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Understanding and Strengthening Effective Coral Reef Governance:

A Map & Compass to Guide Strategic Change in Southeast Asia



Thesis submitted by
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for the degree of Doctor of Philosophy

School of Earth and Environmental Sciences, James Cook University



Exploring the Marine and Tropical Sciences Research Facility
in North Queensland

Understanding and Strengthening Effective Coral Reef Governance:

**A Map & Compass to
Guide Strategic Change in Southeast Asia**

Thesis submitted by

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in November 2010

for the degree of Doctor of Philosophy

in the School of Earth and Environmental Sciences

James Cook University

This work is dedicated to my parents, Fred and Margo,
my siblings, Fredric and Emily, and to Athens
with oceans of love

Statement on the Contribution of Others

I am deeply grateful for the kindness and generosity I received from many colleagues in planning, implementing, and writing my doctoral research. In the end, all decisions about how to conduct the research and interpret the data were mine alone, and I am responsible for any errors that resulted from my decisions.

Intellectual Support

I received advice on the conceptualization of my study, development of my survey instruments, and statistical analysis of my data as described below:

Conceiving the Study

- The idea to adapt a framework for understanding effectiveness in organizations came from a course on Organizational Theory taught by Dr. Art Lysons through James Cook University's School of Business. I am deeply grateful to Dr. Lysons for his engagement in helping me understand the Competing Values Framework, its impact in organizational theory, and how I might adapt it to coral reef governance.
- In the early stages of planning my study, I benefited from conversations with colleagues about how my proposal related to approaches to effectiveness already being implemented in conservation, coastal management, and coral reef governance. These included discussions with: Dr. Leah Bunce-Karrer, Dr. Marc Hockings, Dr. Kem Lowry, Dr. Michael Mascia, Dr. Nick Salafsky, and Dr. Karen Vella.
- I also appreciated advice from Professor Iain Gordon, Jeff Patrick, and Peter Valentine on my proposed methods, and particularly to Professor Helene Marsh for her review of my written proposal.

Developing and Piloting Survey Instruments

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Statistical Analysis

While I conducted all statistical analysis myself, I am grateful for the advice I received during this process:

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Financial Support & Administrative Infrastructure

- I am grateful to Peter Valentine and James Cook University's School of Earth and Environmental Science for supporting my candidature by waiving my tuition, providing a partial living stipend, and providing financial support for statistical training, conference participation, and infrastructure costs.
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- For much of my candidature I was physically located at Australia's Commonwealth Science and Industry Research Organization (CSIRO) laboratory in Townsville and had access to CSIRO's outstanding library and computing services; I am sincerely grateful to Dr. Tony Grice and Dr. Ian Watson for supporting my CSIRO studentship.

Data Collection

I received assistance in planning and implementing my field work in Southeast Asia as described below:

Research Permissions

- I received research permissions from James Cook University's ethics board to conduct my on-line survey and field work in Southeast Asia (ethics approval numbers H2449 and H3066).
- Through collaborations with Rahim Gor Yaman, from the Malaysian National Parks Department, and Dr. Affendi Yang Amri, from the University of Malaysia, I received permission to collect data in Malaysia (permit number: UPE:40/200/19/2365).
- Through partnership with the CSIRO's on-going work in Indonesia, led by Dr. Alex Smajgl, and in collaboration with Professor Jamal Jompa, from the Indonesian Ministry of Marine Affairs and Fisheries and Hasanudin University, Makassar, I received permission for my Indonesian field assistant to collect data in Indonesia.

Selecting Coral Reef Governance Programs to Interview

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Editorial Support & Graphic Design

- Professors Helene Marsh and Iain Gordon provided critical scientific review of my thesis chapters that improved the chapters' logic, rigor, and quality.
- My brother, Fredric Schuttenberg, read the entire thesis twice, commenting on clarity of wording in the early drafts, and grammar and referencing in the final version.
- My friend, Yolanda Garcia, transformed my power point drawings into attractive and intuitive Figures 1.8 and 3.2.

