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# SimReef and ReefGame: gaming for integrated reef research and management

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# SimReef and ReefGame: gaming for integrated reef research and management

## **Abstract**

As threats to coastal and ocean systems grow in scale and complexity, the calls for new approaches to research and management grow in volume. The Modeling and Decision Support Working Group (MDSWG) of the CRTR Program has developed two participatory gaming tools that address the need for integrative approaches to coral reef management. SimReef is a regional model and role-play game aimed at policy makers and industry representatives. It simulates coastal development trajectories and trade-offs between environmental, social and economic concerns. ReefGame is a local-level model and board game that helps local people and reef managers explore interactions between livelihoods, reefs and fisheries. We have used these tools successfully in participatory workshops in the Philippines and Mexico. These experiences demonstrate that using games with stakeholders can be a powerful way to educate and involve the public in coral reef management.

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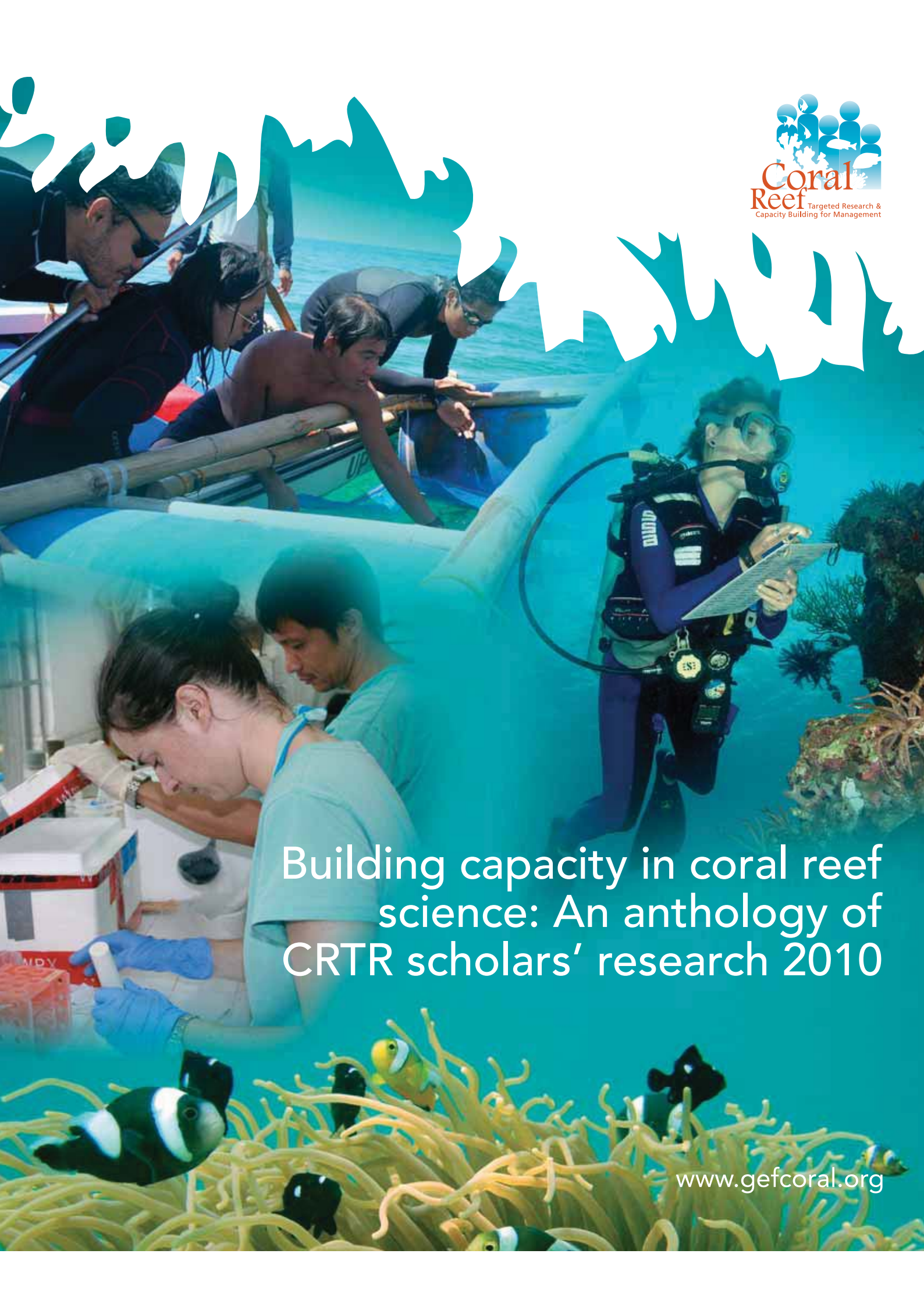
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Building capacity in coral reef  
science: An anthology of  
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**Cover photos:** (top left) Inspecting the nets, Bolinao Reef Flat, Philippines (Photo: M King); (top right) Jess Melbourne-Thomas recording research data (Photo: M Flavell); (bottom) Panda clownfish and three-spot damselfish, Schumann Island, Papua New Guinea (Photo: S Planes); (middle left) Courtney Couch and Mark Dondi Arboleda researching coral disease.



