THE SCHOOL FOR FIELD STUDIES

Principles of Marine Resource Management
SFS 3740

Syllabus

The School for Field Studies (SFS)
Center for Marine Resource Studies (CMRS)
South Caicos, Turks & Caicos Islands

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

COURSE CONTENT SUBJECT TO CHANGE

Please note that this is a copy of a recent syllabus. A final syllabus will be provided to students on the first day of academic programming.

SFS programs are different from other travel or study abroad programs. Each iteration of a program is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Changes in access to or expiration or change in terms of permits to the highly regulated and sensitive environments in which we work;

- Changes in social/political conditions or tenuous weather situations/natural disasters may require changes to sites or plans, often with little notice;

- Some aspects of programs depend on the current faculty team as well as the goodwill and generosity of individuals, communities, and institutions which lend support.

Please be advised that these or other variables may require changes before or during the program. Part of the SFS experience is adapting to changing conditions and overcoming the obstacles that may be present. In other words, the elephants are not always where we want them to be, so be flexible!

Course Overview

"Principles of Marine Resource Management" is intended to introduce the disciplines and tools required to understand and manage marine resources. This component of the academic program at the Center for Marine Resources Studies (CMRS) makes the link between Marine Ecology and Environmental Policy. Topical areas include: fisheries management, marine conservation, fisheries enforcement, marine protected areas, coastal zone management and strategies for sustainable development.

Learning Objectives

Following this course, students should:

1. Understand the basic concepts of resource management and be able to apply that understanding to marine resources, particularly those important to the TCI
2. Have a working knowledge of the tools available for assessing the status of marine resources
3. Understand how MPAs can serve as a valuable management tool for integrated coastal management
4. Have an appreciation for the complex integration of ecological processes, socioeconomic value, and policy issues that makes managing coastal marine resources a challenge.

CMRS Research Direction

During the semester, we will use two case studies to frame our analysis and discussions, each of which addresses specific local issues. An understanding of marine ecology and resource management will be critical in framing our resource policy discussions and analysis and will help focus our research. The two case studies are:

Case Study 1: Assessment - Developing an understanding of the fundamental principles of resource assessment. This section includes fisheries biology, stock assessment, invasive species assessment, and integrated approaches to coastal management, with special emphasis on small island states such as the Turks & Caicos Islands.

Case Study 2: Management – Strategies, with a particular focus on Marine Protected Areas (MPAs), that assist in maintaining or improving the status of marine resources worldwide and especially in the TCI and contribute to economic development and diversification. We will investigate how MPAs can aid in the conservation and enhancement of marine resources and will examine the planning and management of MPAs near South Caicos.

Assessment

Students will be assessed in a number of ways during the course, i.e. stock assessment, data management, written report based on practical components, and group presentation. Written reports will be technical in nature and will require students to present information in a clear and concise manner. Familiarity with word processing software (e.g. Microsoft Word, Apple Pages) and spreadsheet software (e.g. Microsoft Excel, Apple Numbers) is helpful.

Assessment Item	Value (%)
Case Study I: Resource Assessment	
Stock Assessment	20
Invasive Species Exercise Data	10
Case Study I Exam	25
Case Study II: Resource Management	
Conch Assessment Paper	15
Zoning Presentation	20
Participation	10
TOTAL	**100**

Stock Assessment Exercise*

During this desktop exercise you will be conducting a fisheries assessment (using data provided) to obtain hands-on experience with current data analysis. You will use the knowledge and skills gained from the Excel practical and the stock assessment lectures. You will be working individually on provided data and will receive an individual grade.

Invasive Species Exercise*

This field exercise introduces you to visual survey methods during scuba or snorkeling. We will use visual survey methods, and note lionfish behavior, habitat associations, abundance. This data, together with historical data, allows for the abundance of an invasive fish species, lionfish, in habitats around South Caicos to be determined. Fieldwork will be conducted in groups.

Furthermore, this exercise introduces you to data management. Each of you will create and enter all the data collected, by all groups, into a spreadsheet and submit. You will receive an individual grade based on the quality of the spreadsheet organization and usability. You will also receive an individual participation grade for the field exercise and data collection.

Conch Assessment Exercise*

During this field exercise, you will work in groups to employ visual survey methods outlined during the lectures to collect data on the size & age structure of the queen conch (*Lobatus gigas*) population according to habitat type around South Caicos.

