Education Foundation). In contrast with other programs, which focus on particular species (e.g. “indicator species”) or species groups, RLS divers record abundances and size-classes for all fish species and density data for all large invertebrate species that are sighted along transects.

Compared to surveys of indicator groups, the additional time required for a diver to record fishes and macroinvertebrates to species-level is small once at a site with the transect line laid, the major difference being that a more detailed knowledge of marine species is required. Because of this, RLS seeks only those divers that have a reasonable base knowledge of marine species and a desire and capacity to improve their knowledge and contribute to marine conservation.

Reef Life Survey works collaboratively with other volunteer dive groups in southern Australia (Reef Watch, SA and Sea Search, Vic). The more capable and enthusiastic divers within these groups are identified and invited to participate in RLS, where they gain additional training through participation in the national program. The state

groups benefit through their better divers furthering their skills and receiving ongoing support and incentives to undertake regular surveys, whilst RLS benefits from gaining those divers already proven to be capable and committed enough to undertake the more detailed RLS surveys.

Original training format

Five training courses were organised for early 2008. The first was designed as a preliminary test of the training method and format. Given its pilot nature and the need to identify and correct potential issues before going public, this course only involved volunteers known to be proficient in reef census techniques, plus Steering Committee members. This course was run on the east coast of Tasmania from 6th-9th January.

The remaining courses were organised for Flinders Island (Tas), Second Valley (SA) Jervis Bay (NSW) and the Abrolhos Islands (WA), with each running for 5 days and involving the training of 7-11 divers (see table 1 for details of trips and divers). Interested divers contacted project staff following the publication of information about the project in *Dive Log* (an Australasian dive magazine), and through local volunteer research groups and clubs (e.g. Sea Search Victoria and the Solitary Islands Underwater Research group). Of those divers who were interested and available for the scheduled courses, the most appropriate were selected with the assistance of members of the Steering Committee from the state where the training program was to be held. Selection of divers was based on previous participation in volunteer diving activities, dive experience and dive history.

Each course involved an initial evening briefing session, where volunteers were provided background information about the program and its goals, and details of the survey methodology. The following 5 days on each course followed the same format, with two survey dives each day, during which project staff and volunteers undertook surveys together. Training staff collected data from the same time and place as volunteers, allowing direct comparisons of data sets, and also allowing field techniques of volunteers to be readily observed and assessed by training staff.

Survey dives were followed by afternoon and evening sessions in which assistance was provided to each individual diver for clarification of species' identifications, and for training in data entry using standard Excel spreadsheets. Comparisons of trainer and trainee data sets also occurred at this time to identify anomalies and to correct trainee mistakes and major biases associated with the data collection process. At least one project staff member was available for each five volunteers, thus providing sufficient help to those volunteers most in need, and enabling almost all volunteers to reach an appropriate level by the end the training course. Graham Edgar and Rick Stuart-Smith participated on all trips, other than the Jervis Bay course where two suitably experienced scientific divers replaced Graham Edgar.

Plate 3: RLS divers and trainers discuss species identifications and enter data after a day surveying reefs at the Abrolhos Islands.

Revision of training format

Following the initial five training courses, the Steering Committee met to discuss potential ways of improving training methods whilst concurrently collecting a greater amount of useable data for the regions where training was taking place. Because much of the data obtained during the training courses was provided by inexperienced divers, it was not considered adequate for scientific use. As described below in the Data Quality section, data collected by volunteers during training was not considered of sufficient quality for scientific use until after between 4 and 8 dives, depending on diver and location. Consequently, a new format was decided which the Steering Committee agreed was more cost effective for the training of new divers, the updating of skills of trained divers, the continued engagement of trained divers, and the collection of scientifically-credible data. The new format involved organised trips over four day weekends, during which two or three new divers were trained, and previously trained divers were also be invited to attend. For these long weekends, the CERF program covered dive costs and accommodation for both new and experienced divers, and divers covered costs of transportation and food.

Four additional trips following this new format were run between June and October 2008. These training/survey trips were at the Solitary Islands (NSW), Port Phillip Bay (Vic), Rottnest Island (WA), and Edithburgh (SA). This new format proved very successful, with a total of 10 new divers trained and 92 transects surveyed by trained divers and project staff. The numbers of new trainees and previously trained divers on each trip is given in Table 1.

The major benefit of this revised training format was that it allowed priority regions, including important marine protected areas distributed across the continent, to be targeted for survey with the assistance of numerous trained divers. An additional benefit of the new process was that it provided greater opportunity for project staff to undertake surveys with trained divers at various intervals post-training, and thus be able to compare data and ensure data quality was not deteriorating with time after training. It also raised the commitment level of volunteers by providing them with the opportunity to undertake surveys with like-minded individuals on a regular basis.

Table 1. Training courses and training/survey trips during 2008.

Location	Dates	Number of new divers trained	Number of previously trained divers attending
Training courses			
Maria Is. (TAS)	6-9 Feb 2008	5	0
Flinders Is. (TAS)	28 Jan-1 Feb 2008	7	0
Second Valley (SA)	5-10 Feb 2008	10	0
Jervis Bay (NSW)	18-22 Feb 2008	11	0
Abrolhos Is. (WA)	21-25 Mar 2008	9	0
Training/survey trips			
Solitary Is. (NSW)	4-8 Jun 2008	2	5
Port Phillip Bay (VIC)	20-23 Jun 2008	1	5
Rottnest Is. (WA)	25-28 Jul 2008	4	7
Edithburgh (SA)	3-6 Oct 008	3	3
TOTAL		**52**	**20**

The formation of *Reef Life Survey* within People and Parks Foundation (PPF) has meant that training activities through the future will be covered under the liability insurance held by PPF. Assuming that the CERF project is extended, PPF will be sub-contracted to undertake the training, but project staff employed by the University of Tasmania will continue to lead the training and be responsible for the organisation and training of all new divers.

Plate 4: RLS diver with a Leafy Seadragon (*Phycodurus eques*) seen whilst surveying a South Australian Reef.

Data transfer and database systems

Volunteers enter survey data onto pre-formatted Excel spreadsheets. These spreadsheets are emailed to project staff and added to the central reef database of reef biota at the University of Tasmania. Photo-quadrats of benthic cover (seaweeds, encrusting invertebrates and corals) are labelled and sent in batches on CDs to project staff, where they are digitised as required using Coral Point Count software (CPCe, Kohler & Gill 2006), with resulting data on percentage cover of different species also added to the database. Although some errors will inevitably occur when data are entered onto spreadsheets, requiring follow-up queries between project staff and divers as detected, these systems appear to be working well. Filters that screen data errors on entry to the database continue to be refined to improve accuracy and account for any emerging problems.

Project metadata have already been provided to BlueNet, and discussions made regarding the housing of the data within this system for public access to raw data. Early progress is also being made on a user-friendly system for web-based download of data for members of the public through the RLS website.

Reimbursement system

Not all volunteers can cover the additional financial costs of undertaking sub-tidal biodiversity surveys. Indeed, the costs incurred likely contribute to loss of volunteers from the system. In order to cover these major costs, notably air fills and fuel, a reimbursement system is in place, where volunteers can claim $30 per transect surveyed. This amount was determined as appropriate following discussion amongst the Steering Committee and consideration of the opinions of volunteer divers. Feedback from the volunteers suggests that this system is working well, even amongst the more active divers, who are doing approximately a survey per week. The Steering Committee believes that such high activity and commitment would possibly dissolve with time if the divers were left considerably out of pocket as a result of survey commitments. The total cost of reimbursement represents a small proportion of the total CERF budget (<5% to date, but hopefully rising as increasing numbers of transects are undertaken through the future).

ASSESSMENT OF QUALITY OF DATA COLLECTED BY VOLUNTEERS

One of the key objectives of the pilot study was to assess the quality of the biodiversity survey data collected by volunteers; indeed the success of the project and partnerships with management agencies depend on the volunteers being capable of collecting data of suitable quality to provide legitimate analyses of reef condition. A specific hypothesis was that if appropriately trained and resourced, the most enthusiastic and knowledgeable recreational divers can undertake routine investigation of the marine environment to a level equivalent to a scientifically-trained diver.

Multivariate similarity

The quality of survey data collected by volunteers was assessed using data from the first four training courses, which were held at Flinders Island (Tasmania), Second Valley (SA), Jervis Bay (NSW) and the Abrolhos Islands (WA) (Table 1). During training dives, experienced scientific divers undertook surveys along the same or adjacent lines to those set by volunteer divers, allowing comparison of volunteers' data with those of scientists at the same time and place. Scientists also assessed the correct application of survey methods by volunteers and provided appropriate feedback for improvement. At least two scientists collected data with volunteers at each site.

Data collected by volunteers were analysed for their similarity to those collected by the trainer scientists (hereafter referred to as the "trainers") at the same reef sites at the same time. Multivariate similarity is based on both species composition and abundance of individual species, and thus is an appropriate measure of whether volunteers were collecting data similar to those of trainers in both of these aspects.

Bray-Curtis similarity indices (Clarke & Warwick 2001) relating trainee and trainer data were calculated for each site using log-transformed abundance data for all fish and invertebrate species observed. The level of similarity of data produced by the two

trainers provided a benchmark for data quality at each site. This benchmark level of similarity varied considerably between sites, depending on local habitat heterogeneity and whether similar community types were censused on the different transect lines set by the two trainers. Regression of the mean (standard linear regression) and of the 10th percentile (Quantile regression) were performed on data to establish the existence and nature of relationships between the number of training dives undertaken and the similarity of volunteers' data to the trainers. The regression of the 10th percentile (Cade & Noon 2003) assessed whether the poorest quality survey estimates at a site improved with training.

Whilst considerable scatter was evident in multivariate similarities of volunteers' data, most community-level estimates by volunteer divers of reef fish and invertebrate densities were comparable to data produced by trainers at the same site (Fig. 2), including density estimates made by some volunteers during their first training survey. No significant relationship was found between similarity to trainer's data and number of surveys completed (Fishes: $P = 0.823$, macroinvertebrates: $P = 0.114$).

Regression of the 10th percentile of fish similarity data with the number of training dives was also non-significant at $\alpha = 0.05$, but approached significance ($P = 0.074$). This analysis was heavily influenced by data collected from a single shallow site with very few fish species, where the chance sighting of a fish species greatly influenced the similarity value. Seven of the eight surveys with the lowest similarities on the 7th dive were from this site. If data from this site are excluded, a significant relationship exists at the 10th percentile ($P = 0.030$, Fig. 2). This suggests that despite a consistently high average similarity throughout, the frequency of poor quality data (i.e. data least similar to those of scientists) decreased during eight training dives.

