UC SANTA BARBARA
Bren School of Environmental Science & Management

2024 PhD Student Symposium

PhD Symposium Schedule

This symposium will have short (3 minutes) and long (12 minutes) oral presentations, with one short break (25 minutes).

1:00 – 1:05 pm: Welcome remarks
Jaenna Wessling
Co-Chair, PhD Symposium Committee

1:05 – 1:10 pm: Highlights of PhD research at Bren School
Dr. Steven Gaines
Dean and Professor, Bren School

The Bren School expresses its sincere gratitude to our sponsor of the PhD student symposium:

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AEP Channel Counties Chapter, Bank of America Charitable Foundation, Brownstein Hyatt Farber Schreck, California Homebuilding Foundation, Deckers Outdoor Corporation, Latham & Watkins, O'Melveny & Myers, Professional Environmental Managers Association (PEMA), Rincon Consultants, Southern California Edison, The Nature Conservancy, Toad & Co.

Symposium Schedule

ORAL PRESENTATION I

1:10 – 1:25 pm: Brian Lee
“Tree-mendous Changes: Quantifying Changes in Forest Carbon Using Remote Sensing and Machine Learning”

1:25 – 1:30 pm: Wen Tien Wang
“Just Transition Strategies for the Refinery Industry Sector in the USA”

1:30 – 1:45 pm: Sean Denny
“Outsourcing Wildlife Conservation: A Comparative Analysis of Private and Government Management of Protected Areas in Africa”

1:45 – 2:00 pm: Allie Caughman
"Climate Change Reduces Long-term Population Benefits from Marine Protected Areas Through Selective Pressures on Species Movement"

2:00– 2:05 pm: Shay Magahey
"Identifying Changes to El Niño-Southern Oscillation in a Warming Climate"

2:05 – 2:20 pm: Yifan (Flora) He
"Health Impact of Gold Mining in the Brazilian Amazon"

2:20 - 2:45 pm: Break (refreshments available in the courtyard)

Symposium Schedule

(CONTINUED)

ORAL PRESENTATION II

2:45 - 3:00 pm: Cali Pfleger
"The Impact of Marine Cloud Brightening on Eastern Pacific Fisheries"

3:00 - 3:05 pm: Jamie Miller
"Acoustic Behavioral Response of Nesting Western Snowy Plovers to Rocket Launches in Restored Coastal Dunes at Vandenberg Space Force Base"

3:05 - 3:20 pm: Mukta Kelkar
“Empirical Studies on Climate Resilience in MPAs Demonstrate Effectiveness in Limited Contexts”

3:20 - 3:25 pm: Risa Lewis
"Valuing the Mental Health Impact of Climate Change Information"

3:25 - 3:40 pm: Haozhe Yang
"Global Transcontinental Power Pools for Low-carbon Electricity"

3:40 - 3:45 pm: Gemma Del Rossi
"Untangling the Influence of Climate on Agricultural Decision-Making: Evidence from Smallholders in Zambia"

Symposium Schedule

(CONTINUED)

3:45 - 3:50 pm: Closing Remarks
Allie Caughman
Co-Chair, PhD Symposium Committee

4:00 pm: Reception and awards ceremony

Symposium Abstracts

In order of appearance

Title: Tree-mendous Changes: Quantifying Changes In Forest Carbon Using Remote Sensing and Machine Learning

Speaker: Brian Lee
Advisor: Ashley Larsen
Co-authors: Robert Heilmayr, Alex Rich, Lola Fatoyinbo, Nathan Thomas, Atticus Stovall

Abstract: In the face of a rapidly changing climate, forests play a crucial role in sequestering carbon. This project introduces a novel approach to monitoring these critical ecosystems. Central to this project is the open-source data pipeline that fuses data from multiple distinct spaceborne sensors. Our collaboration with one of Chile's largest timber producers, ARAUCO, presents a unique opportunity to use an extensive forest inventory dataset as reference data to compare, train, and validate various machine learning approaches. This synergy between remote sensing and machine learning not only deepens our understanding of forest carbon dynamics but also supports sustainable management and climate mitigation efforts.