You will also analyze data individually and produce an accurate and coherent scientific paper in collaboration with your group. Each group will produce a written report, and each member of the group will be required to write a part of the report. You will receive a group grade and an individual grade. You will be assessed based on your ability to write a scientific report in a coherent and logical way, as well as on data management.

Zoning exercise Presentation*

During this desktop exercise you will review the current marine spatial planning in place around South Caicos and suggest a newly designed system, based on the specific objectives of your stakeholder groups (such as Government fisheries Dept., Ecotourism Consultants, mass tourism consultants, Conservation NGO etc.). You will work in groups and will present your proposed plans as a group. Consider this as the exam for Case Study II. You will receive both a group grade and an individual grade based on content, comprehension, and creativity.

*Complete details of the graded assignments will be issued in separate documents.

Exam will be given after case study I and is based on all aspects of the course – lectures, readings, and field exercises – during that case study.

Grading Scheme

A	95.00 - 100.00%	B+	86.00 - 89.99%	C+	76.00 - 79.99%	D	60.00 - 69.99%
A-	90.00 - 94.99%	B	83.00 - 85.99%	C	73.00 - 75.99%	F	0.00 - 59.99%
		B-	80.00 - 82.99%	C-	70.00 - 72.99%		

General Reminders

Readings: Assigned readings will be available on the student server. It is important that you read all materials prior to the associated lecture since the volume of the material in the class requires a brisk pace, and the readings will be discussed during lecture. Anything contained in the readings is fair game for the exams.

Plagiarism and Cheating: Using ideas and materials of others without giving due credit is cheating and will not be tolerated. A grade of zero will be assigned to anyone caught cheating or aiding another person to cheat, either actively or passively (e.g., allowing someone to look at your exam). All assignments unless specifically stated should be individual pieces of work.

Appropriate use of technology: SFS has worked hard to provide internet access to all its staff and students. **Laptops/tablets are permitted in lectures for the sole purpose of note taking.** Any inappropriate uses (e.g. accessing the internet, messaging, surfing, gaming or other uses not directly involved in course activities) will result in the loss of this privilege and a negative impact on your participation grade. **Cell phones are not permitted in lectures.**

Deadlines: For written and oral assignments, deadlines are instated for several reasons:

1. Deadlines are a part of working and academic life to which students need to become accustomed.
2. Deadlines promote equity among students.
3. Deadlines allow faculty ample time to review and return assignments before others are due.

As such, deadlines are *firm* and extensions will only be considered under the most extreme circumstances. Late assignments will incur at least a 10% penalty (depending on how late it is). Assignments will be handed back to students after a one-week grading period.

Emailing assignments:

1. Word and/or Excel documents should be saved and emailed as .doc, .docx or xls. files, and must be PC compatible. Email to: **ekrzyszczyk@fieldstudies.org**
2. Word documents and excel documents for all individual assignments, exams, reports should be saved as:

   FirstName_LastName_Assignment
   E.g. John_Smith_Lionfish Exercise

   Group assignments should be named…

   Group#_Assignment
   E.g. Group1_DataAnalysis

3. The subject of your email should be the same as these file names.

Participation: Participation in all components of the program is mandatory, as there will be no spare time to catch up on any missed classes. Missing even one lecture or discussion can significantly affect the experience you and your classmates have while at CMRS. You will get as much out of this course as you put into it, so please dive in. In all circumstances, we expect you to respect yourself and your fellow students. Dissent and discord are expected, but disrespect will not be tolerated.

Course Content

Type- L: Lecture, **FL:** Field Lecture**, FEX:** Field Exercise, **DEX:** Desk Exercise, **P:** Student Presentation, **W**: Workshop, **D**: Discussion, **GL**: Guest Lecture, **E**: Exam

