2025 EEMB Undergraduate Research Symposium

Saturday, May, 3, 2025

8:15 AM **Check-In Begins**

9:00 AM **Welcome/Introduction to Symposium**

Todd Oakley, Hannah Lyford

9:15 AM **Session 1**

Please note: "10 minute talks" are 8 minute talks with time for 2 questions

- **10 min talk- Rishima Tewari** — *The Bugs, the Bees, and Baby Blue Eyes: Phenological forecasting based on future climate scenarios*

  Authors: Rishima Tewari, Helen Payne, and Dr. Susan Mazer; University of California, Santa Barbara, Department of Ecology, Evolution, and Marine Biology

  Phenology refers to the study of the timing of events in biological life cycles. Ecosystem functions and stability rely on interactions between plants and animals, and these organisms often interact based on environmental responses that initiate phenological behavior. Since factors that initiate phenological behaviors differ across trophic levels and taxonomic groups, determining the environmental factors that influence an organism's phenology allows us to assess how susceptible these relationships are to climate change. For our study, we evaluated the influence of future projected temperature and precipitation trends on the phenology of the native wildflower Nemophila menziesii and one of its associated pollinators (Bombus vosnesenskii). Electronic museum specimen records were used to obtain phenological data for the identified insect specimen. Specifically, the Global Biodiversity Information Facility (GBIF) was used to obtain pollinator and N. menziesii specimen collection dates which can be used as a proxy for pollinator emergence times and flowering dates respectively. Future projected climatic data from the locations of specimen collection was sourced from the website ClimateNA and merged with the GBIF insect specimen records. We generated random forest models in RStudio to determine how climatic variables will affect the phenology of our study organisms in various future climate scenarios. We predicted that the flowering phenology of N. menziesii will respond differently to predicted climatic variables compared to B. vosnesenskii, because different species appear to be cueing off different environmental variables that change at varying rates. If the phenology of B. vosnesenskii responds differently to predicted climatic conditions compared to the phenology of N. menziesii, this may indicate this relationship is at risk of a phenological mismatch.

- **10 min talk- Sam Joseph –***What's Left Behind: Legacy effects of iceplant (Carpobrotus edulis) on native plant growth in coastal sage scrub communities*

  Authors: Samuel Joseph, Nick Saglimbeni

  In an increasingly interconnected world, ecological communities that previously had no species exchange face an influx of novel species. This can lead to the displacement of native species, threatening biodiversity in sensitive systems.. A prime example of this is iceplant (Carpobrotus edulis) in California's coastal ecosystems. Current research on restoring iceplant invaded ecosystems has focused on mechanisms of invasion and management in restoration contexts. My research aims to enhance our understanding of iceplant invasion by assessing its effect on soil characteristics and native plant growth in local coastal communities. We will grow four California native coastal sage scrub plant species (Isocoma menzesii, Artemisia californica, Eriogonum parvifolium, Ericameria ericoides) in soil mixes made from 5 different field collected soils that differ in time since iceplant was removed from the area. We will assess (i) whether any observed differences correlate with soil nutrient composition and/or root mycorrhizal colonization and (ii) if shrubs grown in more recently invaded soils show decreased growth rates.

- **10 min talk- Erik Beahrs** — *Organelle-Like Membrane Invaginations in Giant Campylobacterota Present Novel Principles of Bacterial Cell Organization*

  Authors: Beahrs E, Gros O, Herman C, Contarini PE, Jorgens D, Date SV, Woyke T, Volland JM

  Our model organisms do not come close to capturing the diversity of bacteria, biasing our understanding of their capabilities. Surface-area-to-volume ratios constrain most bacteria to ~2 µm in length, yet recent studies have identified giant bacteria in six different phyla, some reaching lengths of 9000 µm. The exact mechanisms by which these single-celled bacteria overcome common size limitations are poorly characterized and in need of further study. To address this, we investigated the ultrastructure of Thiovulum imperiosus, a giant Campylobacterota that reaches 50 µm in diameter. Using Focused Ion Beam Scanning Electron Microscopy, we acquired 3D electron microscopy data, then trained a U-Net deep learning module to recognize and label membranes, chemosensory arrays, flagella, and DNA throughout the dataset. This revealed extreme polyploidy, supported by complex invagination of the inner membrane that houses DNA-filled nucleoids in organelle-like compartments. Our findings reveal adaptations that sidestep many of the challenges of growing to great size, and contribute to filling the "complexity gap" observed between bacterial and eukaryotic cells.

- **10 min talk- Zay Chonnad –***Grilling the Gastronomist's Gastropod: Effects of The Blob Heatwave on Farmed Red Abalone Growth*

  Authors: Zay Chonnad, Halley Froehlich, Jordan Gallagher

  Aquaculture is one of the most environmentally low impact food production methods available within food systems today. One of the primary threats is heatwaves, which are increasing in spatial and temporal frequency as a result of anthropogenic climate change. As heatwaves continue to increase in frequency, understanding the impacts of rising sea temperatures on aquaculture is pertinent to adapting this food system. From the summer of 2014 through the spring of 2016, the Blob heatwave hit the coast of Southern California, impacting the temperature of the water intake for The Cultured Abalone farm as well as the amount of kelp available to be harvested and fed to the abalone. By looking at how the growth rates change between cohorts of farmed abalone during and after the heatwave, we can start to understand the direct and indirect consequences of rising sea temperatures on the yields of aquaculture-based food systems.
- **5 min talk- Siena Waldman –***Evolution and Diversification of Silk-Spinning Systems in Corophioid Amphipods*

  Authors: Siena Waldman, Siena McKim, Thomas Turner

  Silk production has convergently evolved over thirty times in arthropods, including at least six times in crustaceans and twice within amphipods. Among amphipods, silk is commonly associated with species in Corophiida, a group that includes both prolific tube building species and species that appear to have lost silk use entirely. This study investigates the diversity and evolutionary history of silk-spinning systems across corophioid amphipods, with a focus on the morphological diversification of silk glands and associated structures. Using histological staining, confocal microscopy, and scanning electron microscopy (SEM), we document extensive variation in silk-related morphology, including the presence of rosette glands, tegumental glands, and diverse silk-altering structures. Moreover, some groups within Corophiida do not appear to build silk structures. Yet, we found that they still retain silk-spinning glandular systems which have been potentially repurposed for new functions. Our ancestral state reconstruction analysis suggests that there has been significant diversification in silk-spinning systems since the corophioid common ancestor, indicating that silk spinning and associated morphological systems are highly adaptable traits that can be retained, modified, or reduced in different lineages. Going forward, we are expanding this work to examine the origins of silk-altering structures as well as the functional implications of silk diversity on suspension feeding behavior and success. Silk spinning is energetically costly, and thus we aim to characterize silk use in correlation with locomotor and feeding morphology to draw conclusions about the natural history of different species. Overall, these findings shed light on novel trait evolution in Crustaceans, highlighting how innovations like silk production can diversify across lineages even after apparent loss of behavioral functions.

- **10 min talk- Jeremy Cowan–** *The Sound of Invasion: Investigating Arundo's Impact on Riparian Birds*
  Authors: Jeremy Cowan, Conor McMahon, Kinley Renger, Tom Dudley

  The Santa Clara River ecosystem of Ventura County, California, represents the region's largest riparian system that remains relatively intact, providing crucial breeding habitat for several at-risk bird species. However, the invasive Giant Reed (Arundo donax) threatens this ecosystem by altering groundwater dynamics and disrupting vegetative cover. This study aims to understand how bird species interact with Arundo versus non-Arundo invaded habitats in the Santa Clara River watershed. We utilized autonomous recording units to assess bird vocalizations (as a proxy for population density) and performed analyses to explore species-habitat associations. We found that endangered bird species such as the Least Bell's Vireos and Southwestern Willow Flycatcher are more likely to use non-Arundo invaded habitat. These findings will help identify restoration targets and inform restoration goals in the Santa Clara River watershed.
- **10 min talk- Hayden Vega–***Fish are Friends: How Fish Help Corals Heal*
  Authors: Hayden Vega, N Munk, A Stier
  Project Objectives: Our objective is to quantify how the common reef-fish, Dascyllus flavicaudus (yellowtail dascyllus), affects tissue regeneration, photosynthetic performance, and growth of the stony coral Pocillopora sp. Aquarium experimental design

  To investigate the relationship between fish presence and coral regeneration we manipulated the presence of D. flavicaudis and wound intensity for the stony coral Pocillopora sp. We collected 72 coral fragments and 108g of fish biomass (36 fish) which we acclimated to ambient tank conditions for three days before wounding. During acclimation, corals were assigned to six tanks (12 corals/tank, 2 tanks/treatment) each tank had 4 corals with small wounds, 4 corals with large wounds, and 4 corals that were unwounded. Three tanks had 36g of fish each while the other three remained devoid of fish. After acclimation, we measured buoyant weight on all corals. For each tank, we wounded an area of 1 cm2 on 4 coral nubbins and an area of 3 cm2 on 4 additional coral nubbins; the remaining 4 nubbins in each tank were left unwounded. Over the course of the next three weeks wound closure was measured daily via microscope photography of a subset of 12 corals (6 with 1 cm2 wounds and 6 with 3 cm2 wounds). After the third week, we measured photosynthetic efficiency via PAM, buoyant weight, and surface area of all the corals.
- **10 min talk- Amelie L'Etoile Goga –** *Prey Preference in kelptoplastidic ciliates Mesodinium rubrum and Mesodinium chamaelon*
  Authors: Amelie L'Etoile-Goga, Holly Moeller

  Kleptoplastidic lineages such as Mesodinium present models for studying the incorporation of stolen organelles into the metabolic machinery of an organism, a similar process to the incorporation of chloroplasts and mitochondria into eukaryotic cells. Kleptoplasty is a metabolic strategy that combines heterotrophy and autotrophy, a mixotrophic organism ingests photosynthetic prey and maintains the prey's chloroplasts within it allowing the host to do photosynthesis despite not being able to produce its own chloroplasts. Many such lineages have come to rely almost exclusively on photosynthesis as their main source of carbon. This increased reliance on kleptoplasty is accompanied by increasingly more complex methods of stolen plastid integration, some including a form of genetic control by the host organism. With this high level of complexity and reliance also comes increased prey type specificity. Understanding the prey selectivity that is exhibited by these species can give insight into prey selection mechanisms and possible limitations to prey plastid integration. Here we studied prey preference within the kelptoplastidic ciliates, Mesodinium chamaeleon and Mesodinium rubrum. We tested prey preference and resulting growth changes through simultaneously offering two prey types and recording relative abundance and growth over the 72 hour experimental period. The more specialized M. rubrum showed a higher degree of prey selection than the more mixotrophic M. chamaeleon. M. rubrum displayed preference for Teleaulax amphioxeia, a known preferred prey type, along with preference for Hemiselmis pacifica, a prey species from outside preferred clade. Across both Mesodinium species little change to growth rates over the 72 hour experiment was observed.