Declaration on Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the *National Statement on Ethics Conduct in Research Involving Humans* (1999), the *Joint NHMRC/AVCC Statement and Guidelines on Research Practice* (1997), the *James Cook University Policy on Experimentation Ethics: Standard Practices and Guidelines* (2001), and the *James Cook University Statement and Guidelines on Research Practice* (2001). The proposed research methodology received clearance from the James Cook University Experimentation Ethics Review Committee (ethics approval numbers H2449 and H3066).

18 November 2010

Heidi Z Schuttenberg

Thesis Format & Publications

Thesis Format

I have written my thesis using American spelling and grammar conventions. My referencing and formatting follow guidance from the 5th edition of the American Psychological Association's *Publication Manual* (2001), a commonly used referencing system in the social sciences.

Publication Plan

After the submission of my thesis, I plan to adapt the chapters for submission to peer-reviewed journals as follows:

Chapter 2: Schuttenberg, H.Z. "Generalizing Theory-Based Evaluations to Strengthen the Foundations of Conservation" intended for submission to *Oryx*.

Chapter 3: Schuttenberg, H.Z. "12 Pillars of Effective Coral Reef Governance" intended for submission to *Coral Reefs*

Chapter 4: Schuttenberg, H.Z., I.J. Gordon, H. Marsh, A. Lysons, P. Valentine. "A Unified Framework for Understanding Effective Coastal Governance" intended for submission to *Conservation Biology*.

Thesis Part 3: Schuttenberg, H.Z., I.J. Gordon, A. Kutt. "A Taxonomy of Approaches to Coral Reef Governance in Southeast Asia" intended for submission to *Ocean and Coastal Management*.

Overall Synthesis: Schuttenberg, H.Z., I.J. Gordon, H. Marsh + regional collaborators "Solving the Coral Reef Crisis: A Unified Framework for Diagnosing & Strengthening Effective Governance" intended for submission to *Science*.

Works Published During my Doctoral Candidature

During my candidature, I published the following works based on consultancies and conference sessions I conducted during my candidature, or projects I completed prior to initiating my doctoral research:

Books

Marshall, P.M. and **H.Z. Schuttenberg**, 2006. *A Reef Manager's Guide to Coral Bleaching*. Great Barrier Reef Marine Park Authority. Townsville, 165pp.

Peer-reviewed journals

Schuttenberg, H.Z. and O. Hoegh-Guldberg, 2007. "A World with Corals: What Will It Take?" *Science* v318 (5 Oct), p42.

- Maynard, J. A., J. E. Johnson, P. A. Marshall, C. M. Eakin, G. Goby, **H. Schuttenberg**, C. M. Spillman, 2009. "A Strategic Framework for Responding to Coral Bleaching Events in a Changing Climate" in *Environmental Management*. 44, pp1–11.
- Hughes, T.P., L.H. Gunderson, C. Folke, A.H. Baird, D. Bellwood, F. Berkes, B. Crona, A. Helfgott, H. Leslie, J. Norberg, M. Nyström, P. Olsson, H. Österblom, M. Scheffer, **H. Schuttenberg**, R.S. Steneck, M. Tengö, M. Troell, B. Walker, J. Wilson, B. Worm, (2007). "Coping with ecological uncertainty: Adaptive Management of Natural Resources" in *Ambio*. 36(7) pp586-592.

Book Chapters

- Schuttenberg, H.Z. and P.M. Marshall, 2008. "Managing for mass coral bleaching: Strategies for supporting socio-ecological resilience." In C. Wilkinson & D. Souter (Eds.), *Status of Caribbean Coral Reefs after Bleaching & Hurricanes in 2005*. Townsville: Reef & Rainforest Research Centre.
- Marhsall, P.M. and **H.Z. Schuttenberg**, 2006. "Adapting Coral Reef Management in the Face of Climate Change." American Geophysical Union Monograph.