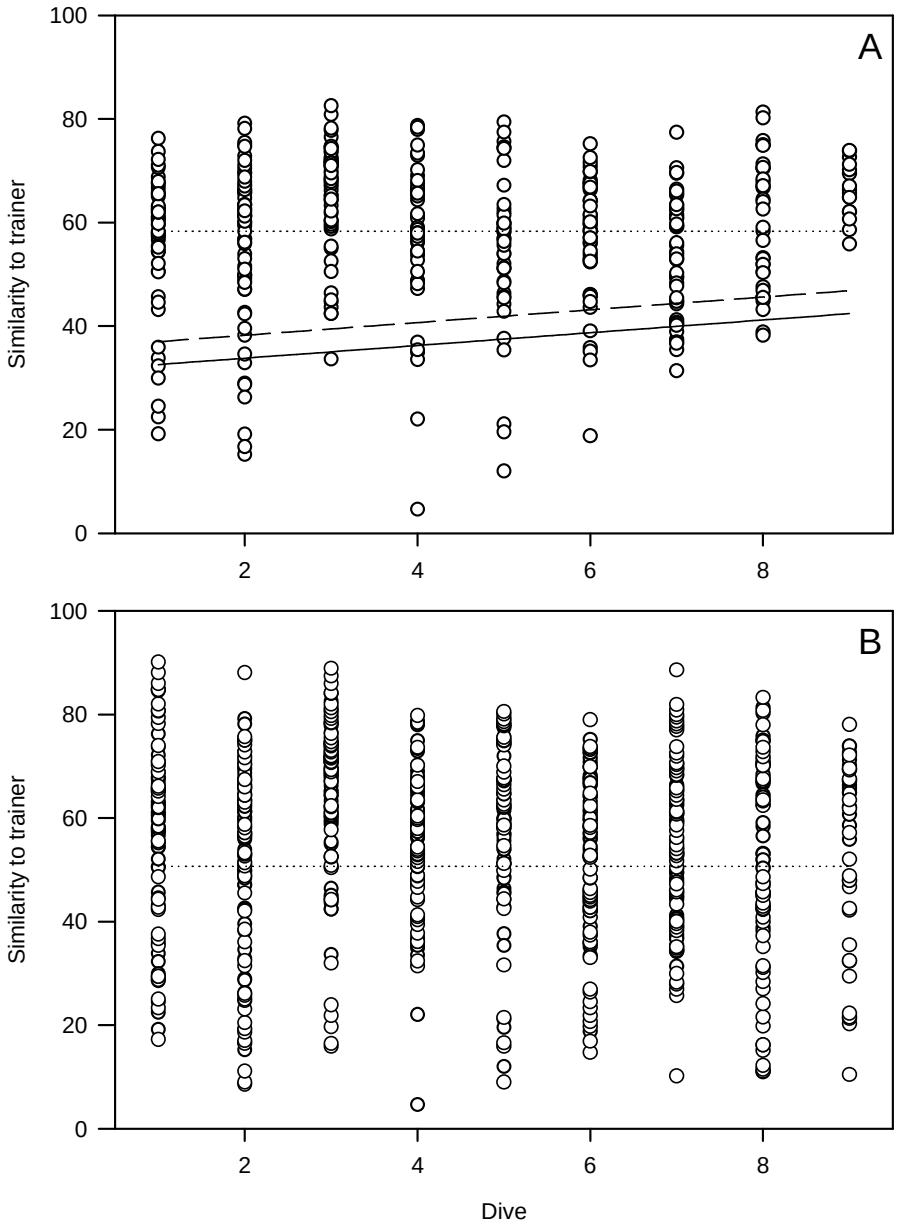

Figure 2. Bray-Curtis similarity of volunteers' data to trainers' data with the number of training surveys (dives). Data from fish surveys are shown in (A) and macroinvertebrate surveys in (B). The dotted lines represent the overall mean similarity between trainers over all courses. The solid black line represents the 10th percentile of fish similarity data, for which regression was approaching significance (P = 0.074). The dashed line is the same analysis when data from an anomalous site on the SA course (on dive 7) are removed (P = 0.030).

Data produced by volunteers that lay within 10% of the mean similarity of data produced by the two trainers was considered to be of adequate standard. For addition to the reef biota database, which was used for analysis of MPA effects as described below, no data produced during the first six training dives were used. Data produced by volunteers after this time were used if the trainee had achieved the threshold for data quality (i.e. data for a site were within 10% of the similarity calculated between the two trainers for that site). A total of 15% of divers trained on the four training courses failed to achieve this benchmark.

Species richness

The number of species recorded is a component of the multivariate similarity of survey data, and is also important in its own right. The number of species recorded represents a diver's ability to distinguish between species observed during the survey and is the factor most likely to differ between divers – particularly between experienced survey divers and those new to the technique. Species richness is an important univariate metric of ecological communities, and can be useful for identifying impacts of disturbances such as habitat degradation and overfishing.

The numbers of species recorded by volunteers during training dives were expressed as a percentage of the number of species recorded by trainers at the same sites and regressed against the number of training dives (Fig. 3). Whilst a lot of scatter is evident, these results show significant positive relationships, either at the mean or at the 10th percentile, demonstrating that there is a tendency for volunteers to record more species as they gain more experience. Importantly, this does not represent an improvement in the ability of divers to *identify* more species, because they are instructed to record all species sighted, even if unidentified. Rather, it represents an improvement in their ability to better distinguish between species or recognise more species as being present, which is critical to the application of the survey technique.

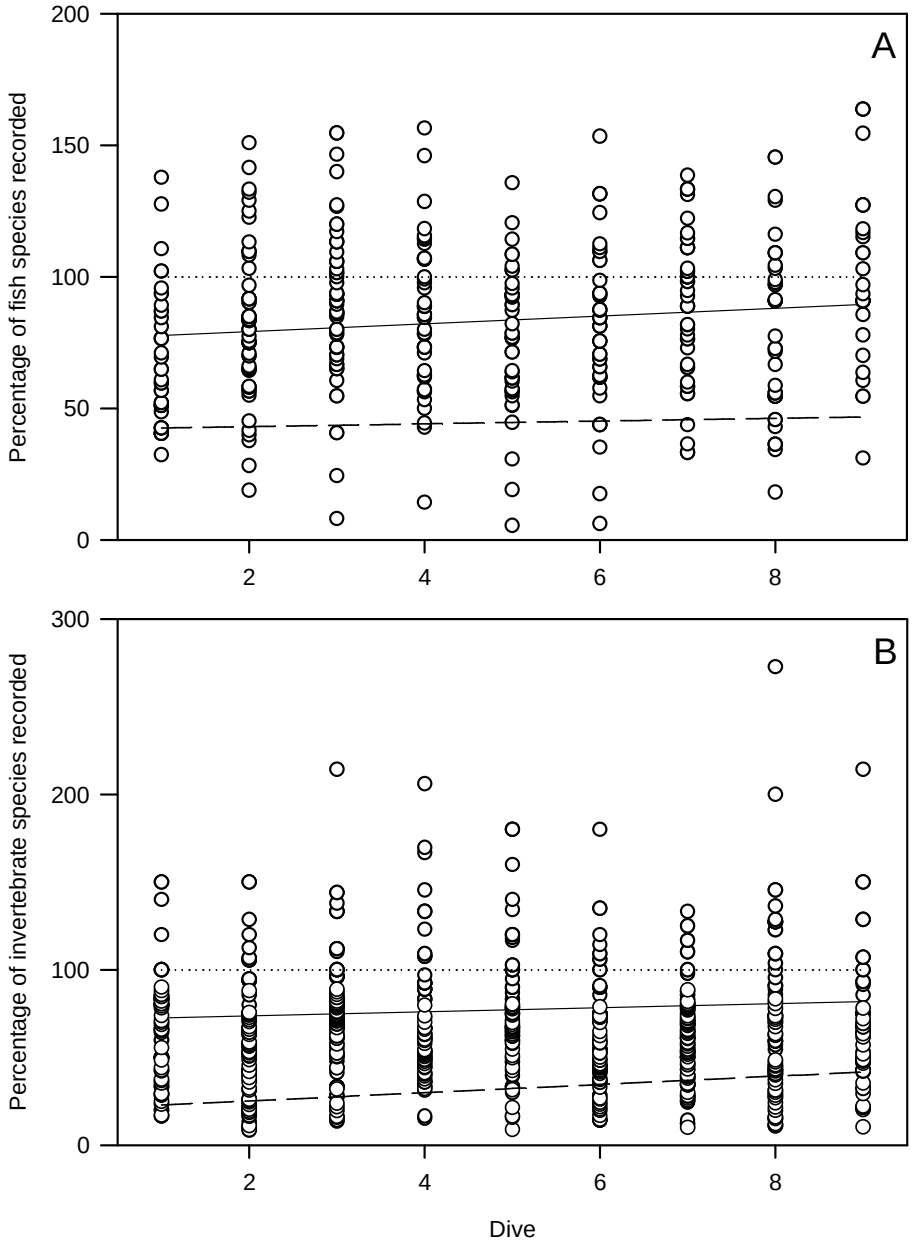

Figure 3. The number of fish (A) and macroinvertebrate (B) species recorded by volunteers (expressed as a percentage of the mean number of species recorded by the two trainers on the same dive) with the number of training dives. The dotted lines represent the number of species recorded by the trainers (100%). The solid black lines represent standard linear regression (Fishes: $P = 0.012$, intercept = 76.18, slope = 1.48; macroinvertebrates $P = 0.140$). The dashed black lines represent regression of the 10^{th} percentile of the data (Fishes: P = 0.594; macroinvertebrates: $P = 0.011$, intercept = 20.55, slope = 2.35).

ONGOING DIVER PARTICIPATION

The pilot study also aimed to assess whether trained volunteers would regularly contribute biodiversity data collected during recreational dives in their own time. The fact that the recreational diving community was willing to participate was clearly demonstrated by the large number of divers who expressed interest in attending a training course (97 – despite little forewarning of courses), by the large number of participants in the training courses (52), and by the number of transects completed during training dives (377). Strong evidence that trained divers maintained enthusiasm is that 251 useable transects have been surveyed around Australia (plus 29 at international locations such as Bali, New Zealand and the Pacific) after training had been completed. This is particularly notable given that the project commenced at the end of summer and that much of the available time since then has coincided with the coldest months, during which far less diving activity typically occurs in the southern states of Australia.

The distribution of survey effort around Australia has been impressive considering the short time frame and the limited number of training courses. Further training will target divers who live in the areas with major gaps in data collection. The distribution of reef sites that have been surveyed to date are shown in Figure 4.

Since the revision of the training format to surveys over long weekends with both new and previously-trained divers, ongoing checks on the quality of data produced by trained divers are routinely undertaken. Active divers who participate in these trips appear to be maintaining or improving their level of skill including species knowledge (see below). For the few divers who had not undertaken any surveys between training and an organised weekend survey, the organised survey provided an important opportunity to revalidate transect survey skills.

