Science and Technology Group
Annual Report FY2018

Payal Shah
Science and Technology Associate

1 Introduction

My research focuses on issues of environmental conservation and sustainability of natural resources. I use economic theory and statistical methods, combined with tools from ecology and biogeography, to evaluate the impact of conservation policies and to develop optimal strategies for conservation efforts in the face of environmental and economic uncertainties. I also use contingent valuation methods to quantify the willingness of people to support and fund conservation efforts.
In collaboration with other PIs and researchers at OIST, I am working with the OKEON (Okinawa Environmental Observatory Network) group on using a watershed model and historical land use/ land cover change data to identify terrestrial "hot spots" that are adversely impacting coral reefs in Okinawa.

2 Activities and Findings

Determinants and Implications of Global Protected Area Effectiveness

Establishing protected areas is a cornerstone of global conservation policy targeted at preservation of species and ecosystems and mitigating the impacts of climate change. We use a high resolution global data of forest cover loss from 2000 to 2012 to evaluate the effectiveness of global protected area network. In table 1, we illustrate the protected area impact on reducing forest cover loss by continent. In figure 1, we show the results for protected area effectiveness for Asia.

Continent	Forest Cover Loss 2000 - 2012 (sq. km)	Protected areas 2000-2012 (sq. km)	PA Impact (sq. km)	PA Impact (% of PA)	PA Impact (% of forest cover loss)
South America	-519,020	1,704,235	33,312	1.95%	6.42%
North America	-576,959	778,362	15,053	1.93%	2.61%
Oceania	-44,616	606,287	1,334	0.22%	2.99%
Europe	-105,761	524,858	2,647	0.50%	2.50%
Asia	-673,343	357,126	3,469	0.97%	0.52%
Africa	-197,332	502,413	1,114	0.22%	0.56%

Table 1

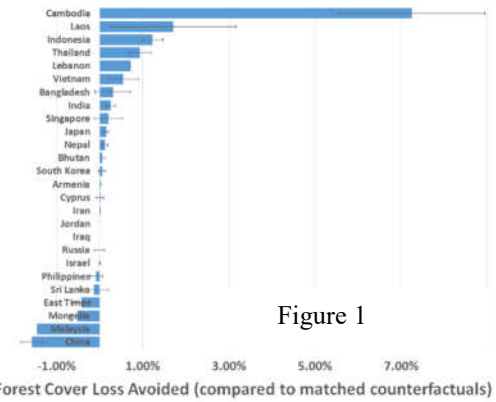

Figure 1

A quasi-dynamic portfolio theory approach for invasive species management

Faced with a growing list of invasive species and limited budgets to respond to their impacts, state and federal agencies must prioritize control effort across a range of invasive species and often over multiple planning periods. We combine portfolio optimization and real options analyses to develop a "quasi" dynamic diversification approach that considers investments across different species and the optimal timing of such investment. Portfolio analyses identifies how a fixed budget should be allocated across species based on risk preferences. The optimal budget allocations identified are then used as an input in a real options model. Using this combined approach, we identify a portfolio that minimizes the spread risk for a given return and accounts for the influence of that risk on the option value (as seen in figure 2).

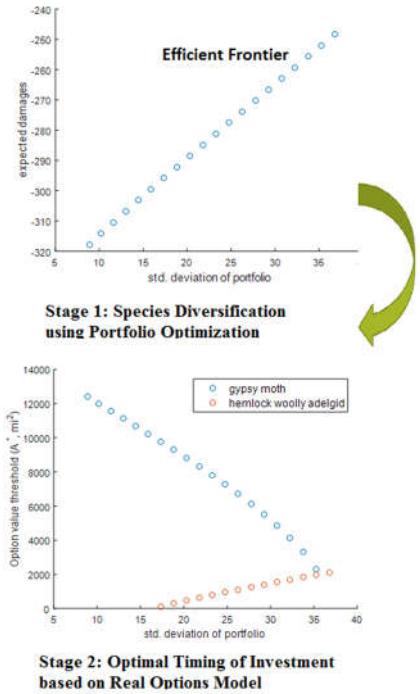

Figure 2

Science and Technology Group
Annual Report FY2018

Payal Shah
Science and Technology Associate

Watershed modeling to identify terrestrial "hot spots" that impact coral reefs in Okinawa

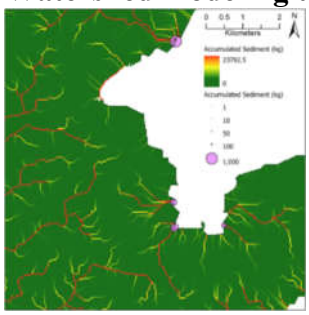

Figure 3a

Globally coral reefs and associated inshore ecosystems are increasingly threatened by runoffs from land based pollutants. As part of the OKEON project at OIST, we use a watershed model to understand the potential impacts of runoff on the marine environment of Okinawa. We have collected and processed a range of datasets including time series of rainfall measurements, soil type classification, time series of land cover classification and weather data. We estimate accumulated (Figure 3a) and local (Figure 3b) runoff quantity over time. We plan on using these run-off estimates to identify terrestrial problem areas or "hotspots" in Okinawa that may have a negative impact on marine environments.

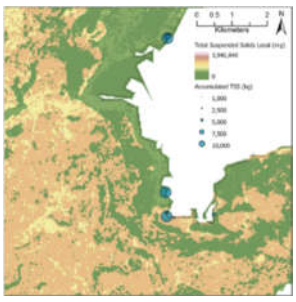

Figure 3b

3 Collaborations

1. Project: Choice experiment survey of Okinawa's marine environment
Collaborators: Paulo A.L.D. Nunes, Global Coordinator of ProEcoServ, United Nations
Yoko Fujita, Professor, University of the Ryukyus
Sahan Dissanayake, Assistant Professor, Portland State University
2. Project: Watershed modeling to identify terrestrial "hot spots" that impact coral reefs in Okinawa
Collaborators: Evan Economo, Assistant Professor, OIS Graduate University
Satoshi Mitarai, Associate Professor, OIST Graduate University
Kenneth Dudley, Technician, OIST Graduate University
3. Project: Optimal conservation planning and climate change uncertainty
Collaborators: Amy Ando, Professor, University of Illinois at Urbana-Champaign
Mindy Mallory, Associate Professor, University of Illinois at Urbana-Champaign
Glenn Guntenspergen, Research Ecologist, United States Geological Survey
4. Project: Global deforestation and protected areas
Collaborators: Kathy Baylis, Associate Professor, University of Illinois at Urbana-Champaign
Jonah Busch, Senior Research Fellow, Center for Global Development
Jens Engelmann, Phd Candidate, University of Wisconsin
5. Project: Multidimensional risk diversification for invasive species management: A quasi-dynamic portfolio theory approach
Collaborators: Charles Sims, Associate Professor, University of Tennessee
Amy Ando, Professor, University of Illinois at Urbana-Champaign

4 Publications and other output

4. 1 Peer Reviewed Publications

1. Shah, Payal, Dissanayake, Sahan, T. M., Fujita, Yoko and Nunes, Paulo, A.D. 2019. Impact of a local, coastal community based management regime when defining marine protected areas: Empirical results from a study in Okinawa, Japan. *PLOS One, 14*(3), p.e0213354.

4.2 Conference Presentation

1. September 2018: Determinants and Implications of Global Protected Area Effectiveness, Heartland Environmental and Resource Economics Workshop, Urbana-Champaign, Illinois, USA.

5 External funding

1. Kakenhi Early Career Scientists 1, April 2018 - March 2020