SOEST SYMPOSIUM 2025

Exploring Earth, Ocean, and Space Science to Address Today's Challenges and Shape Tomorrow's Solutions

Program and Abstracts

Thursday 13 November and
Friday 14 November 2025
8:30 am to 6:00 pm

Keoni Auditorium
Imin International Conference Center
East-West Center
University of Hawai'i at Mānoa

DAY 1 Thursday 13 November

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4:15–6:00 pm **Poster Session** on MSB Lanai **29**

DAY 2 Friday 14 November

8:30–9:00 am	Coffee and snacks	
9:00–10:30 am	**SESSION 4: New Technologies** *Sharing cutting-edge developments in science and technology*	**16**
9:00 am	**A Low-Cost Automated Water Sampler for Monitoring Coastal Water Quality** Cameron Richardson (OCN Graduate Student)	**16**
9:10 am	**What if we could generate electricity while protecting our coastlines from ocean waves?** Clint Reyes (ORE Graduate Student)	**17**
9:20 am	**Advances in Gas Purification to Improve Sustainable Energy Systems** Cecilia Abella (HIGP Graduate Student)	**18**
9:30 am	**A unique instrument for observing the deepest parts of the global ocean** Glenn Carter (OCN Faculty)	**19**
9:40 am	**From Sea to Shore: New Tools to Monitor, Protect, and Power Island Systems** Moderators: Camille Pagniello (ORE Faculty) and Zachary Nachod (OCN Graduate Student)	
10:00 am	Panel Q&A	
10:30 am	**Break (30 min.)**	
11:00 am–12:30 pm	**SESSION 5: SOEST in the Pacific Islands: From Ridge to Reef to Ridge** *Discovering research in SOEST that is central to Hawai'i and other Pacific Islands*	**20**
11:00 am	**Cold pools, Breezes, and Monsoons: Propagating Convection over New Guinea** Mingyue Tang (ATMO Graduate Student)	**20**
11:10 am	**From Seabirds to Sewage: Investigating Terrestrial Nutrient Enrichment to Coral Reefs** Jessica Glazner (OCN Graduate Student)	**21**
11:20 am	**Cradle to Grave: Museum and Video Archives Reveal Diverse Nursery Functions of Deep-Sea Corals and Sponges** Harold Carlson (OCN Graduate Student)	**22**
11:30 am	**Listening to Seismic Waves to See What's Hiding Beneath Hawai'i** Megumi Fujimoto (ERTH Graduate Student)	**23**
11:40 am	**Pacific Ocean Health and Island Fisheries** Moderator: Eileen Nalley (SeaGrant Faculty)	
12:00 pm	Panel Q&A	
12:30–2:00 pm	**Lunch — Wailana Room**	
2:00–3:30 pm	**SESSION 6: New Frontiers in Ocean, Earth, and Space Science** *Exploring pressing issues and developing fields*	**24**
2:00 pm	**Material-based Hydrogen Storage for Sustainable Energy Systems** Isabella Kotsol (HIGP Graduate Student)	**24**
2:10 pm	**Wave Energy Converter Research and Control at the Hawaii Marine Energy Center (HMEC)** Clara Vanessa Encke (ORE Graduate Student)	**25**
2:20 pm	**Deep-sea mining discharge can disrupt midwater food webs** Michael Dowd (OCN Graduate Student)	**26**
2:30 pm	**Identifying Needs for Addressing Contaminants of Emerging Concern in Hawai'i** Lauryn Hansen (Grau Post-Graduate Fellow)	**27**
2:40 pm	**Spatial and Temporal Dynamics of Deep-Sea Coral-Associated Epifaunal Communities** Jack Howell (OCN Graduate Student)	**28**
2:50 pm	**Emerging solutions to increasing resource needs in a changing world: Promises and unknowns** Moderator: Fanny Girard (OCN Faculty)	
3:00 pm	Panel Q&A	
3:30–4:00 pm	**Closing Remarks**	
4:00–6:00 pm	**Pau Hana** on MSB Lanai	

DAY 1 SESSION 1: Ocean, Earth, and Space Processes

Dynamics of Decadal Climate Variability in the Tropical Pacific

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The tropical Pacific plays a fundamental role in shaping weather and climate around the world. Variability in the tropical Pacific sea surface temperatures (SSTs) have significant impacts on weather extremes (e.g., droughts and floods), the global warming trend, and marine ecosystems. We investigate the dynamics and drivers of low-frequency (decadal) variability in the tropical Pacific, which are still debated despite their global impacts. Analyzing the output of a climate model large ensemble, we demonstrate a coupling between the subtropical and equatorial Pacific by the subsurface ocean circulation at decadal time scales. Temperature anomalies that propagate along constant density surfaces (spiciness anomalies) are generated in the subtropical Pacific in both hemispheres and can sometimes be strengthened along their way to the equator in the Southern Hemisphere. Once they reach the equatorial Pacific, the spiciness anomalies can emerge back to the surface and impact the tropical Pacific SST at decadal time scales.