10:35 AM **Break**

10:50 AM **Poster Session 1**

- **Margie Fronduti & Talia Ash –** *Morphology, biomass, and blue carbon storage in Santa Cruz Island's Zostera pacifica seagrass meadows*
  Authors: Margie Fronduti, Talia Ash, Kat Beheshti, Steve Gaines, Hannah Lyford

  Seagrass meadows act as carbon sinks by storing organic carbon in their biomass and via sedimentation, playing a crucial role in absorbing atmospheric carbon dioxide and mitigating the effects of climate change. Zostera pacifica is an understudied species of temperate seagrass, as it was only recently recognized as an independent species from Zostera marina. In this study, samples of Zostera pacifica and cores of surrounding sediment were collected at two sites off of Santa Cruz Island, and seagrass density, depth, and percent cover were measured in the field. In the lab, above and belowground biomass, morphological traits, grain size, and sediment organic carbon were analyzed. Results show a correlation between smaller grain sizes with higher percentages of organic carbon, as well as correlation between greater seagrass biomass (above- and belowground) with organic carbon.These data and the continuous development of a deeper understanding of the morphology and blue carbon storage abilities of Zostera pacifica can bridge knowledge gaps in this understudied seagrass species and help facilitate conservation and restoration of temperate seagrass meadows.
- **Eamon Bashiri –** *"Modulatory Effects of Dopamine on Spontaneous Neural Activity in Ciona"*
  Authors: Eamon Bashiri, Katarina Westermark, Janeva Chung, William Smith

  Ciona, an invertebrate chordate, and the only chordate with a published connectome, holds great potential as a model for understanding the evolution of chordate neural circuitry. In the larval stage, Ciona CNS anatomy exhibits similar morphology to vertebrates, while possessing only 177 neurons. We are studying the role of oscillatory neurons in the Ciona larval CNS. Among oscillatory neurons, a distinct subgroup of forebrain cells, the coronet cells, display a modulatory effect on a specific spontaneous behavior called casting. Ciona larvae exhibit numerous distinct behaviors, including spontaneous casting swims, which are essential for orienting the larvae with respect to ambient light, and which have a period of about 15 seconds that is subject to variation. Although these neurons utilize several neurotransmitters, dopamine appears to be a key modulator of synaptic signalling by the coronet cells. To further elucidate the effects of dopamine on the regulation of spontaneous swim behavior, our group used both an alpha-2A adrenergic receptor agonist (Dexmedetomidine) and antagonist (Atipamezole), to modulate the effects of dopamine signalling. After quantifying the effects of drug exposure in larvae 24-25 hours post-fertilization, we observed an decrease in the period of the spontaneous swims and a decrease in the variability of period length with the use of Atipamezole. Use of Dexmedetomidine had a similar effect in reducing the variability of period length. These findings underscore the significant modulatory impact of dopaminergic signaling in the coronet cells. Further experimentation with both pharmaceutical interventions is necessary to elucidate the downstream effects of dopamine signaling.
- **Lily Strange –** *A Phylogenetic Analysis of the Hybanthus Genus: Reclassifying Hybanthus concolor (Green Violet)*
  Authors: Lily Strange, Dr. Gregory A. Wahlert, UC Santa Barbara

  The Hybanthus genus (Violaceae family) is non-monophyletic, not all Hybanthus species share a common ancestor. Morphological and phylogenetic analysis of Hybanthus suggests the eastern North American Hybanthus concolor (Green Violet) does not belong to the Hybanthus genus (Wahlert et al., 2014). In this project, we will gather further evidence through PCR DNA amplification and Sanger sequencing of the rbcL and trnL-F chloroplast genes from North American and Caribbean Hybanthus. Analyzing these DNA sequences of Hybanthus in a phylogenetic model of the Violaceae family is expected to support the reclassification of Hybanthus concolor to the previously defined Cubelium concolor (T.F. Forst).
- **Olivia Schroeder & Hannah Helms** -*Hopping through the Storm: The Impact of Extreme Weather on Frog Habitats and Genetic Health*
  Authors: Olivia Schroeder, Eva Howell, Hannah Helms, Cannon Mallory, Caitlin Nordheim-Maestas, Cherie Briggs

  Recent mudslides in the Santa Ynez Mountain watershed have severely impacted amphibian habitats and, combined with the confirmed presence of the fungal pathogen Batrachochytrium dendrobatidis (Bd), pose a

significant threat to local species. These include Pseudacris regilla (P. regilla), Pseudacris cadaverina (P. cadaverina), and the threatened Rana draytonii (RLF). Our research investigates how mudslides influence Bd prevalence and the genetic resilience of these frog populations. We hypothesize that mudslide-impacted areas will show higher Bd loads and reduced genetic diversity. We are sampling four sites for P. cadaverina and P. regilla and four additional sites for RLF, with two mudslide-affected and two unaffected sites per species. At each location, we collect ten frogs, swab them for Bd detection, and take toe clips to analyze a microsatellite region of the genome. Swabs are processed using DNA extraction and qPCR to detect Bd, while toe clips are analyzed with DnaSP and custom scripts to assess genetic diversity. Preliminary data from the previous year indicates that Bd prevalence is higher in P. cadaverina than P. regilla and that mudslides may increase Bd rates in P. regilla but not in P. cadaverina. Genetic analyses suggest both species are diverse at non-mudslide sites, though data remain inconclusive for affected areas. Our ongoing monitoring aims to refine these patterns, track changes through time, and contribute to conservation strategies that mitigate disease risk and maintain genetic health in vulnerable amphibian populations.

- **Roo Swain –** *Crabs, Coconuts, and Conservation: Understanding Ecological Changes in Pacific Atolls*
  Authors: Roo Swain, Charlie Braman

  Pacific atolls are unique ecosystems heavily influenced by both ecological and anthropogenic factors. One key environmental driver in these systems are land crabs, which act as key consumers, seed dispersers, and drive nutrient movement. However, historical land use change throughout the Pacific has shifted many atolls from native broadleaf forests to dense coconut palm monocultures. While the impacts of land crabs on the surrounding vegetation are well documented, the reciprocal relationship - how vegetation and canopy cover influence crab activity - remains understudied.

  Using field observations from Tetiaroa atoll, French Polynesia and existing literature, we investigated the following questions: 1) Does overhead canopy cover influence crab activity in Pacific Atolls, and 2) Is there a difference between crab activity in native broadleaf forests versus the heavily altered coconut stands? Based on past studies, we expected to see a positive correlation between crab activity and native broadleaf forests due to increased structural complexity and resource availability within those forests. Trail cameras captured timelapses within 3x3 meter grids at 12 sites to determine the average crab activity. Transects determined the crab burrow density at each site. Hemispherical photos documented the canopy composition at each site. We used generalized linear modeling to determine if the percentage of Cocos/Broadleaf canopy influenced the crab activity in atoll forests.

  With emerging conversations of atoll resilience, particularly in the face of climate change, understanding interactions between vegetation structure and key species such as land crabs becomes increasingly important. If native broadleaf forests are correlated with higher rates of crab activity, this relationship could have implications for broader ecosystem functions. Understanding the intricacies of this relationship could help with future conservation efforts to restore native Pacific vegetation and increase atoll resilience.

- **Veronica Garcia Zepeda** – *Seagrass' Role in Moorea, French Polynesia as a Blue Carbon Habitat*
  Authors: Veronica Garcia Zepeda (UCSB), Lena Capece (Earth Science), Hannah Lyford (EEMB)

  Seagrass can sequester carbon from the atmosphere, which could make them important factors in reducing atmospheric CO2 levels and therefore mitigating the effects of climate change. Seagrass stores carbon through sedimentation and plant biomass; these types of habitats are known as blue carbon ecosystems.To evaluate their carbon storage capacity, sediment core samples were collected from seagrass beds and analyzed. To do this, we used hydrochloric acid to remove the inorganic carbon, the remaining sediment containing the organic carbon was washed, dried, and put through a mass spectrometer to quantify the amount of carbon contained. By examining the amount of organic carbon found in the sediment, we can better understand how effectively seagrasses act as a blue carbon source. These findings contribute to our understanding of seagrass beds as effective blue carbon ecosystems, demonstrating their potential role in long-term carbon storage and their importance in reducing the effects of climate change.

- **Dani Michiels –** *Optimization of DNA Extraction Protocol for Mussel Epigenetic Clock*
  Authors: Dani Michiels, Maddy Weise, Laurel Hiebert, and Soojin Yi

DNA methylation is an epigenetic modification that influences the transmission and expression of genetic information without changing the nucleotide sequence. It is widespread throughout the tree of life, and is a critical component of gene regulation. Gene regulation and corresponding expression change throughout an organism's lifespan as different genes are turned "on" and "off" and mutations accumulate. Fluctuating levels of DNA methylation at particular loci during aging suggest that DNA methylation plays a role in this process. By mapping how methylation levels are altered across the genome, a model capable of predicting the age of an organism based upon its local methylation levels can be generated. These models are called epigenetic clocks. Comprehensive clocks have been constructed for many species, however no such clock exists for marine invertebrates. Thus, the overarching goal of this project is to generate an epigenetic clock for California mussels, a species that lives off the coast of our campus. California mussels are an ideal study organism because they exhibit incremental growth, meaning that their age can be accurately determined by counting the number of rings present in their shells. The main focus of this poster, however, is the formulation of an effective DNA extraction protocol to apply to the tissue samples collected. Optimization is crucial because it preserves the quality of the DNA and therefore will lead to a more reliable and complete epigenetic clock.

- **Kirya Wagner and Jasmine Rebollar –** *Macroinvertebrate Responses to Dissolved Oxygen and Salinity in Devereux Slough*

  Authors: Jasmine Rebollar, Kirya Wagner, Jeremiah Bender, CCBER Lab

  Macroinvertebrates play a key role in aquatic ecosystems as indicators due to their sensitivity to changes in environmental conditions. Regular macroinvertebrate sampling is conducted in the Devereux slough at the University of California, Santa Barbara (UCSB) to monitor species abundance and diversity and assess the ecological health of the system. We examined how salinity and dissolved oxygen (D.O.) influenced the abundance and diversity of four macroinvertebrate species: Amphipods, Diptera Chirominid, Ostracods, and Copepods. We predict a higher abundance of invertebrates when salinity levels are low and D.O. levels are high. Samples were taken across sixteen (16) different sites at Devereux Slough. Filter beakers and mesh sweep dipnets were used to collect samples, with algae and core samples taken by CCBER. Data was transferred to an Excel spreadsheet, and R-studio was used for data analysis. Amphipods and Chironomids were most abundant at low-salinity, moderate D.O sites, Ostracods at low to moderate salinity high D.O sites, and Copepods at high salinity, high D.O sites. The slough has the most abundance when salinity is low and DO is moderate and when salinity and DO levels are high. This is likely due to the invertebrate biological niches fitting under either of those extremes. Tracking species abundance in the slough is critical for future restoration projects. Ongoing research still needs to be conducted to understand the ecosystem as it stands today and will continue to do so in the future.