Title: Just Transition Strategies for the Refinery Industry Sector in the USA

Speaker: Wen Tien Wang
Advisor: Ranjit Deshmukh

Abstract: Air pollution is a pressing global issue, given its significant implications for both environmental quality and public health. This study delves into the notable contribution of the petroleum oil refining industry to air pollution. Despite ongoing efforts to curb emissions, there persists a high demand for refined petroleum products. Aligned with the Biden administration's ambitious goals to mitigate greenhouse gas emissions, the study establishes three distinct scenarios: High Electrification (E+), Less-High Electrification (E-), and Reference scenarios. These scenarios are designed to explore potential pathways for the retirement of refinery stations nationwide. By consolidating existing assumptions and focusing specifically on the refinery sector, the study aims to shed light on its interactions with disadvantaged communities and the associated inequality issues during the energy transition.Through the use of air pollution modeling and health impact assessments, the research examines the repercussions of refinery emissions on diverse communities. Additionally, the study evaluates scenarios based on the Net Zero America pathways to discern their potential implications for low-income, racial, and disadvantaged communities. In essence, this research endeavors to deepen our understanding of inequality in refinery regulation and to chart pathways toward achieving net-zero emissions. It emphasizes the importance of enhancing geographical resolution and addressing inequality concerns across the United States.

Title: Outsourcing Wildlife Conservation: A Comparative Analysis of Private and Government Management of Protected Areas in Africa

Speaker: Sean Denny
Advisor: Bruce Kendall
Co-authors: Gabe Englander, Patrick Hunnicutt

Abstract: Protected areas can conserve wildlife and benefit people when managed effectively. African governments increasingly delegate the management of protected areas to private, non-governmental organizations, hoping that private organizations' significant resources and technical capacities actualize protected areas' potential. Does private management improve outcomes compared to a counterfactual of government management? We leverage the transfer of management authority from governments to African Parks (AP)—the largest private manager of protected areas in Africa—to show that private management significantly improves wildlife outcomes via reduced elephant poaching and increased bird abundances. Our results also suggest that AP's management augments tourism, while the effect on rural wealth is inconclusive. However, AP's management increases the risk of armed groups targeting civilians, which could be an unintended outcome of AP's improved monitoring and enforcement systems. These findings reveal an intricate interplay between conservation, economic development, and security under privately-managed protected areas in Africa.

Acknowledgements: Central Campus Fellowship

Title: "Climate Change Reduces Long-term Population Benefits from Marine Protected Areas Through Selective Pressures on Species Movement"

Speaker: Allie Caughman
Advisors: Steve Gaines, Darcy Bradley

Abstract: Marine protected areas (MPAs) are important conservation tools that confer ecosystem benefits by removing fishing within their borders to allow stocks to rebuild. Fishing mortality outside a traditionally fixed MPA can exert selective pressure for low movement alleles, resulting in enhanced protection. While evolving to move less may be useful for conservation presently, it could be detrimental in the face of climate change for species that need to move to track their thermal optimum. Here, we build a spatially explicit simulation model to assess the impact of movement evolution in and around static MPAs resulting from both fishing mortality and temperature-dependent natural mortality on conservation benefits across five climate scenarios: i) linear mean temperature shift, ii) El Niño/La Niña conditions, iii) heat waves, iv) heatwaves with a mean temperature shift, and v) no climate change. While movement evolution allows populations within MPAs to survive longer, we find that over time, climate change degrades the benefits by selecting for higher movement genotypes. Resulting population declines within MPAs are faster than expected based on climate mortality alone, even within the largest MPAs. Our findings suggest that while static MPAs may conserve species for a time, other strategies, such as assisted migration, may be required in conjunction to conserve species into the future.

Acknowledgements: NSF GRFP

Title: Identifying Changes to El Niño-Southern Oscillation in a Warming Climate

Speaker: Shay Magahey
Advisor: Sam Stevenson

Abstract: El Niño-Southern Oscillation (ENSO) is the most prominent source of natural variability in Earth's climate system, but its response to anthropogenic climate change remains unclear. Some Earth system models indicate that ENSO weakens under a warming climate while others point to more extreme ENSO events as the world warms. The reasons for this discrepancy are unclear and these confounding results must be settled in order to project impacts of future weather and climate extremes due to ENSO. This work utilizes the US Department of Energy's Energy Exascale Earth System Model version 1 Large Ensemble (E3SMv1-LE) to evaluate changes in ENSO and the tropical Pacific mean climate. Preliminary results find an El Nino-like warming pattern in the tropical Pacific, which is consistent with other global climate models and coincides with an increase in ENSO amplitude. E3SMv1-LE indicates that ENSO variability increases from 1850 to 2100, and extremes in both El Nino and La Nina become more frequent and intense under a warming climate. Overall, these results suggest that significant changes to ENSO could arise due to climate change, and societies must prepare accordingly for the increasingly devastating impacts of ENSO events in a warming world.