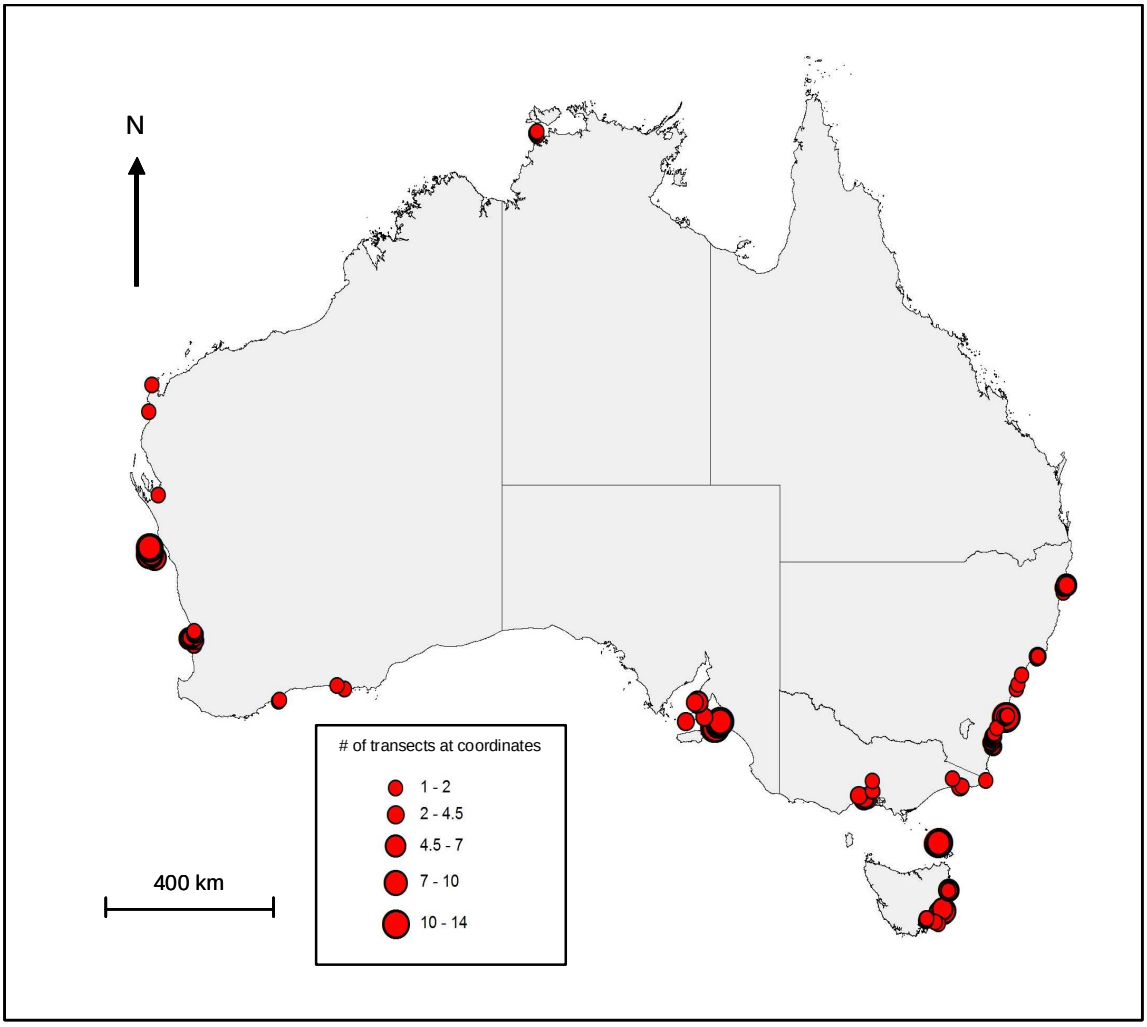

Figure 4. Map of Australia showing reef sites surveyed. Symbol size represents the number of transects that have been surveyed at the same GPS coordinates. Note that many symbols are overlapping.

Amongst the ten previously trained divers who attended the long weekend trips to the Solitary Islands and Port Phillip Bay, six undertook surveys at four or more sites with two skilled researchers also present. Information obtained during these surveys provided an opportunity to statistically assess whether data quality of volunteer divers had been maintained. An index of similarity that related data collected by each of these volunteers with data of the nearest researcher was calculated and compared to values of the same index during training after six dives. Similarity was calculated using the Bray-Curtis index and log transformed data, in the same way as calculated for the assessment of training data.

In order to minimise the potential for individual sites to bias results, similarity indices were based on mean abundances calculated from three training dives and four post-training dives. A paired-sample, two-tailed t-test confirmed that this index had not changed since training (t = 0.601, P = 0.580) for the six divers investigated. Thus, data quality in relation to the trainers was similar to that observed at the end of the training courses.

A notable outcome of the dive program was that volunteers who collected the best quality data during training tended to persist with the program and dedicate the greatest amount of time to follow-up surveys. This is indicated by the significant positive relationship (Pearson correlation coefficient = 0.465; P = 0.010) evident between the quality of data (i.e. similarity to data of trainers) after six dives during the training courses and number of full surveys completed subsequent to training (Fig. 5).

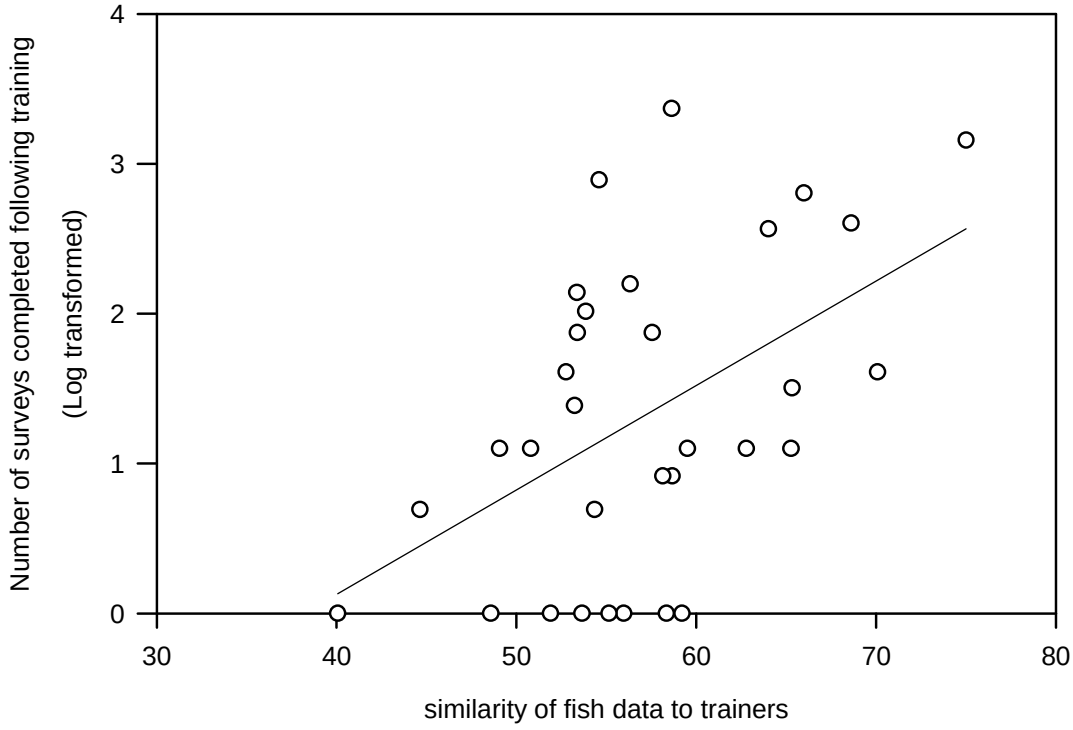

Figure 5. Relationship between number of full surveys completed by each volunteer diver since training ($\log_e(x+1)$ transformed) and similarity of volunteer and trainer survey data sets after six training dives. The solid black line represents a significant linear regression (P = 0.010, intercept = -18.98, slope = 0.422).

The best 27% of divers at the end of the four original training courses all continued collecting data, and none of the worst 21% have done more than 2 surveys post-training. Out of the 15% of divers whose data fell below the similarity cut-off for reasonable quality during training dives, only one has continued collecting data. This diver has since gained more experience and has participated in an additional training trip, and now appears to be collecting useable data. Thus, all data collected by volunteers post-training was considered suitable for scientific analysis.

BROAD-SCALE ANALYSIS OF MPAs

Methods and analyses

An analysis of MPAs was undertaken using the data collected during the pilot study to demonstrate robustness of data and suitability of methods to provide meaningful and useful statistical analyses. Field survey metrics of animal density, abundance and species richness were analysed here in the first quantitative continental-scale assessment of differences between MPAs (shown in Fig. 6) and adjacent fished reference areas. A full description has been written up as a manuscript for submission to the journal *Marine Ecology Progress Series*, and is provided as supplementary information.

A 'control-impact' design based on Analysis of Variance (ANOVA) was used to assess the effects of 'region' (4 levels: sites in or near MPAs in New South Wales (NSW), Tasmania (Tas), SE Australia (Vic/SA) and Western Australia (WA)) and protection 'status' (2 levels: fished zones and sanctuary zones) on reef fish and invertebrate community metrics. Like the factor 'status', 'region' was considered a fixed factor because all major temperate Australian regions were included in analyses. Fishing Zone (FZ) sites included those within MPA boundaries that were in areas with fishing permitted, or nearby sites outside MPA boundaries. Sanctuary Zone (SZ) sites were all located in areas protected from all forms of fishing.

Metrics included in analyses were the total density of fishes, the density of fishes greater than 30 cm (total length), the total biomass of fishes, the biomass of fishes greater than 30 cm, fish species richness, invertebrate species richness, the total

density of invertebrates, and the density of all sea urchins. Density of sea urchins was included in the study because of the possibility that trophic cascades in SZs caused increased numbers of large urchin predators that in turn resulted in reduction in urchin numbers (Shears & Babcock 2003, Pederson & Johnson 2006). All metrics except species richness of fishes and invertebrates were $\log_{10}$-transformed before analysis; however, plots are based on non-transformed data.

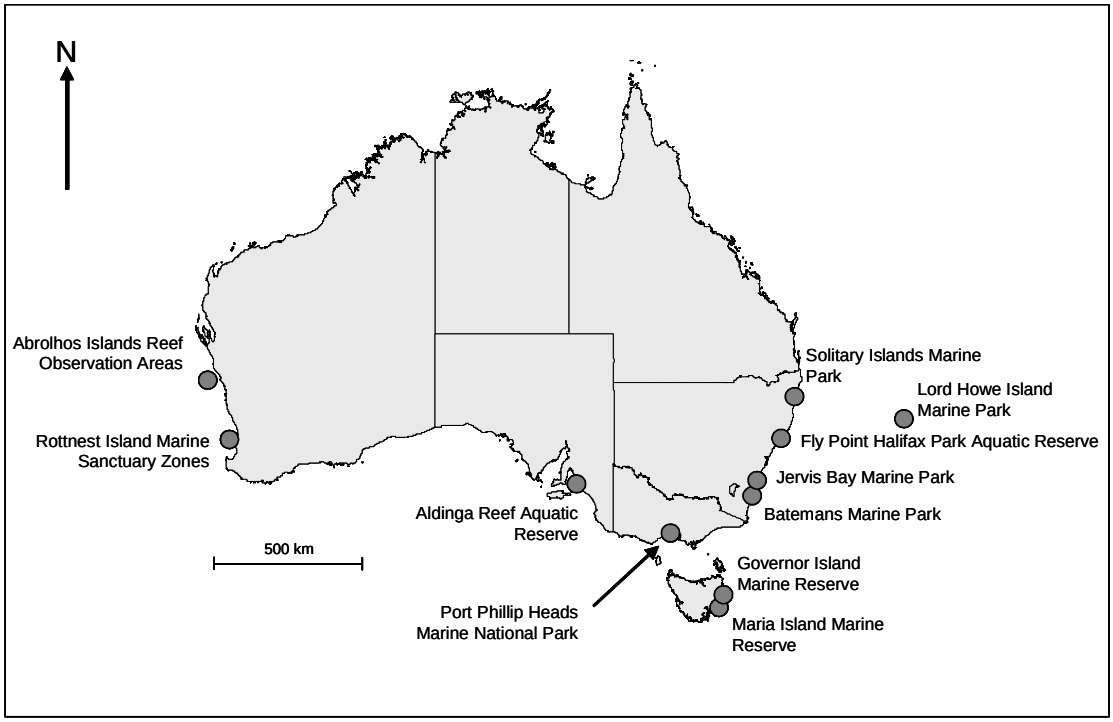

Figure 6. Map showing Marine Protected areas used in analyses.