- **Nicole Harris –** *Identifying Chemosensory, Opsin, and Circadian Rhythm Genes in Ostracods*

  Authors: Nicole Harris, Cheyenne McKinley, Seth Frazer, Todd Oakley

  Connecting genotype to phenotype is a long standing question in biology, especially in non-model organismal systems. In the case of ostracod crustaceans, we know very little about their genetics. Despite their status as non-model organisms, we do have some limited knowledge about their phenotype. For example, diel vertical migration has been behaviorally described in Cypridinid ostracods, eye-specific opsin orthologs were discovered in sequence data from just Skogsbergia lerneri and Vargula hilgendorfii, and observations of foraging behavior likely involving chemosensory navigation. In this project, we utilized bioinformatic tools to investigate the underlying genetics of these phenotypes. First, we compiled available transcriptomes and proteomes of ostracods. We then used data-mining software to collect genes involved in the phenotypes of biological rhythm, vision (specifically opsins), and chemosensation. Using the program BLAST, we then compared our genes of interest to the database of ostracod transcriptomes and proteomes to find homologous (similar) genes. This will provide valuable insight into how ostracod species navigate their environments, detecting food, light, and mates. By looking across the clade of Ostracoda, these results may point to differences in physiology, ecology, behavior, and evolution within ostracods; setting the foundation for future studies focused on gene function to phenotype in ostracods.

- **Yeji Kim, Aurora Segura, Dr. Leander Love-Anderegg, and Indra Boving-** *Assessing taproot growth in California Blue Oak in fire disturbed soil types*

Authors: UCSB LEAF Lab, Dr. Lee Anderegg, Indra Boving

Quercus douglasii, a keystone species in California oak woodlands, faces increasing challenges from anthropogenic climate change, including frequent wildfires and prolonged droughts. These disturbances affect acorn establishment and early root development, which are critical for seedling survival. Our study examined how soil characteristics in disturbed (burned) and undisturbed (unburned) sites influence the taproot growth of California Blue Oak (Q. douglasii) acorns. Using four maternal trees and four soil treatments from the UC Sedgwick Reserve—Burned Chamise, Burned Serpentine, Burned Shedd, and Unburned Shedd—we planted 60 acorns in rhizoboxes and monitored taproot growth over five weeks. Soil texture and water-holding capacity were also measured. Results showed a significant difference in taproot growth among soil types (one-way ANOVA, $p < 0.05$), with the highest growth observed in Unburned Shedd and the lowest in Burned Chamise. Post-hoc Tukey HSD tests confirmed three significant pairwise differences between soil types. Root biomass was positively correlated with clay content in the unburned soil, suggesting a meaningful relationship between soil texture and early root development. Burned Chamise soils, with high sand content and low water-holding capacity, appeared to limit root growth the most. While our hypothesis that unburned soil promotes greater taproot development was partially supported, variability among burned soils suggests other site-specific factors may influence growth outcomes. Limitations included potential root constraint due to rhizobox boundaries and possible root breakage during extraction. This study underscores the importance of soil properties in post-fire oak regeneration and offers insight into habitat restoration strategies under climate-driven disturbance regimes.

- **Chris Hyder –** *Analyzing Drivers of Drought Stress Variability in Coast Live Oak Populations Across the California Central Coast*

  Authors: Christopher Hyder, Piper Lovegreen, Leander Anderegg

  Decreases in Coast Live Oak (Quercus agrifolia) populations have been observed across the California coast as natural recruitment of the species has become too low to support existing populations. Previous studies have identified multiple potential drivers of this decline, with drought stress emerging as a key factor contributing to the conversion of oak woodlands into grasslands. The NASA SHIFT campaign is a hyperspectral imagery campaign that collected shortwave infrared imagery weekly from February through May 2022, alongside the collection of foliar traits for a set of 61 Coast Live Oak trees across both Sedgwick Reserve and Dangermond Preserve. Our study aims to quantify what physical factors are responsible for canopy water content (CWC) variations across both reserves to better understand the biogeographical distribution of the species, as well as to offer insights as to what aspects of climate change will continue to exacerbate population declines. Our analysis took place in both QGIS and RStudio, where canopy water content, soil series, elevation, aspect, and topographic wetness data was extracted for all 61 trees, and then analyzed to determine significance. In the future, we hope to collect soil samples from all sampled Coast Live Oak trees to analyze for nutrients in hopes of better understanding the nutrient cycling capabilities of the species, as little research has been conducted on the role that nutrients play in the diversity of oak woodland ecosystems.

- **Claire Vossler –** *From Exclosure to Exposure: Consumer Pressure Gradient Alters Macroalgae Diversity on Coral Reefs*

  Authors: Claire Vossler, Lauren N. Enright, Kelly E. Speare, Thomas C. Adam, Rebecca Vega Thurber, Deron E. Burkepile

  Coral reefs are among the most biodiverse ecosystems on the planet, but coral cover is declining worldwide due to climate change and local stressors. One driver of reef decline is overfishing, as fishes play an important functional role in reefs by reducing macroalgae abundance through herbivory. When herbivores are overfished, the loss of top-down control allows macroalgae to proliferate and compete with corals. To explore whether these impacts can be reversed, we leveraged an ongoing long-term experiment that mimics the effects of overfishing to test whether marine protected areas (MPAs) could effectively restore benthic community structure and function. This experiment consisted of two parts: 1) examining how benthic community composition on tiles varies under different levels of consumer pressure and 2) investigating whether these tile communities can recover after implementing protective measures. While alpha diversity did not differ between consumer pressure

treatments, high consumer pressure had a significantly lower Shannon-Wiener index compared to treatments with low consumer pressure. Additionally, beta diversity comparisons revealed that, within treatments, tiles exposed to higher consumer pressure had lower dispersion than those with lower consumer pressure. Future steps involve analyzing benthic community composition changes after each community is exposed to ambient consumer pressure, simulating the implementation of an MPA. Understanding how these communities respond to consumer pressure directly informs future management and conservation efforts.

- **Briana Le –** *Observing the thermal tolerance of juvenile Macrocystis pyrifera grown in a hatchery setting through morphometric analysis*
  Authors: Briana Le, Dr. Lauren L. Smith, and Dr. Halley E. Froehlich

  The oceans have been experiencing marine heatwaves (MHW) impacting countless marine organisms unable to tolerate heat stress. Giant kelp (Macrocystis pyrifera) – a foundational macroalgae species – has decreased in some areas along the southern California coast, in part, due to increasing MHWs. MHW can impact the growth and survival of both wild and farmed kelps. As aquaculture of M. pyrifera may increase on the West coast, it is important to understand the impacts of temperature on the juvenile sporophyte stage— the currently understudied stage when farms outplant their crop from the hatchery to the ocean. Determining the thermal tolerance of the juvenile stage may influence when farms outplant kelp for successful grow-out. We explore the thermal tolerance of juvenile M. pyrifera at this hatchery stage by first acclimating kelp in 10℃ and UV-treated water for seven days. Following this, we simulated an outplanting at varying temperatures by exposing the spools (n = 4 spools per treatment) of juvenile kelp to untreated water with six temperature treatments ranging from 5℃ to 30℃ (in 5° increments) for seven days. This exposure was followed by a two-day recovery at 10°C. At the conclusion of the experiment, five individual kelp blades from each spool were photographed and imported into ImageJ to measure surface area, height, and width. We found significant differences in individual blade growth between the heat treatments, with the cooler temperatures experiencing higher growth across all measurements and complete mortality at 30°C. These findings can help inform kelp farms of the time of year kelp lines should be outplanted for optimum growth.
- **Miya Ostboe and Aydan Kelly** – *The foraging behavior of herbivorous fishes on reefs of Rose Atoll*
  Authors: Miya Ostboe, Aydan Kelly, Nury Molina, Deron Burkepile

  Herbivorous fish play a vital role in maintaining the health of coral reefs by grazing algae, promoting coral dominance and reef resilience. Characterization of herbivorous fish foraging behavior on relatively pristine reefs is critical for identifying baseline functioning of ecosystems removed from direct human impacts. Rose Atoll is a remote, uninhabited reef in the Samoan Archipelago and provides a near-pristine natural laboratory to study herbivore foraging behavior on intact reef systems. This project focuses on evaluating herbivory rates and targeted substrates of herbivorous fish within the coral reefs of Rose Atoll, American Samoa. Video analysis of a 0.75 m^2 area was conducted on the four corners of the toll. We collected data on herbivorous fish species identification, fish size, benthic substrate identification, and feeding rates. Despite the critical role of herbivorous fish feeding behaviors in promoting coral reef resilience, there are currently no studies characterizing the foraging behaviors of herbivorous fish on Rose Atoll. This data will provide baseline knowledge on herbivorous fish foraging behaviors on remote reefs removed from anthropogenic impacts, allowing for insightful comparisons with heavily impacted reef communities.
- **Kathryn Kolb** – *How Changes in Salinity Impact the Chlorophyll Content of Salicornia pacifica*
  Authors: Kathryn Kolb, Germán D. Silva, Danae Stathatos, and Jennifer Y. King University of California, Santa Barbara

  Salicornia pacifica, or pickleweed, is a halophyte native to California wetlands. As a halophyte, it is adapted to saline conditions and the adverse impacts that come with living in these environments, including osmotic and oxidative stress. My goal is to determine how salinity affects the chlorophyll content of pickleweed in order to project the potential impacts of climate change on pickleweed growth. The approach I used was to grow pickleweed under greenhouse conditions in control, low, and high salinity irrigation treatments and to measure chlorophyll content after ten months. The control group was found to have 31% more chlorophyll per gram of fresh weight than the low group, and 39% more than the high group. The results suggest that pickleweed will have

reduced chlorophyll content in the future due to increasing salinity of wetland soils as a result of climate change, implying lower productivity and ecosystem function of these wetlands.

- **Chloe Carlstrom and Kate Joos –** *Impact of Human Recreation on Mosquito Populations in the Eastern Sierras*
  Authors: Kate Joos- undergrad UCSB, Chloe Carlstrom- undergrad UCSB, Stephanie Copeland- PhD student Young Lab UCSB

  Outdoor recreation in the United States has become a popular pastime. Participating in such activities often means packing bug spray and accruing itchy bug bites from mosquitoes. Female mosquitoes seek out bloodmeals to aid their reproductive process. Mosquitoes' survival within landscapes necessitates ample host presence. However, in landscapes with seemingly limited host options, the presence of recreating human populations may help sustain mosquito populations. In the Eastern Sierra Nevada, recreational activities- particularly hiking, backpacking, and fishing- occur in alpine locations where mosquito populations also occur. We expect that high human activity will positively correlate with mosquito populations and that human presence as a meaningful host will increase population density. We chose 20 alpine lakes at varying distances from trailheads as a proxy for analyzing the impact of human presence on mosquito populations. Utilizing mosquito traps, we collected over a thousand specimens, then sorted by sex to analyze if the females had had a recent blood meal. We expect to find humans as the major host and population driver of mosquito populations by analyzing the DNA of blood meals and quantitative data collected by each lake. Mosquitoes can vector several zoonotic diseases to human populations. While zoonotic disease is not an issue in the Eastern Sierra, understanding how humans directly affect mosquito abundance as hosts is becoming more imperative as climate change and globalization expand and alter mosquito density.

