Temple University
Department of Biology

- Biology Doctoral Defense -

TITLE

"Range shifts and altered community interactions in the Eastern Pacific kelp forest ecosystem"

Mary Rose Cortese

TIME AND PLACE
Monday, June 10, 2024
10:00 AM
Biology Life Science Building
Room 234

Refreshments will be served at 9:30 AM

Dissertation Committee:
Dr. Brent Sewall, Advisory Committee Chair, Temple University
Dr. Erik Cordes, Examining Committee Chair, Temple University
Dr. Amy Freestone, Committee Member, Temple University
Dr. Jarrett Byrnes, External Member, University of Massachusetts Boston

Zoom: upon request

Please contact the Biology Department with any questions at 215-204-8854

Abstract: Species range movement due to changing ocean conditions is occurring around the world. As species move, they build new interaction networks as they shift from or into new ecological communities. Typically, species ranges are modeled individually, but biotic interactions have been shown to be important to creating more realistic modeling outputs for species. Kelp forests are known to be one of the most productive ecosystems in the world. To understand the importance of consumer interactions in Eastern Pacific kelp forest species distributions, I used a Maxent framework to model a key foundation species, giant kelp (*Macrocystis pyrifera*), and a dominant herbivore, purple sea urchins (*Strongylocentrotus purpuratus*). With neither species having previously been modeled in the Eastern Pacific, I found evidence for non-concurrent southern range contraction and a co-occurring northern range expansion for the two species. While the co-occurring movement may lead to increased spatial competition for suitable substrate, this non-concurrent contraction could result in community wide impacts such as herbivore release, tropicalization, or ecosystem restructuring. When looking at species distributions, an aspect that is often overlooked is species abundance. Drops in species abundance could lead to a species being functionally extinct while still being labeled as present in presence/absence distribution maps. Alternatively, rises in abundance could lead to trophic imbalance without being labeled as an area undergoing change. To understand how species abundance might change in Eastern Pacific kelp forests, I used a Generalized Additive Model framework to understand the relationship between abundance and environmental conditions for a suite of ecologically relevant echinoderm species. I then created a series of distribution models across climate change scenarios using these relationships. These models provide further clarity to how ocean warming may impact marine species as well as giving us a better understanding of where communities may be more vulnerable to restructuring due to altered abundance patterns. Lastly, in addition to range movement, thermal stress is also expected to alter interaction strength. Thermal anomalies occur in both short-term heatwaves and long-term increases to annual mean temperatures. In ectothermic organisms, increased temperatures should directly increase organism metabolism, but studies looking at metabolic change after heatwaves have shown conflicting results to long-term climate change studies leaving questions as to how species will be impacted on short-term and long-term scales. I tested the hypothesis that moderate experimental warming would increase herbivory rates over time for two sea urchin species, with a more pronounced increase occurring during long-term warming in comparison to simulated short-term heatwaves. After simulating both short-term and long-term warming events I found that feeding rates and thermal maxima varied by species and the length of warming event. While short-term heatwave events showed no increase in herbivory rates, longer-term warming led to increased herbivory in both species. Integration of these three studies allows us to create more holistic predictions about ecosystem wide change—providing information not just on changes to organisms' biogeographic range but also how interactions and trophic dynamics may change within that range.