Fish abundance counts and size estimates were converted to biomass estimates using length-weight relationships presented for each species (in some cases genus and family) in Fishbase (www.fishbase.org). In cases where length-weight relationships were described in Fishbase in terms of standard length or fork length rather than total length (as recorded by divers), additional equations provided in Fishbase allowed conversion between different length parameters. For improved accuracy in biomass assessments, the bias in divers' perception of fish size underwater was additionally

corrected using relationships presented in Edgar et al (2004a). Note that estimates of fish abundance made by divers can be greatly affected by fish behaviour for many species (Edgar et al. 2004a); consequently biomass determinations, like abundance estimates, can reliably be compared only in a relative sense (i.e. for comparisons with data collected using the same methods) rather than providing an accurate absolute estimate of fish biomass for a patch of reef.

Regression analyses were also undertaken to assess whether the different response variables varied with distance from the nearest SZ boundary, and whether the biomass of fishes increased in SZs relative to FZs as the time since declaration of MPAs increased. Distance to SZ boundary was measured using GIS and $\log_{10}(x/10)$ transformation, with the calculated log distance value assigned a negative sign if outside the protected area boundary and a positive sign if within. Age of MPAs was calculated using information on dates of declaration of MPAs. The Port Phillip Heads Marine National Park included some sites protected in 1979 (within the original Harold Holt Marine Park), and others protected in an expanded MPA in 1998. The overall age of this MPA used in analyses was calculated as the mean of time of protection of SZ sites surveyed.

Results

Two-way ANOVAs indicated that density of large (>30 cm) fishes, total fish biomass, and biomass of large fishes all varied significantly with MPA protection status, while total fish density and small fish density showed non-significant relationships (Table 2). Biomass of total fishes and large fishes also showed significant relationships with distance of sites from the SZ boundary (Table 2). Fish biomass was consistently higher in SZs in all regions, with ca. 10 kg higher biomass per transect block (Fig. 7).

Although fish species richness appeared slightly elevated in SZs relative to FZs in the Tasmanian, NSW and Victorian/SA regions (Fig. 8), this pattern was not sufficiently consistent to generate a significant result in the global analysis using ANOVA (Table 2). Nevertheless, fish species richness varied significantly with distance from SZ boundary across all sites examined.

Table 2. Results of two-way ANOVAs on the effects of region (df = 3) and status (sanctuary zone vs. fished zone, df = 1) on reef fish and macroinvertebrate communities (error df = 123). R^2 values from regression of the effect of distance to the nearest Sanctuary Zone boundary on the same variables are provided in the last column. *: 0.05> *P* >0.01, ** 0.01> *P* >0.001.

	Region		Status		Region*Status		Error	Distance
Dependent variable	**MS**	**F**	**MS**	**F**	**MS**	**F**	**MS**	***R*²**
Total density of fish	3.535	32.017**	0.151	1.371	0.123	1.111	0.110	0.001
Density of fish > 30cm	0.105	0.690	0.860	5.662*	0.202	1.331	0.152	0.024
Total fish biomass	3.042	18.070**	0.989	5.871*	0.135	0.803	0.168	0.059**
Biomass of fish > 30cm	1.383	3.025*	2.159	4.721*	0.336	0.735	0.457	0.045*
Biomass of fish < 30cm	4.218	41.962**	0.108	1.071	0.039	0.392	0.101	0.027
Fish species richness	612.847	23.769**	11.177	0.434	33.881	1.314	25.784	0.033*
Total density of invertebrates	4.142	15.102**	0.946	3.451	0.246	0.897	0.274	0.01
Invertebrate species richness	0.159	0.028	20.334	3.617	21.494	3.823*	5.622	0
Total density of urchins	14.287	39.639**	0.080	0.222	0.144	0.399	0.360	0.003

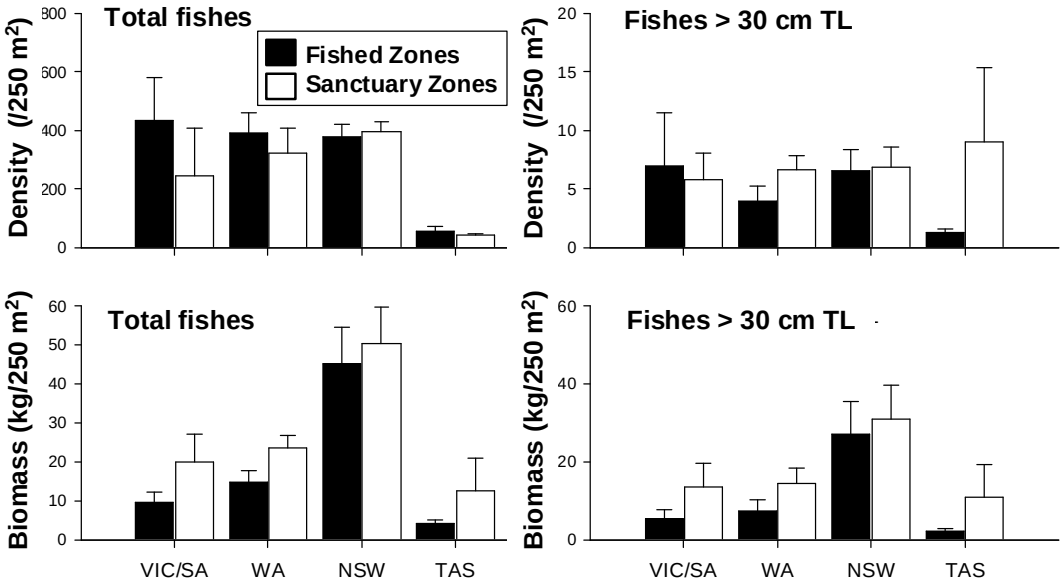

Figure 7. Mean density and biomass of fishes (± SE) per transect block in different regions.

Invertebrate species richness showed a more variable relationship between SZs and FZs, with patterns that significantly differed between the four major regions (ANOVA, Table 2). In the cooler Tasmanian and Victorian/SA regions, invertebrate

species richness was significantly depressed in SZs relative to FZs, whereas in NSW the opposite trend was evident (Fig. 8). Neither macro-invertebrate density nor sea urchin density varied consistently between SZs relative to FZs (Table 2, Fig. 9).

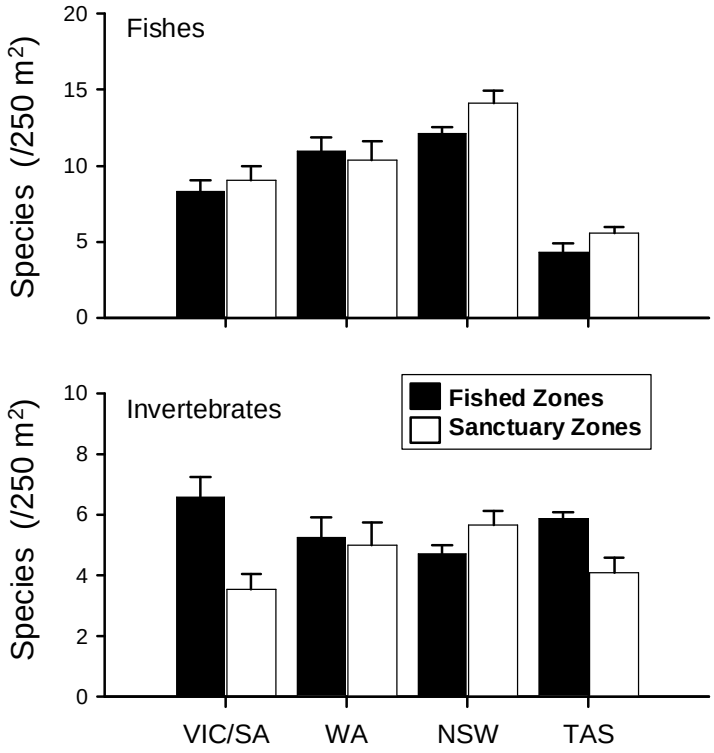

Figure 8. Mean number (± SE) of fish and mobile macro-invertebrate species per transect block in different regions.

ANOVA also indicated that mean values for most of the fish and invertebrate metrics examined varied significantly between different regions (Table 2).

With respect to age of MPAs, total fish biomass (B) increased significantly in SZs relative to FZs with period of protection from fishing (T) (Fig. 10), as assessed using a linear regression based on logged data (log B = -0.27 + 0.21* log T; r^2 = 0.50, P = 0.02). Sites in MPAs that had been protected for about 20 years had on average about

three times the total fish biomass as reference sites in FZs, with no indication that the trend had stabilized at that time. Data from the three MPAs protected for five years or less (Batemans Bay, Lord Howe Island and Jervis Bay) showed no indication of increased fish biomass in SZs; fish biomass in two of these MPAs was in fact considerably lower in SZs than in FZs.

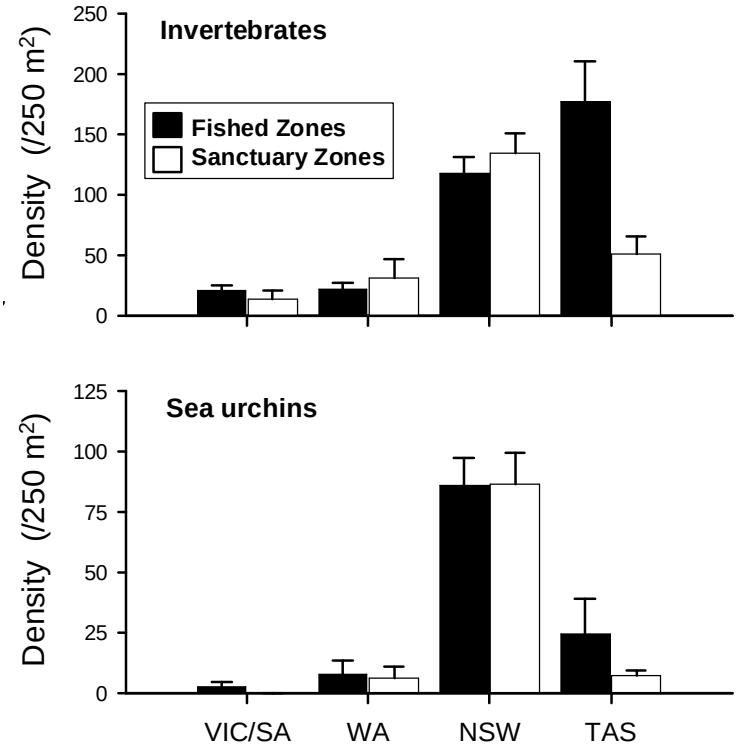

Figure 9. Mean density (± SE) of mobile macro-invertebrates and sea urchins per transect block in different regions.