- **Andie McNeil** – *Nutrient Rescuing Macroalgae for Aquaculture*
  Authors: Andie McNeil, Dr. Lauren L. Smith, Skye Krainer, Briana Le, Abigail P. Van Slyke, Dr. Halley E. Froehlich

  Aquaculture faces many challenges due to climate change, in particular, saltwater aquaculture is vulnerable to marine heatwaves, i.e. sudden and anomalous temperatures. We explored a potential remedy to acute heat-related mortality for farmed seaweeds: the nutrient rescue hypothesis. This hypothesis posits that supplemental nutrients may allow seaweeds to withstand some environmental stressors, such as increased temperatures. To test the hypothesis, we grew three locally farmed species – Ulva spp., Gracilaria pacifica (Ogo), and Palmaria palmata (Dulse) – in a two-factor, fully crossed experiment. For five days, we grew the seaweed at six temperatures ranging from 5°C to 30°C with either high or low nutrient concentrations, then measured percent change in growth. To explore how nutrient conditions prior to the start of the experiment impacted growth we conducted three trials: 1) seaweed straight the farm, 2) seaweed grown in an ocean water (ambient nutrients) batch culture for 14 days prior to the trial, and 3) seaweed grown in an Instant Ocean (no nutrients) batch culture for 14 days prior to the trial. We found no discernible difference in percent change in growth between the direct nutrient treatments across temperature in any of the trials. However, there were growth differences between the trials, with trial 1 performing best. These results may suggest that the amount of nutrients present during a marine heatwave event was less impactful than the amount of nutrients available prior to the heat stress. We also found that Gracilaria performed the best at higher thermal exposure. Aquaculture farms may lessen the effects of marine heatwaves by maintaining high nutrient levels throughout the year – not just during a marine heatwave – and/or focusing production on less sensitive species.

- **Annabel Long –** *Effects of soil quality on the growth and abundance of Artemisia californica and other CSS plants*
  Authors: Annabel Long and Dr. Lisa Stratton, UC Santa Barbara

  Coastal sage scrub (CSS) ecosystems are home to hundreds of bird and butterfly species. Their range has been significantly reduced, so restoration is crucial. Unfortunately, CSS plants at the Audubon Overlook of North Campus Open Space, including the foundation species California sagebrush (Artemisia californica), are not growing as well as expected, yet they thrive on South Parcel. Previous researchers hypothesized that high soil compaction stunts CSS plant growth, but more research is needed on how soil bulk density and soil texture may affect the size and abundance of CSS plants.

Since soil bulk densities greater than 1.47 g/cm^3 inhibit root growth in clay soils and California sagebrush grow best in sandy soils, we hypothesized that there would be a negative correlation between soil bulk density and California sagebrush volume and that California sagebrush would be larger and CSS plants would be more abundant in South Parcel due to higher sand content. We measured the dimensions of California sagebrush closest to locations in Audubon Overlook, which had known soil bulk densities, and South Parcel. We also counted the number of CSS plants within 3 meters of each location and measured soil texture. The largest California sagebrush grew in soils with intermediate soil bulk densities. California sagebrush were significantly larger in South Parcel, and the mean number of living CSS plants in a 3 meter radius was higher there. South Parcel soils were sandier, so sand content may account for these differences. This may inform restoration of CSS ecosystems.

- **Julia Walsh –** *Investigating the physiological and ecological roles of ammonia-oxidizing archaea in marine environments*

  Authors: Julia Walsh, Amber Briesach, Patrick Thieringer, Jose Valera, Alyson Santoro (UCSB)

  Ammonia-oxidizing archaea (AOA) are microbes involved in the first step of nitrification in marine environments, where they convert ammonia to nitrite. This process is essential for nutrient cycling and regulates ammonia concentrations in the ocean. Therefore, studying the physiological and ecological roles of AOA in marine environments is important for understanding the relationship between microbial members and overall ocean health. The growth of AOA in water samples collected off the coast of Santa Barbara, (SBC4.60_25), along with previously isolated AOA cultures, (SCM1, CCS1, and NF5), was studied using nitrite concentration measurements, Guava flow cytometry, and microscopy. From these analyses, the growth rates and cell counts were determined. All cultures grew successfully at 25℃ and a pH of 7.8-8.0 when repeatedly transferred into media with ammonia. Using genome sequencing, water samples collected from Oregon, (WEC2.2400), and Saanich Inlet, British Columbia, (SI120), were placed on a phylogenetic tree with the AOA strains; the grown strains were phylogenetically distinct. These findings further support how AOA are involved in nitrogen cycling and require specific environmental conditions to thrive. In future work, the connection between the presence and absence of specific genes can provide insight as to how these different strains tolerate varying environmental parameters including temperature, pressure, and pH. Specifically, how transport genes are conserved among AOA strains. As the ocean environment continues to change due to climate change, studying AOA behavior can provide an understanding of how these shifts will influence AOA communities, biogeochemical cycles, and broader marine ecosystems.

- **Rachel Bittner –** *Understanding the relationship between sediment grain size and organic matter in a temperate seagrass meadow.*

  Authors: Rachel Bittner, Ella Barbee, Kathryn Beheshti, Hannah Lyford

  Seagrass meadows are of significant interest for their function as natural carbon sinks, capable of storing large amounts of organic carbon in their sediments. However, the specific environmental factors influencing their storage potential, such as sediment grain size, remain insufficiently understood. This study aims to investigate whether seagrass meadow sediments' grain size correlates to their organic carbon-carrying capacity. To explore this, sediment samples were collected and processed using a 63 μm sieve to eliminate finer particles from coarser ones. Organic material was carefully removed, and the remaining sediment was dried and weighed to determine grain size distribution. We expect our findings to suggest that finer sediments are more effective at retaining organic matter, likely due to their greater surface area. Understanding the complexities of these relationships is important in seagrass restoration to mitigate rising global carbon levels.

- **Nia Fox –** *TO FISH OR NOT TO FISH: Can Temporary Closures Impact the Relationships of Benthic Communities in Coral Reefs?*

  Authors: Nia Fox, Olivia Isbell, Anastasia Quintana

  Coral reefs are extremely vital ecosystems to coastal communities and marine life, providing many benefits including storm protection, livelihood, and shelter. Coral reef benthic and fish community composition can be used as key insights into the current state of a reef system. The

purpose of this research is to examine potential relationships between fish and other benthic communities that inhabit the seafloor, inside and outside of restricted areas imposed by a customary practice known as a Rahui. Due to this temporary closure, we will be able to gauge whether it makes any difference in the benthic composition from the different levels of fishing activity. Using the platform CoralNet that provides assistance with machine learning, we are able to annotate and analyze images of coral reefs captured across a select number of sites in Tahiti, French Polynesia. With this research, we will be able to gain more information about these benthic communities and further explore the impacts of temporary fishing closures.

- **Michelle Tran –** *Flying on Broken Wings: Wing Wear Analysis Between Mid-Size Santa Barbara Specialist and Generalist Bee Species Using a Computer Vision Model*
  Authors: Michelle Tran, Katelyn Vo, Jiashu Huang, Charles Thrift, Madeleine Ostwald, Katja Seltmann
  Bee wings experience mechanical stress and collisions over time through an accumulation of flying, foraging, mating, and predator attack events. As such, wing wear has been used as a measure for relative age in bees and has also been found to be related to an increased risk of mortality. This relationship allows wing wear to be used as an indicator for bee health of individual bees and of their respective colonies. Little is known about how additional factors–like size, sex, and diet breadth– contribute to wing wear in bees. The aim of this study is to investigate the variation in wing wear between mid-size Santa Barbara county specialist and generalist bees using two techniques: manual scoring and a computer vision model. This program is an image segmentation model that uses shape analysis data to assign a wing wear score from photographs. The study will also assess the accuracy of these computer generated scores relative to manual scoring and the reliability of these scores within and between bee species. I hypothesize that specialist bees exhibit a higher amount of wing wear due to increased flying strain from selective foraging and increased collisions from greater intraspecific competition due to limited resources. The information derived from this study can inform conservation efforts, particularly for specialist bees that are more vulnerable to habitat loss and climate change which reduces availability of their mutualistic plant species. The application of computer vision models automate wing wear scoring and may be extended to conduct additional wing wear research on bee health and behavior with respect to location, wing structure, and more.
- **Eloisa Vargas –** *Analyzing Bee Body Size as a Potential Factor of the Island Rule*
  Authors: Eloisa Rosalyn Vargas; Madeleine M. Ostwald; Katja C. Seltmann
  Variance in body size of bees can affect multiple factors including pollination ability, floral handling, and response to evolving environmental conditions. Likewise, body size itself is influenced by a range of climate and location-specific environmental factors. Islands represent distinct habitats with unique ecological and climate conditions. Many animals differ drastically in body size in island habitats, but the extent to which this effect occurs in insects is unknown. This phenomenon is known as the "island rule" in which animals are considerably larger on islands when compared to their mainland counterparts. Recognizing these patterns enhances our understanding of how differing environmental conditions between islands and mainlands can drive long-term evolutionary changes in species. I measured body size for each specimen, accounting for sex and missing body parts. In this study, we drew data from the sweat bee, Agapostemon Texanus, and measured their body size by mass. My findings suggested that insects, specifically Agapostemon Texanus, have evolved to greater sizes on islands than those of that on the mainland. These findings help clarify the role between habitat factors and body size variation in this important native pollinator.
- **Adelyn Duong and Aaron Chen –** *Examination of Soil Burn Severity on Redwood & Sequoia Germination*
  Authors: Georgia Fischer, Adelyn Duong, Aaron Chen, Jeffery Qian, Indra Boving, Leander Anderegg
  With increasing global temperatures and fuel aridity, wildfires have been increasing in temperature and intensity. This experiment aims to investigate the impacts of these intense fires on redwood tree reproduction by examining the impacts of the fire on sequoia seed germination. This knowledge will help inform measures to mitigate the impact of climate change on the redwood forests. We took seeds from burn sites of differing severity, then planted them in soils of various burn severities. We also planted store bought seeds and planted them in various burned soils. We expected that the sequoias would grow the best in low/moderate burn soil, followed by

high burn soil, followed by unburned soil. However, we found that overall the plants had the most difficulty in growing in high burn soil. With these findings we have concluded that high burn soil is detrimental to redwood reproduction, and this may mean that with no action, the vegetation of the redwood forests could change dramatically in the following years.