No and Time	*Topics*	*Required Readings*
RM.01 (L, 1.0 hr)	**Introduction to Resource Management** -Introduction to the course -Defining resource management -Marine resources	
RM.02 (L, 1.0 hr)	**Marine Resource Use Overview and History** -History of fishing & humanity's association with the sea -Fishing and fish survey gears -Shifting Baseline Syndrome	Pinnegar, J.K. and G.H. Engelhard. 2007. The `shifting baseline' phenomenon: a global perspective. Reviews in Fish Biology and Fisheries 18:1-16.
RM.03 (L, 1.0 hr)	**Stocks & Populations** -What are fisheries populations and stocks? -Stock identification techniques: morphological, markers, tagging -Absolute & Relative abundance -Stratified sampling methods: assumptions, advantages, and disadvantages	<u>Optional:</u> Milner-Gulland, E. J., and J. M. Rowcliffe. 2007. Conservation and sustainable use: a handbook of techniques, Chapter 1, Sections 1.2-1.3 (book pgs 2-11). Oxford University Press, Oxford. Secor, D. H. 2014. Chapter Two - The Unit Stock Concept: Bounded Fish and Fisheries. Pages 7–16 *in* S. X. Cadrin, L. A. Kerr, and S. Mariani, editors. Stock Identification Methods (Second Edition). Academic Press, San Diego.
RM.04 (L, 1.0 hr)	**Population Dynamics: Age and Growth I** -Why does age matter -Determining age -Uses of age data	Khan and Khan. 2014. Importance of age and growth studies in fisheries management. Conference proceedings document.
RM.05 (L, 1.0 hr)	**Population Dynamics: Age and Growth II** -Why does growth data matter -Growth patterns -Growth models	King, M. G. 2007. Fisheries biology, assessment and management. 2nd ed. Chapter 4 section 4.3 (pg. 189-211). Blackwell Pub, Oxford ; Ames, Iowa.
RM.06 (L, 1.0 hr)	**Population Dynamics: Reproduction** -Reproductive effort -Maturity	King, M. G. 2007. Fisheries biology, assessment and management. 2nd ed. Chapter 4 sec. 4.3.5 (pg. 211-219). Blackwell Oxford; Ames, IA.
RM.07 (L, 1.0 hr)	**Population Dynamics: Recruitment & Survival** -Recruitment curves -Estimating mortality -Factors affecting recruitment & survival	King, M. G. 2007. Fisheries biology, assessment and management. 2nd ed. Chapter 4 section 4.3.6-4.4 (pg. 219-234). Blackwell Pub, Oxford ; Ames, Iowa. Kough, A. et al. (2013) Larval Connectivity and the International management of fisheries. PLoS ONE 8(6): e64970. Doi: 10.1371/journal.pone. 0064970. Pg1-11.
RM.08 (L, 1.0 hr)	**Population dynamics: Mortality and Surplus Models** -Survival / Mortality calculations	

No and Time	*Topics*	*Required Readings*
	-Stock-recruitment relationships -Production and surplus production	
RM.09 (L, 1.0 hr)	Population dynamics: Surplus Models, Maximum Sustainable Yield (MSY), Maximum Economic Yield (MEY) -Calculating MSY -How MSY plays a part in MEY -Discussion of the concept of MSY as a management tool -Overfishing	NOTE: Read these articles to understand pros/cons/challenges of MSY approaches. Do not need to memorize all details of articles. Roberts CM. 2007. Barbequed Jellyfish or Swordfish Steak? An Unnatural History of the Sea. Kolding, J., and P. A. M. van Zwieten. 2011. The Tragedy of Our Legacy: How do Global Management Discourses Affect Small Scale Fisheries in the South? Forum for Development Studies 38(3):267–297.
RM.10 (L, 1.0 hr)	**Stock Assessment Briefing & Calculations Review** -Review of population dynamics calculations -Explanation of exercise and applications used in resource management	
RM.11 (DEX, 1.0 hr)	**Stock Assessment Exercise** -Practical application of the techniques covered in stock assessment discussions	
RM.12 (L, 1.0 hr)	**TCI Conch Fishery** -Conch fisheries overview -Conch fisheries regulations -Conch management strategies	Lockhart et al. (2007) Fisheries of the Turks and Caicos Islands: Status and Threats. GCFI 58: 67-72. <u>Optional</u> Ulman, A. Et al. 2016. Conched out: Total reconstructed fisheries catches for the Turks and Caicos Islands uncover unsustainable resource usage. Frontiers in marine Science 3:71
RM.13 (L, 1.0 hr)	**TCI Lobster Fishery** -Lobster fisheries overview -Lobster fishery regulations -Lobster management strategies	
RM.14 (L, 1.0 hr)	**Global fisheries overview and data-limited fisheries assessment** -Review of fisheries issues and trends around the world -Discussion of assessing data-limited fisheries -Assessment and management of rare and endangered species	Worm B, Hilborn H. et al. 2009. Rebuilding global fisheries. Science 325: 578-585. Watson, R., C. Revenga, and Y. Kura. 2006. Fishing gear associated with global marine catches: I. Database development. Fisheries Research 79(1):97–102. <u>Optional</u> Begg, G. & J. Waldman. (1999). An holistic approach to fish stock identification. Fisheries Research. 43: 35-44.
RM.15	**Invasive Species I**	Lodge, D. M. et al. 2016. Risk Analysis and Bioeconomics of Invasive Species to Inform

