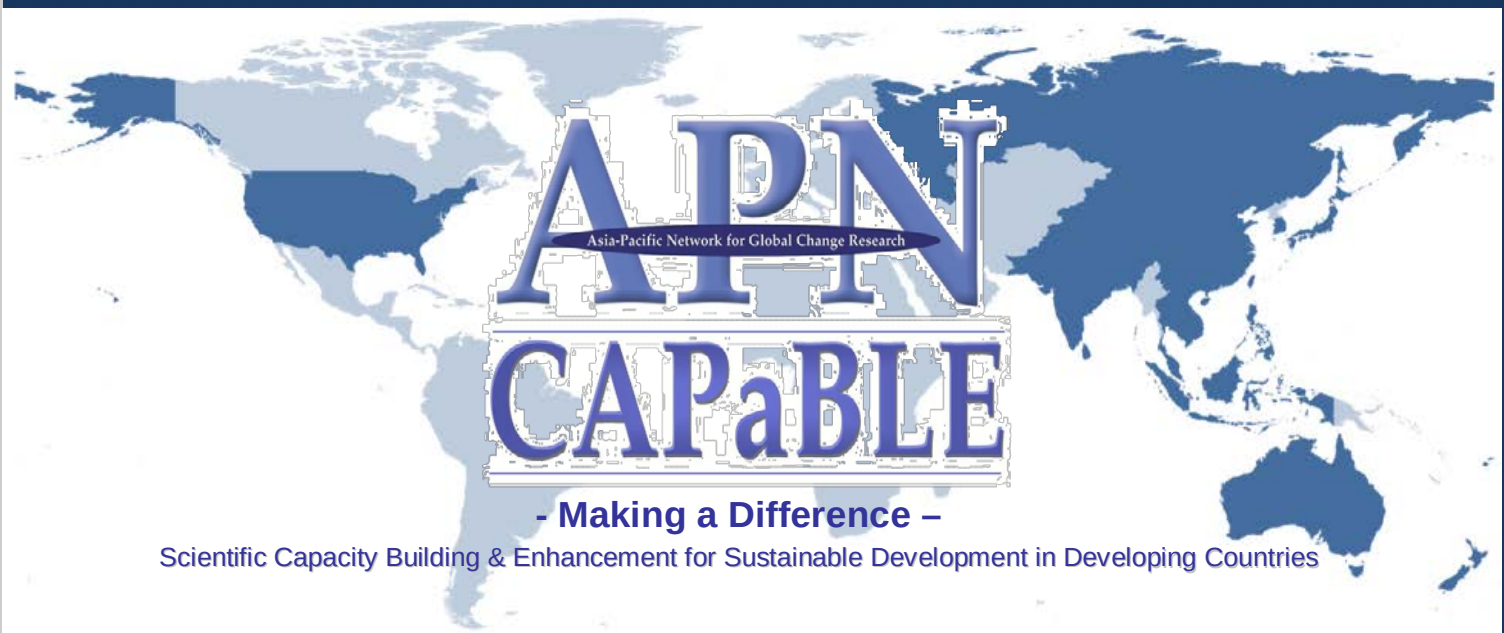
FINAL REPORT for APN PROJECT

Project Reference Number: CBA2013-09NSY

Building Capacity for Socio-ecological Resilience to Coral Bleaching Events & Climate Change in Indonesia, Malaysia, and Thailand



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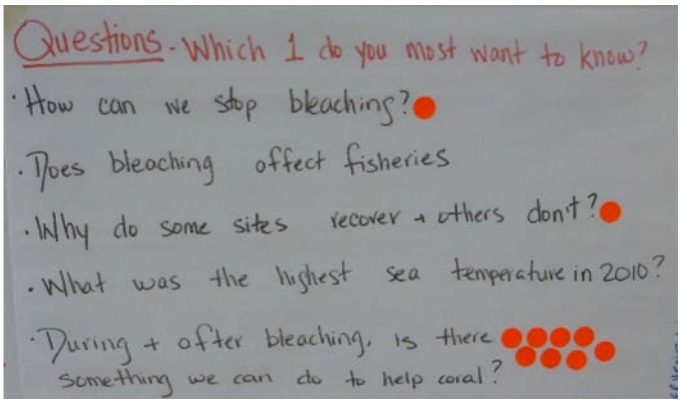
Building Capacity for Socio-ecological Resilience to Coral Bleaching Events & Climate Change in Indonesia, Malaysia, and Thailand



Project Reference Number: CBA-2013-09NSY
Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

At current rates of greenhouse gas emissions, it is projected that up to half of the world's reefs will experience severe bleaching events in any given year by 2030.[1] Coral reef degradation leads to a simultaneous loss is the significant ecosystem services they provide as the foundation for a thriving dive tourism industry, extensive fisheries, and a broad range of regulating services. While significant progress has been made over the last decade in understanding and responding to bleaching events,[2,3] research identifying actions to increase the resilience of the reef tourism industry to coral bleaching is in its infancy. Existing research has focused on assessing economic losses during bleaching events[4], with little scientific work examining adaptation strategies for dive operators or the longer-term consequences of bleaching for the structure of the dive industry, the broader economy, the well-being of dependent coastal communities, and government policy. This project conducted seven multi-stakeholder learning workshops across Malaysia, Thailand, and Indonesia to fill gaps in scientific knowledge and build capacity for supporting social and ecological resilience to future bleaching events.

Keywords

Coral bleaching, dive tourism, fisheries, regulatory services, ecological resilience, socio-economic resilience, capacity building

Objectives

The main objectives of the project were:

1. Raise awareness about the impacts of mass bleaching and climate change on coral reef ecosystems, reef-dependent tourism operators, and national economies;
2. Strengthen interactions among scientists, government decision-makers, and reef-dependent tourism operators to facilitate improved decision-making processes at local to national levels;
3. Provide scientific input on bleaching responses that support social, economic, and ecological resilience;
4. Identify the content for dive operator training materials that will be incorporated into on-going training programs and operator networks; and
5. Strengthen science-policy links and building scientific capacity by collaboratively developing questions & methodologies for future research.

Amount received and number years supported

The Grant awarded to this project was US$44,000 for Year 1

Activity undertaken

Following an extensive ecological and socio-economic data collection during the 2010 coral bleaching event, seven multi-stakeholder learning workshops across Malaysia, Thailand, and Indonesia to fill gaps in scientific knowledge and build capacity for supporting social and ecological resilience to future bleaching events.

Results

- The seven workshops engaged over 150 participants from industry, government, academia, and civic organizations (Figure 3.2).
- Over 25 organizations contributed to hosting the workshops (Appendix E).
- Through these partnerships, APN's US$44,000 leveraged additional investment of US$180,000 (Appendix E).
- The workshops were covered by major newspapers Malaysia, Thailand, and Indonesia (Box 3.1).

- In response to a formal workshop evaluation, participants overwhelmingly reported that the workshops were a good use of their time (Figure 4.1).
- Workshop participants identified the degradation of coral reef condition and the loss of biological diversity as the most important impacts from a major coral bleaching event in 2010; they reported that social and economic impacts from the event were minimal (Table 3.1)
- Workshop participants varied in their views about whether their tourism destination will successfully adapt to projections for more frequent and severe bleaching events; participants at the workshop in Pattaya, Thailand were most confident in their ability to adapt, while those in Gili Islands, Indonesia were least optimistic (Figure 3.1)
- Workshop participants identified improved communication, coordination, education, and enforcement as the most important actions needed in response to bleaching events (Table 3.2).
- Workshop participants' priorities for future research focused on questions about how to strengthen governance, stakeholder awareness, and coral reef resilience (Table 3.3).
- Workshop evaluations showed that relatively few individuals believed that climate change was "not very damaging" to coral reef ecosystems before the workshop, and even fewer afterward (Figure 3.3).
- Participants overwhelmingly reported that they are better prepared to respond to coral bleaching events as a result of their participation in the workshops (Figure 3.4).
- Participants identified the need for improved stakeholder engagement, coordination, and communication as key strategies for supporting the social and ecological resilience of coral reef ecosystems to climate change; the workshops initiated and strengthened stakeholder interactions by bringing together key leaders from the government, business, research, and NGO communities (Section 3.5.2).
- Qualitative responses to the workshop evaluation suggest that the scientific information provided as part of Project Objective 3 was well-received; participant responses to the open-ended evaluation question, "what did you like best about the workshop?" highlighted the technical presentations (13% of the responses offered), the workshop's technical content (23%), and the focus on responsive actions (10%), together constituting over 45% of the responses offered (Figure 3.5).
- Participant input was used to develop the content of training materials to guide dive operators in responding to future coral bleaching events (Appendix F).

Relevance to the APN Goals, Science Agenda and to Policy Processes

The workshop produced outcomes identified as priorities in the 3rd APN Strategic Plan, specifically: strengthened interactions among scientists and decision-makers; provided scientific input to decision-making; provided scientific knowledge to the public; built capacity for sustainable resource use and development; and fostered interdisciplinary understanding of global change issues relevant to the region.

Self evaluation

The workshop series was a resounding success, the foundation of which was the quality of inter-personal relationships within the project team. Within the funding available, the workshop series was packed into a very short timeframe. As such, the project team was on the road or in the air with little respite. This meant that there was limited time for creative engagement by the team, as well as substantial fatigue towards the end of the workshop series. However, the team maintained a 'can do' approach throughout, as is substantiated by the project outcomes.

Potential for further work

Several ideas for future work arose during the workshop series in the research genres of ecology, economics, social science/governance and interdisciplinary studies. These are outlined in Section 5. Of note is the outline for Dive Operator Training Materials regarding climate change and dive tourism in Appendix F.

Publications (please write the complete citation)

Doshi A, Pascoe S, Thébaud O, Thomas CR, Setiasih N, Tan CH, True J, Schuttenberg HZ, Heron SF (2012) Loss of economic value from coral bleaching in S.E. Asia. *Proceedings of the 12th International Coral Reef Symposium, Cairns, July 2012*, *ICRS2012_22D_1.*

Pascoe S, Doshi A, Thébaud O, Thomas CR, Schuttenberg HZ, Heron SF, Setiasih N, Tan JCH, True J, Wallmo K, Loper C, Calgaro E (2014) Estimating the impact of entry fees for marine parks on dive tourism in South East Asia. *Marine Policy* 47:147-152.

Pascoe S, Doshi A, Thébaud O, Thomas CR, Schuttenberg HZ, Heron SF, Setiasih N, Tan JCH, True J, Wallmo K, Loper C, Calgaro E (submitted) Do divers care? The impact of coral bleaching on return diver visits in South East Asia. *Journal of Sustainable Tourism.*

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Thomas CR, Heron SF (2011) South-East Asia Coral Bleaching Rapid Response: Final Report. Commonwealth Scientific and Industrial Research Organisation, Wealth from Oceans Flagship, Australia. 24pp.

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1. van Hooidonk R, Maynard JA and Planes S (2013) Temporary refugia for coral reefs in a warming world. Nature Climate Change 3: 508–511.
2. Marshall, P.M. and H.Z. Schuttenberg, 2006. *A Reef Manager's Guide to Coral Bleaching*. Great Barrier Reef Marine Park Authority. Townsville, 165pp.
3. Eakin CM, Morgan JA, Heron SF, Smith TB, Liu G, et al. (2010) Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005. PLoS ONE 5(11): e13969.
4. Doshi A, Pascoe S, Thébaud O, Thomas CR, Setiasih N, Tan CH, True J, Schuttenberg HZ, Heron SF (2012) Loss of economic value from coral bleaching in S.E. Asia. *Proceedings of the 12th International Coral Reef Symposium, Cairns, July 2012*, *ICRS2012_22D_1.*

Acknowledgments

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Report Citation

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TECHNICAL REPORT

Preface

This project aimed to build capacity within scientific, government, and civic organizations in Indonesia, Malaysia, and Thailand to increase the resilience of coral reefs and key reef-dependent industries to acute climate change impacts. Multi-stakeholder learning workshops in the countries discussed interdisciplinary data collected during and after the 2010 extensive coral bleaching event. The outcomes are priorities in the 3rd APN Strategic Plan, specifically: strengthening interactions among scientists and decision-makers, providing scientific input to decision-making, providing scientific knowledge to the public, building capacity for sustainable resource utilization and development, and fostering interdisciplinary understanding of global change issues relevant to the region.