Conference Papers

- Schuttenberg, H., C. Corrigan, L. McLeod, P. Marshall, N. Setiasih, D. Obura, O. Hoegh-Guldberg, B. Causey, M. Drew, L. Hansen, G. Grimsditch, J. West, A. Skeat, M. Eakin, L. McCook, M. Crawford, P. Kramer and S. Campbell, 2007. "Building resilience into coral reef management: Key findings & recommendations," In: *Proceedings of the 3rd International Tropical Marine Ecosystems Management Symposium*, Cozumel, Mexico, 16-20 October 2006. Cambridge: ICRI.
- Grimsditch, G., **H. Schuttenberg**, O. Hoegh-Guldberg, D. Obura, 2007. "Workshop 4 Report – Adapting coral reef management in the face of climate change – Part II," In: *Proceedings of the 3rd International Tropical Marine Ecosystems Management Symposium*, Cozumel, Mexico, 16-20 Oct 2006. Cambridge: ICRI & ICRAN.
- Schuttenberg, H.Z., 2005. "What Does It Mean to Manage the GBR for Resilience? A Discussion Forum" In: *Proceedings of the Queensland Conservation Congress, September 15 - 17, 2005*. Townsville: North Queensland Conservation Council.

Reports

- Schuttenberg, H.Z., M. Russell & J. Hennessey, 2009. Ecosystem-Based Management of the Great Barrier Reef Marine Park: current status and future directions. Report to the Great Barrier Reef Marine Park Authority and the Reef and Rainforest Research Centre, Townsville, 17pp.
- DRAFT GBR Marine Tourism & Climate Change Action Strategy 2007-2010. 2007. Report to the Great Barrier Reef Marine Park Authority, Townsville, 47pp.
- Malaysia's Coral Triangle Support Partnership: 5 Year Strategy & Year 2 Work Plan. 2009. Report to Coral Triangle Support Partnership and WWF-US, Washington, D.C., 50pp.

Acknowledgments

In 1999, I was working at the University of Rhode Island's Coastal Resources Center when its director, Stephen Olsen, was questioning how we could better strengthen coastal governance initiatives. Several times I heard him engaging colleagues around the problem, "How can we better diagnose what is needed, in different situations, to improve coastal governance and stop global declines in coastal ecosystems?"

Stephen's question stuck with me as I started working on coral reef governance in Southeast Asia the same year. I collected field data in Indonesia for my Master's degree, and then stayed in the region for a year with funding from the US government's Fulbright Scholars program. I was struck by the urgency of reef governance. I was amazed by coral reef ecosystems of extraordinary diversity and productivity, and frustrated in seeing reefs destroyed by coral bleaching and bomb fishing. I felt the precariousness of people whose daily meals were based on the reef fish they caught, and I took hope from local and international colleagues I saw working with strength and purpose in politically and technically challenging environments. During this period, Stephen's question was my way of informally making sense of the diversity of experiences I was encountering. In my doctoral research, I wanted to take on his question more formally.

Early in my time at James Cook University, I saw Dr. Art Lysons present a typology for understanding organizational effectiveness, called the Competing Values Framework. Based on its applications in organizational theory, I thought this framework provided a model for answering Stephen Olsen's question. The project took off when my mentor, Professor Ove Hoegh-Guldberg, offered the financial support required to pursue the idea. Thus, I've spent the last several years adapting the Competing Values Framework to coral reef governance in pursuit of the question:

What approaches can best achieve different coral reef governance goals across varying socio-ecological contexts?

During my work, I have been extremely grateful to the friends and colleagues who have engaged in the project. Many of these contributions are described in the previous section, and I would like to express sincere additional thanks to:

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This thesis has been inspired by Stephen Olsen's question, the dynamic fragility of Asia's coral reefs, care for the people who depend on reef fisheries, and the sincerity and hard work of my colleagues in reef governance. I deeply hope it will be of value to future efforts to diagnose and strengthen coral reef governance in Southeast Asia.