12:00 PM **Lunch Break – LSB Courtyard**

1:00 PM **Session 2**

Please note: "10 minute talks" are 8 minute talks with time for 2 questions

- **10 min talk- Aidan Robertson -** *Maximizing California native wildflower cover to suppress weeds during restoration*
  Authors: Aidan Robertson, Robert Fitch
  Coastal sage scrub, a type of California shrubland, is a threatened plant community where most of its former range has been subjected to urban development, agriculture, and non-native grass invasion. Ecosystem restoration seeks to reverse these impacts by removing invasive species and introducing native species, restoring the land to a pre-disturbance state. However, weed species (non-native, invasive plants) are a persistent challenge limiting the effectiveness of restoration projects to create the end goal plant community. Directly planting coastal sage scrub plants is an important step in restoration, but shrubs can take long periods of time to establish. This creates a time period where bare ground can be invaded by non-native annual plants, thus reducing the effectiveness of a restoration project. Seeding native wildflowers first to provide cover to prevent invasion could be a useful technique to meet the desired community, with the goal of planting coastal sages scrub species later. This project compares several weeding treatments and wildflower seeding rates in a field experiment at UC Santa Barbara's Lagoon Island. The four weeding treatments include prescribed fire, thatch-clearing, grass-specific herbicide, and a control. The three wildflower seeding rates were high rate, low rate, and no seeding of three native California wildflowers: red maids (Calandrinia menziesii), common phacelia (Phacelia distans), and winecup clarkia (Clarkia purpurea). To determine the most effective combination of treatments in establishing annual native cover and maximizing the density of the three seeded wildflower species, cover of all native and non-native species were compared.
- **10 min talk- Tyler Lee** – *Development of a Novel Imaging Approach to Reveal Spatial Organization of Soil Microbial Communities through 3D Electron Microscopy.*
  Authors: Tyler Lee, Nathalie H Elisabeth, Tomas Tyml, Danielle Jorgens, Jean-Marie Volland
  Most life on earth is microbial. Bacteria, Archaea, and microbial eukaryotes are ubiquitous and very abundant in soil where they play major roles in nutrient cycling, plant growth promotion, and maintaining soil structure and health. Soil is a dense, opaque matrix composed of hard, irregular particles with a highly tortuous structure, making it extremely challenging to perform microscopy. For that reason, detailed ultrastructural in-situ observations of soil microbes are limited to a few 2D electron microscopy studies. To overcome this limitation, we developed a new workflow to prepare and analyze soil samples in 3D with Focused Ion Beam Scanning Electron Microscopy (FIB-SEM). We then trained a Deep-Learning model in Dragonfly ORS© to automate segmentations on the data and create accurate 3D models. Using this approach, we analyzed a 1700 µm3 volume of soil at 5 nm isotropic resolution. Cells' ultrastructure, morphology, distribution, and quantification could be extracted from our 3D segmented models providing unprecedented insight into how cells interact with their biotic and abiotic environment in situ. Our results demonstrate the promising capabilities of this new imaging approach to complement omic analyses for microbial diversity characterization in soil. Future directions include analyses of the pores network to better understand how soil microbes shape soil structure.
- **5 min talk- Abigail Van Slyke –** *Count 'em and weep: culturing rockweeds from receptacles*
  Authors: Abigail P. Van Slyke (UCSB), Lauren L. Smith (UCSB), Erica S. Nielsen (The Nature Conservancy), Halley E. Froehlich (UCSB)

Rockweeds, an important group of seaweeds in the rocky intertidal community, are in decline globally due to anthropogenic stressors, spurring conservation efforts to restore and prevent further decline. Rockweeds are a foundation species in the intertidal, and the decline of the rockweed Silvetia compressa in Southern California has decreased invertebrate evenness and richness. Previous S. compressa restoration efforts have removed adult individuals from a source population and transplanted them to a recipient site. Long-term transplantation could have negative impacts on donor populations. Collaborating with the Nature Conservancy, we are interested in culturing S. compressa in a laboratory setting for outplanting to minimize the impacts on donor populations. The first step is understanding the output and density of their receptacles – the reproductive apical tips. One of our goals is to quantify the number of fertilized eggs (zygotes) created by a receptacle. This information is essential to building the methodology for S. compressa cultivation in the lab; informing the number of receptacles needed from donor sites to successfully raise a class of outplants. We collected receptacles, induced egg and sperm release in Petri dishes, and then enumerated zygotes per receptacle. We photographed each Petri dish and counted the number of zygotes using ImageJ. The number of zygotes varied greatly between receptacles, with an average of 10,326 (± 4888) and a range of 1,672 to 21,031. Knowing the mean and variability of reproductive capacity will inform our next steps as we cultivate Silvetia compressa in a hatchery setting for restoration in California.

- **10 min talk- Albert Li –** *The impact of thinning on non-native grass dominance in degraded chaparral communities*

  Authors: Albert Li, Stephanie Ma Lucero, Carla D'Antonio

  With the continuous degradation of the chaparrals in California, restoration is increasingly needed to protect the ecosystem, preserving the biodiversity and the vital ecosystem services it brings. However, reestablishing chaparral on invaded land is challenging, and large-scale success has yet to be seen. Invasive non-native grasses, such as Bromus spp. and Avena spp. post as a great threat to the native chaparral communities, as they have consistently outcompeted chaparral species with their various competitive advantages and with the alternation of the fire regime. Therefore, in many cases, chaparral restoration efforts must be coupled with invasive species control mechanisms like manual removal to achieve the desired level of success. My research evaluates the impacts of thinning non-native grasses, either fully or partially, on the eventual growth and reproductive success of the remaining non-native grass individuals with the ultimate goal of understanding how far removal must go to truly reduce seed set and productivity of this productive, flammable, and invasive species, and to create a physiologically significant benefit to the out-planted native species. My research aims to apply the theory of Constant Final Yield – the theory that at some threshold of plant density, the eventual total plant biomass will be the same – to improve the success of efficiency when conducting habitat restoration of the chaparral ecosystem. The project is currently ongoing, but I will have some data to share.

- **10 min talk- Justin Kim –** *Empirical evaluation of the the predicted predator-prey cycles between fish and fisheries with real-world data*

  Authors: Justin Kim - UCSB, Leonardo M. Feitosa - Bren School of Environmental Science and Management

  Predator-prey cycles are characterized by sinusoidal and out of phase oscillations in which the predator population grows and declines based on prey populations. Fishing is one of the last few human activities in which humans function as predators for wild animals, thus fisheries bioeconomic theoretical models predict predator-prey cycles to occur in fisheries. However, this prediction has yet to be comprehensively and empirically assessed. By assessing this, we can evaluate how realistic these theoretical models are and potentially provide pathways for their improvement. Here, we use stock assessment data from the RAM Legacy stock assessment database to test the existence of predator-prey cycles between fishing effort and the fish stock. We then employed wavelet coherence analysis to the stock-specific time series of spawning stock biomass and fishing mortality to assess the yearly existence of a predator-prey cycle. We found that only ~23% (n = 325) of the stock present in the RAM Legacy database have data we could use to answer this question. From these, ~11% (n = 35) did not have a long enough time series to be evaluated. Our preliminary analysis shows that the lack of fisheries data prevents a comprehensive assessment of such a question. Our future efforts will focus on assessing this for the remaining 290

stocks with enough data. Nevertheless, we underscore the need for better fisheries data collection, especially in countries with poorly-regulated fisheries where open-access fisheries are more prevalent.

- **5 min talk- Rachel Tang –** *To Bee or Not to Bee Hairy: Quantitative Analysis of Pilosity Among Melissodes tepida Subspecies*

  Authors: Rachel Tang, Charles Thrift, Madeleine Ostwald, Katja Seltmann

  Although California native bees are key pollinators for fruits and crops, they remain understudied compared to the Western honey bee. Examining morphological traits in native bees, such as pilosity, or hairiness, to understand taxonomic variation among species can inform and support conservation efforts. Three subspecies of long-horned bees, Melissodes tepida timberlakei, M. t. yumensis, and M. t. tepida, occupy distinct regions across the western United States, but their morphological distinctions remain unclear. Pilosity, or hairiness, is a critical trait for thermoregulation, pollen collection, and species recognition, and may offer key insights into subspecies differentiation. I hypothesize that the three Melissodes subspecies differ significantly in pilosity coverage and lightness as adaptations to their unique ecological niches and climates. To test this hypothesis, I captured, stacked, and analyzed lateral images (both left and right sides) from five specimens per subspecies (totaling 30 images). Using a convolutional neural network explicitly trained for bee hair segmentation, I quantified hair coverage (percentage of hair pixels relative to body surface area) and lightness (numerical value of pixel lightness on a grayscale continuum). ANOVA analyses revealed no statistically significant differences among subspecies in either hair coverage ($p = 0.129$) or lightness ($p = 0.207$). Still, visual representations, such as boxplots and swarmplots, demonstrate Yumensis to be hairier than Tepida and Timberlakei. This trend suggests that increasing the sample size may strengthen statistical significance and highlight pilosity differences. In the future, incorporating additional factors, such as sex differentiation, behavioral evidence, and genetic data, will enhance our understanding of subspecies divergence and inform more accurate conservation strategies.

- **10 min talk- Claire Kim and Kyle Chua —** *Field Courses and Improving Student Mental Health: Undergraduate Perspectives from UCSB*

  Authors: Claire Kim*, Kyle Chua*, Helen Payne, Susan J. Mazer

  There is a growing mental health crisis among undergraduate students. Evidence of increased stress in undergraduates has prompted efforts to implement preventative mental health services at universities. Recent research has highlighted the benefits of exposure to nature, including improved mood and concentration — factors important for student well-being. However, the role and impact of outdoor education, such as field courses, has only recently begun to be investigated, and few studies examine how these courses can improve student mental health. Field courses are especially relevant in studying biology, thus we were interested in how these courses may impact undergraduate student mental health. To address this, we surveyed and interviewed students in lecture, lab, and field courses across four departments (MCDB, EEMB, EARTH, ENV S) at the University of California, Santa Barbara. Surveys consisted of Likert scale and free response questions, while interviews prompted open-ended discussion. These responses were examined for recurring themes using the biopsychosocial framework, and we assembled a codebook for use in qualitative analysis. It was demonstrated that field courses were positively correlated to traits indicative of positive mental health, such as contentment and motivation. In addition, these courses were reported to improve engagement and comprehension. Our study adds to the growing literature on the benefits of field courses and their potential to improve student mental health.

- **5 min talk- Phuong Nguyen –***Literary Analysis of the Socio-ecological advantages of Temporal Fishery Closures*

  Authors: Phuong Nguyen, Nia Fox, Jahat Garcia, Yutian Fang, Dylan Glave, Tasha Quintana

  Coral reef fisheries depend on healthy marine ecosystems to provide valuable resources and services to millions of people worldwide. Unfortunately, reef health is in decline worldwide and the most widespread conservation tool - marine protected areas (MPAs) - have been inadequate to address this problem holistically, with frequent equity concerns and some blatant cases of colonial conservation. This has generated interest in examining and honing alternative approaches to restore fisheries and to protect their ecosystems.
  Temporary marine protection such as temporary fisheries closures or periodic closures may provide this alternative which can be better suited for fisheries management, with deep roots in traditional management systems, but temporary closures are very poorly-studied compared to permanent MPAs. We conducted a

systematic literature review to fill this gap and understand both the economic and social impacts of temporary fisheries closures around the world. Specifically, we screened papers to identify closure designs (size, location, length of time closed), types of governance structure, people's motivation for creating fishery closures, and, most importantly, the results of the fish biomass and diversity within these closures (compared to open areas), and if fishers feel satisfied with these management systems by examining their levels of compliance afterwards. This process started with a search string followed by an initial abstract screening of relevant articles. After, two student screeners independently conducted a full-text extraction for 30+ variables and consolidated discrepancies for 56 published cases. Based on our review of published cases of temporary closures, we found that temporary closures' design and governance are typically in control of local leaders and fishers. This was very different from MPAs which are often imposed by governments. Also, although they were much smaller than MPAs (on average, about 1/20 the size of MPAs), temporary closures tended to increase fish biomass and especially fish size, with typically high levels of compliance. Our review indicates that temporary closures may offer a promising solution to reef health decline despite being small and temporary by maintaining high levels of compliance to management rules by participating fishers.

- **5 min talk- Jahat Garcia —** *Fishers' perceptions of success and failure in Mexico's temporary Marine Protected Areas*

  Authors: Jahat Garcia, Bonnie Basnett, Anastasia Quintana

  Ocean protection is expanding rapidly with a global agreement to protect 30% of the ocean by 2030. Most science on ocean protection has studied permanent closures, with temporary closures presenting a huge research gap. This project attempts to understand fishers' perceptions of success and failure from four sites with temporary marine protected areas in Mexico, in collaboration with community partner Comunidad y Biodiversidad (COBI). Working alongside Bren School PhD student Bonnie Basnett we have successfully planned and are finishing up executing our in depth perception surveys and interviews. Translation, transcription, and analysis of this data from our four different sites are in progress; these results on fishers' perceptions from this project will directly inform a policy brief on temporary protection in Mexico written by colleagues at COBI.