The Coral Reef Targeted Research & Capacity Building for Management (CRTR) Program is a leading international coral reef research initiative that provides a coordinated approach to credible, factual and scientifically-proven knowledge for coral reef management.

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# Deborah Cleland

## SimReef and ReefGame: gaming for integrated reef research and management



Deborah is a PhD student at the Fenner School of Environment and Society at the Australian National University. She graduated with a BA/BSc (Hons) from the ANU after completing a thesis focusing on using visual tools, including participatory models and board games, for coral reef and coastal management in the Philippines. Through her PhD, Deborah will continue to examine the utility and potential benefits of using creative techniques to explore alternative livelihood options and locally-based stewardship arrangements in artisanal reef fisheries, as well as the nexus between art and science.



Deb Cleland and Richard Muallil, ReefGame demonstration workshop, El Nido, Palawan, the Philippines, April 2010. Photo: Rhia Gonzales

## SimReef and ReefGame: gaming for integrated reef research and management

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### Abstract

As threats to coastal and ocean systems grow in scale and complexity, the calls for new approaches to research and management grow in volume. The Modeling and Decision Support Working Group (MDSWG) of the CRTR Program has developed two participatory gaming tools that address the need for integrative approaches to coral reef management. SimReef is a regional model and role-play game aimed at policy makers and industry representatives. It simulates coastal development trajectories and trade-offs between environmental, social and economic concerns. ReefGame is a local-level model and board game that helps local people and reef managers explore interactions between livelihoods, reefs and fisheries. We have used these tools successfully in participatory workshops in the Philippines and Mexico. These experiences demonstrate that using games with stakeholders can be a powerful way to educate and involve the public in coral reef management.

### Introduction

Globally the health of coral reefs is in decline, largely due to human activity (Pandolfi et al. 2005). Key drivers include climate change, overfishing, tourism, and nutrient and sediment flows from agriculture, mining and towns.

Models are often used in integrated coastal management, to aid understanding, develop scenarios, and explore policy options (Siebenhuner and Barth 2005). Here, we combine models with role-playing games, bringing stakeholders together in a non-confrontational, playful environment (Lynam et al. 2002). The players are given control over certain aspects of a model, so they can make their own decisions and explore different outcomes. Role-playing helps participants (including "experts") to understand and experience the pressures and constraints felt by others, and allows them to "see" new ways of thinking about a problem (D'Aquino et al. 2003).

The MDSWG has developed two participatory computer games, SimReef and ReefGame, which have been used in workshops in Mexico and the Philippines.

## SimReef, Quintana Roo, Mexico

### Tourism and coral reefs in Quintana Roo

The arrival of ever-growing numbers of tourists to Quintana Roo, on the Caribbean coast of Mexico, has had a serious impact on the Mesoamerican Barrier Reef system. From about 1975, a wave of mass tourism development has spread outward from the tourist centre Cancun, with annual tourist arrivals now numbering more than 6 million (Daltabuit et al. 2006). Across the state, damage to the reefs caused by human activities has interacted synergistically with natural disturbances, such as hurricanes and coral disease, contributing to the widespread degradation of the reefs (Harborne et al. 2001).

Many industries, communities and families in Quintana Roo are wholly or partly dependent on the ecosystem services provided by reefs, such as coastal protection (Iglesias-Prieto 2009). These groups influence the outcomes of reef management proposals, supporting those they agree with, and blocking those they do not. Improving reef management therefore requires bringing these groups together to create partnerships, share knowledge and, most importantly, negotiate the necessary change in current practices to protect the future of the reefs and the local economy.

### SimReef coupled model and role-play game

'SimReef' is a model and coupled role-play game that captures the regional-scale drivers of social and economic change triggered by tourism development in Quintana Roo. The model was kept as simple as possible, so stakeholders could contribute to scenario development, without being presented with a "finished product".