Table of Contents

1. Introduction

1.1 Background

At current rates of greenhouse gas emissions, it is projected that up to half of the world's reefs will experience severe bleaching events in any given year by 2030.[1] Broad scale coral bleaching occurs when anomalously high sea temperatures cause corals to expel the symbiotic algae that live within their tissues and provide up to 90% of corals' energy requirements. Bleached corals can recover after temperature stress abates; however, stress that is severe or persists for several weeks can lead to mortality. While in this compromised state, corals are more vulnerable to disease, competition from other benthic species, and anthropogenic stressors, such as some tourism, fishing, construction activities, or water pollution. Reefs that experience high coral mortality typically take 5-20 years or more to recover from bleaching events and often lose some of their former biological diversity; in some cases, corals fail to recover and reefs instead become dominated by algae.[2]

Coral reef degradation leads to a simultaneous loss in the significant ecosystem services reefs provide as the foundation for a thriving dive tourism industry, extensive fisheries, and a broad range of regulating services. In the Asia-Pacific region approximately 150 million people derive benefits from coral reefs.[3] These benefits may be degraded or lost as a result of coral bleaching; for example, an extensive bleaching event in 2010 resulted in losses to reef-dependent tourism estimated at US$ 50-75 million across Indonesia, Malaysia, and Thailand.[4]

While significant progress has been made over the last decade in understanding and responding to bleaching events,[5,6] research identifying actions to increase the resilience of the reef tourism industry to coral bleaching is in its infancy. Existing research has focused on assessing economic losses during bleaching events,[4,5] with little scientific work examining adaptation strategies for dive operators or the longer-term consequences of bleaching for the structure of the dive industry, the broader economy, the well-being of dependent coastal communities, and government policy.

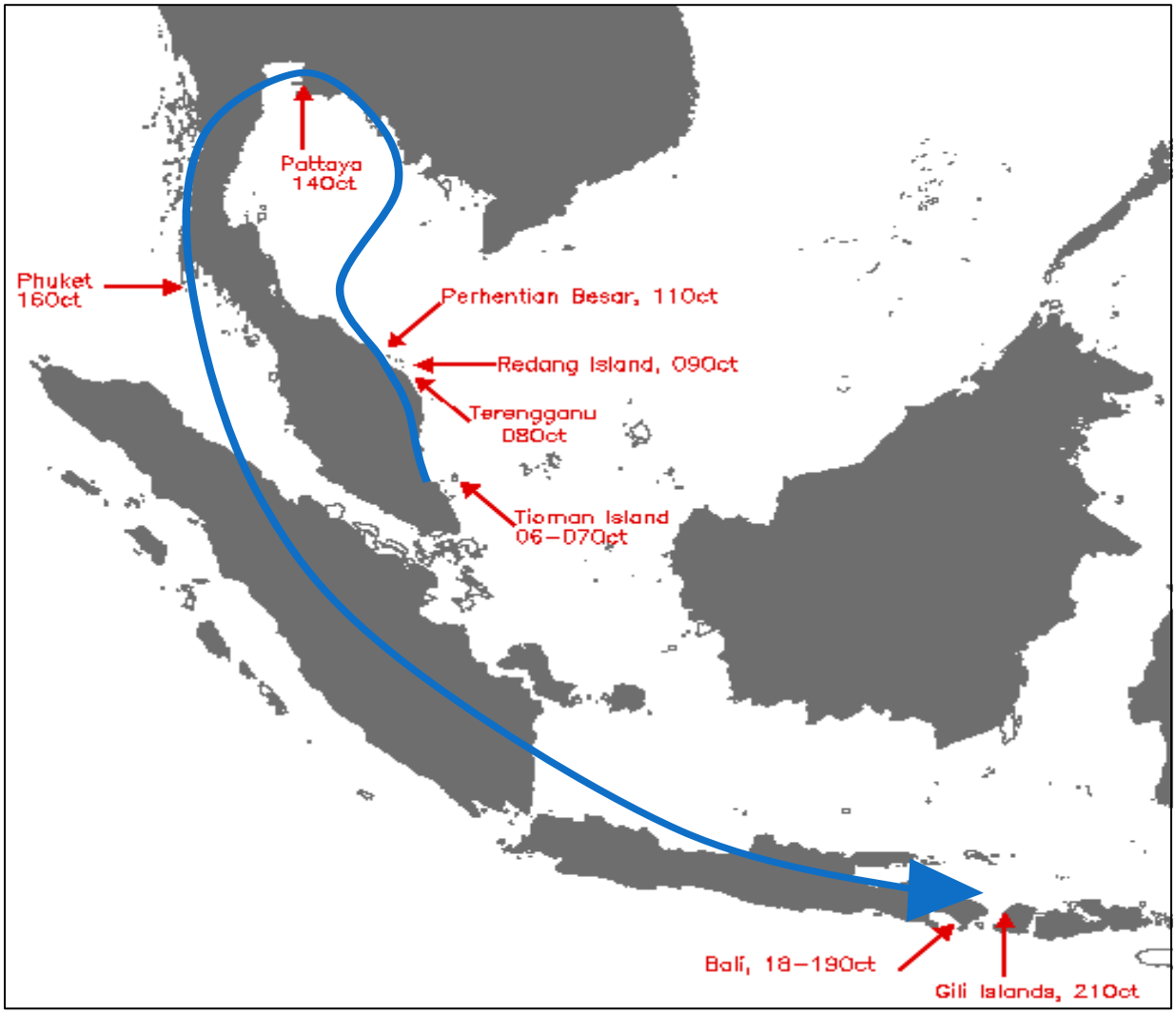
This project aimed to work with dive industry, government, NGO, and academic stakeholders to fill this gap in scientific knowledge and build capacity for supporting social and ecological resilience to future bleaching events. It was predicated on work conducted in Indonesia, Malaysia, and Thailand during an extensive bleaching event in 2010. Ecological surveys characterized the bleaching event, and quantitative socio-economic surveys of 575 divers assessed diver perceptions of the bleaching event, the influence of those perceptions on support for different management actions, and the resulting economic impact. Concurrent qualitative surveys were conducted with dive operators to explore their perceptions of the event on their business and the ways they were seeking to adapt their operations. The locations studied are highly dependent on dive tourism, and outcomes from these case studies are indicative of the main, short-term socio-economic impacts from bleaching events.

The outline of this report is as follows: Section 2 describes the seven stakeholder workshops and two regional collaboration meetings. Section 3 presents the workshops' outcomes. Section 4 draws on the results of project activities and workshop evaluations to investigate the project's effectiveness in achieving its stated objectives. Section 5 describes identified future directions.

2. Methodology

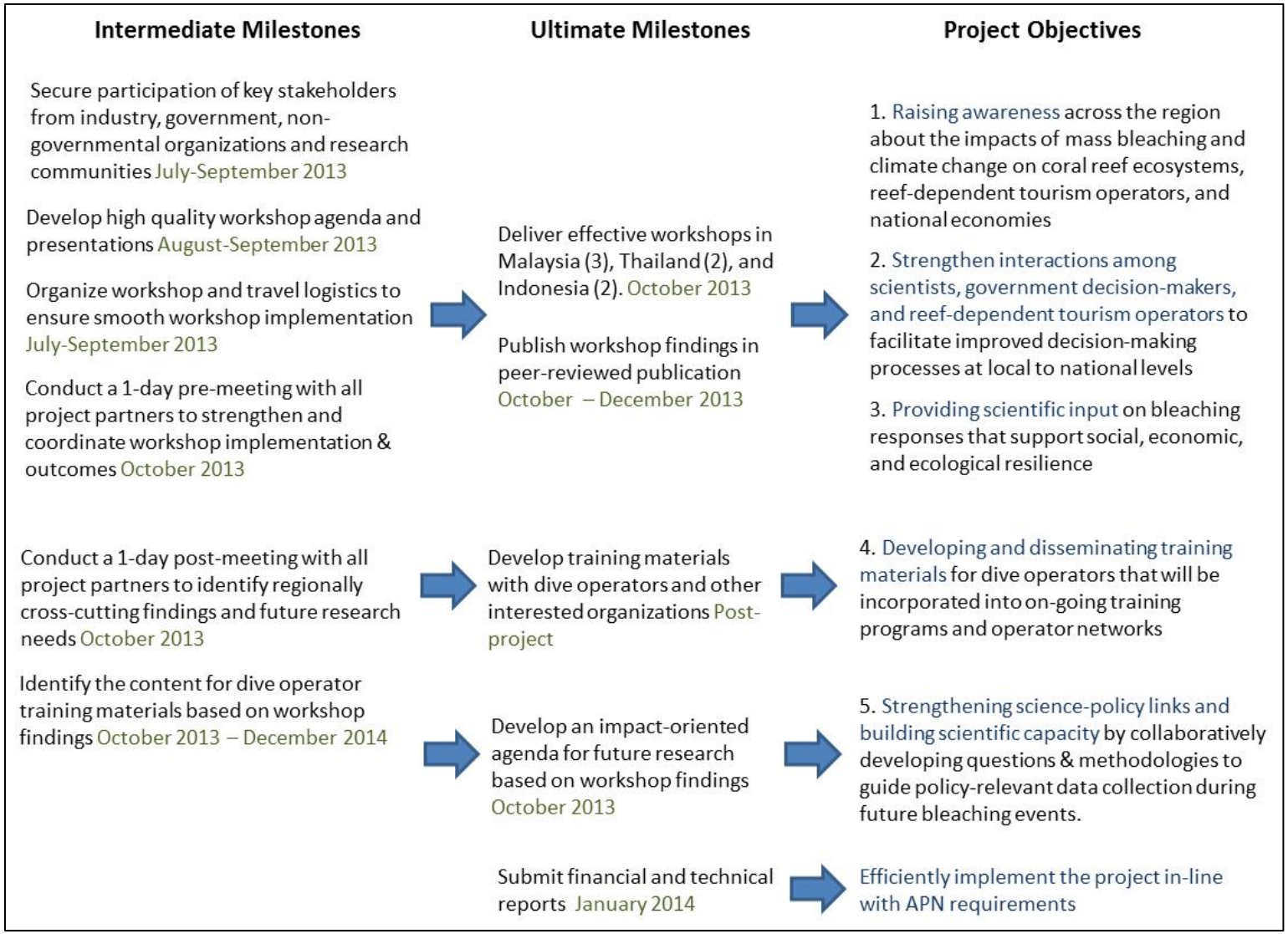
2.1 Project Design and Report Content

The formal project design consisted of holding seven workshops (Figure 2.1) and two regional collaboration meetings to achieve the project's five objectives (Figure 2.2); project goals were further supported by a range of opportunistic and informal activities, described in Box 2.1.



eld in 2013.

Figure 2.2 Logic model illustrating how the project's intermediate and ultimate milestones were expected to achieve its objectives.



2.2 Regional Collaboration Meetings

Regional meetings involving the project's nine implementing partners were conducted before and after the stakeholder workshops; these meeting agendas are provided as Appendix A. The Regional Pre-Meeting was held in Tioman, Malaysia on 6 October 2014, and focused on building relationships between team members, refining the workshop's presentations and exploring how to best take advantage of the regional and interdisciplinary characteristics of the project. During the Pre-meeting, every workshop presentation was revised through a process of constructive group feedback, team members identified and clarified the roles they would play during the workshops and the team reaffirmed its shared goals for the project.

The Regional Post-workshops Meeting was held in Bali, Indonesia, on 19 October. It focused on harvesting the insights revealed through the stakeholder workshops to develop effective training materials for dive operators, prioritize future research collaborations, and outline concepts for peer-reviewed papers; the results of these discussions are presented in Section 5. Despite team fatigue after two weeks of intensive travel and workshop facilitation, the team left the Post-meeting enthusiastic about initiating a "Phase 3" for the project that would address key information gaps identified during the workshops, and developing effective training materials to meet the needs identified by dive operators.

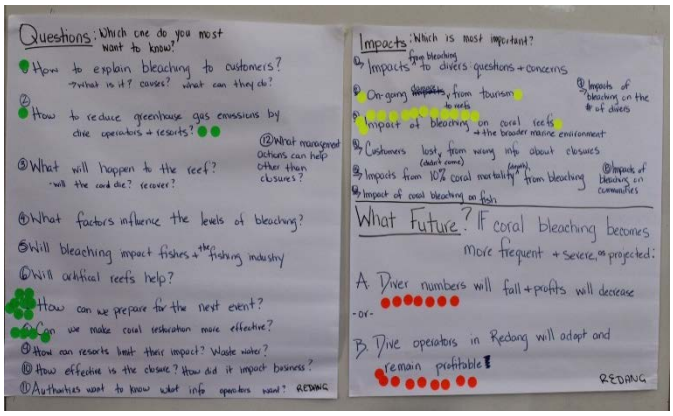
2.3 Multi-stakeholder Workshops

Seven multi-stakeholder workshops were held in Malaysia, Thailand, and Indonesia to collaboratively investigate the impacts of the 2010 bleaching event and options for responsive actions (Box 2.1); the agenda for Perhentian, Malaysia is presented in Appendix B as an example. The participants for each workshop are listed in Appendix C.