AI Models for El Niño Prediction

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El Niño-Southern Oscillation (ENSO) is a primary driver of global climate variability, causing widespread impacts from droughts to floods that affect economies and communities worldwide. Accurate, long-range forecasting of ENSO, particularly for the stronger events, remains a key goal in climate science to enable effective preparation and response. In the era of machine learning and AI, new methodologies can be used to build neural networks fit for this challenge, given their strength in complex tasks like pattern recognition. By training these networks on climate variables known to influence El Niño's development, our research shows skillful predictions for strong events in the eastern Pacific with lead times of up to 8 months. While the complexity of AI can make it seem like a "black box," this challenge can be addressed with explainable AI methods. These tools provide insight into the model's decision-making process, allowing us to verify its ability to identify physically meaningful precursors to major events. Causal inference methods can further test the model's logic to determine if it can uncover physical relationships. AI methods can have physics embedded onto it with the so-called physics-informed neural networks. This approach can integrate established theories like the El Niño recharge oscillator to ensure the model adheres to fundamental physical principles that can boost its performance. Furthermore, the simulation of climate by AI methods can be used to obtain detailed information about the state of the ocean and atmosphere with a fraction of the computational cost of traditional numerical models. This efficiency accelerates experimentation and can lead to timely prediction of El Niño conditions

Lava-fountaining dynamics of the 2024–2025 Kīlauea eruption

Natália G. Pasqualon[1], Bruce F. Houghton[1], Rose Forshaw[1], Matthew R. Patrick[2], Kiriana Anderson[1], Caroline M. Tisdale[1]

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The 2024-2025 eruption of Kīlauea is the first high-fountaining event at the summit since 1959 and the sixth eruption within Kaluapele since the summit collapse in 2018. Since eruption onset in December 2024, 31 eruptive episodes have occurred as of this writing. The complete record of the episodes, acquired through HD webcams, timelapse, and 4K and 8K cameras, allows the quantification of eruptive parameters, characterization of fountaining dynamics at sub-second intervals, and inference of subsurface processes. Over time, eruptive episodes have become more regular. The last 10 episodes have an average duration of 9 hours, while repose intervals are longer, with an average of ~7 days. Fountaining activity occurs in two vents approximately 150 meters apart, on the floor of Halema'uma'u crater. We observe four periods of alternating intensity between the two vents: south vent dominance during Episodes 1–3 and 12–18, and north vent dominance during Episodes 4–11 and 19–31. Each episode typically has four stages of fountaining behavior: (1) an initial phase of short-lived, unsteady fountaining with low pulses and occasional lava overflow; (2) an hour-long waxing stage in which the pulsating fountain grows rapidly towards a maximum height (50 to 400 m); (3) a prolonged waning stage marked by increasing unsteadiness and gradually decreasing height; and (4) a final shutdown stage, with a rapid drain-back from the fountain into the vent. We conclude by discussing the transitions and relationships between very low dome fountains, low and prolonged steady fountains, high narrow fountains, and rare wide splaying fountains, and their relation to vent geometry and mass eruption rate.

Understanding Kīlauea Volcano's Explosive Temper over the last 30,000 years

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Hawaiian Volcanoes are among the most active in the world, erupting nearly every 1–2 years on average over the past century. Yet they have been considered tamer than other volcanoes worldwide because, over the last 200 years, eruptions have consisted generally of vast lava flow outpourings. This activity is responsible for destruction of residential areas but less prone to life-threatening, explosive eruptions. This view has completely shifted in the last 20 yrs. Kīlauea is now known to undergo cycles of explosive and effusive activity that can last for centuries or millennia. The last two explosive cycles are well known, but only span the last 2500 yrs of activity of a volcano that breached the ocean surface >100,000 yrs ago. But Kīlauea has numerous other tephra sequences that underlie the last two explosive units, indicating that explosive-effusive cycles may be the norm rather than the exception for Hawaiian shield volcanoes. This study seeks to unravel the origins, duration, and distribution of tephra from the period 30,000 - 3,500 years ago, which potentially includes a ~10,000 years-long explosive cycle grouped under the umbrella term "Pahala Tephra" for its widespread occurrence both on Kīlauea and Maunaloa. By understanding the magmatic and volcanic edifice configurations under which explosive cycles develop, scientists can identify the symptoms and plan for future occurrences of long-term hazardous tephra production in Hawai'i.