  There is emerging interest in the potential of temporary protection to meet the commitments of 30x30 in a way that is equitable and involves fishers in management, but this is a huge research gap. To fill this research gap, a large international research team led by researchers at UCSB called TEMPO (Temporal Ecosocial Management and Productivity of the Oceans) is conducting social science and natural science research in Mexico and French Polynesia, paired with systematic literature review, to understand the impact of temporary fisheries closures. TEMPO aims to understand: (1) where temporary closures emerge (social and ecological context), (2) what happens in the water (social and ecological outcomes through time), and (3) what arguments are used to support success stories (perceptions of success and failure).

  Our four sites in Mexico are specifically located in Celestune, San Felipe (Actam Chuleb Marine Reserve), Cozumel (Maria Elena Village), and El Rosario. We have over 100 in depth surveys and 19 interviews with fishermen across these reserves, with more being conducted at our last site. The project aims to develop a deeper understanding of how and whether fishers perceive temporary closures to be successful in four sites in Mexico.

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2:20 PM Poster Session 2 and Coffee Break

- **Ranjana Raghavan –** *Exploring the Cultivation and Bioconvective Behavior of Sulfur-Oxidizing Bacteria, Thiovulum spp.*

  Authors: Ranjana Raghavan, Dr. George Schaible, Dr. Jean-Marie Volland, UCSB

  Environmental bacteria remain largely unexplored, with an estimated 99% of species uncultivated and lacking phenotypic characterization. To address this gap, we investigated Thiovulum spp., a group of sulfur-oxidizing environmental chemolithoautotrophs known for their complex community behaviors. Through coordinated upward swimming, Thiovulum cells displace surrounding fluid, driving a process known as

bioconvection. This process involves coordinated flagellar beating, which circulates nutrient-laden water through the cell community, optimizing sulfur oxidation. Despite being studied for nearly 200 years, Thiovulum has never been successfully cultivated in pure culture, hindering efforts to investigate its behavior. This study reports the successful enrichment of Thiovulum spp. from the UCSB campus lagoon and investigates the environmental factors governing their bioconvective structure formation. We tested multiple cultivation conditions and found that incubating sediment within a dialysis membrane significantly enhances growth, suggesting that metabolite diffusion supports Thiovulum spp. proliferation. Using this enrichment culture, we examined the effects of cell density and oxygen availability on bioconvective structure formation, revealing that micro-oxic conditions induce bioconvection. These findings advance our understanding of microbial community dynamics and provide a foundation for further ecological and physiological studies of Thiovulum spp.

- **Georgia Fischer –** *A Comparison of Fungal Endophyte Diversity within Two Different Pine Species.*
  Authors: Georgia Fischer, Ryoko Oono, University of California, Santa Barbara

  This research project examines the community diversity of fungal endophyte species from Tiaotai Mountain in the Zhejiang Province of China. A comparison is made between two pine species, Pinus massoniana (Chinese Red Pine) and P. hwangshanensis (Huangshan pine), to understand patterns of host specificity. Data collection began in 2018 when surface-sterilized pine needles were preserved in growth media, allowing fungal endophytes to be cultured. Barcode regions of the ribosomal DNA were sequenced with Sanger technology for all cultured endophytes. The species richness and diversity between trees and pine species were compared, as well as the relative abundance of the different fungal classes between the pine hosts. We found many fungi belonging to the genus Lophodermium, known for its host specificity to pines. The Chinese Red Pine exhibited a greater diversity than the Huangshan pine. The taxonomy of fungal endophyte diversity discovered in Chinese Red Pine and Huangshan Pine in China is compared to that found in Pinus resinosa (Red pine) growing in the USA, as reported in the literature, as they are closely related species. I will discuss the similarities of endophytic taxa among hosts growing thousands of miles apart when the hosts share a recent evolutionary history.
- **Jackie Sirotic –** *Exploring the Influence of El Niño-Southern Oscillation on Seawater pH and Sea Surface Temperature in the Santa Barbara Channel*
  Authors: Jackie Sirotic, Sylvia Kim, Regina Temino-Boes, Débora Iglesias-Rodriguez

  The Santa Barbara Channel (SBC) is influenced by the El Niño-Southern Oscillation (ENSO), a climate pattern characterized by alternating warm (El Niño) and cool (La Niña) phases that affect ocean currents and environmental conditions. During the extreme 2015-2016 El Niño preceded by the Pacific Blob, the SBC experienced anomalously high sea surface temperature (SST) accompanied by very low nitrate concentration at 7-10 m depth (Reed et al., 2016). Furthermore, an unprecedented calcifying phytoplankton bloom was observed in the SBC (Matson et al., 2019). However, the impact of ENSO on carbonate chemistry and nutrient cycling across the SBC remains less understood. Understanding these impacts is vital for predicting the effects of climate variability on SBC marine ecosystems.

  In this study, a time-series of seawater pH was measured through UV spectrophotometry with m-cresol purple dye alongside total alkalinity (TA) analysis, to better understand the dissolved inorganic carbon system in the SBC. Samples were preserved with diluted mercuric chloride to prevent biological activity that could interfere with the chemistry, and each sample was measured in triplicate to ensure reproducibility. This pH and TA data were then used to examine the potential changes in the carbonate system in the SBC in response to various ENSO phases. Satellite imagery was also employed to assess the spatial distribution of oceanographic parameters across the region to help understand the trend in pH changes.

  The findings from this study will help fill the knowledge gap linking environmental changes and marine ecosystems, offering valuable information for future climate predictions.
- **Ella Heidman Pinkner –** *Seeds of Survival: Assessing the Relationship Between Wildfire Severity and Giant Sequoia Regeneration*
  Authors: Ella Heidman Pinkner, Indra Boving, Leander Anderegg

  Climate change, combined with long-term suppression of wildfires, has led to unhealthy levels of fuel buildup which significantly increases both the risk and intensity of wildfires. While studies have demonstrated the

positive role of fire in the release and regeneration of Giant Sequoia seeds, recent research suggests that increasingly severe wildfires may also contribute to their decline. This study seeks to quantify whether fire intensity has a significant impact on the number of seeds dropped for regeneration in Giant Sequoia (Sequoiadendron giganteum) populations. Seed traps were deployed in areas with a high density of sequoia trees in high, moderate, low, and unburned sequoia grove sites within Sequoia National Park. Once collected, the seed traps were then sieved through to count and record the number of seeds within the traps. Average seed size and total seed weight of each trap were also documented. Preliminary results using Rstudio demonstrate a potential negative correlation between number of seeds dropped and burn severity; however, the R squared value of 0.03 suggests that more data is required to fully answer our research question. In the future, we hope to process additional seed traps to not only collect more data on Giant Sequoias, but additionally on Pine and Cedar populations within the areas of interest. Our results may offer insight into understanding how fire severity affects the regeneration of sequoias which may aid in their conservation as well as mitigate the risks associated with their decline.

- **Taryn Hozdic –** *Battle of the Shells: Analyzing force-induced breakage patterns of Pacific razor clams*
  Authors: Amelia Ritger, Taryn Hozdic

  As marine organisms face warming temperatures and changing oceanographic conditions, calcifying organisms in particular are highly susceptible to ocean acidification (a decline in ocean pH). Pacific razor clams along the Pacific Northwest coast provide important economic services and are highly valued by indigenous communities in the area. Recently, their shells have been observed to be weaker and more easily damaged during harvest. Thus, we aimed to understand the potential consequences of environmental stressors, like ocean acidification, on the strength and failure modes (force-induced breakage patterns) of razor clams. To determine failure mode and shell strength, we used an Instron tensile tester to apply force to razor clam shells of varying sizes and measured two events: the first breakage and the final breakage that resulted in catastrophic failure. During this process, we also observed and recorded shell failure modes. Our results indicate that thicker, stronger shells tend to exhibit a different failure mode than thinner, weaker shells. Smaller and thinner shells also exhibit greater variability in their breakage patterns. These trends may differ between populations. The shell strength and failure mode of Pacific razor clams is important when considering predator-prey interactions, as stronger shells provide effective defenses against predators and may benefit the razor clam fishery. Therefore, understanding these relationships becomes increasingly important as we learn more about how different species respond to variable ocean conditions.
- **Kinley Renger –** *Effects of Arundo donax Invasion on Riparian Bird Communities: Vocalization Patterns and Microhabitat Preferences in the Santa Clara River*
  Authors: Kinley Renger, Jeremy Cowan, Conor McMahon, Tom Dudley

  The Santa Clara River ecosystem in Ventura County, California, is one of the region's largest remaining intact riparian systems, providing critical breeding habitat for several at-risk bird species. However, the invasive Giant Reed (Arundo donax) threatens this ecosystem by altering groundwater dynamics and disrupting native vegetation cover. This study investigates how Arundo presence influences bird species through microhabitat changes. Using autonomous recording units (ARUs), we assessed bird vocalizations as a proxy for population density and performed multivariate analyses to examine the relationship between call rates and environmental variables, including temperature, time of day, and vapor pressure deficit (VPD). We hypothesize that riparian birds exhibit higher call rates in microhabitats dominated by native vegetation, avoiding the altered conditions created by Arundo. Findings from this study aim to inform restoration strategies focused on preserving endangered riparian bird species by addressing the ecological impacts of Arundo invasion.
- **Pratyush Rallapally –** *Pixelating Persistence: A Spatially Explicit View of Bullfrog Population Dynamics (work in progress)*
  Authors: Pratyush Rallapally, Kacie Ring, Cherie Briggs

  Native amphibian species in California have been declining rapidly, with American bullfrogs (Rana catesbeiana) acting as a major–if not primary–driver due to their predation, resilience, and role as competent hosts for amphibian pathogens. Existing management strategies are often ineffective and further limited by cost,

time demands, and logistical constraints, highlighting a need for more modern approaches. One promising alternative is simulation modeling, which has become more accessible in ecological research but remains underutilized in invasive species management. To explore this, we are developing a spatially explicit, individual-based model to simulate bullfrog population dynamics within Pleasanton Ridge Regional Park in Northern California. The model was developed using HexSim, a versatile life history simulator that integrates individual interactions with spatial data. By incorporating detailed demographic stages and movement behaviors, our model aims to provide a better understanding of bullfrog persistence and spatial distribution within the park. In addition to simulating population dynamics, individual-based models can help identify promising management strategies to test in the field, making subsequent trials more strategic. Preliminary results reveal the emergence of population hotspots that may serve as ideal intervention targets. In future work, we intend to employ network analysis to further investigate trends in population connectivity and disease transmission among bullfrogs. Our work underscores the utility of HexSim as a tool in quantitative ecological research and highlights its potential to inform data-driven conservation and invasive species management strategies.