The morning session of each workshop focused on understanding the social, economic, and ecological impacts of bleaching, particularly the 2010 bleaching event. Background presentations were given on the causes of bleaching and the temperature stress and ecological impacts of the 2010 bleaching event. Workshop participants then participated in small group discussions to identify the impacts of bleaching in their area and the main questions they had about bleaching; the findings of these discussions are presented in Section 3. Group discussions were followed by expert presentations on the impacts of the 2010 bleaching event on diver satisfaction, dive operators and the economy, based on data collected in each workshop location during the 2010 event. The morning concluded with a synthesis exercise in which participants confirmed a list of impacts and questions developed during the group discussions; participants then voted on the impact they considered most important, the question they most wanted answered, and the future scenario they thought most likely for the dive industry in their area given projections of increases in the frequency and severity of bleaching (see Section 3).

The afternoon session of each workshop focused on investigating actions that could be taken in response to the short- and longer-term implications of bleaching. Presentations were given on plans for responding during bleaching events, based on existing best-practice models from Malaysia and Bali, Indonesia. Expert presentations then offered ideas for supporting longer-term ecological and social resilience based on the best available science. Following these presentations, workshop participants again participated in small-group discussions to identify responsive actions and questions they had about taking action. The afternoon concluded with another synthetic exercise in which participants confirmed a list of actions and questions developed during the group discussions and voted on those that they found most important. In Indonesia, participants also voted on their preferred "response triggers," which are levels of bleaching that initiate specific management actions, such as expert monitoring or restrictions of tourism and fishing activity.

Box 2.1 The knowledge-exchange workshops used expert presentations (A) and small group discussions (B) to share information. The results of small group discussions (C) were synthesized into workshop-wide lists (D), and participants voted (E) on the impacts, actions, and questions they found most important. Participants highlighted the value of interacting with colleagues from different sectors and organizations (F). Traveling (G) and working together strengthened relationships between project partners (H) from Malaysia, Thailand, Indonesia, Australia, and the USA.



All participants were offered the opportunity to complete a Workshop Evaluation Survey (Appendix D). The survey asked respondents to answer Likert-scale questions both before and after their workshop. Questions were designed to assess whether the workshops had a measurable impact on: participants' awareness of bleaching and climate change, support for management, and perceptions of stakeholder cooperation. The survey also included two quantitative questions on the overall benefit of the workshops and two open-ended questions about the workshops' strengths and weaknesses.

3 Results & Discussion

3.1 Impacts from the 2010 bleaching event

During the morning session of each workshop, participants broke into small groups of 6 to 12 people to discuss the questions:

How did you experience the 2010 bleaching event? What impacts were most important? Why?

- *How was the reef affected?*
- *What did divers experience?*
- *How were dive operators affected?*
- *How were communities affected?*

The impacts identified in the small groups were presented, discussed, and collated into a workshop-wide list. Workshop participants were then asked to place a sticker on the impact they considered most important. The impacts from each workshop were collated into a project-wide list and prioritized. In order to prioritize the impacts, each was allocated points on the following basis:

- 1 point for each workshop that identified the impact;
- 2 points for each vote the impact received from any workshop participant.

The top ten impacts identified through this prioritization process are presented in Table 3.1. Ecological degradation of coral reef ecosystems, particularly loss of fish and biodiversity, was the greatest concern for workshop participants; the top three impacts reflect this concern. A lack of understanding about bleaching and ways of responding to it was a second theme identified (Impacts 5 and 8). Throughout the workshops, participants noted that while the bleaching was extensive (Impact 10), dive operators were mainly able to adapt their operations (Impact 6) and to avoid economic losses. The more significant impacts resulted when bleaching caused higher levels of coral mortality (Impacts 1, 3, 4, and 7).

Table 3.1 Top ten bleaching impacts identified by workshop participants through small group discussions and individual voting

1	There have been decreases in fish and biodiversity
2	Coral reef condition and dive operators are more affected by issues other than bleaching
3	There have been negative impacts on overall coral reef condition
4	Loss of shallow reefs has caused coastal erosion
5	Dive operators did not know what to do
6	Dive operators adapted operations by changing sites or the kinds of trips they offered
7	After the bleaching there are a limited number of good sites and competition for sites has increased, potentially leading to conflict with fishers
8	The local community did not know what was happening and was not affected
9	Some divers were upset or concerned, and some asked for a different site or did not want to return because of the bleaching
10	In many cases, bleaching was extensive

3.2 Future scenarios

While voting on the impact they considered most significant at the end of the morning session, workshop participants were also asked to vote on what future they saw for their place if coral bleaching continues to increase in frequency and severity as projected (Figure 3.1). Differences in

optimism about the ability of dive operators to adapt and remain profitable probably reflect the different characteristics of each tourism destination as well as past operator experiences. Workshop participants on the Gili Islands, Indonesia were most concerned that "diver numbers will fall and profits will decrease." Participants in Tioman, Malaysia and both Thailand destinations were more likely to believe that "dive operators will adapt and remain profitable."

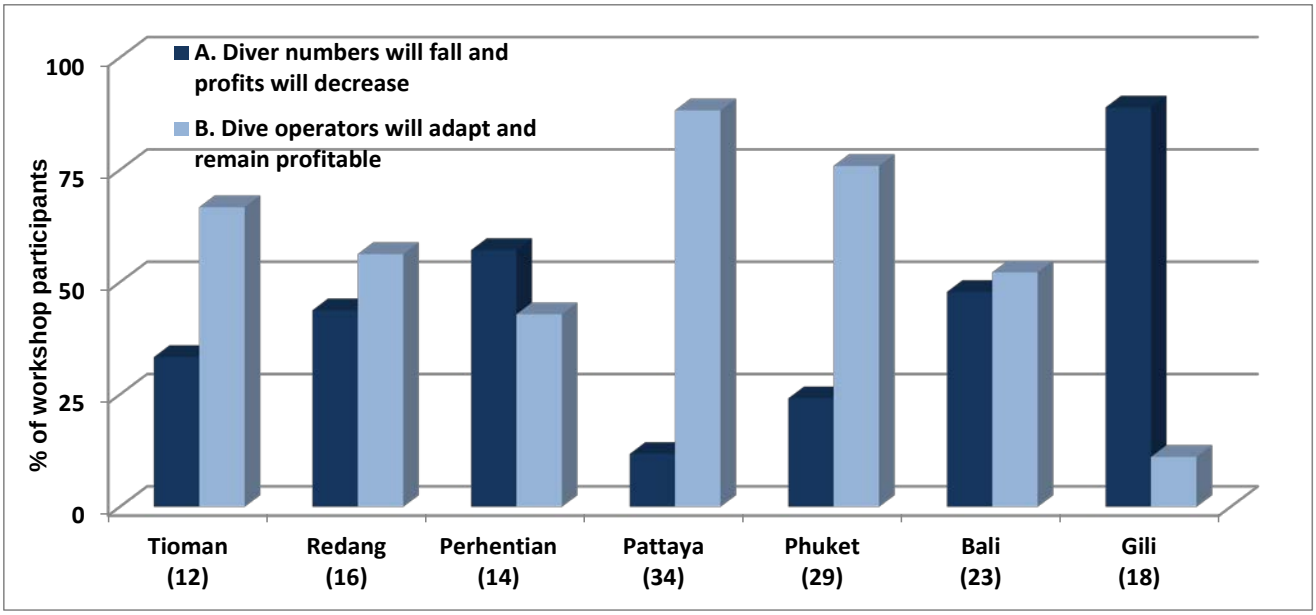


Figure 3.1 What Future? Workshop participant votes on the socio-economic impact they expected for their place if coral bleaching becomes more frequent and severe as projected.

3.3 Responsive Actions

During the afternoon session of each workshop, participants broke into small groups to discuss the question: *What actions are most important to implement during a bleaching event and to support social & ecological resilience?* The responsive actions identified in the small groups were presented, discussed, and collated into a workshop-wide list. Workshop participants were then asked to place a red sticker on the action they thought was most important to implement and a yellow sticker on the action representing their second priority. The actions from each workshop were collated into a project-wide list and prioritized. To prioritize the actions, each was allocated points on the following basis:

- 1 point for each workshop that identified the action;
- 2 points for each yellow vote the action received from any workshop participant;
- 4 points for each red vote the action received from any workshop participant.

The top ten responsive actions identified through this prioritization process are presented in Table 3.2. The top three priorities for action aimed to strengthen the governance of reef systems by improving coordination, communication, and enforcement. Management actions aimed at protecting reef ecosystems make up 50% of the list (Actions 4-6 and 8-9). Actions to sustain dive tourism businesses (Action 7) and to monitor reef condition (Action 10) were also identified.

Table 3.2 Top ten responsive actions identified by workshop participants through small group discussions and individual voting

1	Improve engagement, coordination, and communication between government, businesses, NGOs, and local communities about coral reef management issues
2	Implement education and outreach programs to raise awareness, particularly for snorkelers and divers
3	Enforce existing rules, particularly those related to marine parks and fisheries
4	Improve communication and coordination during bleaching events by developing and/or socializing Bleaching Response Plans and forming Response Committees
5	Close sites and/or reduce the number of divers at certain locations during bleaching events
6	Develop and implement codes of conduct and certification programs for divers, dive operators, snorkel guides, and tourism businesses
7	Create and use alternative dive sites, such as wrecks and artificial reefs
8	Implement restrictions other than site closures during bleaching events
9	Improve water quality
10	Implement reef monitoring by dive operators and scientists

3.4 Priority Questions

During the small group discussions, workshop participants were asked to identify the questions they had about the socio-ecological impacts of bleaching (morning session) and potential responsive actions (afternoon session). The questions identified in the small groups were presented, discussed, and collated into a workshop-wide list. Workshop participants were then asked to place a sticker on the question they most wanted answered. The questions from each workshop were collated into a project-wide list and prioritized. In order to prioritize the questions, each was allocated points on the following basis:

- 1 point for each workshop that identified the question;
- 2 points for each vote the question received from any workshop participant.

The top 20 questions identified through this prioritization process are presented in Table 3.3. Approximately 50% of these questions focus on how to design and implement management actions that can effectively support the ecological resilience of coral reefs to bleaching; roughly half of these focus on technical issues (Questions 4, 6, 8, 9, 11, and 15) and the other half on management logistics (Questions 2, 5, 8, 15, and 18). Thirty percent of the questions focus on governance issues related to roles, responsibilities, transparency, funding, and enforcement (Questions 1, 3, 7, 10, 13, and 14). The remaining 20% of the questions focus on understanding bleaching and its ecological (Questions 12, 16, 17, and 19) and social (Question 20) impacts.

Table 3.3 Top 20 questions identified by workshop participants through small group discussions and individual voting

1	How to get stakeholders engaged in the sustainable use and conservation of coral reefs?
2	How should we report bleaching, share information, and coordinate during bleaching events?
3	Who has the responsibility to implement the management actions identified at these workshops?
4	Which actions are most effective for helping reefs recover before, during, and after bleaching?
5	What kind of tourism "codes of conduct" work to improve environmental stewardship and do they require a dedicated authority to provide oversight?
6	How much area should be protected to support resilience and for how long? How much extra time to we get for investing in resilience?
7	How to get financial support to implement reef management actions?
8	How to implement site closures, including how to design, communicate, enforce them while protecting dive opertors from negative economic impacts?
9	Can restoration, transplantation, or "technical interventions" help corals resist and/or recover from bleaching?
10	What roles and responsibilities do different institutions have during bleaching events?
11	How can we reverse ecological impacts?
12	Why is the bleaching impact different between sites & depths?
13	How can we better increase transparency, reduce corruption, and improve enforcement?
14	Beyond coral bleaching, what are the broader governance arrangements for reef management?
15	What are the pros and cons of closing sites to divers and snorkelers during bleaching events?
16	What is coral bleaching and what causes it?
17	How does bleaching affect fish, fisheries, and sharks?
18	Which education and outreach strategies are most effective for raising awareness during bleaching events?
19	How much of the reef will recover from bleaching? When?
20	What are the impacts of bleaching on tourism and national & local economies?

3.5 Project Outcomes

This project conducted seven multi-stakeholder learning workshops across Malaysia, Thailand, and Indonesia to fill gaps in scientific knowledge and build capacity for supporting social and ecological resilience to future bleaching events; the project's objectives were to:

1. Raise awareness about the impacts of mass bleaching and climate change on coral reef ecosystems, reef-dependent tourism operators, and national economies;
2. Strengthen interactions among scientists, government decision-makers, and reef-dependent tourism operators to facilitate improved decision-making processes at local to national levels;
3. Provide scientific input on bleaching responses that support social, economic, and ecological resilience;
4. Identify the content for dive operator training materials that will be incorporated into on-going training programs and operator networks; and
5. Strengthen science-policy links and building scientific capacity by collaboratively developing questions & methodologies for future research.