No and Time	*Topics*	*Required Readings*
(L, 1.0 hr)	-Ecological and economic effects of invasives -Assessment and management of invasive species	Policy and Management. Annual Review of Environment and Resources 41(1):453–488.
RM.16 (L, 1.0 hr)	**Invasive Species II – FEX preparation** -Lionfish invasion -Effects of lionfish invasion -Assessment and management lionfish -Preparation for lionfish field exercise	Optional: Benkwitt, C. E., et al. 2017. Is the lionfish invasion waning? Evidence from The Bahamas. Coral Reefs 36(4):1255–1261. Green, S. J., et al. Côté. 2012. Invasive Lionfish Drive Atlantic Coral Reef Fish Declines. PLOS ONE 7(3):e32596. Smith, N. S., et al. 2017. Density-dependent colonization and natural disturbance limit the effectiveness of invasive lionfish culling efforts. Biological Invasions 19(8):2385–2399.
RM.17 (L, 1.0 hr)	**Case Study I Review: Assessing resources**	Optional review reading: Cooper, A.B. 2006. A guide to fisheries stock assessment. NH Sea Grant.
RM.18 (E, 2.0 hr)	**Case Study I Exam**	
RM.19 (FEX, 4.0 hr)	**Invasive Species Field Exercise** -Survey of lionfish abundance in habitats around South Caicos -Dissection of lionfish	
RM.20 (L, 1.0 hr)	Case Study I Exam Debriefing	
RM.21 (DEX, 1.5 hr)	**Invasive Species Data Management Exercise** -Excel data management of collected lionfish data	
RM.22 (L, 1.0 hr)	**Introduction to Conch Field Exercise** -Introduction to methods for conch abundance estimation -Collection and analysis of conch abundance data from South Caicos waters -Interpretation and presentation of abundance data with regard to MPA effectiveness	Medley PAH, Ninnes CH (1999) A stock assessment for the Conch (*Strombus gigas*) fishery in the Turks and Caicos Islands. Bull Mar Sci 64(3): 399-406
RM.23 (FEX, 1.0 hr)	**Conch Field Exercise practice run** -In-water trial of survey skills necessary to collect and record accurate data during the conch field exercise	
RM.24	**Ocean Pollution Management** -Causes of pollution	Law, K. L., and R. C. Thompson. 2014. Microplastics in the seas. Science 345(6193):144–145.

No and Time	*Topics*	*Required Readings*
(L, 1.0 hr)	-Concepts and strategies to manage pollution -International and regional agreements	Stafford, R. and P.J.S. Jones. 2019. Viewpoint- Ocean Plastic Pollution: a convenient but distracting truth. Marine Policy 103:187-191. <u>Optional</u> Wang, J., et al. 2016. The behaviors of microplastics in the marine environment. Marine Environmental Research 113:7–17.
RM.25 (FEX, 8.0 hr)	**Conch Field Exercise** -Data collection in water of Protected Area verse Non-protected area	
RM.26 (DEX, 3.6 hr)	**Conch Exercise –Write Up** -Data analysis -Reporting findings	
RM.27 (L, 2.0 hr)	**Introduction to fisheries management** -Discussion of fisheries management -EDF catch shares game	
RM.28 (L, 1.0 hr)	**Aquaculture** -General concepts of aquaculture -Effects of aquaculture -Caribbean aquaculture	Alvarez-Lajonchere, L. and Ibarra-Castro, L. (2013) Aquaculture species selection method applied to marine fish in the Caribbean. Aquaculture. 408-409: 20-29.
RM.29 (L, 1.0 hr)	**Introduction to Marine Protected Areas & Effects on Fisheries** -Defining MPAs -Protected Areas as tools for coastal resource management -Consideration of pros and cons of MPAs for fisheries	Edgar, G. et al. (2014) Global conservation outcomes depend on marine protected areas with five key features. Nature. 506: 216-220. Cinner, J. E., et al. 2018. Gravity of human impacts mediates coral reef conservation gains. Proceedings of the National Academy of Sciences 115(27):E6116–E6125. <u>Optional:</u> Gell FR, Roberts CM. 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology & Evolution* **18**. Angulo-Valdés, J. A., and B. G. Hatcher. 2010. A new typology of benefits derived from marine protected areas. Marine Policy 34(3):635–644.
RM.30 (L, 1.0 hr)	**MPA Planning & Management** -Selecting protected areas -MPA planning and management options -Data, surveillance and enforcement requirements for MPAs -Regulations pertaining to use -Baseline survey methods -Determining the success of MPAs	Roberts C. et al. 2003. Applications of Ecological Criteria in Selecting Marine Reserves and Developing Reserve Networks. Ecological Application 13(1): 215-228.
RM. 31 (L, 1.0 hr)	**The TCI government and Non-governmental organizations** -Management agencies in the TCI -What these agencies manage	