- **Danae Stathatos –** *One Salty Pickle: Understanding Physiological Responses of Salicornia pacifica for Coastal Restoration*

  Authors: Danae Stathatos, Germán D. Silva, Kathryn Kolb, Jennifer Y. King, Environmental Studies Program, UC Santa Barbara

  This project examines the effects of soil salinization on Salicornia pacifica (pickleweed), a dominant species in California's salt marshes, by analyzing changes in important functional traits: leaf mass per area (LMA) and leaf water content (LWC). Salt marshes provide vital ecosystem services like carbon sequestration and coastal protection, but are increasingly threatened by climate change and human activity. Rising sea levels and altered hydrological cycles are intensifying soil salinity levels, disrupting ecosystem functions and community compositions. Our findings show that as soil salinity increases, LMA increases and LWC decreases, suggesting improved water-use efficiency and potential resistance to salinization. This helps predict pickleweed's survival in future coastal wetlands impacted by climate change and informs restoration and management strategies, in various activities such as selecting resilient species, to protect and enhance salt marsh ecosystem resilience amidst rising salinity and sea levels.

- **Katelyn Vo –** *Body Size-Mediated Wing Wear: Applying Scored Degrees of Wing Damage in Native Bee Species from Image Segmentation Model*

  Authors: Katelyn Vo, Michelle Tran, Jiashu Huang, Charlie Thrift, Madeleine Oswald, Katja Seltmann, University of California, Santa Barbara

  Damage to bee wings commonly occurs during ecologically-essential foraging and flight activities of bees. Interactions and collisions with native environmental conditions such as wind and vegetation leave wings exposed to potential wear and tear. Morphological traits influence bee flight performance, as bees with larger body sizes demonstrate increased flight distance capacity and foraging range. We analyze the degree of wing wear as an indicator of these activities, predicting that larger bees will accumulate more wing damage from extended exposure to environmental wear. We imaged wings across bee species native to Santa Barbara County. By manually creating masks to isolate the wing, we trained a computer vision model with ground-truth data to identify pixels in wing images and separate them from the background. This image segmentation model allows for shape analysis and comparison of degree of wear in the wing's margin across various species through this large-scale collection of qualitative data. We also created a manual wing wear scoring index to compare accuracy with this model. Genera such as Bombus and Xylocopa that tend to have larger body sizes, indicated by high perimeter:area ratio, are predicted to be assigned, on average, higher scores of wing wear compared with smaller species being assigned lower scores to indicate experiencing less wear. By comparing wear patterns, these correlations could offer insight on species resilience in their native habitats, suggesting that species with larger body sizes may be more vulnerable to environmental stresses that require more demanding flight and foraging efforts. This model could then have potential research applications as bioindicators of the local foraging ecology and environmental stress/fragmentation.

- **Ixel Medrano –** *Conservation genomics of the endangered southern river otter Lontra provocax in the Valdivian coastal reserve, Chile*
  Authors: Ixel Medrano, Lillian D. Parker, Susette Castañeda-Rico, Aurora Trejo, Seanessy O. Lyons, Madeleine Becker, Maximiliano Sepúlveda, & Jesús E. Maldonado

  The southern river otter (Lontra provocax) has the smallest range of the world's 13 otter species. It is an understudied and endangered carnivore native to the southwestern coast of South America. The species is threatened by the American mink (Neovison vison), an invasive bridge host species for canine pathogens such as canine distemper virus, due to their use of shared latrines. This mink population was established within the Valdivian coastal reserve in Chile from individuals that escaped from local fur farms. Previous studies have shown that mink can act as hosts that allow disease transmission between unconnected host populations. This interaction has led to conservation concern for the endemic otter populations due to disease risk transmission from mink to otter. Extracted DNA from otter and mink scat samples as well as mink ear punches gives us the opportunity to gain a better understanding of the genetic structure and genetic diversity of otters and mink coexisting within the Valdivian coastal reserve. We present the results of our hybridization capture efforts to enrich and sequence mitochondrial genomes and AMELX/Y sex genes to determine the sex of mink and otter individuals. We also provide the results of our data analyses comparing the genetic diversity and connectivity of the two species across the Valdivian coastal reserve. These results will be used to better inform the conservation management of the local southern river otter population.
- **Diana Flores –** *Stress the Killer: Fungal Pathogen Batrachochytrium dendrobatidis Response to Environmental Stressors*
  Authors: Diana Flores, Cannon Mallory, Cherie Briggs, UCSB

  From North America to Asia, amphibian populations are experiencing significant declines across the globe. The deadly amphibian disease Chytridiomycosis caused by the fungal pathogen Batrachochytrium dendrobatidis (Bd) is one of the leading causes of global amphibian declines. Given the limited understanding of this highly adaptable pathogen, we examined how distinct Bd isolates from epizootic and persistent populations responded to environmental stressors such as temperature fluctuations and nutrient availability. Preliminary data suggest mixed responses to environmental stressors. Qualitative measurements demonstrated epidemic strains grow faster in ideal conditions while persistent strains may demonstrate greater resilience to environmental stress. To quantitatively assess strain-specific responses, each Bd isolate was cultured under alternating temperatures and varying nutrient conditions. After a two week exposure period, growth curves indicated both isolates exhibit similar growth patterns under fluctuating temperatures, however there may be a significant isolate specific response to nutrient stressors. Expanding upon these findings, we aim to further assess Bd's adaptability by testing a wider range of environmental stressors. Bd has been documented in various species across all continents, except Antarctica, posting a serious world wide threat to amphibian biodiversity. Understanding Bd disease dynamics may offer valuable insight for developing effective mitigation strategies to protect declining and endangered amphibian species.
- **Elena Neuburger –** *Growth in the Absence of Hosts: A Comparative Study of Batrachochytrium dendrobatidis on Plant-based and Standard Media*
  Authors: Elena Neuburger, Lourdes Velazquez, Caitlin Nordheim-Maestas, Cherie Briggs (UC Santa Barbara), Teagan McMahon (Connecticut College)

  Batrachochytrium dendrobatidis (Bd) is the chytrid fungal pathogen responsible for amphibian declines globally. Given its devastating ecological impact, it is critical to understand the factors that enable Bd's persistence in various environments, even in the absence of hosts. This project will assess Bd's ability to utilize plant-based nutrients extracted from field-collected vegetation and compare its growth to standard tryptone-agar and nutrient-absent controls. This study will test various Bd strains, including epizootic and endemic strains, to assess potential differences in their ability to utilize plant-derived nutrients. If Bd has persistence linked to nutritional versatility, then we will see increased Bd growth from non-keratinized nutrient sources compared to control environments lacking nutrients. We expect Bd to grow better on plant-based media than in nutrient-absent conditions but less than in tryptone-agar controls. Additionally, Bd strains isolated from long-term persistent sites

(enzootic) may exhibit an enhanced capacity to utilize external nutrient sources since persistence in low-host environments likely favors traits supporting environmental survival–possibly via metabolic flexibility. This research provides insights into the ecological resilience and adaptability of Bd and informs broader strategies for amphibian conservation.

- **Arnie Johnson, Divyanshi Autade, and Jayden Maramis** – *The Great Tomato Gas-Up: How Tomato Plants Respond to Elevated [CO2]*
  Authors: Undergrads: Arnie Johnson, Divyanshi Autade, Jayden Maramis; Grad student: Indra Boving; PI: Dr. Lee Anderegg

  As atmospheric CO2 levels rise due to climate change, understanding the effects of elevated CO2 on plant growth is essential for predicting agricultural productivity and ecosystem dynamics. This study investigates how elevated CO2 (700 ppm) influences carbon allocation, growth patterns, and physiological traits in tomato plants (Solanum lycopersicum). Over a 25-day period, plants grown under elevated CO2 conditions were compared to controls (ambient CO2, 423 ppm) in terms of stem height, stem diameter, leaf mass per area (LMA), root-to-shoot ratios, stomatal conductance, and leaf temperature. Results indicate that elevated CO2 promoted increased stem growth, thicker leaves (higher LMA), and a higher root-to-shoot ratio, suggesting a shift in carbon allocation towards both above-ground and root structures. Despite no significant change in stomatal conductance, elevated CO2 plants exhibited higher leaf temperatures, likely due to reduced transpiration and altered leaf angles. These findings suggest that elevated CO2 enhances tomato plant growth by optimizing carbon allocation, though physiological responses like stomatal conductance and water use efficiency may also shift. Future research should explore the long-term effects of elevated CO2 on reproductive success and crop yields under varying environmental conditions.

3:20 PM Session 3

- **10 min talk- Jorge De La Cruz –** *Applying geometric morphometrics to assess morphological divergence in bees*
  Authors: Jorge De La Cruz, Charles N. Thrift, Madeleine M. Ostwald, Katja C. Seltmann, University of California Santa Barbara

  Wing venation characteristics are fundamental for defining and classifying insects, but traditional methods of morphological identification for structures with complex geometries are challenging and time-consuming. This poses a challenge to the ease and accessibility of biodiversity research and studies examining ecological morphotypes. Bees have relatively conserved wing morphology, but the divergence between groups remains poorly understood and has not been thoroughly quantified. In this study, we employed geometric morphometrics to assess divergence in wing vein morphology across bee taxa. Geometric morphometrics allows for detailed shape analysis of wing structure, which may provide insights into evolutionary relationships. By digitally landmarking nine homologous wing vein characters of a large sample of bees, we quantified and compared morphological variation across several recognized species, genera, and families to assess whether the resulting morphological clusters reflect evolutionary divergence. Previous exploratory analyses demonstrate the ability to differentiate species within a genus and even among populations, testifying to a high level of precision. The extent to which our groupings based on morphometric data align with established phylogeny and the effects of allometry are investigated. This study assesses the potential of geometric morphometrics to infer the phylogenetic placement of indeterminate bee species based solely on wing vein morphology and practical implications for an efficient species identification pathway.
- **10 min talk- Claire Cady –***V is for Vaginal Cytology: Hormonal Analysis of the Mouse Estrous Cycle*
  Authors: Claire Cady, Nora Wolcott, Dr. Michael Goard

  An accurate understanding of women's reproductive health has long been hindered by the underrepresentation of female subjects in preclinical research. Male models are often the default, so male physiology becomes the standard. This has contributed to major gaps in knowledge surrounding female-specific issues such as hormonal fluctuations, reproductive disorders, and mood regulation.

  Mice and humans have analogous hormonal cycles, the estrous and menstrual, respectively, marked by

fluctuations in estrogen and progesterone. This makes female mice valuable models for studying the effects of hormonal modulation. However, the perceived complexity of tracking the estrous cycle has historically discouraged researchers from working with female mice.

Vaginal cytology has developed into the standard for estrous cycle tracking by using cellular composition in vaginal smears to distinguish between four stages: proestrus, estrus, metestrus, and diestrus. Each stage features a unique mix of epithelial, cornified, and leukocyte cells, serving as a reliable and replicable indicator of hormonal state. This manual classification of vaginal samples laid the foundation for now creating automated identification. The EstrousNet, created by the Goard Lab, is a machine learning model trained on labeled cytology images to streamline and further improve precise classification. This model is currently being used to explore the effect of the estrous cycle on the changes in dendritic spine density. A project that sits on the forefront of research aimed to understand neuroendocrinology in women, and built on the back of vaginal cytology.