In addition to achieving its stated objectives, discussed in the sections that follow, the project also performed well in leveraging APN's US$44,000 investment. The proposal originally submitted to APN estimated a US$158,000 leverage; the actual leverage was $180,000; details of the partners and their contributions are provide in Appendix E.

3.5.1 Objective 1: Raising awareness across the region about the impacts of mass bleaching and climate change on coral reef ecosystems, reef-dependent tourism operators, and national economies

The project aimed to achieve its first objective by presenting scientific findings about the ecological, social, and economic impacts of the 2010 bleaching event; discussing these impacts with different stakeholder groups; and engaging the media (Box 3.1). The results of the morning sessions of each workshop, presented in Section 3.1, are evidence that this objective was achieved. Further evidence as to the extent to which Objective 1 was achieved through the project comes from the results of the workshop evaluation survey, which asked participants to answer a series of questions before the workshop started and again after the workshop concluded (Appendix D). Of the 167 workshop participants, 125 completed the survey, yielding an impressive 75% response rate (Figure 3.2).

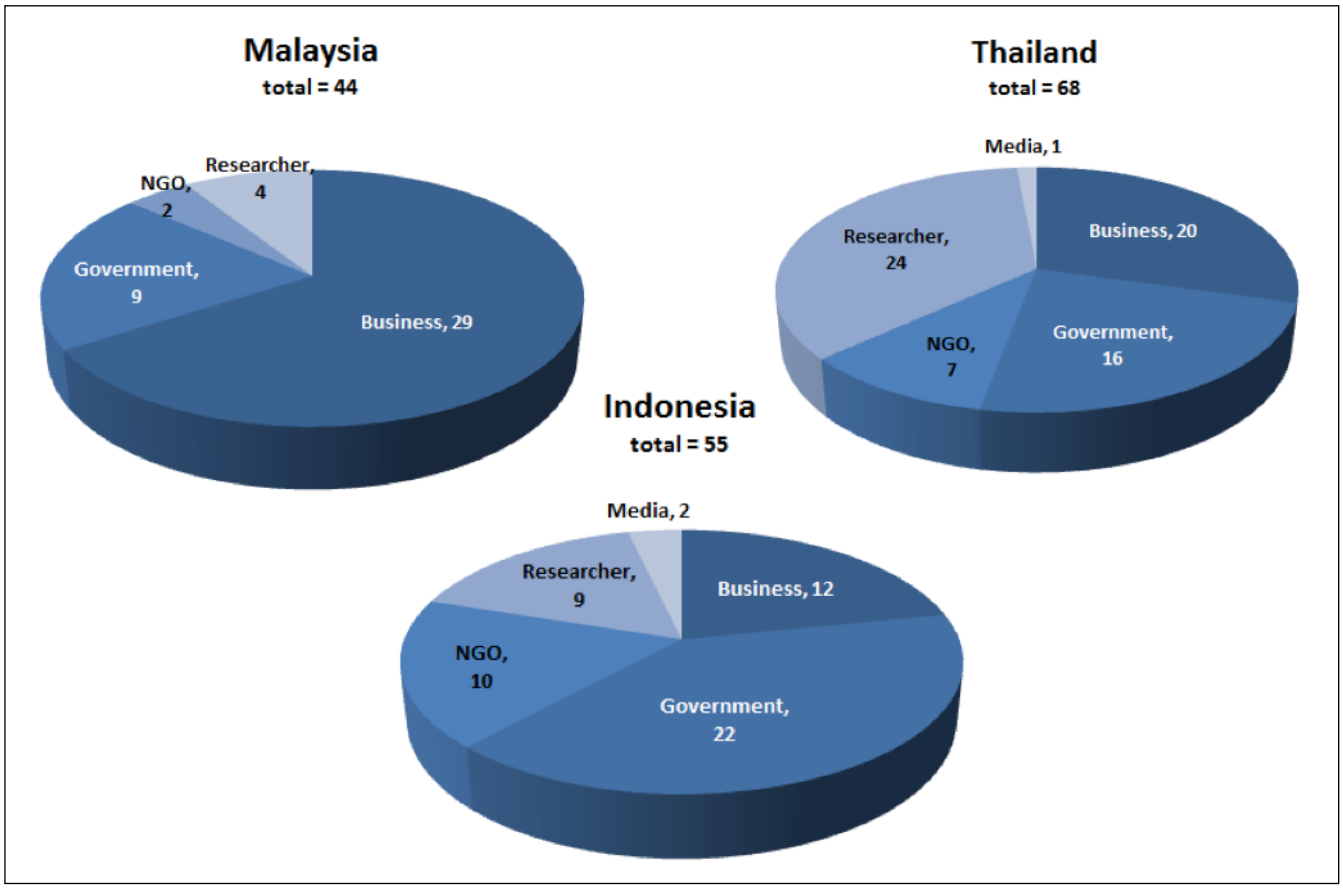


Figure 3.2 Composition of the 167 participants engaged in the seven multi-stakeholder workshops

Box 3.1 The workshops received media coverage from major news sources in each country.

Malaysia: http://www.fz.com/content/keeping-coral-bleaching-bay

Thailand: http://www.thephuketnews.com/phuket-hosts-workshop-on-understanding-and-strengthening-resilience-to-coral-bleaching-events-42387.php

Indonesia: http://www.thejakartapost.com/bali-daily/2013-10-19/scientists-diving-industry-join-hands-recover-ri-s-coral-reefs.html

Indonesia: http://www.thejakartapost.com/news/2013/10/19/scientistsdivingindustryrecoverriscoralreefs.html

Indonesia: Radio Republic Indonesia (link not available)

The first section of the Workshop Evaluation Survey asked participants to rate the extent to which climate change and coral bleaching were damaging to the condition of coral reef ecosystems. Relatively few individuals believed that climate change was not very damaging before the workshop, and even fewer afterward (Figure 3.3). Overall, the mean participant ratings of damage increased from 4.70 to 4.93, while the median scores increased from 5 to 6. While there is a strong trend in the data towards climate change being considered extremely damaging, a number of individuals in the Malaysian workshops indicated that they believed climate change was less damaging after the workshops than before. The most likely explanation for this result is that the acute economic impacts to dive operators during the 2010 beaching event were minor, as supported by both the data collected during the 2010 event and group discussions at the workshops. Thus, if some Malaysian businesses did not recognize the longer-term impacts of more frequent bleaching on overall coral reef condition, they may have taken the 2010 bleaching experience as indicative of the future ecological and economic impacts from bleaching, potentially alleviating their concerns. It is also possible that these individuals were confused by the scoring system; however, any confusion would be expected to also affect their responses to other questions, and this was not seen in the data.

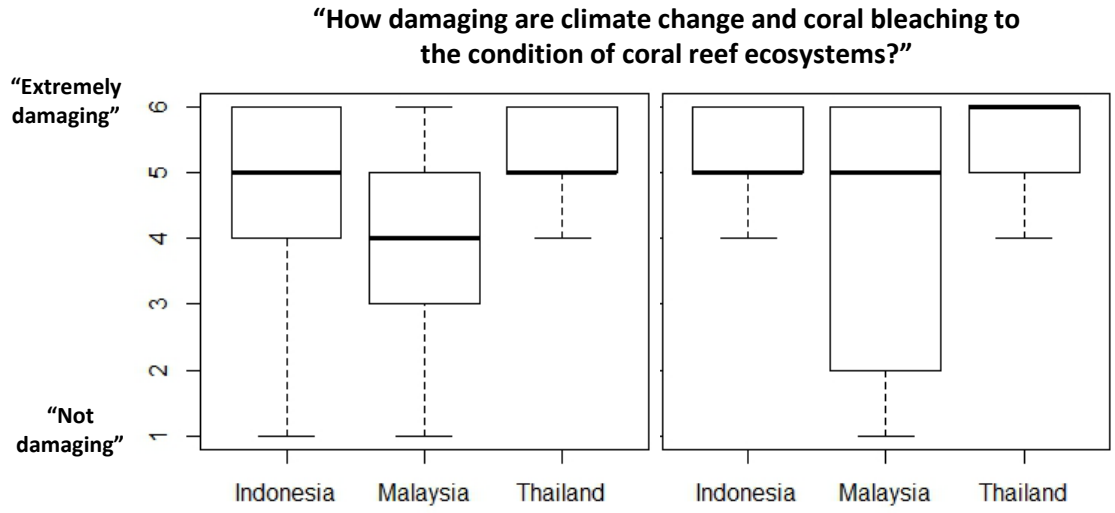


Figure 3.3. Participant perceptions of the extent to which climate change and coral bleaching are damaging to coral reef ecosystem condition before (left) and after (right) the workshops. The dark line depicts the median score, while the box depicts the upper (75%) and lower (25%) quartiles; the dashed lines show the 90% confidence limit.

The second part of the Workshop Evaluation Survey asked participants to rate their agreement with three statements about the impacts of climate change and coral bleaching events on reefs and reef-dependent industries, and with four statements about the efficacy and potential side effects of responsive management actions. Changes in participant perceptions before and after the workshop were analyzed using non-parametric statistics; negatively worded statements were reversed prior to analysis so that higher scores indicate greater concern about impacts or greater support for reef management (Table 3.4). The survey results show that participants arrived at the workshops believing climate change and coral bleaching were problems for coral reef ecosystems, and their participation in the workshops confirmed those beliefs. However, while respondents recognize climate and bleaching as threats to reefs, they do not see these global threats as more concerning than proximate threats from fishing and water quality; this result is consistent with scientific information shared at the workshops that the best way to support reef resilience to climate change is through good management of local stressors.

Participant support for management action was greater for awareness-raising actions (Management Questions 2 and 4) than for actions to close areas to divers during bleaching events (Management Questions 1 and 3). Participants agreed that bleaching events were good opportunities to raise awareness. In Indonesia, participant agreement that it was better to tell people about coral bleaching events increased after the workshop at a level that was statistically significant (Management Question 2). Workshop participants were largely neutral about both whether closures would help reefs survive bleaching events and whether closures would negatively affect operator businesses. Across all three countries, participants were more likely to agree that closures could be beneficial for reefs after the workshops (Management Question 1), however, these changes did not reach statistical significance in any of the study countries.

Table 3.4 Comparison by country of workshop participant ratings on 7 statements related to climate change impacts and responsive management actions before and after the workshops. Negatively worded statements were reversed; ratings were made on a 6-point scale where 1 = "Strongly Disagree" and 6 = "Strongly Agree."

			Malaysia		Thailand		Indonesia	
			n=36		*n=55*		*n=34*	
Problem Awareness Questions			mean	median	mean	median	mean	median
1	Climate change is likely to damage coral reef ecosystems	before	4.94	5.00	5.35	6.00	4.94	6.00
		after	4.89	5.00	5.35	6.00	4.88	6.00
2	Coral bleaching is a big problem for coral reefs	before	5.05	6.00	5.07	6.00	5.26	6.00
		after	4.69	6.00	5.25	6.00	4.59	5.00
3	Compared to other issues facing dive tourism operators, climate change is a big deal	before	4.05	4.00	4.42	4.00	4.17	4.00
		after	4.40	5.00	4.35	4.00	4.39	4.00
Support for Management Questions								
1	Closing some areas to tourists during coral bleaching events will help reefs survive	before	4.03	4.00	4.65	5.00	3.90	4.50
		after	4.47	5.00	4.89	5.00	4.38	5.00
2	To protect dive tourism businesses, it is better to tell people about coral bleaching events	before	5.05	5.00	5.64	6.00	4.18	4.50
		after	5.11	5.00	5.58	6.00	5.33	6.00*
3	Closing some reef areas to tourists to protect coral condition will not hurt dive tourism businesses	before	4.13	4.00	4.62	5.00	4.13	4.00
		after	4.03	5.00	4.55	5.00	4.06	4.00
4	Coral bleaching events are good opportunities for raising diver awareness about climate change	before	5.13	5.00	5.11	5.00	4.88	5.00
		after	5.03	5.50	5.16	5.00	5.06	5.00

* indicates a statistically significant change at the 0.05-level

The last rating question in the Workshop Evaluation Survey asked participants to evaluate whether they felt more able to respond to bleaching events after the workshop. The survey results suggest

that the workshops were successful in building stakeholder confidence for responding to future bleaching events (Figure 3.4).

