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Report by Rick Stuart-Smith – 2011 Churchill Fellow

To study ‘scientifically-trained volunteer divers in a marine and conservation network’

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INTRODUCTION

I am a co-founder, executive officer and day-to-day manager of a national non-profit marine science and conservation program called Reef Life Survey (www.reeflifesurvey.com). We train and support the most committed volunteer SCUBA divers in the collection of scientific data on marine biodiversity, with resulting information feeding into biodiversity management and scientific studies. Both myself and founder Professor Graham Edgar are marine scientists, and thus the strengths of the Reef Life Survey program have been in the quality and utility of the data collected. My Churchill fellowship gave me the opportunity to learn more about program management (including marketing and PR, training and educational aspects, for example) more rapidly than I could have otherwise, through visiting large programs that do these things particularly well.

I would like to express enormous gratitude to the Winston Churchill Memorial Trust of Australia and Churchill Fellows Association of Tasmania for the award of the Fellowship and assistance and encouragement throughout the process. The whole experience has been amazing and rewarding.

I would like to thank my wife Jemina, who provides constant support in everything I do, even though it means we continually lose our weekends! Jemina encouraged me to apply for the Churchill Fellowship and supported me all the way. I would also like to thank Graham Edgar and Scoresby Shepherd for their very kind words in references and support for the Churchill travel and in everything I do with Reef Life Survey.

All those I visited during my travel also deserve thanks, particularly Chris Mason-Parker, Isobel Pring and Richard Nimmo, who all went out of their way to help.

EXECUTIVE SUMMARY

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Churchill Fellowship to study scientific training and engagement of volunteer divers in marine science and conservation.

My Churchill fellowship gave me the opportunity to visit a number of other programs that train and engage volunteer divers in other parts of the world. Some of these I chose because they are the largest, most well established in the world and have already had to deal with many of the organisational and logistical challenges that face Reef Life Survey and other Australian community diver programs. I also visited a couple of smaller operations which do particular aspects very well, such as concentrating on higher-level training of divers in scientific methods.

Some of the most important things I learnt during my fellowship included new training techniques, particularly those tailored for training divers in coral reef environments, where data collection is an order of magnitude more difficult due to the high diversity of fishes. In Australia there are currently no opportunities for divers to learn to do full species-level surveys of coral reef fishes, other than what we do in Reef Life Survey. Following my Churchill Fellowship, I can improve the way we do this now, and have already begun preparing new training tools. I also learnt a lot about how the larger organisations deal with program management issues like insurance and volunteer recruitment, and have come back with inspiration and ideas on how to improve the marketing of Reef Life Survey as a globally significant program.

A particular highlight of my fellowship was my visit to the Global Vision International field base in the Seychelles. It was set up in some dilapidated ruins in a jungle setting, just back from a beautiful bay. Despite the rugged outer appearance, they had a comprehensive and modern set-up, with everything from a scuba gear shed and tank filling station, fit-for-purpose vessels and large mess hall areas. It really looked like the volunteer experience there would be something the divers would remember for the rest of their lives. There were lots of good points about the way GVI does things, but the base alone was inspiring.

The results of my fellowship will directly improve the management and effectiveness (and hopefully increase the size and scope) of Reef Life Survey, as well as be shared with other community groups through our partnerships and participation in citizen science workshops.

PROGRAMME

1st – 14th May 2012 Maldives.

- Tiny Islands Volunteers, marine conservation program
- Planet SCUBA

15th – 24th May 2012 Seychelles

- Marine Conservation Society Seychelles
- Global Vision International

25th May – 2nd June 2012 Tanzania

- ECO2

3rd – 9th June 2012 London

- Blue Ventures
- Coral Cay Conservation

10th – 16th June 2012 Bonaire

- CIEE

MAIN BODY

Background

The idea of engaging members of the public in collecting scientific data, or ‘citizen science’, has long been recognised as an invaluable tool for terrestrial biology, both in terms of generating large quantities of data as well as public awareness and skills. The best examples come from the amateur bird watching community, who have contributed a significant amount of knowledge on changes in the distributions of species and the timing of migrations over time and space scales that would be impossible for individual scientists, or even large collaborative scientific teams, to cover¹. The application of citizen science in the marine environment has evolved only relatively recently, but offers many similar opportunities.