No and Time	*Topics*	*Required Readings*
	-Difficulties of management in the TCI	
RM.32 (FEX, 1.5 hr)	**Enforcement Field Exercise** -Students participate as Conservation Officers of DECR, TCI Government to enforce local regulations	
RM.33 (L, 1.0 hr)	**Coastal & Marine Zoning** -Integrated Coastal Zone Management -Maintaining and improving the status of marine resources -Marine Spatial Planning -Putting MPA planning and management into practice -Discussion of Large Marine Ecosystem Management	David, G., et al. 2010. Integrated coastal zone management perspectives to ensure the sustainability of coral reefs in New Caledonia. Marine Pollution Bulletin 61: 323-334. <u>Optional:</u> Halpern, B. S., et al. 2010. Placing marine protected areas onto the ecosystem-based management seascape. Proceedings of the National Academy of Sciences 107(43):18312–18317. Heck, N., A. et al. 2017. Management priorities for seawater desalination plants in a marine protected area: A multi-criteria analysis. Marine Policy 86:64–71.
RM.34 (DEX, 8.0 hr)	**Zoning Exercise** -Designing plans for management of marine resources in TCI to reflect the interests of various stakeholder groups	Bustamente, G., et al. 2014. Marine protected areas management in the Caribbean and Mediterranean seas: making them more than paper parks. Aquatic Conservation: Marine and Freshwater Ecosystems 24:153-165.
RM.35 (L, 1.0 hr)	**Climate Change effects on Fisheries** -Are fisheries affected by climate changes? -How are fisheries affected by climate change?	Sumaila, U. R., et al. 2011. Climate change impacts on the biophysics and economics of world fisheries. Nature Climate Change 1(9):449–456.
RM.36 (L, 1.0 hr)	**Natural disaster and fisheries: Hurricanes** -Fisheries sustainability as affected by natural disasters -Hurricane effects on fisheries	Solís, D., L. Perruso, J. del Corral, B. Stoffle, and D. Letson. 2013. Measuring the initial economic effects of hurricanes on commercial fish production: the US Gulf of Mexico grouper (Serranidae) fishery. Natural Hazards 66(2):271–289. NOTE: You do not need to understand the details of the model described in this Solís paper. Pomeroy, R. S., B. D. Ratner, S. J. Hall, J. Pimoljinda, and V. Vivekanandan. 2006. Coping with disaster: Rehabilitating coastal livelihoods and communities. Marine Policy 30(6):786–793.
RM.37 (P, E, 2.0 hr)	**Zoning Exercise Presentations** -Present new plans for management of marine resources in the TCI based on stakeholder groups	
60+	**Total Hours**	

Reading List

*Readings in **Bold** are required. Readings are listed in the order they appear in the syllabus

Halpern, B. S., et al. 2008. A Global Map of Human Impact on Marine Ecosystems. Science 319(5865):948–952.

Milner-Gulland, E. J., and J. M. Rowcliffe. 2007. Conservation and sustainable use: a handbook of techniques, Chapter 1, Sections 1.2-1.3 (book pgs 2-11). Oxford University Press, Oxford.

Secor, D. H. 2014. Chapter Two - The Unit Stock Concept: Bounded Fish and Fisheries. Pages 7–16 *in* S. X. Cadrin, L. A. Kerr, and S. Mariani, editors. Stock Identification Methods (Second Edition). Academic Press, San Diego.

Khan and Khan. 2014. Importance of age and growth studies in fisheries management. Conference proceedings document.