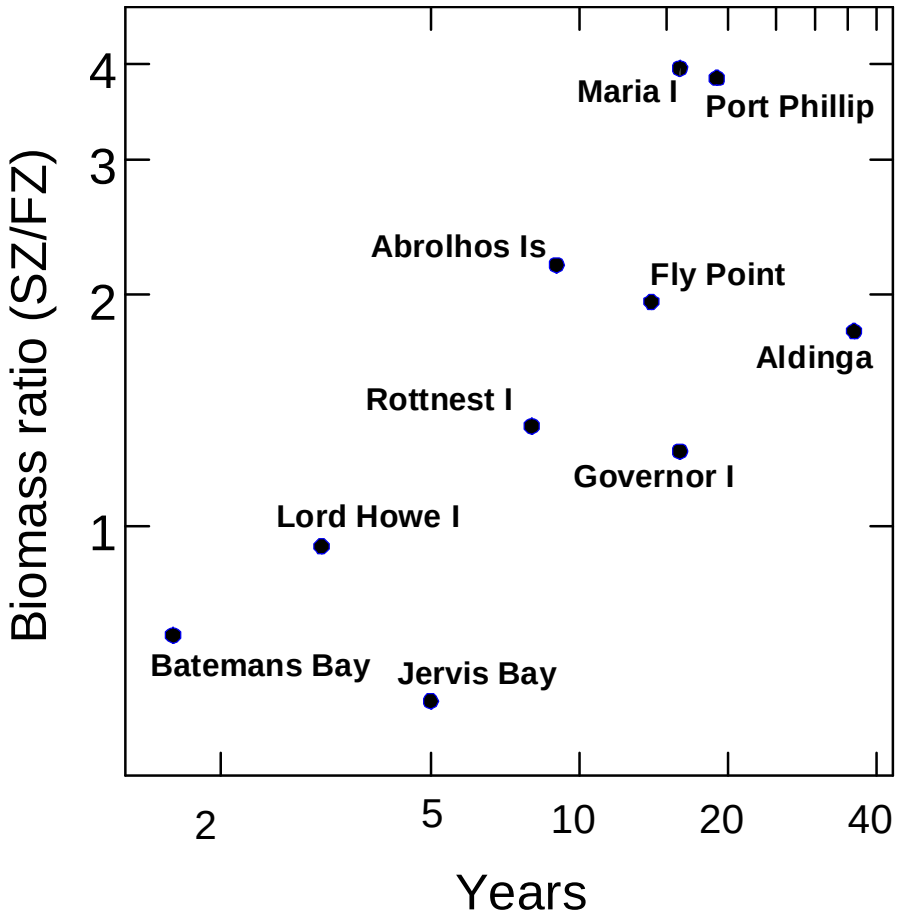

Figure 10. Relationship between proportionate difference in fish biomass in sanctuary zones relative to adjacent general use zones and period since establishment of MPAs investigated.

Relationships between MPA effects and fish size were assessed by relating mean fish density per transect block at different sites with size classes of fishes for MPAs declared for more than five years. Size class information was binned into 2.5, 5, 10, 20, 40 and 80 cm size classes (Fig. 11). Fishes in the smallest (2.5 cm) size class were on average approximately four times more abundant in FZs than in SZs (Fig. 11). Although this difference appears highly significant in the figure, and a significant result is evident in a t-test with untransformed data ($P = 0.027$), the test was influenced by a few sites with very high abundances of small fishes. When assessed using t-test with logged data the result was only significant if α is set at 0.1 ($P = 0.09$). By contrast, the largest (80 cm) fishes observed were an order of magnitude more often sighted in SZs than FZs, a highly significant outcome ($P = 0.009$).

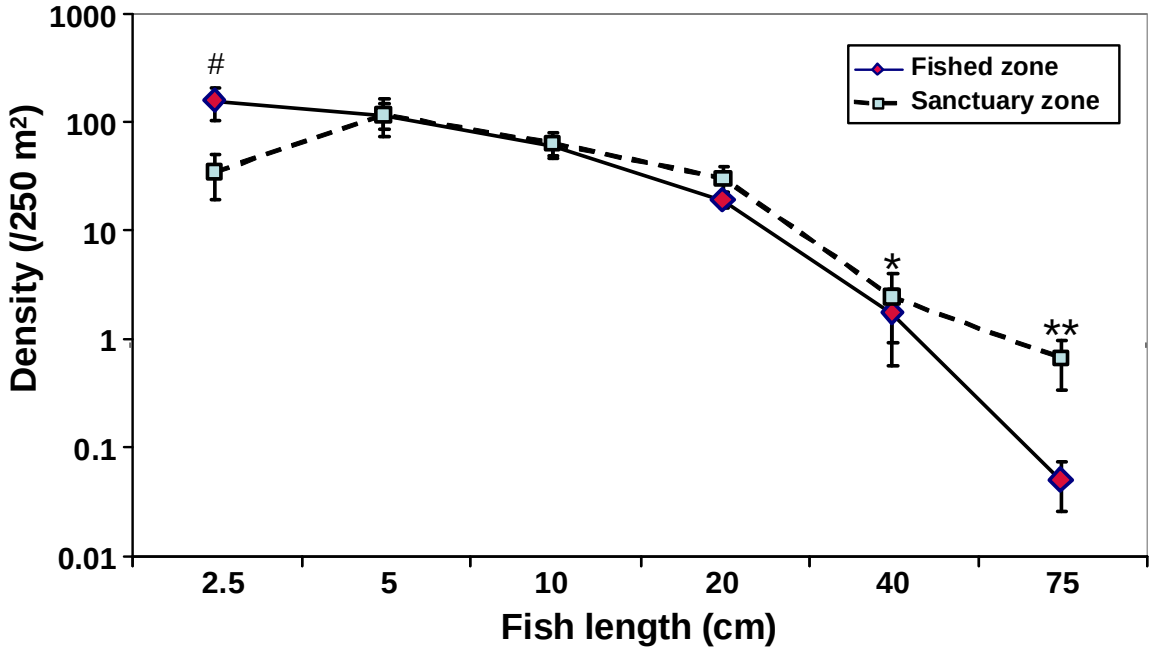

Figure 11. Relationship between mean fish density per transect block (± SE of site means) in different size classes in sanctuary zones and fished zones. Size classes with significant differences in densities between management zone types, as revealed using t-tests with log transformed data, are indicated by asterisk (#: 0.1 >*P*>0.05; *: 0.05> *P* >0.01, ** 0.01> *P* >0.001). Data relate to MPAs established >5 years.

Discussion on outcomes of MPA analysis

The most predictable result of our study of MPA effects was that greater fish biomass was present in SZs compared to FZs. Similar outcomes are widely reported from other MPA studies (Harmelin-Vivien et al. 2008, Kleczkowski et al. 2008), including meta-analyses (Côté et al. 2001, Halpern 2003). For other metrics, notable differences were evident between empirical results presented here and summary outcomes of prior meta-analyses.

Amongst the density and species richness metrics examined, only fish species richness showed a positive effect associated with protection from fishing, as indicated by a significant correlation with distance from SZ boundary. The lack of consistent positive responses to SZs for the metrics fish density, invertebrate density and invertebrate species richness contrasts with outcomes reported by Halpern (2003). He found that fish and invertebrate species in 63% of reserves in a global meta-analysis had significantly higher density than in fished areas (P<<0.001), and that 59% of reserves had significantly higher species richness than fished areas (P<<0.001).

The difference in outcomes between this empirical study and meta-analyses presumably relates at least in part to publication selectivity. Large fishes as a group, including the commercially important species, were found in our study to be significantly more abundant in SZs than FZs, but this trend was swamped by the variability in patterns displayed by the much more abundant smaller fishes. The published literature is dominated by studies of large commercial species; hence it is not surprising that meta-analyses show extremely strong overall positive relationships between fish density and protection.

Our study in fact provided an indication that small fishes may be negatively affected by protection from fishing. This was suggested by a steep decline in fish density in the 2.5 cm size class relative to 5 cm size class in SZs but not in FZs. The t-test associated with this difference was at the margins of statistical significance.

A reduced density of small fishes in SZs is consistent with the hypothesis that trophic cascades occur widely in protected MPAs. If this hypothesis is correct, then increased densities of large fish predators following protection from fishing will negatively impact prey populations. Fish predators typically consume prey at ca. 5% of their body length (Edgar & Shaw 1995), hence increased densities of fishes in the 40-100 cm size range would be expected to have greatest negative influence on fish in the 1.4-5 cm size range. They would also be expected to negatively affect invertebrate prey populations.

Invertebrate densities across southern Australia did not show a consistent relationship with protection from fishing. Patterns appeared to be strongly affected by local effects, with small invertebrate species at particular sites dominating faunas and perhaps obscuring continental trends.

Although fish and invertebrate species richness are often cited to be higher in SZs than in FZs, no convincing explanation accounts for this pattern at the local scale, other than through the increased likelihood of sighting large fish species and lobsters along transects. Because of increased fish and lobster predation in SZs, decreased richness of invertebrates along transects could in fact be expected. We found a

significant relationship between fish species richness and distance from SZ boundary, and no consistent MPA effect associated with invertebrate species richness.

Regardless of patterns of species richness at the scale of transects, MPAs clearly increase biodiversity at regional scales through supplementation of additional community types to the seascape. MPAs protected from fishing through the long-term possess community types quite different to those in fished areas in terms of total fish biomass, and include large individuals of species that are functionally absent from fished regions.

One outcome of our MPA analysis of particular relevance to conservation managers is that, contrary to previous paradigms (Halpern 2003), ecological changes may not be evident in MPAs during the initial five years following protection from fishing. In general, such effects increasingly manifest over at least 30 years, perhaps much longer.

The slow development of MPA effects likely confounded our ANOVA tests because the age of MPAs differed greatly between regions, with most SZ sites studied in NSW, in particular, protected recently (<5 years) compared to SZ sites investigated in other states. An assumption of the general ANOVA test of continental-scale effects was that effect sizes associated with declaration of MPAs were similar in all four regions.

Another notable observation associated with the analysis of MPA age is that biomass was higher in FZs than in SZs in the three youngest MPAs (i.e. SZ/FZ ratio <1 in Fig. 7). This outcome may relate to chance, but could also be caused by a general bias introduced during public consultation on proposed MPA zones. Fishing stakeholders and fishery biologists typically advocate strongly for SZs to be located in areas with relatively few fish resources, and hence generally low fish biomass, compared to areas that remain open to fishing (Edgar et al. 2004b, Lynch 2006, Edgar et al. 2008).

The attached draft manuscript "*A continental-scale analysis of ecological effects of marine protected areas based on underwater visual transects surveyed by volunteer divers*" includes additional discussion on results of the MPA analysis

GENERAL DISCUSSION

General progress and success

Following huge enthusiasm for the project and high levels of commitment by volunteers and conservation managers (and project staff), the volunteer monitoring of Australian rocky reef communities project has exceeded our most optimistic expectations with respect to success. Ten months after commencement, the *Reef Life Survey* program has been established within a durable institutional home and 52 divers have been trained, with most actively undertaking routine surveys of sub-tidal reef biodiversity. Importantly, not only the recreational SCUBA diving community has shown enormous support and enthusiasm for the program, but also appropriate management agencies, existing community-based monitoring groups, and regional NRM bodies. Representatives from the Department of Environment and Conservation in WA, the Department of Environment and Heritage in SA, the Parks and Wildlife Service, Tasmania, and the Department of Environment and Climate Change, NSW are on the Steering Committee and devote time to the project, demonstrating the interest in, and support for the project by these management agencies. Additional evidence of support is provided in Appendices 1 and 2.

The idea that committed and skilled recreational SCUBA divers can collect scientific-quality biodiversity data on sub-tidal reefs has been shown to work effectively, with the majority of divers on training courses proving to be capable. They have also been sufficiently committed to undertake reliable monitoring when provided ongoing assistance through this project.

The major remaining potential limitation regarding the assistance of volunteers when collecting scientific information relates to the *ad-hoc* distribution of survey effort compared to that of directed scientific studies. We overcome this limitation by strategic planning of the long weekend survey trips when training new divers, through the assistance of previously trained divers who concurrently collect useable data. The

location of these trips is chosen according to data needs, and thus survey effort is directed to a large extent.