The marine environment is out of sight, and compared with the terrestrial environment, there is a greater possibility that changes resulting from human activities are going unnoticed. Increasing our observational capacity by training enthusiastic members of the public to collect useful data allows a more detailed picture of what marine life occurs where, and how things are changing through time.

There are now numerous marine citizen science programs around the world, ranging from those that provide introductory training or just database facilities for casual observations, through to those that involve one or two months of intensive training and field activities or ongoing participation.

Professor Graham Edgar and I recently established the Reef Life Survey (RLS) program in Australia in order to provide more trained eyes underwater and a nationally-standardised mechanism for collecting marine biodiversity information that are scientifically credible. RLS has so far proven incredibly successful in training volunteer divers and generating large quantities of high quality and detailed data, but rather than ‘resting on our laurels’, we recognise that there is much that can be learnt from other organisations and programs around the world that undertake related training and data collection. Such learning can not only be applied to RLS, but also to many community-based marine programs in Australia.

This project specifically focussed on programs which undertake reef biodiversity surveys using visual census techniques (visual observations recorded underwater by SCUBA divers). Visual censuses are challenging and require a particularly good knowledge of the species in an area. They provide an exceptionally valuable picture of the marine life at a given location and time,

¹ B. L. Sullivan et al., eBird: A citizen-based bird observation network in the biological sciences. *Biological Conservation* 142, 2282 (2009).

and depending on the level of detail in the information collected, can be used for a broad range of purposes, including:

- Informing establishment/placement of marine protected areas (MPAs),
- Measuring the success of management actions (including MPAs, species protection, anchoring restrictions)
- Identifying trends related to pollution, climate change and other human disturbances.

The level of detail in the data collected is a particularly relevant aspect when it comes to the application of such methods by citizen scientists. Detail in the case of reef biodiversity surveys can be broadly classified into taxonomic, abundance and size information categories. Figure 1 provides a representation of the range of detail in these categories, with scores applied to each to provide a quantitative assessment of total detail upon aggregation (ranging from 3 to 9).

Level of detail	1	2	3
Taxonomic	Subsets of species sighted - Family level - Non-taxonomic based (e.g. morphotypes)	Subsets of species sighted (species level) - Key/Indicator species - From selected families/groups	All species sighted
Abundance	Abundance not estimated	Abundance estimated in categories (e.g. 1=1-10, 2=11-100, etc)	Abundance counts
Size	Size not estimated	Sizes estimated (coarse size categories/'bins')	Sizes estimated (numerous size classes)

Figure 1. Representation of detail gradients in visual census data.

It is often assumed that a significant trade-off occurs between the level of detail in the data collected and the number of divers that can be trained (and thus the quantity of data that can be collected). This assumption stems from the logic that the time required to train divers to identify all species and undertake surveys makes involving large numbers of people logistically difficult. Additionally, fewer divers may be committed enough to invest greater time in learning detailed methods on a voluntary basis. Thus, typical programs that engage volunteer divers collect data at a low or moderate level of detail (e.g. a cumulative detail score of 6 or less), leaving collection of detailed data, most useful for management and scientific purposes, to professional scientific teams (which can invest time and money in training and maintaining skilled staff).

Reef Life Survey was founded on the basis of engagement of volunteer divers committed enough to undertake substantial training to enable data to be collected at the highest detail possible (and to maintain continued voluntary involvement to allow ongoing data collection). Although RLS is still young, we are conscious that reducing the number of participants can reduce public engagement and awareness outcomes, but wish to maximise the benefits of the program, extending beyond direct scientific and management outcomes.

RLS has a national coverage and comprehensive training methods, but in order to increase the monitoring capacity of RLS in the high diversity (and consequently much more difficult to survey) tropical regions of Australia, we also recognise that training methods could be improved to build the number of active volunteers capable of collecting reliable data in these areas.

This project thus sought to learn from the management and training methods used by programs that have been operating for much longer time periods or use particularly relevant methods to tackle the challenges experienced by RLS (and other Australian programs).

Aims

There are many aspects of program management that remain challenges for RLS and other marine programs in Australia. The primary aim of the project was thus to understand how other international programs deal with the challenges of training volunteer divers to collect useful data, including aspects such as volunteer recruitment, retention, logistics in remote areas, obtaining and maintaining funding, and training methods, particularly for high diversity coral habitats where data collection requires a high level of skill. Site visits and meetings with management staff were used.