DAY 1 SESSION 2: Global Environmental Change

Drivers of Marine Heatwaves in a Changing Climate

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Marine heatwaves are periods of extreme sea surface temperatures (SSTs) which can have serious ecological and socioeconomic impacts. Taking into account the increase in mean upper ocean temperature, future changes to marine heatwaves statistics are almost entirely a result of changes to SST variance. The projected changes to SST variance in the future climate are spatially heterogeneous, with some areas experiencing less variance in the future, and others increased variance in the current generation of climate models. Moreover, the pattern of SST variance change differs between climate models. To determine the physical mechanisms behind these changes, we used a stochastic climate model to attribute the projected SST variance change in the extratropics to three drivers: ocean memory, El Niño-Southern Oscillation (ENSO) teleconnections, and stochastic noise (weather) forcing. We found that climate models generally agree that ocean memory will decline, resulting in decreased SST variance. Models also generally agree that the variance of the noise forcing will increase, resulting in enhanced SST variance. Changes to the ENSO teleconnection differ greatly between models, likely as a result of the substantially different future changes to ENSO in different models.

Record-breaking heat stress drives continued *Acropora* coral decline across the Caribbean

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Coral reefs were exposed to record-setting heat stress accumulations in 2023 and 2024 during the fourth global coral bleaching event (GCBE4). Across the Caribbean, the impacts of these back-to-back marine heatwaves have been particularly severe for critically endangered *Acropora* corals, whose populations have been in decline since the late 1970s. To quantify coral mortality across the Caribbean following GCBE4, we compiled species-level data of *Acropora palmata* and *Acropora cervicornis* collected by a broad network of local monitoring teams. Surveys were conducted across the entire region, from the Florida Keys to Panama and from the Southern Gulf of America to the Lesser Antilles. Levels of mortality were compared across the region and between depths, and related to heat stress accumulation calculated by the NOAA Coral Reef Watch Degree Heating Week product. Maximum heat stress exposures were >20°C-weeks in some locations, while the majority of sites exceeded 18°C-weeks, leading to high levels of mortality for both species. Areas such as the Florida Key's experienced a functional extinction of acroporids (mortality of 97.8–100%), but certain locations appear to harbor resilient *Acropora* stands such as Tela Bay, Honduras, where 0% mortality was observed—potentially due to local mitigating effects such as reduced light intensity from high turbidity or a high prevalence of heat-tolerant algal symbionts. The decline of this already rare coral genus across the Caribbean demonstrates the critical impacts of increasingly severe marine heatwaves. Given the critical role of *Acropora* in forming complex reef architecture and contributing to reef stability through carbonate production, the continued loss of these corals poses a significant threat to the resilience and long-term health of coral reef ecosystems in the Caribbean.

Legionella diversity and distribution across global soils

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Legionellosis is an infectious disease caused by bacteria from the genus *Legionella*, which utilizes secretion systems (types I, II and IV) to replicate intracellularly across a range of hosts such as amoeba and mammalian macrophage cells. Recorded incidents of Legionnaires' disease have steadily climbed since the first case in 1976, multiplied more than fivefold in the past two decades, and rebounded since 2021 after a slight dip that coincided with the COVID-19 pandemic (CDC). The economic impact of Legionellosis has been estimated to be over $800 million annually, and this disease has a high mortality rate (between 5–10%). The majority of Legionellosis cases have occurred in the summer and fall, suggesting that precipitation, temperature and humidity might be driving pathogen load or transmission. However, it has yet to be systematically evaluated whether these abiotic variables are linked with an increase in Legionella abundance in the environment, which is increasingly relevant as global temperatures continue to rise.

Here, a global analysis was conducted using more than four thousand 16S rDNA amplicon datasets collected across six continents to untangle the relative abundance, diversity and distribution of Legionella within their natural soil habitats. To do so, a well-curated custom BLAST database was created to select for *Legionella* 16S sequences, and all hits were further screened phylogenetically to confirm their taxonomic identity. Continental-scale datasets were selected that contained detailed metadata, which allowed comparisons of *Legionella* abundance against a suite of abiotic variables, most notably temperature and precipitation. By parsing more than 500,000 *Legionella* sequences, potential hotspots for common pathogenic species (*L. pneumophila* and *L. longbeachae*) were also identified for risk-predictive mapping of Legionnaires' disease.