Opportunistic data collected by trained divers while undertaking their own surveys outside of organised trips also has considerable value, as indicated by use of data from the Batemans and Fly Point/Halifax Park MPAs in the continental-scale MPA analysis. No CERF project staff were involved in surveys in these areas.

As the team of trained RLS divers expands and the proportion of data obtained from opportunistic surveys increases relative to planned trips, the value of the opportunistic data set is expected to greatly increase. Deficiencies associated with haphazard location selection will be offset by the large amount of data collected through space and time. For example, a hypothetical analysis of changes in blue groper abundance along the NSW coast over a 10 year period might have reasonable statistical power if the same sites were surveyed a few times during this period by a team of scientific divers, but will likely have greater power and more general outcomes if a far greater number of haphazardly-selected sites are surveyed each year along the entire coast.

The CERF/RLS program has a similar basis to existing community marine monitoring programs such as Reef Watch (SA), Sea Search (Vic) and Reef Check (international); however, a major difference is that not all interested divers are invited to participate. The program focuses on training and involving the most capable and committed of the interested divers, with the goal of ensuring that all data are scientifically-credible and that survey outputs are maximised per capita. Training is provided free to selected divers, and some financial assistance is given for surveys outside of subsidised survey trips. Thus the program invests time and money in those divers capable and prepared to collect data of sufficient quality on a regular basis. Whilst some divers appear to have dropped out in the first year, the attrition rate is expected to decrease as the ability to identify suitable divers increases through partnerships with existing state-based groups (e.g. Reef Watch SA, Sea Search, Vic) and regional NRM bodies, and through recommendations of previously trained divers.

The CERF/RLS program also differs from most other volunteer dive programs in possessing strong partnerships with primary users of survey data. Data collected

through the program are immediately useful to collaborating management agencies. Because these agencies have representatives on the Steering Committee, program activities can be directed to best suit management needs. Additionally, the program has a solid scientific foundation including advice from well-respected marine scientists also on the Steering Committee, providing a means for program activities and data to also be of greatest use to science.

Pilot study focus and success

The goals of the one-year pilot study and all milestones have been met. Survey dives carried out independently following training have generated scientific insights with respect to the distribution of species. A number of range extensions, as validated by photographs, and possible new species have been noted. An example of this project outcome is included in Appendix 1, where a diver trained during the CERF project describes surveys in Darwin Harbour. New Northern Territory records for one fish and one nudibranch species are noted.

A particular research question addressed during the pilot study was whether broad-scale effects of MPAs were evident in terms of a set of ecological indicator metrics. In addressing this research question, methods and data were demonstrated to be sufficiently robust to provide meaningful statistical analyses and useful outcomes. Data collected through the project are expected to be used to answer many other important research and management questions through the long-term (see below for examples), not only with respect to effects of MPAs but also impacts of climate change and introduced species.

Medium- and long-term plans for the extended CERF project and Reef Life Survey

Through the support of key stakeholders and the formation of the *Reef Life Survey* program within the People and Parks Foundation, the project is now in a solid position to expand into the long-term. This will nevertheless require initial achievements to be consolidated through the training of additional divers over the next two years. A critical mass of trained divers in each state is needed to overcome the present isolation of many individual participant divers. Overall activity should

greatly increase once this critical mass is passed through communal enthusiasm and joint local activities.

A preliminary timetable for training/survey trips for the next 12 months is outlined below in Table 3. This timetable allows divers to be trained in areas with reef survey data needs identified as a high priority by management agencies, or where local NRM boards have expressed an interest in developing a partnership with the program. Note that Lord Howe Island is included in this program. This is an expensive location to undertake surveys; however, reef surveys at this location will be heavily subsidized by the Lord Howe Island Board (accommodation), the NSW Marine Park Authority (some logistic costs) and the volunteer divers involved (airfares). In part because of recent outbreaks of invasive sea urchins, the NSW Marine Park Authority sees great value in surveys of the Lord Howe Island Marine Park and are keen to facilitate acquisition and analysis of quantitative reef data.

Table 3. Preliminary plan for training/survey trips for 2008/2009.

Month	Location	Dates	Location	Dates
2008				
December	**NSW** Batemans Bay	Fri 5th – Mon 8th	**TAS** Tasman Peninsula	Fri 19th – Mon 22nd
2009				
January	**VIC** Sorrento	Fri 9th – Mon 12th	**WA** Albany	Fri 23rd – Mon 26th
February	**TAS** Wynyard	Fri 6th – Mon 9th	**NSW** Lord Howe Is.	21st Feb – 2nd Mar
March	**SA** Kangaroo Is.	Fri 13th – Mon 16th		
April	**WA** Ningaloo Reef	Fri 10th – Thur 16th		
May	**NSW** Port Stephens	Fri 8th – Mon 11th		
June	**VIC** TBA	Fri 5th – Mon 8th		
July	**NSW** Solitary Islands	Fri 10th – Mon 13th		
October	**SA** TBA	Fri 2nd – Mon 5th		

Two additional funding proposals have been submitted to extend the capabilities of the *Reef Life Survey* program and the locations in which additional divers can be trained and surveys undertaken. Regional NRM bodies have expressed support for training and monitoring, so a Caring for our Country (Community Coastcare) proposal was submitted which included partnerships with NRM bodies in south-eastern Australia. An AusAID proposal was also submitted that would extend *Reef Life Survey's* activities to developing Southeast Asian and Pacific countries.

The level of support from potential collaborating parties for the two submitted proposals, the ability of People and Parks Foundation to receive tax-deductible donations for RLS, and the potential to explore sponsorship by multi-national companies with coastal interests/impacts, clearly show promise for the long-term financial viability of the program. Once the program has a large number of committed divers (>100) and a good spatial distribution of these divers, it should be possible for project staff and training courses to fluctuate with ongoing levels of funding to a large degree. This will provide program resilience for times of low funding plus an ability to greatly extend the program scope as funding sources permit.

Data collected through the RLS program through the long-term will be invaluable, not only to management agencies that have specific data needs for developing and managing MPAs, but also for broader conservation management goals. Internationally significant research developed through this program will likely prove critical for:

(i) identifying biodiversity hot spots and sites of exceptional global conservation significance,

(ii) assessing the distribution and magnitude of human threats to coastal ecosystems,

(iii) parameterising models describing the dynamics of the marine environment,

(iv) providing a baseline for assessing the long term impacts of climate change, invasive species, fishing, and other human impacts on the near-shore environment, and

(v) identifying marine taxa that are threatened and possess declining populations, and hence are in most need of management intervention.

Thus, the *Reef Life Survey* program, developed through the CERF significant project "Volunteer monitoring of Australian rocky reef communities", will provide the necessary long-term empirical data and the scientific outputs to enable better and more-informed management of Australia's near-shore marine resources. It is likely to play a major role in the conservation and scientific understanding of marine biodiversity.

Acknowledgements

We would particularly like to thank the steering committee members for their efforts: Alan Jordan, Andrew Green, Andrew Zacharek, Bryan McDonald, Ian Shaw, Kevin Bancroft, Rebecca Koss, and Scoresby Shepherd, as well as Tim Lynch and Pia Winberg, who were also on the steering committee for part of the year. The support of Stefan Töpfer, CEO of Winweb International Ltd and Barry Andrewartha and Belinda Barnes, editors and publishers of Dive Log and Sport Diving, has also been instrumental in helping the program become established, and they deserve special thanks.

Importantly, we would like to acknowledge the volunteer divers – without their commitment and skills, the program clearly would not be possible. All participating divers are thanked, with particular thanks going to Tom Davis, Andrew Green, Bill Barker, Sue Newson, John Allen, Keith and Terina Saunders, Margo and Ashley Smith, Don Love, Liz Oh, Kevin Smith, Paul Day, Jen Hoskin and Tim Forster. We would also like to thank James Brook for assistance with many aspects of the project, most notably guidance with the database, assistance training volunteers, and general advice to the steering committee, and Liz Oh and Alejandro Velasco for assistance with digitising photo-quadrats. Thanks also to: Rudie Kuiter, Neville Coleman, Martin Gomon and Scoresby Shepherd for offering book discounts to RLS divers; LeGear, for their donation of a Luminox dive watch as a prize for a committed volunteer; a number of dive operators who assisted with field work (named on the RLS website); and the Rottnest Island Authority for assisting with field logistics and subsidised costs. Lastly, we would also like to thank NRM facilitators and management agency staff that have shown support for the program, some of which have also written letters of support for funding applications, and also Fran Clements from Jervis Bay Marine Park for her help with permits.

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Appendix 1. Supporting documents: SCUBA diving community.

Dear Barry and Belinda,
Last year DiveLog carried an article calling for volunteers to be involved in an Australia wide reef life survey. The impetus for the project was to gather information with scientific rigor/validity regarding the current health or not of reef systems around Australia as a benchmark for ascertaining changes in a vital but seldom seen natural resource. Reef systems contribute significantly to all levels of industry and therefore society, from fishing through to tourism. Australia is blessed with extensive coastlines and numerous reefs to which our shipwreck history attests.
Divers are privileged to know reef systems intimately. Fishermen seek them feverishly but the majority of Australians see only beautifully edited images of them on their TV screens. They know little or nothing of the beauty or degradation of their local waterways. Reefs are out of sight and out of mind and therefore in the clinically efficient world of money and politics, out of sight equates to out of funding.
The funding for the Reef Life Survey program is finite and subject to annual review over its three year life. Good science is often done on the smell of an oily rag and is anchored by committed and dedicated individuals. This project is ambitious with a capital ?A? and is certainly anchored by two totally committed coordinators, Dr Rick Stuart-Smith and Dr Graham Edgar of the University of Tasmania. This project has some awesome vision and all recreational divers in Australia should be aware of it and consider how they might contribute to its success. Dive training teaches you to be proactive and this is a project that needs the dive community to be proactive at every level, whether it is physical contributing survey information or urging politicians to be aware of the importance of the project and commit to maintaining its funding.
My wife and I have had the privilege of joining the vanguard of initial volunteers, (4th group actually) and have just undertaken an intensive five day training course in the spectacular Abrolhos Islands aboard Rat Patrol, skippered by Jay Cox. (As an aside, get seven mates together and go diving with Jay and Tim on Rat Patrol and experience some superlative diving in the Abrolhos. You will soak up some awesome history, dine on magnificent seafood and see some seldom dived islands rich from the convergence of temperate and tropical influences.) Visit Jay?s website; www.abrolhosislandcharters.com.au)
Eight volunteers, Margo, Ash, Hisayo, Kevin, Paul, Hamish, Terina and I. Five days, two dives a day, fish and invertebrate identification and cross-referencing then entering the data into a database shell that combined with photo quadrants from along the transect giving a snap shot of the reef about the Abrolhos. (about 40, 50m transects of over 100km of the islands) From here all trainees are focussed on recreating the same parameters in their local dive settings on a regular and repeated basis. The aim, a massive database and benchmark that consistently reviews the health of the reef and density of life forms. Such a snapshot from thousands of locations around Australia will start to develop a clearer picture of the true health of our critical reef systems, such that the vulnerabilities can be identified, imperilled habitats protected and managed as well as sustainable practices encouraged and supported. The out of sight will be visible in hard data, demonstrated and defendable in terms that everyone can understand.
This project does not seek to upstage the numerous and invaluable projects such as Reef Watch, Project Aware and the various Coastal Care programs, but elevates and sharpens the science to which such programs already contribute valuable information.

