Science and Technology Group
# Annual Report FY2022

Payal Shah

Science and Technology Associate

1 Introduction

In my research, I use economic theory and statistical methods, combined with tools from ecology and biogeography, to analyze social and environmental impacts of natural resource management policies, to formulate optimal strategies to address environmental challenges such as climate change, and to evaluate preferences for ecosystem services. The major contributions of my research have been in advancing fundamental knowledge of: (1) how to do efficient and optimal conservation planning to deal with issues of climate change uncertainty, and (2) how to quantify and measure the impact of conservation policy on ecological outcomes.

2 Activities and Findings

Robust conservation prioritization under climate change for alpine vegetations in Daisetsuzan National Park using portfolio optimization theory

Figure 1
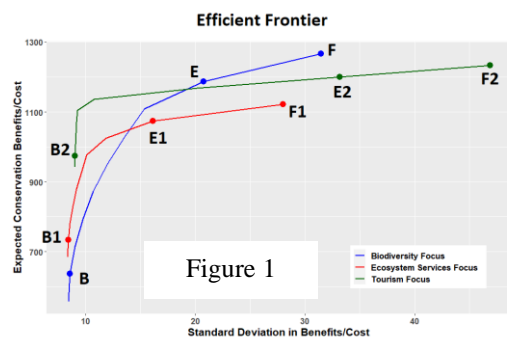
Daisetsu National Park is an important conservation region in northern Japan. The area is rich in alpine plant species that support biodiversity, provide a range of ecosystem services, and support the tourism industry. These alpine vegetations are expected to be particularly vulnerable to climatic changes. We evaluate the expected changes in four types of alpine vegetation (i.e. snow bed, fellfield, wilderness and shrubs) for three climate scenarios and two GCM models across the approximately 900 sq. km. study site. Our unit of observation is 1 sq. km. by 1 sq. km. grid. We then combine Marxan site prioritization with portfolio optimization to identify which grids are most important for conservation efforts (see figure 1 for preliminary results). This is the first study to conduct portfolio optimization at a fine scale and simultaneously combine the Marxan approach to arrive at optimal site selection output.

Evaluating the heterogenous impacts of conservation easements on property prices across the conterminous United States

Figure 2
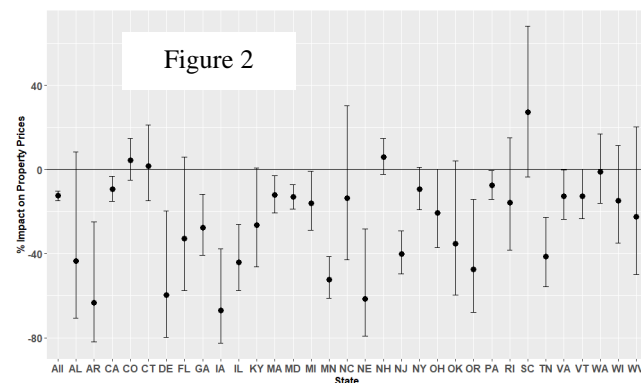
Conservation easements are a widely used policy measure in the United States. We use quasi experimental methods on a spatially explicit dataset across the conterminous United States to estimate the impact of easements on property prices. We find easement encumbered properties sell at a 13.3% discount to matched unencumbered properties. Post matching OLS regression results also indicate a significant and negative discount of 3.1% for encumbered properties (see figure 2). We find that easement encumbered properties with a focus on agricultural or wetland conservation, larger parcel size, greater conversion pressures, and which are on flat land, experience a large discount on property prices.

Science and Technology Group
Annual Report FY2022
Payal Shah
Science and Technology Associate

3 Collaborations

1. Robust conservation prioritization under climate change for alpine vegetations in Daisetsuzan National Park using portfolio optimization theory
   Collaborators: Fumiko Ishihama (Researcher, National Institute for Environmental Studies)
   Oguma Hiroyuki (Researcher, National Institute for Environmental Studies)
   Amagai Yukihiro (Researcher, National Institute for Environmental Studies)

2. 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

3. Fine scale conservation planning with limited climate change information
   Collaborators: Valentin Popov, Lecturer, University of St. Andrews
   Jonathan Rhodes, Professor, The University of Queensland
   Rebecca Runting, Lecturer, University of Melbourne

4. Flexible Conservation Decisions for Climate Adaptation
   Collaborators: Jonathan Rhodes (Professor, The University of Queensland)
   Paul Armsworth (Professor, University of Tennessee Knoxville)
   Brett Bryan (Professor, Deakin University)
   Gwenllian Iacona (Assistant Professor, Arizona State University)
   Ascelin Gordon (Senior Research Fellow, RMIT University)
   Rebecca Runting (Lecturer, The University of Melbourne)
   Kerrie Wilson (Professor, Queensland University of Technology)

5. Evaluating the heterogenous impacts of conservation easements on property prices across the conterminous United States
   Collaborators: Christoph Nolte (Assistant Professor, Boston University)

4 Publications and other output

4.1 Publications:

- Popov, V., Shah, P., Runting, R.K. and Rhodes, J.R., 2022. Managing risk and uncertainty in systematic conservation planning with insufficient information. *Methods in Ecology and Evolution*, 13(1), pp.230-242.
- Rhodes, J.R., Armsworth, P.R., Iacona, G., Shah, P., Gordon, A., Wilson, K.A., Runting, R.K. and Bryan, B.A., 2022. Flexible conservation decisions for climate adaptation. *One Earth*, 5(6), pp.622-634.
- Shah, P. and Nolte, C. 2023. Evaluating the heterogenous impacts of conservation easements on property prices across the conterminous United States. Revise and Resubmit in *Land Economics*

4.2 Seminar and Presentations:

- October 2022. Combining Portfolio Optimization and Marxan for Robust Conservation Prioritization under Climate Change in Daisetsuzan National Park. Heartland Workshop, Illinois, USA.

5 External funding

1. Kakenhi Early Career Scientist I (April 2020 – March 2023)
Project: Multidimensional risk diversification for conserving coastal wetlands under climate change uncertainty; Funding Amount: $22,500
2. Japan International Cooperation Agency (JICA) Grant as Co-PI (April 2022 – March 2026)
Project: Empirical research on the effects of the SHEP approach on small-scale farmers in Ethiopia