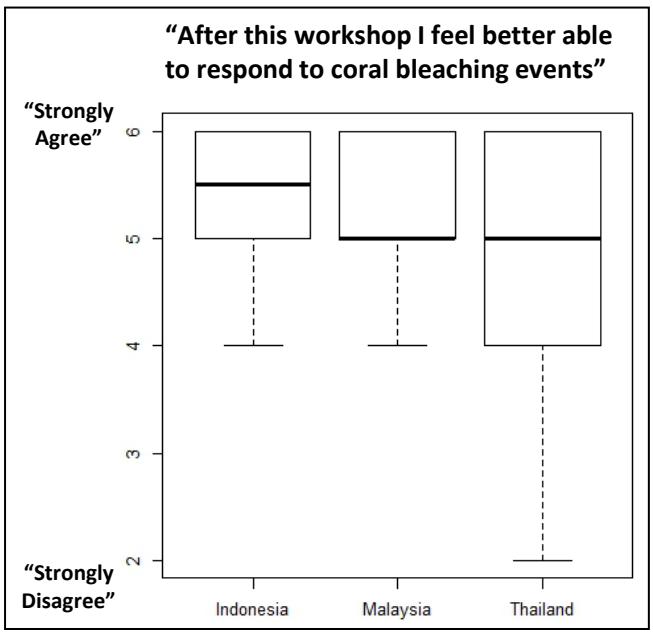


Figure 3.4 Participant agreement with the statement, "after this workshop, I feel better able to respond to coral bleaching events"

3.5.2 Objective 2: Strengthen interactions among scientists, government decision-makers, and reef-dependent tourism operators to facilitate improved decision-making processes at local to national levels

The logic model for this project is predicated on an assumption that better relationships between government, business, and other stakeholders will improve responses to coral bleaching and climate change. Discussions at the workshops and the Workshop Evaluation Survey support this assumption and indicate that the workshops contributed toward strengthening stakeholder interactions.

The first way the workshops strengthened stakeholder interactions was through their invitation lists and their structure. Workshop participants represented a variety of stakeholder groups, including marine park managers, national and local government officials, dive operators, conservation NGOs, local academics, resort operators, fishers, and the media (Figure 3.2). The workshop agenda alternated formal presentations with small group discussions and whole of workshop synthesis exercises (Appendix B). Evidence that workshop participants enjoyed and benefitted from these interactions is both anecdotal (Box 3.2) and evident in the workshop evaluation. The Workshop Evaluation Survey included an open-ended question asking participants, "What did you like best about the workshop?" Of the 52 responses offered, 36% referred to interacting with other stakeholders, sharing information, or the small group discussions (Figure 3.5).

The efficacy of the project's logic model was also supported by the workshop discussions. The afternoon discussions on actions that could be taken in response to climate change and coral bleaching heavily emphasized the need for better stakeholder coordination, which requires active and collegial stakeholder relationships. Actions were identified through small group discussions and prioritized through a participant voting exercise (Section 3.3). Based on this process, the highest priority responsive action identified by workshop participants was, "Improve engagement, coordination, and communication between government, businesses, NGOs, and local communities

about coral reef management issues." Their fourth priority for action also emphasized effective stakeholder interactions and coordination: "Improve communication and coordination during bleaching events by developing and/or socializing Bleaching Response Plans and forming Response Committees."

Quantitative data from the Workshop Evaluation Survey are consistent with the qualitative findings that emerged from the workshops. In general, workshop participants did not agree that government, business, and NGO stakeholders had similar ideas about how to respond to bleaching events, nor were good at cooperating in making such decisions (Table 3.5); participants were somewhat more confident in the ability of government and business to work together in responding to bleaching (Stakeholder Cooperation Question 1). The workshops did not necessarily increase participant confidence in the ability of different stakeholders to work together in responding to bleaching, and in some cases participant ratings of stakeholder cooperation are lower after the workshops than before, although none of these changes are statistically significant. This result may have occurred because the workshop discussions brought to light differences in opinion about what responsive actions should be taken; in these cases, we view the workshops' role in identifying the issues that are impeding good cooperation and coordination as a positive step toward improving these essential processes. In other cases, participant evaluations suggested improvements in stakeholder cooperation after the workshops, and in Indonesia this improvement in participant ratings was statistically significant (Stakeholder Cooperation Question 3).

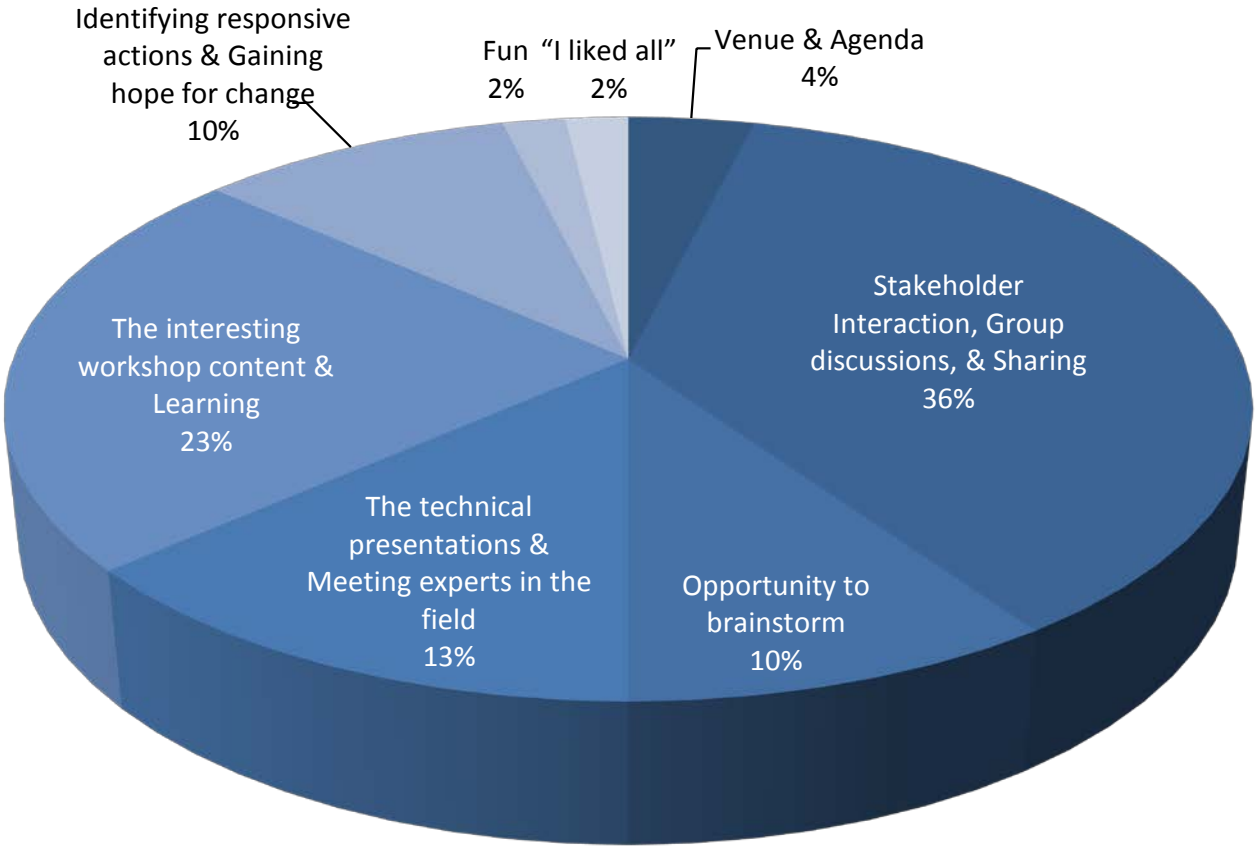


Figure 3.5 Participant responses to the open-ended workshop evaluation question: *What did you like best about the workshop?*

Overall, the workshops identified the need for improved stakeholder engagement, coordination, and communication as a key strategy for supporting the social and ecological resilience of coral reef ecosystems to climate change. Further they brought together key leaders in government, business, research, and the NGO communities to initiate and deepen this process. Workshop evaluation comments indicate that the workshops were positive in fostering relationships and that participants enjoyed the discussions with their colleagues.

Box 3.2 Anecdotal evidence supported the workshops' effectiveness in strengthening stakeholder interactions, such as this example from Pattaya, Thailand.

Participants at the workshop in Pattaya, Thailand felt that bringing together stakeholders from the government, industry, research, and NGO communities was valuable enough to be repeated. Toward the end of the workshop, participants from the non-governmental organization, Dive Tribe – Thailand, offered to host a similar workshop next year, and subsequently made the post below on their Facebook page.

Table 3.5 Comparison by country of workshop participant ratings on 4 statements related to stakeholder cooperation in responding to bleaching before and after the workshops. Negatively worded statements were reversed; ratings were made on a 6-point scale where 1 = "Strongly Disagree" and 6 = "Strongly Agree."

			Malaysia		Thailand		Indonesia	
			n=36		*n=55*		*n=34*	
Stakeholder Cooperation Questions			mean	median	mean	median	mean	median
1	The government and business operators can work well together to respond to bleaching events	*before*	5.13	6.00	4.50	4.50	5.21	6.00
		after	4.83	6.00	4.63	5.00	4.91	6.00
2	There is agreement between business operators, the government, and NGOs on how to respond to bleaching events	*before*	3.79	4.00	3.70	4.00	5.21	6.00
		after	3.67	3.00	3.75	4.00	4.53	5.00
3	The government, business operators, and NGOs have the same ideas about the best way to respond to bleaching events	*before*	2.54	2.00	2.96	3.00	2.67	3.00
		after	2.51	2.00	3.19	3.00	3.58	3.00*
4	In our area there is good cooperation between the government, businesses, and NGOs in making decisions about how to respond to bleaching events	*before*	2.62	2.00	3.17	3.00	3.16	3.00
		after	3.15	3.00	3.06	3.00	2.72	3.00
* indicates a statistically significant change at the 0.05-level								

3.5.3 Objective 3: Providing scientific input on bleaching responses that support social, economic, and ecological resilience

The project's third objective was met through three presentations given at the beginning of each workshop's afternoon session: one on bleaching response plans, one on supporting long-term ecological resilience, and one on supporting long-term socio-economic resilience. Evidence that the scientific information shared as part of this objective was well received by workshop participants is evident in the workshop discussions and evaluations. The detail and sophistication of the workshop discussions on responsive actions and key questions (Sections 3.3 and 3.4) illustrate that these technical presentations were understood and that participants were interested in engaging with the ideas presented. Additionally, participant responses to the open-ended evaluation question, "what did you like best about the workshop?" highlighted the technical presentations (13% of the responses offered), the information discussed (23%), and the focus on responsive actions (10%), together constituting over 45% of the responses offered (Figure 3.5).

3.5.4 Objective 4: Identifying the content for dive operator training materials that will be incorporated into on-going training programs and operator networks

The need for a training program for dive operators and other reef-dependent tourism industries was reinforced throughout the workshop discussions. The workshop sessions on bleaching impacts identified that dive operators did not understand what was happening or what to do. The sessions on responsive actions prioritized, "implement education and outreach programs" as action 2 of 24 and "Train/build capacity for dive operators" as action 18 of 24.

The multi-country project team has developed the content for dive operator training materials based on the issues and questions raised during the workshops (Appendix F). This annotated outline will become the basis for additional funding proposals to work with professional curriculum developers and a steering committee of dive operators in order to develop a high-quality training program. The training program will be incorporated into on-going work with the dive communities in the study countries through project partners Coral-Indonesia, Reef Check-Malaysia, Reef Check-Indonesia, and WWF-Thailand.

3.5.5 Objective 5: Strengthening science-policy links and building scientific capacity by collaboratively developing questions & methodologies for future research.

The interactions with workshop participants inspired project team members to identify research questions and methods that address the key issues and questions raised during the workshops, as envisioned in Objective five. The research concepts identified are discussed further in Section 5 and reflect the multi-disciplinary expertise of the team's members and the team's continued interest in comparative research between the three study countries. Team members have already held meetings with potential funders to initiate some of the research identified.

4 Conclusions

The workshops conducted with funding from APN and contributions from over 15 partner organizations were effective in achieving their objectives (Section 3), and were enjoyed by workshop participants (Figure 4.1). They helped fill scientific gaps in understanding the main social impacts of bleaching, identified responsive actions, and prioritized questions for future collaborative research (Section 3); these results have formed the basis for training materials that will be developed for dive operators (Appendix F). Perhaps most importantly, the workshops have forged relationships across stakeholders, disciplines, and countries for effectively responding to future coral bleaching events. The project's implementing partners look forward to building on these accomplishments through scientific publications and future research proposals.