Each group interacts with the SimReef interface, shown on a projector screen. The interface is a schematic representation of the Quintana Roo coastline, showing the location of key ecosystems and human settlements (Figure 1).



Figure 1. Sim Reef Interface

Green = forest, blue = open sea, brown = urban, light blue = lagoon, dark blue = fringing reef, teal = seagrass, pink = temples, grey = cenotes (fresh water holes), pale yellow = scrub and open land, dark yellow = agriculture

The SimReef role-play game mimics real-life negotiation patterns, whilst maximising interactions between groups. The roles represent four major interest groups in Quintana Roo – conservation agencies (public and private), tourism, fisheries and the government (shown as circles in Figure 2 and Figure 3). Each group is given simple goals to structure play and aid strategy formation (indicated in brackets in Figure 2 and Figure 3). For example, the tourism industry's goal is profitability, measured by the income of resorts over each time step.



### 3. New tools for understanding and managing coral reef systems

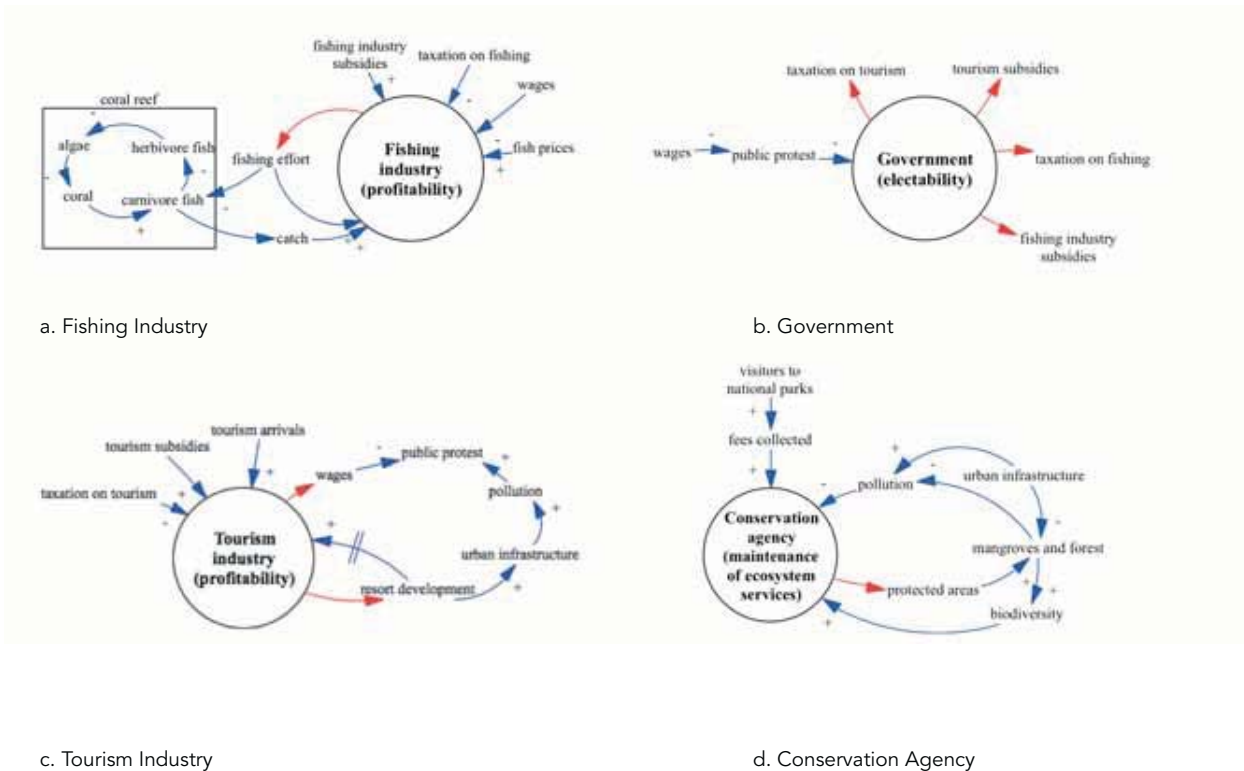


Figure 2. The four roles and their goals, inputs and outputs

The above diagrams illustrate the four roles and their inputs/ outputs, as represented in the SimReef model and role-play game. Positive and negative feedback relationships are marked with +/- signs. Black circles represent the roles discussed in text. Dotted arrows and bold text represent the decisions each role was responsible for (e.g. the Conservation Agency decided the size and location of protected areas).