Organisation details

Tiny Island Volunteers

Tiny Islands is a program run out of the UK, but based on Velidhoo, an island in the Noonu atoll in the Maldives. They work with local dive shop and guesthouse 'the Lazy Gecko' to run dive operations in their marine conservation program. I was most interested to learn from marine conservation team leader Kylie Merritt how they deal with the remoteness of their field activities and attempting to survey the high fish diversity. The program operates by training and engaging mostly fee-paying gap-year students to assist in program activities, with fees covering program costs (which are kept relatively low). The key to their success in operating in such a remote location appears to be the close relationship with a local dive shop. I imagine the majority of the dive shop business is also supported by the volunteer program,

so it appears to be a mutualistic relationship that has been set up to enable both to succeed.

Planet SCUBA

Planet SCUBA is a tourism company that operates dive charters in the Maldives and out of Singapore, but which is interested in establishment of an eco-tourism facility in the Maldives. I used the opportunity to discuss with business owner Alex Bryant the incorporation of marine biodiversity monitoring by trained volunteers into their plans. We discussed potential future collaboration between Reef Life Survey and Planet SCUBA, and possibilities of island-based research and education stations for local Maldivians and travelling Australian volunteers.

Global Vision International

GVI have two field bases in the Seychelles; the main one is on Mahe at Cap Ternaie in the northwest corner. It is a reasonable distance from the capital of Victoria and is relatively isolated, nestled in the bush away from any settlements. The first impressions of the field base are along the lines of a dilapidated Jurassic Park or ruined Mayan city, with GVI occupying the remains of an old, run-down resort on land owned by Emirates, who lease it to the Seychelles Government, who in turn lease it to GVI. While the buildings are only just intact, there is ample space and large rooms are set aside as the field store for SCUBA gear storage and maintenance, SCUBA tank filling station, main office and the 'mess hall/kitchen'. There are then a series of volunteer and staff quarters on the top level. The rustic and run-down appearance of the buildings has its own charm and after becoming more acquainted with the base, it becomes clear that it is a very well organised base with excellent facilities. It is also only a few hundred metres from the local Marine Protected Area, where much of the training and monitoring occur – Baie Ternaie. So it serves its purposes very well in terms of location and facilities.

Chris Mason Parker (Seychelles program coordinator) pointed out that GVI's presence was initiated seven years ago through an invitation by the Seychelles government, who were concerned about recovery of the local coral reefs following the mass coral bleaching that occurred during the 1998 El Nino. Although a key purpose of the GVI field station is to facilitate the training of fee-paying volunteers from abroad in reef biodiversity survey methods and contribute data on reef condition collected by trained volunteers to the Government, it also provides the basis to provide education and training opportunities to the local community – which was not particularly evident until spending time with Chris. A key goal of the operation is in fact local awareness raising and capacity building, and involvement of international fee-paying volunteers helps achieve these goals.

They train a large number of volunteers, with 24 volunteers present at any one time, with stays of 4, 8 and 12 week durations. There are 12 full-time staff (usually at least 8 at the Cap Ternaie field base). High staffing levels and a well-established field base appear to be key to GVI Seychelles' success and high volunteer participation rates.

In terms of training methods and data collection, the Seychelles Government relies on GVI and the MCSS to undertake all non-fisheries monitoring of the local marine environment. The Seychelles have a relatively diverse local marine fauna and flora, so monitoring of this will always be challenging, whether by scientific teams of trained volunteers. Importantly, only volunteers that have undergone and passed the GVI training are able to collect data that contribute to the ongoing monitoring of Seychelles reefs, so this makes the training and survey methods very important. From the outside it was not clear what level of detail the data were collected at. For fishes, GVI get around the issue of high species richness by only recording subsets of species: (1) those that are easy to recognise and thus can be recorded most reliably by people with varying levels of skills/experience, called 'group 1 fishes', and (2) those that are exploited or of commercial importance, called 'group 2 fishes'. This results in manageable lists of species that volunteers must learn during training, but comes with a reduction in the utility of the final data collected once trained. Training resources include PowerPoint presentations showing the species on the appropriate list and sometimes the distinguishing features. Assessment is done during dives, when volunteers must point out each species on the list to trainers on at least 3 occasions, on land when they may take random identification tests, and a final test where they must achieve at least 95%. The protocols and resources used are well-developed and although easier to implement using subsets of species, the techniques could successfully be applied to more detailed methods.