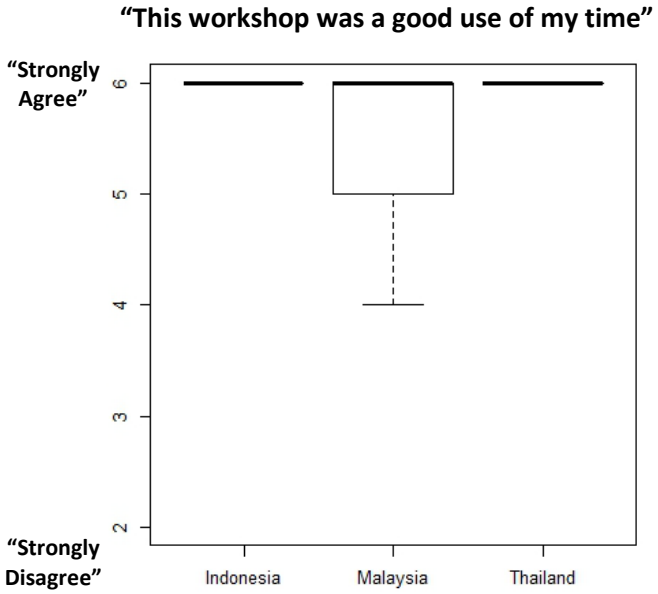


Figure 4.1 Participant agreement with the statement, "This workshop was a good use of my time."

5 Future Directions

Box 5.1 Ideas for future research developed during the workshops

Interdisciplinary

Understanding and strengthening the social-ecological resilience of dive destinations to climate change; in-depth case studies in each country
Evaluate the ecological and economic fisheries impacts form coral bleaching, and how they may be improved or exacerbated by various management responses
The ecological, economic, and social impacts of snorkeling on coral reef condition and resilience
The ecological, economic, and social impacts of displacement to Tioman resulting from the high management fee in Johor.

Ecological

Evaluating methods to support ecological resilience
Assessing the impacts of divers and snorkelers on reef condition & resilience
Assessing the effectiveness of education in reducing diver damage
Assessing the effectiveness of effectiveness of closures during coral bleaching events on promoting coral survival and reef recovery (including considerations of displacement impacts)
Assessing the effectiveness of measures to improve or maintain water quality
Evaluating the effectiveness of measures to maintain or increase herbivorous fish and biodiversity
Evaluating the effectiveness of reef restoration methods
Resilient site mapping to optimize management options

Economic

Develop protocols for measuring the economic impacts of bleaching
Economic analysis of strategies for income diversification and benefits-sharing

Social/Governance

Understanding barriers to effective coral reef governance
Action research to support social learning and collaborative action among NGOs, government, and the dive industry
Comparison of different certification schemes: level of requirement, pros and cons and optimal option for business engagement to help build reef resilience (waste water, waste management, education program etc.)

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3. Burke L, Reytar K, Spalding M and Perry A (2011) Reefs at Risk Revisited. Washington, DC, USA: World Resources Institute: www.wri.org/reefs.
4. Doshi A, Pascoe S, Thébaud O, Thomas CR, Setiasih N, Tan CH, et al. (2012). Loss of economic value from coral bleaching in S.E. Asia. *12th International Coral Reef Symposium, Cairns, July 2012*, *ICRS2012_22D_1.*
5. Marshall, P.M. and H.Z. Schuttenberg, 2006. *A Reef Manager's Guide to Coral Bleaching*. Great Barrier Reef Marine Park Authority. Townsville, 165pp.
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Appendix A. Agendas for Regional Collaboration Meetings

Pre-meeting Agenda - 6 October 2013, Tioman Island, Malaysia

Participating Team Members: James Tan, Sean Pascoe, Heidi Schuttenberg, Scott Heron, Emma Calgaro, Alvin Chelliah, Edmund Chai, James True, Julian Hyde, Naneng Setiasih, Petch Manopawitr

Part 1 – Orienting toward shared goals

9:00 Welcome Ole: Scott
9:05 Ice-breaker: Naneng
9:15 History & Goals of the Project:
Overview presentation: Heidi
Discussion: all

Part 2.A – Effective Workshop Delivery: Agenda

9:45 Agenda for Malaysia workshops, including team member roles
10:00 Dealing with different languages
10:15 Agenda variations for Thailand and Indonesia

10:30 Coffee Break

Part 2.B – Effective Workshop Delivery: Presentations

11:00 Bleaching overview & ecological impacts: Scott and ecologists
11:30 Morning social presentations: Heidi, Sean, Emma
12:00 Afternoon presentation on response/resilience: Heidi, Petch, Emma, Scott, Naneng

12:30 Lunch

Part 2.C – Effective Workshop Delivery: Outcomes & Facilitation

1:30 Facilitation outcomes & strategies
2:00 Facilitation practice 1 – Edmund & Alvin to facilitate two problem groups
2:15 Facilitation practice 2 – James Tan & Emma to facilitate two problem groups

2:30 Coffee

Part 2.D – Effective Workshop Delivery: Communication, Evaluation/Reporting & Admin

3:00 Communication strategies: press, "situation reports," Facebook, other?
3:30 Evaluation (Heidi/Emma/Edmund)
3:40 Project reporting (Heidi/Sean/Scott)
3:50 Financial management & reporting (Sean)

Part 3 – Project Outputs & Outcomes

4:00 Dive Operator Training Materials (Naneng, Petch, Julian to lead during post-meeting session)
4:20 Publications (Heidi to lead during post-meeting session)
4:40 Future Collaborations & Phase 3 (Scott to lead during post-meeting session)

Post-meeting Agenda - 19 October 2013, Bali, Indonesia

Participating Team Members: James Tan, Heidi Schuttenberg, Scott Heron, Emma Calgaro, Alvin Chelliah, James True, Julian Hyde, Naneng Setiasih, Petch Manopawitr, Derta Purwita, Amar Doshi, and Sue Chen

Part 1 – Reflections

9:00 Welcome Ole & video: Scott
9:10 Ice-breaker: Naneng
9:20 Goals & agenda for the post-meeting – Heidi
9:25 Reflection: all – Julian & Sue to facilitate
9:45 Evaluation results – Amar to present

10:00 Part 2 – Preliminary Findings

10:00 Key Impacts from 2010 – preliminary analysis of workshop results – Emma & Scott

10:20 Coffee

10:30 Responsive Actions – preliminary analysis of workshop results – Heidi & James

11 to 12:30 Part 2 - Dive Operator Training Materials – led by Training Team: Julian/Alvin/Sue, Naneng, Petch, Heidi

- Content for training materials
- Next steps: Proposal for training material development, potential funders, etc.

12:30 Lunch

1:30 to 2:45 Part 3 – Publications, Reporting & Admin – Heidi to facilitate

- Project report: outline, writing assignments, and deadlines
- Publications: manuscripts, writing teams, and deadlines
- Receipts & other financial matters

2:45 Coffee

3:15 to 4:30 Part 4 – Project Phase 3: Future Collaborations – Heidi & Scott

- Topics/focus for future collaborations
- Potential partners
- Funding opportunities
- Next steps

4:30 Until next time – James True to lead closing exercise

Appendix B. Example Agenda for Multi-stakeholder Workshop

AGENDA: A Workshop on Understanding & Strengthening Resilience to Coral Bleaching Events

Friday, 9th October 2013 - National Marine Parks Office, Perhentian Island, Malaysia

Workshop Goals:

1. Learn from the 2010 coral bleaching event
2. Identify and prioritize options for building social & ecological resilience to future bleaching events
3. Identify and prioritize questions for future research about the impacts of bleaching and potential responsive actions

8:30 Registration of participants

8:45 Introductions

- Workshop facilitators and participants
- Workshop Goals

9:15 Impacts of the 2010 bleaching event

- Heat stress & climate impacts on coral reef ecosystems – Scott Heron
- Ecological impacts: locally & regionally – James Tan

9:40 Introductions to the small group discussions

9:45 Coffee Break

10:00 Small Group Work

- *Discussion Questions*: How did you experience the 2010 bleaching event? What impacts were most important? Why? What questions did you have about the event or its impacts? Which questions are most important?
- *Expected Outputs for each group*: 1) prioritized list of impacts; 2) prioritized list of questions

11:00 Group report – small group representatives will summarize discussions

11:25 Impacts of the 2010 bleaching event

- Impacts to tourist diver experiences – Heidi Schuttenberg
- Economic impacts – Sean Pascoe

11:40 Morning Synthesis

- Whole group discussion to identify cross-cutting experiences, developing a shared list of the major issues and impacts.
- *Expected Outputs for each group*: 1) prioritized list of impacts; 2) prioritized list of questions

12:00 Photo opportunity and lunch

12:45 Strategies for Supporting Social & Ecological Resilience

- Supporting reef resilience to bleaching & climate change – Heidi Schuttenberg
- Supporting social resilience to bleaching & climate change – Emma Calgaro
- Malaysia's Bleaching Response Plan – Alvin Chelliah

1:25 Introductions to the small group discussions

1:30 Small Group Work

- *Discussion Questions*: What actions are most important to implement during a bleaching event to support social & ecological resilience? Why? What barriers exist to implementing these actions? How should these actions be implemented and by whom? What questions do you have about actions that could be taken during bleaching events to support resilience?
- *Expected Outputs for each group*: 1) prioritized list of actions; 2) prioritized list of questions; 3) for top 3-5 actions, identification of key barriers and who should take action

2:30 Coffee break

2:50 Group report – small group representatives will summarize discussions

3:20 Whole group discussion – The group discussion with confirm cross-cutting ideas and prioritizing a list of actions that could be implemented during future bleaching events.

3:45 Closing

Appendix C. Multi-stakeholder Workshop Participants

No	Workshop	Name	Organization
Malaysia			
1	Tioman	Izarenah Md Repin	Department of Marine Park Malaysia (DMPM)
2	Tioman	Faedzul Rahman Rosman	Malaysian Nature Society
3	Tioman	Kee Alfian Abdul Adzis	National University of Malaysia
4	Tioman	Shahabudin Hamdi	DMPM
5	Tioman	Rosie Cotton	Tioman Dive Centre
6	Tioman	James Wilkinson	Tioman Dive Centre
7	Tioman	Mat Kadri	Berjaya Tioman Dive Centre
8	Tioman	Nic Emery	B&J Diving
9	Tioman	James Learwood	B&J Diving
10	Tioman	Reynolds Estera	Ray Dive
11	Tioman	Zainal Rahman	B&J Diving
12	Redang	Knev Lim	Laguna Redang Island Resort
13	Redang	Marina William	Redang Bay Resort
14	Redang	Jusleey Agong	Redang BayResort
15	Redang	Brent John Bautista	Laguna Redang Island Resort
16	Redang	Raymond Cheah	Sari Pacifica Resort and Spa. Redang
17	Redang	Liew Hock Chark	Universiti Malaysia Terengganu
18	Redang	Albert Appolo Chan	DMPM
19	Redang	Marvin Chiah	Coral Redang Island Resort
20	Redang	Kenny Wong	Coral Redang Island Resort
21	Redang	Bahari	The Taras Beach and Spa Resort
22	Redang	Syarifuddin Mohamad	The Taras Beach and Spa Resort
23	Redang	Toh Kam Seng	The Taras Beach and Spa Resort
24	Redang	Teng Jan Shir	Pelangi Resort
25	Redang	Ellie Moey	Pelangi Resort
26	Redang	Azizul Fariha	DMPM
27	Redang	Maznah Yusoph	DMPM
28	Redang	Safaiz	DMPM
29	Perhentian	Choo Poh Leem	World Wildlife Fund for Nature
30	Perhentian	Md Nizam Ismail	DMPM
31	Perhentian	Gazi Md Nurul Islam	Universiti Putra Malaysia
32	Perhentian	Long She Ling	Ecoteer
33	Perhentian	Ronnie Ng Chee Yeong	Bubbles Dive Resort
34	Perhentian	Gan Siew Ban	Bubbles Dive Resort
35	Perhentian	Saipullah B Jamaludin	DMPM
36	Perhentian	Affendi Yang Amri	University of Malaya
37	Perhentian	Lee Kang Ee	Quiver Dive Team
38	Perhentian	Azwan Che Husin	Turtle Bay Divers
39	Perhentian	Wan Mohd Hafaal	Turtle Bay Divers
40	Perhentian	Lau Wei Zhi	Seahorse Divers
41	Perhentian	Soh Chee Kiat	Watercolours Resort

42	Perhentian	Charlotte Anne Cheong	Universal Divers
43	Perhentian	Wan Azli Wan Yusoff	DMPM
44	Perhentian	Zulkifli Mat Nor	Bubu Resort