- **5 min talk- Aryan Chopra and John Hagedorn –** *Automated Detection of Historical Vernal Pools Using Machine Learning and ArcGIS*

  Authors: Joanna Tang, Aryan Chopra, John Hagedorn at UCSB

  Vernal pools are ecologically critical seasonal wetlands that have faced extensive habitat loss throughout California over the past century. Accurate mapping of their historical distribution is essential for informing conservation and restoration strategies. In this project, we developed a deep learning-based object detection model within the ArcGIS Pro framework to automatically identify vernal pools from historical aerial imagery of Santa Barbara County, covering the 1980s, 1990s, and early 2000s.

  Using georeferenced aerial photographs provided by UC Santa Barbara's DREAM Lab and FrameFinder platform, we trained the model specifically on verified Santa Barbara vernal pool data. Once optimized, the model demonstrated high accuracy in detecting vernal pools across the Santa Barbara dataset. Notably, after this initial training phase, we applied the model to historical aerial imagery from other regions of California. The model successfully generalized its learning, accurately identifying vernal pools beyond Santa Barbara, thus showcasing its robustness and broader applicability.

  Our workflow integrated data preprocessing, manual annotation, iterative model refinement, and deployment in ArcGIS for visualization and spatial analysis. This project highlights how combining deep learning techniques with GIS platforms can facilitate large-scale, automated habitat mapping. The methodology offers a scalable solution for historical ecological research and can support future conservation efforts across diverse regions.

- **10 min talk- Jonatan Kaare-Rasmussen** – *Clustered by Choosy Clients: How Fish Behavior Regulates the Spatial Distribution of Cleaning Services*

  Authors: Jonatan T. Kaare-Rasmussen, A. Raine Detmer, Eleanor M. Caves, Holly V. Moeller

  Cleaner shrimp have a mutualistic relationship with coral fish in which they remove parasites on a fish for an energetic gain. The cleaner shrimp inhabit stationary sea anemones, requiring the fish "clients" to locate and select a cleaning station. To better understand how different fish movement strategies affect the spatial distribution of cleaning stations, we developed an Individual Based Model giving us explicit control over fish movement and decision-making mechanisms. We tested two fish movement strategies: exploration-based (in which fish are able to locate the nearest cleaning station within a given movement radius) and memory-based (in which fish relocate cleaning stations they have visited previously). We find that both movement strategies can result in patchy distributions of cleaning stations, but only when fish directional movement overcomes random dispersal for food acquisition. We also used empirical cleaning station visit frequency data to parameterize our model, demonstrating that reefs populated by "choosy" clients willing to travel large distances to visit preferred cleaning stations are more likely to have clustered cleaning stations.

- **5 min talk- Schuyler Capita –** *Charting The Winds of Fate - Exploring the Role of Wind Stress as a Driver of Coastal Sage Scrub Plant Community Assemblage*

  Authors: Schuyler Capita*; Leander D. L. Anderegg, Ph.D.†; Amy E. Frazier, Ph.D.‡; Shane Dewees, Ph.D.§; Michael Burnett†; Izzy Lopez‡

  * University of California, Santa Barbara, Environmental Studies

† University of California, Santa Barbara, Ecology, Evolution, and Marine Biology
‡ University of California, Santa Barbara, Geography
§ University of California, Santa Barbara, Earth Research Institute

Wind has well-documented impacts on plant functional morphology, influencing processes such as evapotranspiration, assimilation, and growth. However, to date, no research has directly explored the effects of wind stress—a combination of wind speed and exposure—on coastal sage scrub (CSS) plant communities. Also known as low chaparral, CSS is characterized by chronic onshore wind exposure, particularly at Point Conception, the foremost headland along the California coastline. Although previous studies have examined wind stress primarily through the lenses of treeline restriction and soil erosion in alpine and steppe ecosystems, a significant gap remains in understanding its role in community assemblage, structure, and function within coastal drylands. With rising temperatures altering global wind gradients and increasing the frequency and intensity of extreme weather events, it is critical to understand how native plant communities—and ecologically sensitive habitats such as CSS—respond to these climatic shifts. To address this gap, this study asks: (1) Is wind stress a driver of coastal sage scrub community assemblage? (2) Does wind stress drive patterns in community-level functional trait expression? (3) How does wind stress compare to other environmental variables in predicting variation in plant community structure and function?

- **10 min talk- Rosie Manner –***In the Heat of Conservation: Studying Wildlife Response to Coastal Prescribed Burns*

Author: Rosie Manner*; Hillary Young, PhD*; *UC Santa Barbara, Ecology, Evolution, and Marine Biology

Prescribed burns– an indigenous practice reintroduced into modern land management– are critical for reducing wildfire risks, restoring ecosystems, and maintaining biodiversity. However, the effects of these burns on wildlife behavior, habitat use, and population dynamics remain understudied, particularly in California's unique coastal ecosystems. This senior thesis project focuses on understanding how wildlife populations respond to prescribed burns and contribute to the ongoing study of better understanding California fires. Primary observed and monitored species include mammals such as coyotes, bobcats, mule deer, wild pigs, mountain lions, and foxes– as well as bird species like California quail, Western scrub-jays, and acorn woodpeckers. These species represent diverse ecological roles and provide insights into how prescribed burns affect wildlife across trophic levels. The study employs two primary noninvasive monitoring methods: motion-activated camera traps and point count surveys. Camera traps are deployed across fifteen sites, and divided into three treatment groups: 1) fenced + burned, 2) grazed + burned, and 3) grazed + unburned control. The sites that are fenced are permeable to most mammal species except for the cattle– minimizing grazing pressures at those sites. Point count surveys are conducted multiple times at each site respectively to assess bird and mammal abundance and diversity. Data collection spans pre-burn (October 2024) and immediate post-burn (December 2024), capturing a comprehensive timeline of wildlife responses. This research contributes to fire ecology by providing valuable insights into how prescribed burns affect biodiversity. The findings will inform land management practices, supporting the refinement of burn strategies to balance ecological resilience with wildlife conservation.

- **10 min talk- Alan Sheu** – *MIXO-COBALT: INCORPORATING MIXOTROPHIC NANOFLAGELLATES INTO AN OCEAN ECOSYSTEM MODEL*

Authors: AUTHORS: Alan D. Sheu (EEMB, UCSB), Jessica Y. Luo (GFDL, NOAA), Kevin M. Archibald (EEMB, UCSB), Holly V. Moeller (EEMB, UCSB)

Plankton in the marine ecosystem have been historically modeled to fit into the strict ecological niches of autotrophy and heterotrophy. However, we now know that a large portion of plankton inhabit a hybrid mixotrophic role that partakes in both strategies. Despite this, relatively few global ocean models include mixotrophs as a functional group. Therefore, we modified the COBALT (Carbon, Ocean Biogeochemistry, and Lower Trophics) model, a global biogeochemical ocean ecosystem simulation, to create Mixo-COBALT, implementing a class of mixotrophic nanoflagellate observed to play a large role in ocean bacterivory. We

allowed mixotrophs to have a growth-maximizing metabolic strategy in which investments in photosynthesis vs phagotrophy respond to resource availability in the environment. We illustrate the effects of mixotrophy on community structure and biogeochemical function by running the model at the Bermuda Atlantic Time Series (BATS) station with a one-dimensional domain. Notably we find strong correlations between mixotroph metabolic strategy and factors like prey biomass and nutrient density at the DCM where they are not present in the upper mixed layer. This demonstrates that mixotrophic plasticity is most influential in conditions of dynamic nutrient and prey availability whereas under the oligotrophic surface conditions, investment strategy is governed more by the inherent energetic efficiencies of phototrophy and phagotrophy. Ultimately, Mixo-COBALT provides a means of further investigating ecological sensitivity to mixotrophs and their response to environmental conditions, potentially allowing for several classes of mixotrophs and full global simulations.

- **5 min talk- Cayenne Wong –** *Wing Asymmetry in Halictus ligatus: A Comparative Study of Bee Populations from California (Santa Barbara) and Georgia (USA)*

  Authors: Cayenne Wong, Colman Yeung, Charles Thrift, Katja Seltmann

  Wing venation, particularly asymmetry, plays a critical role in insect classification and can provide insights into developmental stability, environmental stress, and genetic variation. We attempt to show how environmental pressures and genetic factors affect bee wing structure over time. However, research on wing asymmetry in lesser-studied bee species, such as Halictus ligatus (a species of sweat bee), remains limited. Identifying insects at the species level presents challenges that can hinder ecological studies, particularly those investigating biodiversity and environmental influences on morphology.

  This study applies geometric morphometrics to assess variation in wing asymmetry in H. ligatus populations from two distinct regions: Santa Barbara, California (n = 40), and Georgia, USA (n = 40). We quantify differences in wing morphology to evaluate potential influences of environmental and genetic factors through advanced imaging techniques and landmark-based shape analysis. We hypothesize that ecological differences between these regions contribute to detectable variations in asymmetry, potentially reflecting developmental instability or local adaptation.

  The findings of this study will contribute to broader discussions on phenotypic plasticity, pollinator health, and conservation by providing new insights into how environmental pressures shape morphological traits. Data analysis is ongoing, and results will be presented at the UCSB EEMB Undergraduate Research Symposium and the UCSB Undergraduate Research Colloquium in 2025.

- **10 min talk- Michela Gunther –** *Consumer pressure increases coral lesion prevalence and severity over four years*

  Authors: Michela Gunther (EEMB), Deron Burkepile (EEMB), Greta S. Aeby (Hawai'i Institute of Marine Biology, University of Hawai'i), Thomas C. Adam (MSI), Kelly E. Speare (School of Geographical Science and Urban Planning, Arizona State University), Rebecca Vega Thurber (MSI), and Julianna J. Renzi (EEMB)

  Corals are crucial foundational species in tropical ecosystems. However they are facing increasing threats from climate change, nutrient pollution, and overfishing. These stressors may be related to emergent coral diseases, which are becoming increasingly common, but we know little about what causes these diseases or their effects on coral health. To explore how nutrient enrichment and reduced fish consumer pressure (i.e., simulated overfishing) influence the severity and prevalence of a coral disease, we tracked the fate of Pavona corals in a manipulative experiment that crossed fish exclusion with nutrient enrichment for four years on the island of Moorea, French Polynesia. We tracked red lesions in Pavona, which we propose are the result of endolithic hypermycosis (EH), an emergent marine fungal disease. We characterized the severity of coral lesions annually as the percent of each colony with red discoloration and tracked colony survival. Our results show that higher consumer pressure (i.e., more "natural" conditions) led to increased EH prevalence and severity, while nutrient enrichment had no detectable effect. Plots with more macroalgae also had higher lesion prevalence and larger corals were more likely to have lesions, consistent with trends in other coral diseases. Although many corals survived with red lesions, greater lesion severity was associated with an increased likelihood of colony mortality, suggesting EH has adverse effects on coral fitness. These findings provide insight into how fish communities,

nutrient enrichment, and increasing macroalgal abundances affect coral lesions, with important ramifications for predicting coral reef responses to global change.

4:50 PM Awards/ Closing Remarks

Holly Moeller, Hannah Lyford

Tabling at URS:

Organization: SEEDS
Primary contact: Madelyn Balochie, 831-801-0597 (cell), mbalochie@ucsb.edu (email)
Description: SEEDS (Strategies for Ecological Education, Diversity, and Sustainability) is a student group associated with the Ecological Society of America (ESA). We offer members with hands-on experience in ecology and provide volunteer, internship, career, and research opportunities on campus and in the local Santa Barbara area.

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