GVI have extensive experience undertaking operations like the one at the Seychelles, and a key goal of mine was to see how they dealt with the logistical and management difficulties associated with taking a large number of volunteers diving. Insurance is always a critical issue for volunteer dive groups in Australia, and GVI deal with this by only centrally covering the liability insurance of staff and making it a participation requirement for volunteers to have either DAN (Divers Alert Network) dive travel insurance, or a travel insurance policy that specifically covers repetitive diving. Volunteers also must sign a waiver. Although it seems to be a bit to ask of volunteers who are not only providing their time free of charge, but are actually paying to provide it, DAN insurance is not expensive and any travelling divers should consider this anyway. Whether such a mechanism would work for locally based divers in Australia would require an enquiry to DAN, but will be worth following up.

GVI deals with the issues of undertaking diving in a remote area by purchasing and servicing all their own dive equipment, including a vessel, compressors

and tanks. This is costly, but clearly provides the flexibility needed to operate in a relatively remote area. It also requires staff to be multi-skilled, being able to service SCUBA gear as well as train volunteers in reef survey techniques. Having a significant international reputation must be important to being able to locate and retain such staff. Catering, maintenance of living facilities and preparation and cleaning of equipment is dealt with through assigning volunteers to 'duty groups', each with a staff member to supervise. Volunteers all pull their weight to help operations run smoothly.

Marine Conservation Society, Seychelles

The MCSS is a non-government organisation based in the Seychelles which forms a major provider of fisheries-independent marine research to the government as well as publishing in the scientific literature. I discussed MCSS activities with Dr David Rowat (Chairman, Marine Conservation Society, Seychelles). While the MCSS does involve volunteers in data collection, Dr Rowat said this was limited to less complex projects and in smaller numbers. The MCSS prefers to undertake most reef biodiversity research using external scientists and that most volunteer-based data collection is in the form of video and image analysis (office-based) and field assistance for tagging studies of turtles and sharks. Major projects involve whale sharks, rays, turtles and other large mobile (and exploited) species, using acoustic tagging and BRUV (Baited Remote Underwater Video) techniques. The volunteers involved often come previously-trained from participation with Global Vision International's program in the Seychelles. Thus, there appears to be very little training of volunteers in the MCSS. In addition to this important relationship with GVI, MCSS has an important partnership with the Seychelles Government to help direct research needs to those that are locally needed and don't overlap with Government activities. The MCSS also has an emphasis on publishing results in peer-reviewed scientific journals, which not only qualifies research outputs as of a reasonable standard (through the peer-review process), but also ensures results are spread through the global scientific community. The management of the MCSS is formed of people with scientific experience and management knowledge rather than those with a campaigning and public awareness and engagement focus.

Eco2

I spent a number of days diving with Isobel Pring, marine research and training manager at Eco2, and discussing successful approaches to program establishment for long term monitoring by volunteer divers. Eco2 is a relatively young and promising organisation, which operates under an interesting business model and in a very challenging environment. It was established as a result of marine work in the Mtwara area of southern Tanzania by Frontier. The work by Frontier and Martin Guard was instrumental in establishing a desperately needed marine reserve (MRMP), and after Frontier ceased operations in the area, Martin established Eco2 in order to provide the support needed for monitoring the local marine environment. Eco2 principally operates

as a dive tourism operation and is currently cementing this side of operations in order to support the environmental monitoring side further. Isobel Pring is the person responsible for the marine research and training side of Eco2 operations, and is establishing this in a 'multi-layered' approach which promotes education and training, but specifically seeks to collect high-quality, detailed data that are most appropriate for local monitoring and research.