Volunteering to be involved in this program at any level means hard work, but the added dimension to your personal diving is incomparable and a significant contribution to the future habitat and maintenance of a sport for which we all live and breathe! If you can?t be active in the frontline, be proactive in getting your dive group/club/community involved; Australia?s reef systems will love you for it and pay you and your grandchildren back ten fold. Thank you Barry and Belinda for allowing DiveLog to bring this worthy project to the fore of the diving community in Australia.
Tropical regards,
Keith Saunders
Darwin NT
• Keith, great to hear from you on this fabulous project! I was fortunate to attend the Inaugral meeting of this group in Hobart chaired by Graham Edgar and it is a delight to receive your email bringing us up to date on what is happening. We wish you every success with this project in the future.

A1(a). Letter to the editor from Keith Saunders published in Dive Log in May 2008 referring to the Reef Life Survey program.

Words from warmer waters….

Story and pics by **Keith Saunders**

While much of Australia is freezing, Darwin is a balmy 30 degrees. It's cafe latte diving. Yes, that is the visibility for more than 20 days of every month. During neaps we may be blown away with 5m of visibility but usually it is less. Transects are challenging (You hope that the dark shape on the other side of the line is your buddy). Going out with commercial and recreational dive operations has proved problematic due to the fact there is inevitably a "mud-skipper" in the compliment. Terina and I bit the bullet, modified our boat and teamed up with Dr Richard Willan and Neil Wright, two keen divers from the museum to focus on transect diving.


Glossodoris rufomarginata

In a town named after Charles Darwin, you might expect to encounter a few unknowns, as we've seen in our initial forays. We recounted to Richard that we had seen some *Glossodoris rufomarginata* on our initial dive to be told it wasn't likely as they had never been recorded in Darwin Harbour. Photos are priceless, and yes, the species was a first for the harbour. Seeking confirmation on what we thought were a school of small fusiliers, Dr Helen Larson, Curator of Fishes at the NT museum identified them as *Paracaesio xanthura*, a first ever recording in NT waters. There were healthy populations of these fish, but they just hadn't been recorded before, which just demonstrates the value of the RLS experience, where research-orientated divers applying scientific rigor should add handsomely to our bench-mark scientific knowledge of our beloved and valuable reef systems

Tropical regards,

Keith Saunders


Glossodoris atromarginata


Southern fusilier (Paracaesio xanthura)

Thanks Keith. For those that didn't see it, Keith also wrote a fantastic letter to Dive Log (May 2008) about RLS and his and Terina's involvement. If you didn't see it or can't get hold of it, just email us and we'll send you a copy of the letter. If anyone has any stories or views they would like to share in our next issue of this newsletter. Feel free to email us: reeflife.survey@utas.edu.au

A1(b). Story by CERF volunteer diver Keith Saunders of Darwin in the Reef Life Survey Newsletter (issue 2) describing new species recorded in Darwin Habour.

THE IMPOSSIBLE SURVEY

By Tom Davis

For the past few months I have been taking part in the 'Reef Life Survey' program which is encouraging recreational divers to conduct surveys at dive sites around Australia. As I was planning a trip to Tulamben on Bali's North-East Coast, I jokingly asked the organisers if data from Bali would be useful. They replied "We'd love to get some survey data from there, it would be fantastic!", and so my fate was sealed.

Instead of spending the weeks leading up to the holiday dreaming of a relaxing break, the weeks were spent studying tropical ID books, and sweating about the logistics of doing a marine life survey in teaming tropical waters.

On arrival at Tulamben Wreck Divers, where we stayed for the trip, I told our dive guide, Made, that we were planning to count the fish in the Coral Gardens. He shook his head sadly and muttered under his breath in Balinese. "It's OK!" I explained "We only want to survey a 50m long section of the reef, not the whole Coral Gardens!" This explanation was greeted by a puzzled look, and I was forced to pull out the 50m survey tape that I had packed for the holiday, and drew a sketch on my dive slate showing him the plan. It was only then that he fully comprehended the insanity of what was proposed.

Made at the artificial reef

For a full survey we needed to complete two fish transects, where we recorded the fish species sighted in a 5m wide band along the 50m transect tape, and ideally the numbers and sizes for each type of fish. After completing this we then needed to record the mobile invertebrates and cryptic fish sighted within a meter of the tape. Most of the divers I talked to in Tulamben considered this to be an impossible feat, but wished us luck for the attempt.

My wife Nicola and I conducted a reconnaissance dive a couple of days prior to the big day, and planned out a survey site extending from the artificial reef, in the middle of the Coral Gardens, along the coral outcrops, and into the area teaming with Anemones and Anemonefish. This site covers a small but lively section of the available reef, and is at a depth of only 8m giving us plenty of time for the dive.

All of our preparations were now complete and on a calm sunny morning Nicola and I, along with Made our guide, commenced our attempt to achieve the impossible. Armed with a survey tape, digital cameras, pencils, clipboards, and waterproof paper, we entered the water and swam down towards the starting point for our

Fish hovered in midwater

survey. We were immediately surrounded by clouds of Pacific Basselets, Three-spot Dascyllus, and Headband Humbugs. We tied off the survey tape to the artificial reef structure shaped like a small plane, and headed out across the reef, noting down the fish species we recognised and taking photos of species that were new to us. The black sand that makes up the bottom throughout Tulamben Bay highlighted the darting motions of some Ribbon Eels, and a school of Blue-lined Snapper swam past requiring furious addition.

Everywhere around us fish hurried about on their daily routines, or sat on the bottom observing our behaviour. Parrotfish grazed on the algae and Moon Wrasse swooped in the peck over sand disturbed by a fossicking Stripe-spot Goatfish. As we progressed we encountered several cleaning stations where large fish patiently waited for the attentions of the resident Cleaner Wrasse. Midnight Snapper hovered in midwater and Coral Cod rested under coral overhangs waiting their turn to be cleaned. Further along we crossed a large area of Anemones inhabited mostly by Pink Anemonefish, but also by Skunk, Clark's, Spine-Cheek, and Western-Clown Anemonefish. There were masses of Ring-tail Cardinalfish with their iridescent blue markings shining in the sunlight.

A group of Philippine Butterflyfish cruised sedately by and several other species of Butterflyfish were observed pecking at the coral, mostly in mated pairs. In the distance an Emperor Angelfish with its striking yellow and blue lines competed with a number of Moorish Idols who looked like the bandits of the reef with the black masks over their eyes.

By now our pencils where glowing almost red hot from frantic scribbling and our cameras were almost constantly occupied trying to capture the incredible biodiversity at the site. Our first fish transect identified 75 different species of fish, with a further 30 species observed in the second 50m stretch, giving an insane 105 different types of fish within a space smaller than an Olympic swimming pool!

In reality there were far more species present than we recorded, as it was impossible to count the blennies, gobies, and grub fish dashing around on the bottom, never mind accounting for the night dwellers cowering in coral crevices. A comparison with survey data collected in Perth's temperate waters showed that this biological hotspot has at least 4 times as many species along a 50m stretch as we would typically see at home.

With the fish survey out of the way, we could now focus on trying to count the invertebrates along the survey tape. So once more we set out, this time much closer to the bottom, trying to avoid brushing the stinging hydroids while looking into nooks and crannies.

Blue Seastars were spaced at regular intervals along the tape, along with several other species of Starfish. A group of Sexy Shrimp inhabited one of the Anemones along with some Anemonefish, and a number of Mantis Shrimps came out to observe our passing. Featherstars crowned most coral outcrops and the sharp spines of Urchins revealed their hiding places, waiting for night-time when they could come out to feed. A pair of Banded Coral Shrimp hung upside down, under an overhang, and a solitary Tiger Cowrie sat beside the tape just waiting to be counted. A group of divers heading in the opposite direction goggled at our bizarre behaviour in amazement, and dashed off some photos of us, no doubt to record one of the highlights of their holiday.

We added a further 12 invertebrate species to our tally and then packed away the survey gear and set off at a gentle drift across the coral gardens to enjoy the remainder of this awesome dive site. A Blacktip Reefshark briefly joined us on our drift, before departing with a flick of its tail just as I switched my camera out of Macro! Another section of artificial reef housed a school of Bannerfish and as we exited t. e water we were surrounded by inquisitive Wrasses foraging in the sand kicked up by our dive boots.

Doing dives that extend your capabilities can be very rewarding and you get a great sense of satisfaction when you achieve something that you have never done before. A Reef Life Survey may not provide the adrenaline thrill of wreck penetration, or deep cave diving, but it certainly isn't a relaxing resort dive where you just swim along following a guide and watching the scenery!

The dive was also a great cultural experience as we were able to involve the dive guides in our survey, and it provided endless amusement for the Balinese at Tulamben Wreck Divers who for days afterwards just looked at us and shook their heads as if to say "They must be crazy!"

So was the survey impossible? Well not exactly. It was impossible to do a thorough job on our first attempt, but we gave it a damn good try, and next time we'll do better! Maybe next time we'll have a go at a survey on the Liberty wreck, as it has even more fish species on offer!

A Ribbon Eel extends over the sand

A1(c). Story by CERF volunteer Tom Davis published in *Dive Log* in September 2008.

Appendix 2. Supporting documents: state marine management agencies and regional NRM bodies.

News

Marine park study yields a bonanza

DEDICATED recreational divers came face to face with science, and some interesting fish, when the Jervis Bay Marine Park was visited last week by a select team to study the biodiversity of rocky reefs. The team of 12 divers was chosen from dive clubs from Sydney, Canberra and Melbourne, as well as the local Jervis Bay Dive Club.

Over five days, divers were taught methods and skills from researchers from the University of Tasmania similar to those that have been used to monitor the reef diversity in the Marine Park during the past five years and prior to the Marine Park zoning. Close to four kilometres of reef was covered over five days, and 132 fish and 42 invertebrate species were identified and counted.

Jervis Bay Marine Park manager Leigh Harris said the research program was undertaken in collaboration with the Jervis Bay Marine Park, and such surveys continued to indicate a recovery of species such as the red morwong in its sanctuary zones.

"The marine scientists recognised there was a wealth of dedicated recreational divers, with great local knowledge and passion, who could contribute to our growing knowledge of temperate marine reefs.

"All the divers needed was a helping hand to refine their species identification and teach them the methods of the surveys.

"These budding ecologists could be let loose to gather data on temperate reefs and feed it back to a database at the University which was now analysing the data collected last week and compare it to other surveys from around Australia," Mr Harris said.

• FROM THE DEPTHS: Researcher Marlene Davey from the University of Tasmania emerges from the Jervis Bay Marine Park with local divers who helped out with the studies last week.

A2(a). Article referring to the Jervis Bay training course and the support of the Jervis bay Marine Park, published in the *South Coast Register*.

Dr Rick Stuart-Smith
The People and Parks Foundation
Level 10, 535 Bourke St, Melbourne, Vic
AUSTRALIA 3000

22 July, 2008

Dear Dr Stuart-Smith

The NSW Department of Environment and Climate Change (DECC) is responsible for protecting the ecological health and improving the condition of coastal environments through the conservation and management of its natural values. A key component of these objectives is the assessment and monitoring of key environmental indicators which are used to determine present condition and assess change over time. A key marine indicator relates to the status of rocky reef biota, particularly that of macroalgae and key invertebrates. There are considerable gaps in our understanding of the current health and condition of nearshore rocky reefs within the greater Sydney region. Recent evidence indicates that there has been a considerable loss of macroalgae in this region, which has important implications to the ecological health of these coastal habitats.