Title: Health Impact of Gold Mining in the Brazilian Amazon

Speaker: Yifan (Flora) He
Advisors: Mark Buntaine, Robert Heilmayr
Co-authors: Anna Pede, Jacqueline de Aguiar Barros, Robert Heilmayr

Abstract: Small-scale and artisanal gold mining (ASGM) can degrade the environment and lead to a variety of negative health outcomes associated with mercury use and mosquito-borne diseases. Gold mining has been accelerating in the Brazilian Amazon in the past decade, raising concerns over its impact on population health, especially health of Indigenous peoples. Yet, no study has systematically documented the health impact of gold mining across the Brazilian Amazon, and causal evidence is lacking. In this study, we use an instrumental variable design with cluster LASSO variable selection to isolate the effect of gold mining on health. We find that gold mining increases malaria, dengue, and Zika prevalence among the general population. Gold mining negatively affects Indigenous populations in several indicators of newborn health, and the magnitude of impact increases with time. Mining has mixed impact on newborn health among the general population. Our results highlight the broad, long-lasting, and unequal health effects of gold mining in the Brazilian Amazon. We provide key evidence to guide policy interventions in regulating gold mining and addressing its health impacts.

Acknowledgements: Michael J. Connell Memorial Fund Research Award

Title: The Impact of Marine Cloud Brightening on Eastern Pacific Fisheries

Speaker: Cali Pfleger
Advisor: Sam Stevenson
Co-authors: Mukta Kelkar, Sadie Cwikiel, Cheryl Harrison, Chen Xing

Abstract: Anthropogenic alterations to the Earth system have disrupted the climate on an unprecedented scale. As climate intervention methods may cause further disruptions to the Earth system, it is critical to understand their potential environmental and ecological consequences. One of these methods is marine cloud brightening (MCB) in which sea spray aerosol particles are injected over the ocean to increase the albedo of marine stratocumulus clouds. Even with the promise of using MCB to cool the planet and reduce some impacts of anthropogenic global warming, there are major caveats as the ecosystem response to MCB is unknown. To fill this gap, we investigate the impacts of MCB on El Niño Southern Oscillation (ENSO) dynamics in the Eastern Pacific by using the ARISE-MCB model and future climate change SSP scenarios to assess potential impacts on economically significant fisheries in the region from 2035-2069. First, to analyze the response of changes in ENSO magnitude and evolution, we identify changes in sea surface temperature (SST) and biological variables in response to MCB and SPP2-4.5 (intermediate) scenarios. We then use the Bioeconomic Marine Trophic Size-Spectrum (BOATS) model, a process-based ocean ecosystem model with dynamic fishing that has been used in a number of future climate applications This is the first interdisciplinary study of the MCB effects on fishery responses to ENSO, combining state-of-the-art climate and fisheries modeling techniques. This work is motivated by the lack of research on MCB's impact on climate, along with the well-documented impacts ENSO has on Eastern Pacific fisheries productivity.

Title: Acoustic Behavioral Response of Nesting Western Snowy Plovers to Rocket Launches in Restored Coastal Dunes at Vandenberg Space Force Base

Speaker: Jamie Miller
Advisor: Bruce Kendall

Abstract: Vandenberg Space Force Base has a long history of monitoring the impacts of rocket launches on federally threatened snowy plovers to balance Base mission needs and ESA obligations. Historically this has taken the form of daily observational surveys to document population distribution shifts and using time-lapse and pre-programmed video cameras on nests to determine nest abandonment rates and flushing behavior in response to the noise. These methods test the immediate impacts of a single launch, but the pace of SpaceX launches is scheduled to increase. It is challenging to use these measures to assess accumulating stress levels resulting from the increasing number of launches occurring on Base. Studying vocalization behavior may tell a more comprehensive story of snowy plover launch disturbance response since audio monitoring at nests can be done on a continuous basis, rather than just during launch windows. The proposed research will demonstrate how plover vocalization behavior changes in response to the increased pace of rocket launches at Vandenberg. Behavioral changes may be an indicator of increased stress which can impact plover reproductive fitness. This study will also investigate whether and how restored coastal dunes on Base may mitigate launch noise impacts.

Title: Empirical Studies on Climate Resilience in MPAs Demonstrate Effectiveness in Limited Contexts

Speaker: Mukta Kelkar
Advisors: Darcy Bradley, Steve Gaines
Co-authors: Jessica Couture, Danielle Ferraro, Chris Free, Steve Gaines, Darcy Bradley