Every round each group in the role-play game makes decisions about the use of the resources under their control (linked with red arrows in Figures 2 and 3). For example, the tourism role decides the average wage and how many resorts to develop, whilst the fishing role establishes (legal) fishing effort. These decisions then have flow-on environmental and social effects, measured by indicators like 'pollution' and 'public protest'. In turn, these indicators affect the outcomes for the government and the conservation agency. Each group must reach a consensus on their decisions, and negotiate access to funds and approvals through the government. For example, the conservation agency has to obtain permission from the government to establish new protected areas. After reaching consensus, the final decisions are coded into the model. Facilitators then present the results, including whether each group is meeting their established goals.

### 3. New tools for understanding and managing coral reef systems

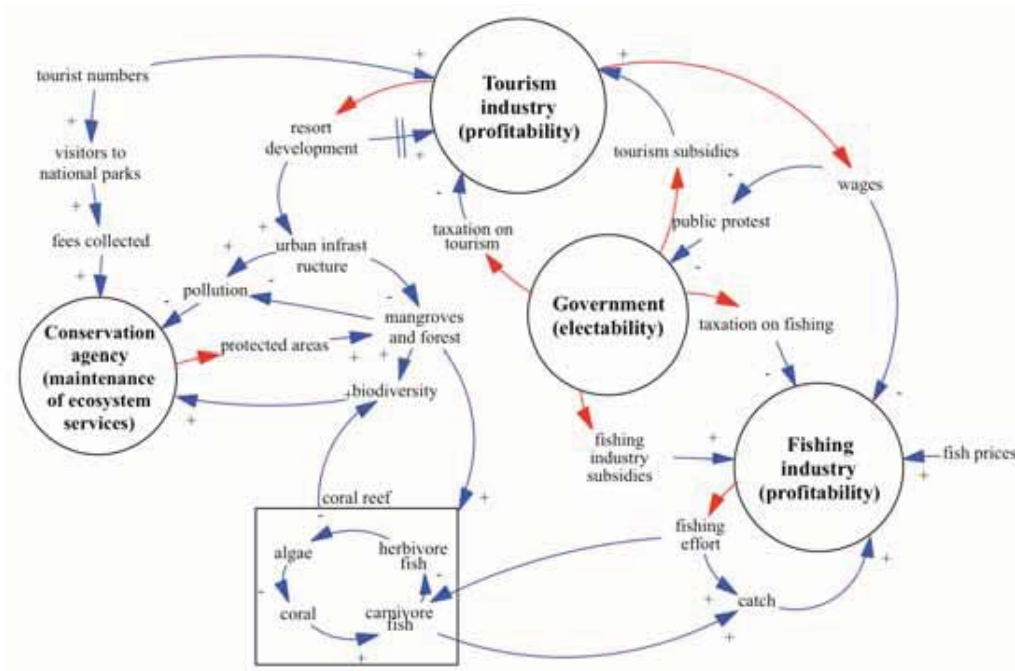


Figure 3. Complete causal loop diagram

The above diagram illustrates the interlinking of the four roles and their inputs/ outputs introduced in figure 2. Positive and negative feedback relationships are marked with +/- signs. Black circles represent the roles discussed in text. Red lines represented the decisions made by each entity

#### SimReef workshop

SimReef was played at a participatory workshop in Akumal, Quintana Roo, in October 2005. A group of 15 local people participated, representing the federal government's conservation agency, social and marine scientists, a local environmental NGO and an eco-tourism operator. No representatives from the fishing industry were present, although they had been invited. Participants were divided into the four role-play groups, each with a facilitator. Four rounds of the game were played, representing four years. Whilst the model was updated with each round's decisions, the underlying data and assumptions for each of the model's components were presented, so the participants could comment on their perception of the validity of the assumptions, and their recommendations for improving the model. Finally, participants were asked to reflect on the game/model, and its potential for further use as a management tool both in the Quintana Roo context and more generally.

#### Workshop outcomes

SimReef in Mexico helped to foster relationships and encourage interaction, learning and exchange between researchers and local participants. Introducing fun and play to the participatory context had a particularly positive impact on stakeholder engagement, pointing to some potential for researchers battling stakeholder fatigue.

However, the positive potential of SimReef did not overcome the problems caused by our lack of contact with local stakeholders prior to arriving in Mexico. The outcomes of the workshop were not connected to ongoing projects nor effectively linked to management priorities. Commitment from the individuals and institutions that possess the power to change the behaviours and activities that drive reef degradation is essential. Without this, models and participatory processes in general cannot engage effectively with the structural barriers to improved marine management. These lessons were used to improve design and implementation of the MDSWG's second participatory modeling experiment.