Future Climate Change Stresses on the Hawaiian Marine Ecosystems

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We know that as the climate warms, increasing temperature will put stress upon the marine ecosystems; however, along with temperature there are other stresses that change with a warming climate, including ocean acidification and decreasing oxygen in the water. The combination of these factors could have a major impact on various ecosystems around the Main Hawaiian Islands from coastal coral reefs to deep-sea, long-line fisheries. Unfortunately, the global climate models used for climate projections are ill equipped to resolve the Hawaiian Islands and the processes that are important around them. We have created a fine-scale model of the Main Hawaiian Islands that resolves these processes so that we can examine how three different climate scenarios (low to high emission scenarios) will affect Hawai'i. We find that these stresses vary substantially across islands and even from windward to leeward sides. This research provides key information for fisheries management, marine protected area managers, and policymakers to plan for the future of Hawai'i.

DAY 1 SESSION 3: Building Resiliency

Sea level rise and coastal erosion: What they mean for O‘ahu’s infrastructure

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Marine heatwaves are periods of extreme sea surface temperatures (SSTs) which can have serious ecological and socioeconomic impacts. Taking into account the increase in mean upper ocean temperature, future changes to marine heatwaves statistics are almost entirely a result of changes to SST variance. The projected changes to SST variance in the future climate are spatially heterogeneous, with some areas experiencing less variance in the future, and others increased variance in the current generation of climate models. Moreover, the pattern of SST variance change differs between climate models. To determine the physical mechanisms behind these changes, we used a stochastic climate model to attribute the projected SST variance change in the extratropics to three drivers: ocean memory, El Niño-Southern Oscillation (ENSO) teleconnections, and stochastic noise (weather) forcing. We found that climate models generally agree that ocean memory will decline, resulting in decreased SST variance. Models also generally agree that the variance of the noise forcing will increase, resulting in enhanced SST variance. Changes to the ENSO teleconnection differ greatly between models, likely as a result of the substantially different future changes to ENSO in different models.

ʻŌpae ē, ʻōpae hoʻi — An assessment of ʻōpaeʻula resiliency in North Kona, Hawaiʻi

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Loko waiʻōpae (anchialine pool) habitats are tidally influenced, land-locked aquatic habitats with subterranean connections to the sea that are home to unique assemblages of organisms, such as the endemic shrimp, ʻōpaeʻula (*Halocaridina rubra*). ʻŌpaeʻula abundance is intimately linked to the perpetuation of Native Hawaiian fishing practices along the North Kona coast of Hawaiʻi as these shrimps are highly valued as superior palu (chum/bait) to catch ʻōpelu (mackerel sp.). However, the stability of ʻōpaeʻula populations and their anchialine environments is threatened by introduced, non-native, and invasive species, eutrophication resulting from groundwater contamination and runoff from anthropogenic sources, and seawater inundation caused by sea level rise. Decreases in ʻōpaeʻula populations are of critical concern to lineal descendants, customary practitioners, and loko waiʻōpae caretakers. In this study, we are working in partnership with community groups and organizations to understand how ecosystem controls, such as water quality and predator introduction, impact the presence and behaviors of ʻōpaeʻula. We sampled and surveyed a total of 30 loko waiʻōpae habitats and ʻōpaeʻula populations, quarterly, during 2023–2024 across North Kona, Hawaiʻi. Here, we aim to characterize ʻōpaeʻula behaviors in response to predators and changes in water quality. Extensive behavioral studies on wild populations of ʻōpaeʻula are lacking. Therefore, our study will help illuminate behaviors and conditions that aid in the protection of ʻōpaeʻula populations, and assist in identifying where conservation efforts will be most effectively utilized for the preservation of their unique habitats.

Imu and ʻĀina Momona: Exploring the Intersection of Indigenous Stewardship and Conservation Science

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Indigenous knowledge in Hawaiʻi includes practices to cultivate abundance in coral reefs, a vital response to overfishing and habitat loss. One such practice is the construction of imu (traditional fish houses), which use coastal rocks to form miniature reefs in nearshore waters. By enhancing structural complexity, imu attract fish and increase culturally significant resource species, yet their effectiveness has rarely been quantified. This study, co-developed with the Hāʻena community and guided by an ʻāina momona framework of sustainable abundance, investigates the role of imu in fostering biodiversity and resilience in the Hāʻena Community-Based Subsistence Fishing Area. Using visual transects, underwater video, and habitat complexity analysis, we tested whether imu act as recruitment hubs for juvenile fish and reshape community composition. Year-two results show significant increases in fish abundance, biomass, and species richness at imu compared to controls. Analyses indicate shifts in community structure, suggesting imu not only attract fish but also generate new habitats that strengthen ecological resilience. Our findings highlight the potential of imu to integrate Indigenous stewardship with ecological science, informing conservation strategies that restore ʻāina momona while honoring traditional Hawaiian practices.