Abstract: Marine protected areas (MPAs) have demonstrably improved local biodiversity and biomass, but their ability to maintain ecosystem function in the face of climate change is not well understood. Unlike when extractive activities such as fishing threaten marine ecosystems, MPAs do not directly regulate climate-driven changes within their borders. We sought to identify 1) which ecological features within MPAs should theoretically mitigate negative ecological effects of climate change, and 2) the extent to which evidence exists to support their effectiveness. We conducted a systematic literature review of empirical studies on the effect of MPAs on local ecosystems impacted by climate change to identify cases in which MPAs mitigate known climate impacts, have no mitigation effect given climate impacts, or exacerbate climate impacts. Of the 49 papers that met our inclusion criteria, a roughly similar number found positive effects as found no effects, while less than 10% found negative effects. Positive MPA effects were mostly driven by trophic interactions; for example, some MPAs fostered higher top predator or herbivore abundance, which prevented the dominance of sea urchins (in kelp forests) or algae (in coral reefs) relative to reference sites when faced with temperature-driven community shifts. The findings from this study identify when MPAs are best-suited to be a climate solution, when MPAs are unlikely to be an effective climate solution, and where more information is needed to determine the MPA effectiveness.

Acknowledgements: John Arnhold and Conservation International

Title: Valuing the Mental Health Impact of Climate Change Information

Speaker: Risa Lewis
Advisor: Christopher Costello

Abstract: While sometimes negative emotions such as anxiety are healthy to encourage action and problem-solving, the inundation of climate change information may frequently trigger maladaptive or pathological emotional responses in such a way that this provision of information is welfare-reducing. Some types of information may have a lower mental health cost than other types of information, and this distinction is pertinent when designing policies that include information interventions, such as mandatory GHG emissions disclosure in products, advertising regulations, or social norms interventions aimed at increasing voluntary climate action. Quantitative estimates of these cost differences may augment qualitative observations to provide a stronger argument to seriously consider mental health impacts in policy choice. After proving that physical damages are insufficient to explain a willingness to pay more than a penny for emissions intensity information—and insufficient to explain a desire to avoid the information—it is clear that not physical, but mental components of utility are driving the value of information in the context of climate change. Finally, based on predictions from a model of attention, I describe a lab experiment designed to capture a lower bound of the mental health cost of different types of climate change information.

Title: Global Transcontinental Power Pools for Low-carbon Electricity

Speaker: Haozhe Yang
Advisor: Ranjit Deshmukh

Abstract: The transition to low-carbon electricity is crucial for meeting global climate goals. However, given the uneven spatial distribution and temporal variability of renewable resources, balancing the supply and demand of electricity will be challenging when relying on close to 100% shares of renewable energy. Here, we use an electricity planning model with hourly supply-demand projections and high-resolution renewable resource maps to examine whether transcontinental power pools reliably meet the growing global demand for renewable electricity and reduce the system cost. If all suitable sites for renewable energy are available for development, transcontinental trade in electricity reduces the annual system cost of electricity in 2050 by 5–52% across six transcontinental power pools compared to no electricity trade. Under land constraints, if only the global top 10% of suitable renewable energy sites are available, then without international trade, renewables are unable to meet 12% of global demand in 2050. Introducing transcontinental power pools with the same land constraints, however, enables renewables to meet 100% of future electricity demand, while also reducing costs by up to 23% across power pools. Our results highlight the benefits of expanding regional transmission networks in highly decarbonized but land-constrained future electricity systems.

Acknowledgements: UCSB Chancellor's Fellowship

Title: Untangling the Influence of Climate on Agricultural Decision-Making – Evidence from Smallholders in Zambia

Speaker: Gemma Del Rossi
Advisor: Kathy Baylis
Co-authors: Patrese Anderson, Kathy Baylis

Abstract: Concerns about the impact of climate change on smallholder agriculture have spurred numerous studies evaluating altered climatic conditions on farmer adaptation strategies and potential crop yields. In this study, we ask: in a changing climate, when is it optimal to plant crops? The critical decision of when to plant crops influences labor allocations, input decisions, and consequently, the success of the harvest. We evaluate farmers' adaptive behavior concerning growing season adjustments by providing causal estimates of how changes in temperature and precipitation impact decisions related to when and how much maize to plant. Utilizing a panel dataset covering over 1000 rural households in Zambia from 2016-2019 in conjunction with remotely-sensed climate variables, this research explores induced adaptations using observational data. We examine two adaptations: planting dates and frequency of plantings. By leveraging naturally occurring inter-year and spatial variations in weather during the study, our empirical approach follows a standard panel fixed effects framework to capture the differing planting dates for maize across Zambia. Initial findings reveal significant impacts of increased temperature and precipitation occur two weeks before typical planting dates on advancing observed planting dates. Future investigations will incorporate additional climate variables like the week of start-of-season (SOS) rainfall, high-heat days, and growing degree days (GDD) into our analysis; and potentially explore how optimal planting date adjustments impact maize yields for rural households under different climate change scenarios.

The 2024 Bren PhD Student Symposium Committee

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