Thailand			
45	Pattaya	Wayne Phillips	Mahidol University International College
46	Pattaya	Gwyn mills	Dive Tribe
47	Pattaya	kanjana Srinapa	Happydivenet
48	Pattaya	David Smith	Bangkok Scuba Divers
49	Pattaya	Kitithorn Sanpanich	Institute of Marine Science, Burapha University
50	Pattaya	Suchai Worachananant	Kasetsart University
51	Pattaya	Nengnoy Yossundara	Save Our Sea (SOS)
52	Pattaya	teerayut tunteeraponchai	rayong office of natural resources and environment
53	Pattaya	Supawat Kanatireklap	Department of Marine and Coastal Resources
54	Pattaya	Wichin Suebpala	Ramkhamhaeng University
55	Pattaya	Anchalee Chankong	Marine and Coastal Resourses Research Center (Rayong)
56	Pattaya	Orn-anong Bundit	DMCR
57	Pattaya	chainarong Rungthong	Research Center of Department of National Park
58	Pattaya	Nisit Ruengsawang	Rajamangala University of Technology Krungthep
59	Pattaya	Tawin Kim	MUIC/Dive Tribe
60	Pattaya	Mark Warren	Dive Tribe
61	Pattaya	Narinratana Kongjandtre	Burapha University
62	Pattaya	Pasinee Worachananant	Kasetsart University
63	Pattaya	Laird Allan	Mahidol University
64	Pattaya	Suchana Apple Chavanich	Chulalongkorn University
65	Pattaya	Ronawon Boonprakob	DMCR
66	Pattaya	Arnupap Panichpol	Chulalongkorn University
67	Pattaya	Somyos Yossundara	Save Our Sea (SOS)
68	Pattaya	Paige Prescott	Ruamrudee International School
69	Pattaya	Aiwa Pooamorn	MUIC/Dive Tribe
70	Pattaya	Bob robinson	dive tribe
71	Pattaya	Wunvisa Indprapal	Research Center of Department of National Park
72	Pattaya	Jamrearn buaruang	Ramkhamhaeng University
73	Pattaya	Voranop Viyalkarn	Chulalongkorn University
74	Pattaya	Phiraphat Boonpetch	Rayong Dive Center
75	Pattaya	Bamroongsak Chatananthawej	Marine and Coastal Resourses Research Center (Rayong)
76	Pattaya	Chuntapak Kantawang	Trad Provincial office of natural resources and environment
77	Pattaya	Kristan Hart	Ramkhamhaeng University
78	Pattaya	Weera Thongparai	Chonburi Provincial Office of Natural Resources & Environment
79	Pattaya	Jaturong Boontharam	Rayong Dive Center
80	Phuket	Liz Ward-Sing	Shark Guardian
81	Phuket	Catherine Dietschi	Sea Bees diving

82	Phuket	Jirapong Jeewarongkakul	Reef management co.ltd.Owner
83	Phuket	Prarop Plangngan	Phuket marine national park protected areas innovation center
84	Phuket	John Roberts	Anantara
85	Phuket	Wichin Suebpala	Ramkhamhaeng University
86	Phuket	Brendon Sing	Shark Guardian
87	Phuket	Kristan Hart	International Coastal Network
88	Phuket	Paul Chamniern	IUCN
89	Phuket	Kanokwan Homcha-aim	SEEK Phuket
90	Phuket	Nok Malaidang	Phuket marine national park protected areas innovation center
91	Phuket	Nalinee Thongtham	PMBC
92	Phuket	Phongtheera Buapet	PSU Phuket
93	Phuket	Petchrung Sukpong	Green Fins-thailand
94	Phuket	Werachart Pengchumrus	PMBC
95	Phuket	Joseph Blasy	Sea Bees diving/Go Eco Phuket
96	Phuket	Pinsak Suraswadi	DMCR
97	Phuket	Krongkaew Soo-ampon	SAMPAN Project
98	Phuket	Hansa Chansang	PMBC
99	Phuket	THANONGSAK	CHANMETHAKUL
100	Phuket	Matt O'Connor	Scuba Ninjas
101	Phuket	Nick Anthony	SEEK Phuket
102	Phuket	Niphon Phongsuwan	PMBC
103	Phuket	Wolfgang Sauerhammer	Paradise Diving Asia
104	Phuket	Mike crwashaw	green fin
105	Phuket	Andrew Hewett	The Adventure Club
106	Phuket	Suwat Murngdee	Similan National Park
107	Phuket	Tipamat Upanoi	PMBC
108	Phuket	Kittipan Sabkhoon	Maikhao Marine turtle Foundation
109	Phuket	Onanong Cheablam	Walailak University
110	Phuket	Saranu Pin,jaroen	Go Andamun
111	Phuket	Supaporn buaniam	Phuket Marine nationalpark proteced areas innovation center
112	Phuket	Kanyapoj Chaiprapan	Class Act Media Co., Ltd.
Indonesia			
113	Bali	I Wayan Parsa	Dsbudpar Kabupaten Karangasem
114	Bali	I Ketut Jati	Eco Dive Amed
115	Bali	Nikka Amandra G	CI Indonesia
116	Bali	Dondy Rafianto	ADS-I Indonesia
117	Bali	Desy Nurhayati	The Jakarta Post
118	Bali	Reinier Vos	Jukung Dive
119	Bali	Muliarta	KBR
120	Bali	Andi Afriandi	Yayasan Reef Check Indonesia
121	Bali	I Putu Eka Suyasa	DPKP Kabupaten Karangasem
122	Bali	IW Arthana	FKP - UNUD
123	Bali	Nyoman Sugiarta	Bahari Prawara LMMAS Tejakula

124	Bali	Riyan Heri	BIDP
125	Bali	Aulia Seto	UNDIP
126	Bali	Gunadika	Disparda Bali
127	Bali	I Gede Astika	Mimpi Resort Menjangan
128	Bali	I Nengah Sukarya	Mimpi Resort Tulamben
129	Bali	Rizya L Ardiwijaya	TNC
130	Bali	Ikram	BPSPL
131	Bali	Jaya Ratha	CI Indonesia
132	Bali	Nixon R	Universitas Nusa Cendana - NTT
133	Bali	Nuryani Widagti	BPOL - KKP
134	Bali	A. Manaf	Dinas Perikanan dan Kelautan Kab. Buleleng
135	Bali	Astari	DKP Bali
136	Bali	Omega Raya S	IPB
137	Bali	Retno Nuraini	Yayasan Reef Check Indonesia
138	Bali	Gayatri	Yayasan LINI
139	Bali	Deny S Yusup	Biologi UNUD
140	Bali	Veronica Niken	CORAL
141	Bali	Yoga Ibnu Graha	BPSPL
142	Bali	Intan Enditya	BPSPL
143	Bali	Made Tri FY	BPSPL
144	Bali	Hendra N	BPSPL
145	Gili	Yuonne Bgstrom	Big Bubble Dive
146	Gili	H. Lukman	Kadus Gili Trawangan (Head of Sub-village)
147	Gili	Yudiarso Permana	BPSPL
148	Gili	Malik	Blue Marlin Dive
149	Gili	Satiman Bakti	KLH
150	Gili	Musa	KLH-KLU
151	Gili	Martanina	BKKPN Kupang
152	Gili	Hotmariyah	BKKPN Kupang
153	Gili	Abdul Wahab	UPT LPBIL - LIPI
154	Gili	Anhar	UPT LPB - LIPI
155	Gili	Supardi	Perikanan
156	Gili	Hannaning	Disperhubkominfo
157	Gili	Sulmanal Farzi Ali	Blue Marlin Dive - Gili Meno
158	Gili	Sander Buis	Oceans5
159	Gili	Ata	Gili Cares
160	Gili	Sabil	BKKPN Kupang
161	Gili	Mujmal	Oceans5
162	Gili	Delphine Robe	Gili Eco Trust
163	Gili	HM. Laduni S.pd	SMK Pariwisata Gili Trawangan
164	Gili	Salman	Pemenang Sub-District
165	Gili	Adhi Yulianto	Budpar NTB
166	Gili	Ki Agus Muhasbi	WCS
167	Gili	Omega Raya	Bogor Agriculture Institute

Appendix D. Workshop Evaluation Survey

Pre-workshop Survey

Please complete this side of the survey before the workshop

Thank you for completing this survey to help us improve the workshops. Your participation is voluntary and your survey responses will remain anonymous. Please ask us if you have questions or concerns. Thank you.

Please rate the following in terms of how damaging they are to the condition of coral reef ecosystems.

		1 = not damaging					6 = extremely damaging
1	Fishing	1	2	3	4	5	6
2	Water pollution from development and agriculture	1	2	3	4	5	6
3	Tourism and recreation	1	2	3	4	5	6
4	Climate change and coral bleaching	1	2	3	4	5	6

Please rate the extent to which you agree or disagree with the following statements. If you do not understand a statement, please leave it blank.

		1 = strongly disagree,					6 = strongly agree
5	Climate change is not likely to damage coral reef ecosystems	1	2	3	4	5	6
6	Closing some areas to tourists during coral bleaching events will not help reefs survive	1	2	3	4	5	6
7	The government and business operators can work well together to respond to bleaching events	1	2	3	4	5	6
8	To protect dive tourism businesses, it is better to keep coral bleaching events a secret	1	2	3	4	5	6
9	There is agreement between business operators, the government, and NGOs on how to respond to bleaching events	1	2	3	4	5	6
10	Coral bleaching is a big problem for coral reefs	1	2	3	4	5	6
11	The government, business operators, and NGOs have different ideas about the best way to respond to bleaching events	1	2	3	4	5	6
12	Closing some reef areas to tourists to protect coral condition will hurt dive tourism businesses	1	2	3	4	5	6
13	Compared to other issues facing dive tourism operators, climate change is not a big deal	1	2	3	4	5	6
14	In our area there is not good cooperation between the government, businesses, and NGOs to make decisions about how to respond to bleaching events	1	2	3	4	5	6
15	Coral bleaching events are good opportunities for raising diver awareness about climate change	1	2	3	4	5	6

Post-workshop Survey

Please complete this side of the survey at the end of the workshop

Please rate the following in terms of how damaging they are to the condition of coral reef ecosystems.

		1 = not damaging					6 = extremely damaging
16	Fishing	1	2	3	4	5	6
17	Water pollution from development and agriculture	1	2	3	4	5	6
18	Tourism and recreation	1	2	3	4	5	6
19	Climate change and coral bleaching	1	2	3	4	5	6

Please rate the extent to which you agree or disagree with the following statements. If you do not understand a statement, please leave it blank.

		1 = strongly disagree,					6 = strongly agree
20	This workshop was a waste of my time	1	2	3	4	5	6
21	Climate change is not likely to damage coral reef ecosystems	1	2	3	4	5	6
22	Closing some areas to tourists during coral bleaching events will not help reefs survive	1	2	3	4	5	6
23	The government and business operators can work well together to respond to bleaching events	1	2	3	4	5	6
24	To protect dive tourism businesses, it is better to keep coral bleaching events a secret	1	2	3	4	5	6
25	There is agreement between business operators, the government, and NGOs on how to respond to bleaching events	1	2	3	4	5	6
26	Coral bleaching is a big problem for coral reefs	1	2	3	4	5	6
27	The government, business operators, and NGOs have different ideas about the best way to respond to bleaching events	1	2	3	4	5	6
28	Closing some reef areas to tourists to protect coral condition will hurt dive tourism businesses	1	2	3	4	5	6
29	Compared to other issues facing dive tourism operators, climate change is not a big deal	1	2	3	4	5	6
30	In our area there is not good cooperation between the government, businesses, and NGOs to make decisions about how to respond to bleaching events	1	2	3	4	5	6
31	Coral bleaching events are good opportunities for raising diver awareness about climate change	1	2	3	4	5	6
32	After this workshop I feel better able to respond to coral bleaching events	1	2	3	4	5	6

33. What did you like best about the workshop?

34. How could this workshop have been better?

Appendix E. Contributing Organizations & Financial Leverage

Activity	Organisation	In-Kind (US$)	Cash (US$)
Collection and analysis of data from before and after the 2010 bleaching workshops that form the basis for this proposal	U.S. National Oceanic and Atmospheric Administration	10,000	20,000
	Australia's CSIRO	50,000	10,000
	Australia's Department of Sustainability, Environment, Water, Population & Communities		10,000
	The Nature Conservancy		5,000
	Prince of Songkla University, Thailand	500	1,000
	University of Terengganu	800	
	Macquarie University	3,000	
	Consultant Heidi Schuttenberg	8,000	
	Consultant Emma Calgaro	7,500	
Administrative Support	Australia's CSIRO	5,000	
Personnel Support	Australia's CSIRO	15,000	
	U.S. National Oceanic and Atmospheric Administration	10,000	2,500
	Reef Check Indonesia	1,500	
	Coral Reef Alliance	1,500	
	Conservation International Indonesia	500	
	Wildlife Conservation Society - Indonesia	200	
	Reef Check Malaysia	5,000	
	University of Malaysia Terengganu	2,000	
	Department of Marine Parks Malaysia	1,000	
	Prince of Songkla University, Thailand	1,000	
	WWF-Thailand	3,000	
Travel Support	University of Malaysia Terengganu	750	
	Department of Marine Parks Malaysia	750	300
Workshop Support	J.W. Marriott, Phuket	1,500	
	Department of Marine and Coastal Resources, Thailand	1,500	
	Department of National Marine Parks, Malaysia	1,500	
Workshop Input and Endorsement	Department of National Parks, Wildlife & Plant Conservation, Thailand		
	Balai Kawasan Konservasi Perairan Nasional (BKKPN)		
	Balai Pengelolaan Sumberdaya Pesisir dan Laut (BPSPL)		
	Marine and Fisheries Agency Bali Province		
	Marine and Fisheries Agency Buleleng Regency Bali		
	Livestock, Marind and Fisheries Agency Karangsem Regency Bali		
	Tourism Agency Bali Province		
	Tourism Agency Karangasem Regency		
	Udayana University		
	IUCN Thailand		
	Prince Songkla University, Thailand		
	SEEK Phuket		
	Office of the Governor, Phuket, Thailand		
Total		**131,500**	**48,500**
		180,000	

Appendix F. Content for Dive Operator Training Materials

Climate change and dive tourism: What every operator should know

Syllabus Ver 1, 13/12/11

Summary of actions
This chapter summarized all of the action checklists that are available throughout the documents

I. Climate change projections & impacts
I.1. The future is now: ACT KNOW

Information box:
Coral reef function and services; include spill over effects (for both fish and coral)

I.2. Sea temperature and coral bleaching
A simple history, projections of sea temperature and bleaching events

Information box:
Coral bleaching theory: include explanation that bleaching can happen to other species, the rule of thumb of differentiation of bleaching response

Information box:
What can operators/resort do to reduce greenhouse gas emissions?