The three main components to Eco2's research and training side provide:

- 1) A low-level training option for short-stay, fee-paying dive tourists who wish to learn more about the marine environment. The data generated from these will not contribute to anything, but the funds generated will help support the other aspects. It will contribute to awareness raising and education goals.
- 2) Multi-week stays for post-graduate marine science students to undertake a research project that is locally-relevant. This provides an opportunity for post-graduate training where there is local support for marine fieldwork in a remote and logistically-difficult location (a unique and valuable opportunity for students from other countries), while data generated can be tailored to contributing to both the student's degree as well as local monitoring and research objectives.
- 3) Multi-week to multi-month stays where more intense training can be provided to a small number of committed volunteers who can assist in the detailed local monitoring, using species-level methods.

While a young organisation, the combination of these mechanisms is innovative and highly promising, and the discussions and diving with Isobel confirmed that this will be a successful and valuable operation in an area that badly needs it. In particular, the methodologies used for the 3rd level mentioned above are very much in line with what is used by Reef Life Survey in Australia and training and exchange opportunities may present in future.

Coral Cay Conservation

I chatted with Jan-Willem van Bochove (Head of Science for CCC) in the UK. CCC is one of the oldest (if not the oldest) marine citizen science programs, being established in 1986. It has an excellent reputation for historically engaging large numbers of volunteer divers in various field camps around the world. They currently have two major operations involving volunteers collecting reef biodiversity data on SCUBA: Cambodia and Philippines. The latter is their largest program and has approximately 15 volunteers go through per month, with volunteer fees providing the main funding source. The Cambodia operation, however, has a more variable volunteer participation rate, averaging approximately five volunteers per month. Consequently, this program is heavily reliant on grant funding (ca. 80% of program costs from grants).

Each program has five field staff who are also volunteers, but are selected from interviews and typically hold a degree in marine science and experience in remote field camp situations. These staff train the volunteers, and in order to ensure the trainers are well versed in local marine life and the applicable methods, an overlap period is ensured between staff changeovers, so incoming staff are trained by outgoing staff. This system ensures there are always a sufficient number of training staff available, but it means that the level of staff expertise may be more variable and that 'corporate memory' can be lost. There are also usually up to five local staff employed to drive boats, cook and maintain equipment.

Similarly to GVI, insurance is dealt with through requiring all volunteers to have adequate travel and dive insurance (e.g. DAN), while staff liability is covered by a policy held by the central office.

Unusually, survey methods differ between the programs. The reasoning behind this is that they can be adapted to be most suitable to the local situation/local management needs and they are attempted to be made compatible with any other large efforts that exist in that particular area. For example, the Philippines program uses Reef Check methods as these are extensively used in the Pacific.

There are obviously pros and cons to varied methods, and even at the highest level of detail in data collected in CCC programs, there are limitations to data usage. Training methods also have to be tailored to the methods, but CCC have well-refined training methods that are very similar to those used by GVI and Blue Ventures (below).

Blue Ventures

In the UK, I also visited Richard Nimmo, managing director of Blue Ventures. Like CCC, Blue Ventures is another of the largest and most successful of the programs that involve volunteers that travel to be trained and undertake marine surveys on SCUBA. They currently have two large programs where this occurs: Madagascar and Belize.

The Madagascar operation is well established and funded almost entirely through volunteer fees, including the extension activities outside of the biodiversity surveys. Approximately 120 volunteers are trained at Madagascar each year and 50 staff are present in the country, where there is also another operations office. The data collected here are more detailed than many other programs (approximately 200 species of fish are monitored), but importantly they allocate easier tasks to those that are not reaching high enough data quality standards. Data are tested through computer-based tests with pass or fail and through one on one comparison with trainers during/after dives. Training usually takes 3 weeks. Blue Ventures owns all the required SCUBA gear, compressors and vessels, so is incredibly well set up.

The Belize operation differs in that it is less well-established (compared to Madagascar), and although set up to be self-sustaining (volunteer fees), it is still recovering the establishment costs (e.g. boats, compressors etc). It uses different methods that focus more on fisheries species, with a main goal of providing annual reports to the Belize Fisheries Department for management purposes. Approximately 90-100 volunteers are trained each year and just under 50 staff are present.

Both operations require divers to get to Advanced Diver level before participating in surveys. They have instructors present to provide qualifications if people arrive with no prior SCUBA experience (or not at Advanced level). Volunteers must also have DAN insurance (it must be DAN), and staff are covered by company liability insurance and by a type of DAN insurance for dive centres.