Abstract

Background

Coral reefs are the most productive and biologically diverse marine ecosystems, and they provide ecosystem services to an estimated half billion people through fisheries, tourism, and coastal protection. To protect these values, significant investments have been made to stem reef decline, resulting in successes on a case by case basis. Overall however, the accelerating scope and scale of the threats facing coral reefs have overwhelmed existing governance regimes, creating a widespread call to improve the effectiveness of coral reef governance. My research addresses the problem of how to better learn from on-going experiences in coral reef governance to reverse the current degradation of reef ecosystems.

Improving effectiveness is simultaneously a process of strengthening individual initiatives and learning from experiences across a range of sites to develop a body of theory that can be used to diagnose and improve diverse governance arrangements. To date, the process of learning from past experiences has been fragmented, largely because the complexity of the governance enterprise confounds a straight-forward understanding of how lessons learned from one initiative might appropriately be applied elsewhere. All programs facilitating coral reef governance vary in their specific goals, the management strategies they implement, their organizational characteristics, and the socio-ecological contexts in which they operate. Given this complexity, what approach can be used to move beyond context-specific, case-by-case successes to achieve effective governance on scales that can turn the tide on coral reef decline?

Overview

My doctoral research aims to address this problem by adapting a framework from organizational theory. I develop a conceptual typology – “or Map and Compass” – that contextualizes the experiences of individual coral reef governance programs toward better planning, cross-site learning, and theory development (Thesis Part 2). The typology complements existing approaches for evaluating the effectiveness of coral reef governance by providing an innovative strategy for generalization. I then apply the Map and Compass in Southeast Asia to develop a field taxonomy that describes approaches to coral reef governance being implemented in that region (Thesis Part 3). This field application serves to validate the Map and Compass. It also provides insights into the key assumptions underpinning dominant approaches to coral reef governance in Southeast Asia, which suggests ways they might be further strengthened.

The Unified Effectiveness Framework: A Map of Effectiveness in Coral Reef Governance

Part 2 of my thesis develops a conceptual typology of effective coral reef governance. Effectiveness is not a discrete concept, but a multidimensional construct. The conceptual map provides an overarching, visual framework that explicitly describes effectiveness, and offers a common denominator for appropriately comparing coral reef governance programs to strengthen theory and practice. Because it is a comprehensive description of effectiveness, the conceptual map is called the Unified Effectiveness Framework (UEF).

The UEF was developed by replicating an approach from organizational theory. As an input to this analysis, I conducted a detailed review of 12 evaluation systems related to coral reef governance, and identified a comprehensive list of the concepts included under the umbrella construct of effectiveness. I then used an on-line survey to elicit opinions from 80 experts in coral reef governance about the similarities between 17 concepts that spanned the breadth of the effectiveness construct. Analyzing these data with multidimensional scaling produced a picture of the experts' shared mental model of effectiveness.

My analysis found a high degree of consensus among the experts around the resulting conceptualization, which organized effectiveness along two axes: the balance between social versus ecological goals, and the balance between governance processes versus governance outcomes. Using the literature, I demonstrate that the four quadrants which emerge from these axes are highly aligned with the major theoretical paradigms relevant to coral reef governance: Integrated Coastal Management, Community-Based Management, Ecosystem-Based Management, and Adaptive Management. My review describes the inherent tensions and complementarities between these four governance paradigms, and develops a set of hypotheses that become the basis for further validation of the UEF through field testing in Southeast Asia.

A Field Taxonomy of Approaches to Coral Reef Governance in Southeast Asia

Part 3 of my thesis applies the Unified Effectiveness Framework to develop a theory-based taxonomy of the approaches currently being implemented by coral reef governance programs in Southeast Asia. The taxonomy identifies patterns in the goals, strategies, organizational characteristics, and socio-ecological context of 61 programs facilitating coral reef governance in the region.