I.2.1. Ecological impact
Impacts worldwide (include pass bleaching events) + impacts identified from the 2009-2010 bleaching events in Malaysia, Thailand, and Indonesia.

Information box:
Summary of ecological data information pre, during, and post bleaching.

I.2.2. Socioeconomic impact
Impacts worldwide (include pass bleaching events) + impacts identified from the 2009-2010 bleaching events in Malaysia, Thailand, and Indonesia.

Information box:
Short term vs. long-term economic impact of bleaching learnt from Thailand, Malaysia, and Indonesia.

Information box:
Micro vs. macro economic impacts of bleaching learnt from Thailand, Malaysia, and Indonesia.

Related appendices:
1. Theory of market vs. non market value and how it is measured.

1

2. Theory of micro vs. macro economy with analysis on economic aspect of single impact from bleaching vs. cumulative impacts (bleaching and other impact) in a longer term.

I.3. Other CC impact to corals (Ocean acidification, sea level rise, storm)
Simple examples of impacts (such as to tourism infrastructure) and how these impacts all-together further deteriorate coral condition.

Information box:
Graph, photo, and simple explanation

Related appendices
3. Ocean chemistry and coral health

I.4. Cumulative impacts and Climate Change impacts
List of existing impacts and how these impacts all together make things worse

Information box:
Graph, photo, and simple explanation

Information box:
Crown of Thorn Starfish impact

Exercise 1:
List of the climate change impact and other stressors on your area
Begin by listing CC impacts before moving on to the listing of other shocks and stressors that impact areas under investigation. Please acknowledge that these shocks and stressors may not be generated locally.

II. Supporting Reef Resilience
II.1. What is reef resilience, and why it is important?
Reef resilience definition with an easy analogue

II.2. Principles and component of reef resilience
- Different simple stories/practical examples of dive sites that are more affected by bleaching compare to others, with real examples from dive sites in South East Asia and other region identified.
- Action: Participating in reef resilience assessments and protecting naturally resilient reefs as "seed banks"

Information box:
Principles and component of reef resilience Biological (genetic and species), physical (cooling, shading, screening, stress tolerance), and ecological (food web interaction, reproductive cycle, population connectivity, coral and fish recruitment)

2

Exercise 2

Identifying resilience dive sites in your area.

II.3. Reef Resilience steps
Simple steps on what to do to increase reef resilience

Exercise 3

Take the three top resilience dive sites from exercise 2; list the stressors from exercise 1 for each site. For each of the stressors, list any of on going management actions that are already applied there, and whether or not this answer to the stressors. If not, why?

II.3.1. Efforts that always have to be in place/on going management efforts: Threats reduction and right MPA/dive area design

Re stress the need to reduce stress, as well as provide information about a scientific intervention in designing a resilient MPA/dive area.

Information Box:
Summary of MPA resilience design (TNC resilience, and Maynard score card)

Information Box:
Examples on collaboration effort (with dive operator local community) and in designing resilient MPA from Bali and other places available

Related appendices:
4. Summary of reef managers guide, and linkages
5. More detail explanation and examples of the MPA resilience design

II.3.1.1.Water quality

- Question & Answer: How does water quality impact reef condition & resilience?
- Actions: Treating resort sewage and managing resort development

II.3.1.2. Minimizing diver impact
Question & Answer: Do divers really impact reef condition & resilience:
Actions: diver briefing, diver numbers

Information box:
Result of the CSIRO sociosurvey in Malaysia, Thailand, and Indonesia: how tourists like ecofriendly dive operator, and how the dive briefing is important aspect for their satisfaction

II.3.1.3. Connectivity

- Question & Answer: No reef is an island: why reefs need to be connected to be resilience ecologically and why management of reefs work better under a network.

3

- Actions: collaborate and exchange information with other dive operators in other sites

Exercise 4

Are/is there any actions from the list you made in the exercise 3 that you will add or remove? What will be your final list?

II.3.2. Responsive efforts

Reef managers guide triangle diagram with an emphasis on action lists on each of the interface points.

Exercise 5

Take the three top resilience dive sites form exercise 2, list the stressors from exercise 1 for each area, and check what kind of responsive management actions that are already applied there during and after the last mass bleaching event your dive sites encounter. In your opinion, are the responsive management actions applied to the stressors listed.

II.3.2.1. Responding to bleaching event

- Simple guidelines on monitoring the event's likeliness and developing response to bleaching
- Simple guidelines on reporting bleaching in Indonesia (include standard monitoring guidelines)
- Simple guidelines on reporting bleaching in Malaysia (include standard monitoring guidelines)
- Other monitoring guidelines

Information box:
Example of the bleaching response plan in Indonesia and Malaysia: what are the mechanism (focus on what dive operator can do/check list), and how this improving our understanding on bleaching event.

Information box:
NOAA prediction tool and how to subscribe

Information box:
Result of the sociosurvey in the three countries about how tourists like dive operator that monitor their reef

Related appendices

6. Global monitoring protocol summary and link
7. List of local organizations in the region that they can contact during bleaching event/to report bleaching

4

II.3.2.2. Management actions during recovery

- Re- stress: bleaching coral is not dead, but it is weak and need our help
- Re-stress; this management actions are actions we recommend on top of the on going management efforts that have to be in place.
- Action: Check list on what to do if bleaching result in high mortality
- Minimize diver impacts
  - ✓ Site closures
    - Why this can be a significant steps for recovery
    - Guidelines on site closures (how big, what area, how to communicate, etc.)
    - How to overcome the barriers (Collaborative enforcement; Creating incentives/ compensation; Changing perceptions to change behavior)

Information box:
Case study: Lesson Learnt from Malaysia:

- Communicating the closures:
- Case study: enforcing together (with the operators)

  - ✓ Dive restrictions and tougher implementation of Code of Conduct
    - Diver number limitation options
    - Diver restriction options (no beginner divers at certain sites)
    - Higher enforcement on going restriction/code of conduct
    - Re stress the dive briefing and regular reminder during the dive

Information box:
Examples from bleaching response plan Indonesia and Malaysia

II.3.3. Can we turn back the clock? Options and limitations for actions to restore and rehabilitate coral reefs

Challenges & opportunities

- Checklist of considerations

II.3.3.1. Interventions to help reefs recover after high coral mortality

- Substrate stabilization, examples, pro and cons
- Providing artificial substrates, examples, pro and cons

Information Box:
What do reefs need to recover after high coral mortality

5

II.3.3.2. Interventions to restore coral structure and reef ecosystem
Coral nurseries & transplantation, examples, pro and cons

Information Box:
Other type of intervention (restore fish): examples, pro-cons, summary of scientific rule of thumbs, and why it's not so far a common intervention

Exercise 6

Will you add or remove actions from the list that you made in the exercise 4?

III. Communication

Exercise 7

What are your standard mechanism (through web, dive briefing, etc.) and content in your marketing/communication to your guests?

III.1. We like ecofriendly dive operator

Re-emphasize our results on what people like from dive operator, and the most important factors that affect satisfaction (Increasing value (comfort, information, diver numbers, price); Good reef condition & fish numbers; Water visibility)

III.2. How to explain coral bleaching to divers: tips and tools

- Diver perceptions of coral bleaching based on the CSIRO survey 2010 in three countries.
- Question and answer on facts and myths of coral bleaching and list of actions

Information Box:
Should I keep bleaching a secret?

III.3. Benefit of networking

- Reemphasis connectivity issue on benefit in managing reef in a network
- Role of broader organizations (country, regional, global) (T)

Related appendices:
List of local organizations in the region that they can contact during bleaching event/to report bleaching (Appendix 7)
8. List of members in Indonesia and Malaysia bleaching response plan

Exercise 8

Will you add more mechanism/content in your marketing/communication to your guests? What will be your final list?

IV. Overcoming barriers to action

IV.1. Common barriers to implementing actions for resilience

Apathy by operators & government; Lack of resources; Lack of information; Lack of influence

IV.2. Influencing policy & management

Organizing for influence

Information Box:
Resources for community organizing

Information Box:
Case study: influence of a well-organized dive association, example from Bunaken and other area

IV.3. Fund-raising for management

- Overview of approaches
- Resources for creating sustainable financing mechanisms

Information Box:
Examples of sustainable financing mechanism from Roatan; Raja Ampat, Bunaken, Amed, etc.)

Information Box:
List of potential proposal

Exercise 9

Do you have a way to overcome the barrier you stated at exercise 8?

V. Adapting business for climate change

V.1. Levels of adaptation

From divers to destinations: Simple strategies to maintain profitability in the context of climate change: Check lists

V.2. Adopting business and destination

- A simple way to diversify income streams & markets
- A simple was to access finance: savings, credit & credit histories and insurance
- Strength of social & business networks

Information Box:
Examples from Pemuteran, Gili, and other areas

7

Exercise 10

What will be your best practical option of adaptation?

8

Appendix G. List of Young Scientists

Sue Yee Chen, Reef Check Malaysia, sue@reefcheck.org.my

> *"It was truly rewarding to be part of the project team and to help with the workshops. I consider myself fortunate to have been able to learn not only about the science being done in other countries but also about organising and running workshops internationally, something I have never done before."*

Amar Doshi, Queensland University of Technology, Australia, a1.doshi@qut.edu.au

> *"For this project, I was involved in the economic valuation of costs from coral bleaching. During the workshops, I was one of the facilitators of small group discussions. It was an invaluable opportunity to work with the many experienced scientists and researchers, as well as engage in discussions with the participants who were representatives of various stakeholders. The opportunity to communicate the research findings as well as understand the issues from the perspectives of first-hand stakeholders allowed me to consolidate the importance of research in this field and the need for cohesion between all the parties involved to draw up relevant outcomes. It has also further stimulated my interest in environmental and resource economics."*

Alvin Chelliah, Reef Check Malaysia, alvin@reefcheck.org.my

> *"Working with this group of international scientist and being part of the workshops was a awesome experience. It was something different for me and the team were very helpful and supportive in guiding us along the way. It helped me gain a lot of soft skills, something they never thought us in university. "*

Lau Chai Ming, University of Malaya, Malaysia, e_lcm@yahoo.co.uk

> *"It was a fascinating experience to be involved in this project alongside international scientists with different disciplines. Being a part of the team that conducted the field surveys, organized and facilitated the workshops, I have learnt the crucial communication skills among the stakeholders and scientists. I realised that the conservation of coral reefs involves more than just science, but society and economics as well. This project has spark my interest in pursuing multidisciplinary coral reef studies in hopes to be a coral reef scientist."*

Derta Purwita, Reef Check Indonesia, derta@reefcheck.org.in

Glossary of Terms

APN – Asia-Pacific Network for Global Change Research

CORAL – Coral Reef Alliance

CSIRO – Commonwealth Scientific and Industrial Research Organisation, Australia

MPA – Marine Protected Area

NGO – Non-Governmental Organisation

NOAA – National Oceanic and Atmospheric Administration, United States of America

TNC – The Nature Conservancy

WWF – World Wide Fund for Nature