Central office doesn't have a specific PR staff member, but there are 2 finance staff, a conservation program manager, a volunteer coordinator/sales and marketing officer, the managing director (Richard) and the director of conservation. The entire company is run through grants to an associated charity (set up to receive grants) and field operations largely funded by fees of volunteers.

CIEE

I met Jason Flower, who runs tropical biodiversity survey training courses for students. The CIEE on Bonaire has a different focus from the other organisations I visited; it primarily provides training for students who wish to become scientists. I wanted to see what sorts of training programs they operate as it is essentially the same as training citizen scientists, even if many of these students are likely to end up in a career of marine science.

The CIEE offers courses at a different range of levels from the most basic and introductory level to supporting post-graduate research by students practising marine science at a higher level. The facilities are excellent and the location absolutely perfect for training in tropical marine biodiversity surveys. There was a lot of enthusiasm and passion amongst the students, no doubt greatly boosted by the facilities, location and convenience offered by the CIEE and Bonaire.

Table 1 summarises some of the key characteristics of each of these organisations and where Reef Life Survey sits in relation to them. Although not a quantitative comparison, it shows that programs with higher volunteer participation rates do in general collect data at lower levels of detail (as measured using the detail index in Figure 1), and that the types of data usage are also related to the level of detail.

Table 1. Characteristics of organisations undertaking reef fish field training and data collection by unpaid SCUBA divers. For organisations which have multiple programs, only information relating to their main program is presented.

	Global Vision International	Blue Ventures	Coral Cay Conservation	Eco2	Tiny Islands	CIEE	Marine Conservation Society (Seychelles)	Reef Life Survey
Administration								
Funding model	Volunteer fees	Volunteer fees	Volunteer fees	Ecotourism	Volunteer fees	Student fees	Grants/Donations	Grants
No. staff	>20	>50	>20	<5	<5	5-10	<5	<5
Participation								
Volunteer type	Gap year	Gap year	Gap year	Tourist/student	Gap year	3 ^o student	Various	Various
No. trained/year	>100	>120	>180	<10	10-50*	10-50*	<10*	<10
Data collection†								
Taxonomic coverage	2	2	2	2-3	1-2	2-3	2-3	3
Abundance detail	2	2	2	2-3	1	2-3	2-3	3
Size detail	1	1	1	1-3	1	1-3	1-3	3
Data use								
Management reports	Primary	Primary	Primary	No	No	No	Primarily	Primary
Scientific publications	Occasional	Occasional	Occasional	No	No*	Occasional *	Occasional	Primary
Available to public	Summaries	Summaries	Summaries	Some	No*	No*	No*	Yes
Student projects/theses	No	No	Occasional	Yes	No*	Yes	Yes*	Yes

*represents estimate

†Values from Figure 1.

CONCLUSIONS AND RECOMMENDATIONS

Although not all outlined in the sections above, five critical and consistent messages evolved through my fellowship that will put what we do in Australia into context as well as help improve the way we do things: (1) There really does appear to be a trade-off between the number of divers involved and the level of detail collected in the data, and that Reef Life Survey is globally unique in what we already achieve, (2) Changing data collection roles appears to be the most widespread way of managing data quality in terms of dealing with volunteers who don't perform at a high level, (3) The use of remote field locations appears to be a promising tactic to improve effectiveness of training and data collection through reducing distractions to volunteers and enhancing team dynamics/camaraderie, (4) Although obvious and clichéd, partnerships are critical. Aligning activities with dive shops and government agencies greatly enhances logistical capabilities and outcome applicability, (5) DAN insurance appears to be a global standard for volunteer SCUBA operations, and may be an appropriate avenue for insurance support for volunteer activities in Australia.

Recommendations of the study primarily fit into those that we must take on board for Reef Life Survey, in order to improve training in high diversity areas and operational effectiveness. More broadly applicable recommendations for other community-based monitoring groups in Australia are:

- That contact is made with DAN Asia-Pacific to enquire about the possibility of an insurance cover that was specifically appropriate for Australian community diver operations.
- PR and marketing are important tools that are neglected in many Australian programs. Australia has an impressive network of local community groups undertaking marine activities, many of which are amongst the best in the world. This needs to be recognised by these groups and the Australian public.

I am an active participant in citizen science workshops and will share these recommendations along with other key learning from my fellowship during such workshops and through my regular contact with a large number of community diver groups in Australia.