The South-East Australian Reef Biodiversity Assessment Project (SEARBA) aims to provide high quality data on current coastal biodiversity and reef health in high priority coastal habitats within the greater Sydney region, and simultaneously build volunteer community skills and knowledge in coastal and marine biodiversity monitoring. It will also provide an effective mechanism for forming and strengthening partnerships between the volunteer divers, scientists and Catchment Management Authority managers to maximise the skills available for, and the cost-effectiveness of the collection, analysis, and interpretation of marine biodiversity data.

The information will allow NSW DECC to evaluate and report on rocky reef condition in this important region and help to support management decisions that aim to protect biodiversity and increases resilience of marine ecosystems to major threats such as climate change, marine pests, sedimentation and pollution. For this reason the NSW DECC is very supportive of this Community Coastcare application as it will deliver ecological information that is essential to maximising the benefits of marine monitoring activities throughout the greater Sydney region. It will also add considerable value to the existing DECC research investment, which has recently conducted detailed seabed habitat mapping throughout much of this region.

Yours sincerely,

Mr Tim Pritchard
Acting Director Environment and Conservation Science

59-61 Goulburn Street, Sydney
PO Box A290, Sydney South NSW 1232
Phone: +61 2 9995 5000 (switch)
ABN 30 841 387 271
www.environment.nsw.gov.au

Department of **Environment & Climate Change** NSW

A2(b). Letter from NSW DECC in support of the Reef Life Survey program and a funding application to Caring for our Country.

COAST ACTION

COASTCARE

Communities Caring for our Coast

Port Phillip Region

To Whom It May Concern

Tuesday, 22 July 2008

RE: Caring for the Country : Community Coastcare 2008

It is with pleasure, as the Coast Action/Coastcare Facilitator for Port Phillip to provide support to the *South-East Australian Biodiversity Assessment Project* conducted by ***Reef Life Surveys*** (***RLS***). This project will provide benefit to Victoria by increasing the capacity and extent of ***RLS*** to involve volunteer SCUBA divers in scientific marine monitoring in our State.

RLS is a recent program endorsed by the People and Parks Foundation. Having worked with the Foundation since 2006, primarily through Sea Search, I have found the Foundation's approach professional and staff highly motivated.

The delivery of this innovative program by ***RLS***, using trained divers has been very well received in Tasmania, South Australia, New South Wales and Western Australia and soon here in Victoria. Experience gained and clearly defined objectives will assist in the success of the program. ***RLS*** are building capacity and stewardship through a volunteer network of highly skilled recreational divers throughout Australia. The information collected is compatible to the scientific data and research on marine ecosystems in the respective States.

This National network approach is an example of what can be achieved by committed teaching staff with long term vision. The program will contribute to environmental education by involving the community in its activities and lead to improving biodiversity across the coastal reserves. The key directions of the program are reflected within the Victorian Coastal Strategy, Port Phillip and Westernport Regional Catchment Strategy and biodiversity objectives, Victoria's Biodiversity Strategy.

What is needed is reliable information on the state of the marine environment, at a suitable scale over the long-term and this is what is being delivered through volunteer divers around Australia under the direction of ***Reef Life Survey*** team.

Yours sincerely,

Phillip Wierzbowski
Coast Action/Coastcare Facilitator - Port Phillip Region
Department of Sustainability and Environment

30 Prospect Street
Locked Bag 3000
Box Hill, Victoria 3128
Telephone: (03) 9296 4525
Mobile: 0411 409 815 (work)
Facsimile: (03) 9296 4710
Email: Phillip.Wierzbowski@dse.vic.gov.au

State Government Victoria — Department of Sustainability and Environment

A2(c). Letter from PP CA-CC in support of the Reef Life Survey program and a funding application to Caring for our Country.

Department of Environment, Parks, Heritage and the Arts

GPO Box 1751, Hobart TAS 7001
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Rick Stuart-Smith
Research Fellow
Marine Biodiversity Research Group
Tasmanian Aquaculture and Fisheries Institute
Private Bag 49
HOBART TAS 7001
E-mail: Rick.StuartSmith@utas.edu.au

Dear Rick

Community Coastcare Application – Reef Life Surveys

Thank you for your email of 18 July 2008.

The Parks and Wildlife Service is pleased to support your proposal to seek funding for an expansion of the SE Australian Reef Biodiversity Assessment Project, to be conducted in association with Reef Life Survey, a program of the People and Parks Foundation.

This project will build volunteer community skills and knowledge in coastal and marine biodiversity monitoring, and will provide an ongoing survey of current biodiversity and resource condition in the marine parts of south-eastern Australia that most need it.

Your proposal will also act to create and reinforce partnerships between community groups and volunteer divers, researchers such as yourself, users such as recreational dive companies, and resource managers such as the Parks and Wildlife Service (DEPHA) and the Wild Fisheries Branch (DPIW).

We are particularly interested in the prospect of scheduled Reef Life Surveys being carried out in the marine nature reserves (MNRs) that are managed by the Parks and Wildlife Service. One of these MNRs (Maria Island) has its own volunteer community group and another (Tinderbox) is likely to have one in future.

Should you have any further queries about this matter please contact Richard Koch, Marine Reserves Management Officer on telephone 03 6233 6767 or 0437 660 499 or email Richard.Koch@parks.tas.gov.au.

Yours sincerely

Stuart Lennox
ACTING GENERAL MANAGER
PARKS AND WILDLIFE SERVICE

23 July 2008

A2(d). Letter from Tasmania PWS in support of the Reef Life Survey program and a funding application to Caring for our Country.

Sydney Metropolitan
CATCHMENT MANAGEMENT AUTHORITY

ABN 93 695 453 413

Ground Floor, Macquarie Tower,
10 Valentine Ave, Parramatta. NSW 2150
PO Box 3720, Parramatta. NSW 2124.
Tel: 02 9895 7898 Fax: 02 9895 7330
Internet: www.cma.nsw.gov.au

File Ref:
Letter No: 0603796
Contact: Lesley Diver
Phone: 02 9895 6282
Email: Lesley.Diver@cma.nsw.gov.au

23 July 2008

Rick Stuart-Smith
Reef Life Survey Co-Director
C/O People and Parks Foundation
Level 10, 535 Bourke St
VIC 3000

Dear Sir/Madam

Re: COMMUNITY COASTCARE GRANT APPLICATION – REEF LIFE SURVEY

I wish to express the support of the Sydney Metropolitan Catchment Management Authority (SMCMA) for the proposal by Reef Life Survey, a program of the People and Parks Foundation, to undertake training of Sydney SCUBA divers and provide monitoring of sub-tidal reefs in the Sydney region. The proposal will add value to the scientific monitoring capacity in this region, and will assist community groups to understand the assets within and threats to the aquatic environment.

I will happily provide in-kind assistance to this project by providing avenues for identification of appropriate and committed divers and posting relevant information in our newsletter and on our website. I will also facilitate communications between NSW Department of Primary Industries, Department of Environment and Climate Change and NSW Marine Parks Authority to encourage valuable links with existing and proposed monitoring programs for those organisations. I will also provide direction in the development of the educational biodiversity report proposed to ensure it best meets local needs.

Please feel free to contact me if you have any queries relating to SMCMA's support for this proposal.

Yours sincerely

Lesley Diver
Place Manager, Sydney Harbour and Tributaries
Sydney Metropolitan CMA

For: John Carse
A/General Manager

A2(e). Letter from Sydney Metro CMA in support of the Reef Life Survey program and a funding application to Caring for our Country.

10/535 Bourke St
Melbourne, VIC 3000
Telephone: 13 19 63
Facsimile: 9629 5563
Website: www.parkweb.vic.gov.au
A.B.N. 95 337 637 697

July 22nd 2008

Dear Sir/Madam

RE: Caring for our Country Grant Application – Reef Life Survey

I strongly recommend the SE Australian Reef Biodiversity Assessment Project proposed for funding of their Community Coastcare application. I believe that this project, proposed by Reef Life Survey, a program of The People and Parks Foundation, is essential to expanding community capacity in relation to marine issues. The project will provide training for a greater number of divers to a high scientific skill level so that they can monitor subtidal reefs across the state. There are still many gaps in our knowledge of subtidal reefs in Victoria. The additional knoweldge that would be gained as a result of this project would make an invauluable contribution to our understanding of reefs and better inform our management of these important marine habitats. The project would also play a very important role in helping build community interest and stewardship in the marine environment.

Parks Victoria has been working to assist community groups to undertake detailed and rigorous marine monitoring methods developed for use in parks, known as Sea Search. Building community stewardship and capacity are aims that Parks Victoria shares with the People and Parks Foundation and the approach proposed meshes well with the Sea Search program.

Should you, or Caring for Our Country, require further advice on this matter please contact me anytime on 8627 4859.

Yours sincerely

Steffan Howe
Manager, Marine Science
Research and Management Effectiveness Branch
Parks Victoria
Level 9, 535 Bourke Street
Melbourne VIC 3000

A2(f). Letter from Parks Victoria in support of the Reef Life Survey program and a funding application to Caring for our Country.

Lord Howe
ISLAND BOARD

Ref: EV009
Enquiries: Chris Haselden

31 July 2008

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Private Bag 49, Hobart TAS 7001
Australia

Re: Lord Howe Island Reef Life Survey Proposal 2009

Dear Rick,

I write to advise you that your application for the use of the Lord Howe Island Board (LHIB) Research Facility for staff and volunteers of the Reef Life Survey training and survey trip from 21st February – 3rd March 2009 has been approved.

The LHIB endorse this project and will offer in-kind support through the use of the LHI Research Station as accommodation for visiting researchers and volunteers, along with any other assistance we can provide while you are on the Island. Given the potential benefits to the conservation and management of LHI World Heritage Area and LHI Marine Park, the proposed research project is worthy of funding and we wish you the best of luck with your application.

The Research Facility provides a basic level of accommodation, including a laboratory workspace. All facilities are share. For your information please find below a list of general conditions for use of the Research Facility:

- Accommodation shall be restricted to those actually undertaking work or research. Spouses, children, friends etc. not directly involved in the approved work or research will not be permitted use of the facility.
- Length of stay will be restricted to the minimum time required to undertake the proposed work or research. The facility will not be available for additional time either preceding or following the minimum period required to undertake the work or research. The facility will not be available for permanent, long-term or holiday accommodation.
- Long-term storage of equipment or material is not permitted, and all equipment and materials are to be returned to the mainland at the conclusion of the visit unless authorised by the Board.
- Users of the facility will be required to maintain the facility in a clean and tidy condition.

The LHIB is aware that although your application for use of the research facility indicates that the program will commence from 21st February – 3rd March 2009, the dates may change depending on a more suitable timeframe for both your group and the local tour operators. We have made a tentative booking for these dates.

It would be appreciated if you could contact Chris Haseiden, Ranger LHIB by 28 November 2008 with conformation of the dates required by your group and one week prior to your arrival on the Island. Chris can be contacted on 02 6563 2063 if you require any further information.

Yours sincerely

31/07/08

Stephen Wills
A/CEO
Lord Howe Island Board

A2(g). Letter from the Lord Howe Island Board in support of the Reef Life Survey program and offering in-kind assistance for training and surveys at LHI.