## ReefGame, Bolinao, the Philippines

### Fishing and reefs in Bolinao

Overfishing is the overwhelming issue for reef management in Bolinao. Falling catches and catch per unit effort are two indicators that target species are close to collapse. Fishing effort needs to be radically reduced if fish stocks are to recover (Meñez et al. 1991; McManus et al. 1992; Licuanan et al. 2006). The burgeoning aquaculture industry, upper-catchment clearing, chemical agriculture and domestic waste streams are also harming the health of the marine ecosystem (Talaue-McManus et al. 2000). Together, these factors mean that the region's growing fisher population is relying on a dwindling resource base that can no longer support the needs of their families. However, limited funds and corruption in the government have meant that little effective management action has been taken (Graham and Sol 2004).

### ReefGame coupled model and role play game

ReefGame aims to help fishers understand how overfishing is harming both their livelihoods and the reef, and to start discussions about what could be done. At the same time, we hoped to increase understanding of the fishers' behaviour and livelihood choices as their catches declined.

Unlike SimReef, where users interact directly with the computer interface, ReefGame is primarily a board game. Participants playing in pairs are given a particular fishing identity – with a boat, a family size and ongoing expenses that they have to pay each round. There is also a role for a banker/fish buyer.

Two identical game boards represent a coastal area with an offshore island, made up of sea and land cells and bearing a schematic resemblance to the coast of Bolinao (see figures 4 and 5). Habitat cards are distributed on the sea cells, showing where mangrove, seagrass, coral-dominated reef and algae-dominated reef are located. Designated land cells have livelihood icons, initially one for each of the different activities available (e.g. carpentry and taxi-driving).

Half the participants play around each board. Using both boards means that groups are kept small and different conditions and scenarios can be applied to each. Scenarios include Marine Protected Area implementation, introduction of different livelihoods and migration possibilities, and natural disasters.



Figure 4. Game board showing fisher and habitat tokens



Figure 5. Fishers playing ReefGame

In each round of the game, each pair either goes fishing (by moving their token to any sea cell) or works for a wage in another occupation (the corresponding land cell).

The computer model accompanying ReefGame calculates each pair's catch and income. Fishers receive fish tokens that represent catch biomass. Fish tokens are swapped for money tokens, which are used to track each pair's income (or debt). After players receive their gross earnings, the banker collects family expenses from each player.

### ReefGame workshop

Twenty fishers played ReefGame at a one-day participatory workshop in Bolinao, the Philippines in September 2007. We have also used ReefGame as an educational tool in undergraduate and postgraduate workshops at different venues around Australia and the Philippines.

### 3. New tools for understanding and managing coral reef systems

#### Workshop outcomes

The Philippines workshop demonstrated that models and games are powerful community education and outreach tools, eliciting rich responses and discussion from participants. Facilitators commented that workshop attendees interacted enthusiastically and naturally with the game and each other. This is in stark contrast to interview and focus groups they had experienced, where 'information extraction' was the sole purpose, creating a stilted one-way interrogation. Participants were also pleased about experiencing something different from the 'typical' workshop setting with butcher's paper and PowerPoint presentations. Most also identified that the workshop had helped them build relationships with peers and learn about reef function and management.

#### Further research

Together with an extended team based at the University of the Philippines, MDSWG members secured funding from the David and Lucille Packard Foundation through the Ecosystem Based Management (EBM) Tools Network to run participatory modeling workshops in 5 different towns throughout the Philippines in 2010. These workshops will have a strong emphasis on multi-sectoral integration to help find sustainable alternative and supplementary livelihoods for the artisanal fishers who are dependent on reefs. Thus, we will continue the approach initiated with SimReef and continuing with ReefGame in using models and games to improve outcomes of participatory modeling workshops for people and management.

#### Conclusion

SimReef and ReefGame have very different foci and target audiences, but both were able to elicit creative and interactive responses from key stakeholders. Thus far, gaming has been a valuable tool to build relationships and conduct social research. Moreover, it shows promise as a decision support tool for marine managers. The SimReef workshop demonstrated the dangers of neglecting the traditional concerns of participatory research, particularly local power relationships and the integration of the researchers with the local community and decision-making processes. However, we have drawn a number of important lessons from these experiences, and have incorporated stronger and more direct links to management decisions in our current work.

#### Acknowledgements

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