Using a stratified sampling design, I collected data from coral reef governance programs in the Southeast Asian countries of Indonesia, Malaysia, Philippines, and Thailand through 200 surveys administered by local field assistants. The mixed methods survey collected detailed information on the investments each program made in 65 different management strategies, and the respondents' perceptions of the programs' organizational characteristics, accomplishments, and socio-ecological context. Following an approach from organizational theory, one section of the survey,

called the UEF Compass, collected information that allowed me to draw a profile of each program on the Unified Effectiveness Framework. I tested the reliability and validity of the UEF Compass with a confirmatory factor analysis, and the results validated the measurement properties of the Compass.

I hierarchically clustered the 61 coral reef governance programs using data collected with the UEF Compass, and identified five distinct approaches to coral reef governance. Using analysis of variance, discriminant analysis, and qualitative research methods, I describe each of these approaches in terms of its theory-of-action, management strategies, programmatic and contextual characteristics, and reported strengths and weaknesses. The five approaches are traditional park management, community-based management, collaborative management, adaptive management, and a “balanced” approach that focuses on volunteer restoration and livelihood enhancements.

Conclusions: Reconciling Theory with Practice

I conclude the thesis by comparing the hypotheses represented by the Unified Effectiveness Framework with the results of the Field Taxonomy for Southeast Asia to assess the validity and usefulness of my proposed “Map and Compass.” I determine that the UEF exhibits the essential characteristic of a good typology, which is the ability to simplify multidimensional complexity in meaningful ways. I also identify three discontinuities between theory and practice that warrant further research. Overall, I find that there is support for the Unified Effectiveness Framework as a valid and useful typology for interpreting and contextualizing practical field experience.

Acronyms

AGFI	Adjusted Goodness-of-Fit (test statistic for SEM models)
ANOVA	Analysis of Variance
AMOS	Analysis of Moment Structures (software)
APA	American Psychological Association
CBD	Convention on Biological Diversity
CBD COP	Convention on Biological Diversity Conference of Parties
CBD SBSTTA	Convention on Biological Diversity, Subsidiary Body on Science, Technical, and Technological Advice
CBNRM	Community-Based Natural Resource Management
CI	Conservation International
CIPP	Context-Input-Process-Product Evaluation Model
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CMP	Conservation Measures Partnership
CVF	Competing Values Framework
EBM	Ecosystem-Based Management
GFI	Goodness-of-Fit test statistic for structural equation models
ICCs	Intraclass Correlations
ICDP	Integrated Conservation and Development Project
ICM	Integrated Coastal Management
IUCN	International Union for the Conservation of Nature
MANOVA	Multivariate Analysis of Variance
MDS	Multidimensional Scaling
MPA	Marine Protected Area
NGO	Non-governmental Organization
SEM	Structural Equation Modeling
SPSS	Statistical Package for the Social Sciences
TNC	The Nature Conservancy
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNCED	United Nations Conference on Environment & Development
UEF	Unified Effectiveness Framework
USAID	United States Agency for International Development
UTOS	Units-Treatments-Observations-Setting Evaluation Model
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society
WRI	World Resources Institute
WWF	World Wildlife Fund

Acronyms continued

Unified Effectiveness Framework - Relative Quadrant Measures

(also see Sections 5.2.7 & 5.3.3, Fig 5.5, and Table 5.9)

R-AM	Relative Adaptive Management (measure)
R-CB	Relative Community-Based Management (measure)
R-ECO	Relative Ecosystem Protection (measure)
R-ICM	Relative Integrated Coastal Management (measure)

Unified Effectiveness Framework - Strategic Intent Clusters

(also see Sections 6.2.1 & 6.3.1 and Figs 6.2 & 6.3)

AM Cluster	Adaptive Management Cluster
BAL Cluster	Balanced Cluster
CB Cluster	Community-Based Cluster
CB-Hybrids	Community-Based Hybrids (i.e., a larger cluster combining the ECO-CB group & ICM- CB group)
ECO Cluster	Ecosystem Protection Cluster
ECO-CB Cluster	Community-Based : Ecosystem Protection Cluster
ICM-CB Cluster	Community-Based : Integrated Coastal Management Cluster

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