King, M. G. 2007. Fisheries biology, assessment and management. 2nd ed. Blackwell Pub, Oxford ; Ames, Iowa.

Lockhart et al. (2007) Fisheries of the Turks and Caicos Islands: Status and Threats. GCFI 58: 67-72.

Kough, A. et al. (2013) Larval Connectivity and the International management of fisheries. PLoS ONE 8(6): e64970. Doi: 10.1371/journal.pone. 0064970. Pg1-11.

Roberts CM. 2007. Barbequed Jellyfish or Swordfish Steak? An Unnatural History of the Sea.

Kolding, J., and P. A. M. van Zwieten. 2011. The Tragedy of Our Legacy: How do Global Management Discourses Affect Small Scale Fisheries in the South? Forum for Development Studies 38(3):267–297

Watson, R., C. Revenga, and Y. Kura. 2006. Fishing gear associated with global marine catches: I. Database development. Fisheries Research 79(1):97–102.

Begg, G. & J. Waldman. (1999). An holistic approach to fish stock identification. Fisheries Research. 43: 35-44.

Lodge, D. M. et al. 2016. Risk Analysis and Bioeconomics of Invasive Species to Inform Policy and Management. Annual Review of Environment and Resources 41(1):453–488.

Worm B, Hilborn H. et al. 2009. Rebuilding global fisheries. Science 325: 578-585.

Green, S. J., et al. Côté. 2012. Invasive Lionfish Drive Atlantic Coral Reef Fish Declines. PLOS ONE 7(3):e32596.

Smith, N. S., et al. 2017. Density-dependent colonization and natural disturbance limit the effectiveness of invasive lionfish culling efforts. Biological Invasions 19(8):2385–2399.

Benkwitt, C. E., et al. 2017. Is the lionfish invasion waning? Evidence from The Bahamas. Coral Reefs 36(4):1255–1261.

Law, K. L., and R. C. Thompson. 2014. Microplastics in the seas. Science 345(6193):144–145.

Wang, J., et al. 2016. The behaviors of microplastics in the marine environment. Marine Environmental

Research 113:7–17.
Cooper, A.B. 2006. A guide to fisheries stock assessment. Chapters 3-4. NH Sea Grant.
Medley PAH, Ninnes CH (1999) A stock assessment for the Conch (*Strombus gigas*) fishery in the Turks and Caicos Islands. Bull Mar Sci 64(3): 399-406

Alvarez-Lajonchere, L. and Ibarra-Castro, L. (2013) Aquaculture species selection method applied to marine fish in the Caribbean. Aquaculture. 408-409: 20-29.
Edgar, G. et al. (2014) Global conservation outcomes depend on marine protected areas with five key features. Nature. 506: 216-220.

Cinner, J. E., et al. 2018. Gravity of human impacts mediates coral reef conservation gains. Proceedings of the National Academy of Sciences 115(27):E6116–E6125.

Gell FR, Roberts CM. 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology & Evolution* 18.

Angulo-Valdés, J. A., and B. G. Hatcher. 2010. A new typology of benefits derived from marine protected areas. Marine Policy 34(3):635–644.
Roberts C. et al. 2003. Applications of Ecological Criteria in Selecting Marine Reserves and Developing Reserve Networks. Ecological Application 13(1): 215-228.

David, G., et al. 2010. Integrated coastal zone management perspectives to ensure the sustainability of coral reefs in New Caledonia. Marine Pollution Bulletin 61: 323-334.

Halpern, B. S., et al. 2010. Placing marine protected areas onto the ecosystem-based management seascape. Proceedings of the National Academy of Sciences 107(43):18312–18317.

Heck, N., A. et al. 2017. Management priorities for seawater desalination plants in a marine protected area: A multi-criteria analysis. Marine Policy 86:64–71.
Sumaila, U. R., et al. 2011. Climate change impacts on the biophysics and economics of world fisheries. Nature Climate Change 1(9):449–456.

Solís, D., L. Perruso, J. del Corral, B. Stoffle, and D. Letson. 2013. Measuring the initial economic effects of hurricanes on commercial fish production: the US Gulf of Mexico grouper (Serranidae) fishery. Natural Hazards 66(2):271–289.

Pomeroy, R. S., B. D. Ratner, S. J. Hall, J. Pimoljinda, and V. Vivekanandan. 2006. Coping with disaster: Rehabilitating coastal livelihoods and communities. Marine Policy 30(6):786–793.