Can Stabilizing the Seafloor Help Coral Reefs Recover Naturally?

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The escalating frequency and intensity of acute disturbance events, including mass coral bleaching, storms, and continued ship groundings, are causing increasing concern over the loss of reef complexity across the Pacific. Substrate destabilization and the associated increase in unconsolidated substrate inhibit the survival of young corals and coral outplants. Hawaiian reefs are particularly susceptible to declining complexity due to slow coral growth rates, low crustose coralline algae abundance, and high wave energy. This limited natural capacity for rubble field consolidation suggests that active substrate stabilization is warranted. This study experimentally tests two manual rubble stabilization methods—boulder piles and mesh. We are conducting this study on a rubble field on West Oʻahu caused by a large ship grounding. Specifically, we are investigating which method is most effective at facilitating reef growth, increasing coral populations, enhancing habitat provisioning, promoting outplant survival, and stabilizing rubble. Structures were installed in Fall 2024, followed by the addition of coral outplants to enhance stabilization and coral recovery. Preliminary results just six months post-installation indicate that attachment methods were sufficient to keep structures attached through an active swell season. There was a significant 2-fold increase in juvenile coral abundance on the boulder piles, while colony abundance remained stable at the mesh and control plots. Despite initial successes, challenges such as undercutting of rubble under boulders, bioerosion from urchins, and rubble inundation are being observed. We are building capacity with Hawaiʻi's Division of Aquatic Resources and local community practitioners through workshops and regular hands-on involvement. Lessons learned from this project and complementary stabilization projects in Hawaiʻi will be consolidated and shared to inform scalable approaches across the state.

DAY 2 SESSION 4: New Technologies

A Low-Cost, Modular Autonomous Water Sampler for Coastal Biogeochemical Monitoring

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Water sampling is critical for understanding aquatic systems. Compared to human-led collection efforts, the increased temporal coverage associated with automated water sampling technology can help capture short-term fluctuations in seawater chemistry. However, existing autosamplers, while effective in specific contexts, often face limitations that hinder comprehensive data collection (e.g., cost, accessibility, size/weight, modularity, etc.). Here we present the Modular Autonomous Water Sampler (MAWS), an open-source, low-cost system developed by an interdisciplinary team of graduate students in just 16 weeks as part of ORE 653: Ocean Instrumentation and Technology. MAWS employs off-the-shelf, interchangeable components that require minimal technical expertise to assemble and configure. Its flexible design and custom software interface allow users to easily expand sampling capacity and collect up to 8 discrete samples at user-selected times. At approximately $800 for a single sampling unit and $250 per additional sampling unit, MAWS provides a cost-effective solution for measuring carbonate chemistry parameters, including total alkalinity (TA), dissolved inorganic carbon (DIC), and pH. With simple component substitutions, the system can also support trace metal and organic material analyses, broadening its utility across aquatic research.

What if we could generate electricity while protecting our coastlines from ocean waves?

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In this study we present a dual functional wave energy converter composed of an oscillating water column (OWC) and a slotted breakwater. This design can be used to power nearshore facilities while serving as shore protection. The use of a slotted breakwater also allows for better circulation and interaction with marine life. Analytical and numerical models were developed to understand the interactions of the design parameters e.g. incoming wave height, wave transmission, power extraction, wave loading. Availability of quick and efficient models also allow for design optimization based on user-defined criteria. The numerical model based on boundary element method allows us to further examine geometrical changes to the design, wherein we further assess the effects of adding a horizontal plate below the OWC chamber. Overall, the combined design shows significant improvement in power generation together with further improvement on the breakwater aspect. Future work includes performing a multi-parameter optimization, extension to irregular wave conditions, and looking into the effects of varying bathymetry.

Advances in Gas Purification to Improve Sustainable Energy Systems

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Acidic gases such as sulfur dioxide and hydrogen sulfide pose significant health and environmental risks while also causing damage in emerging technologies such as hydrogen fuel cell systems and semiconductor manufacturing. Effective filtration systems are essential to mitigate these effects by capturing the acidic gas contaminants before they degrade performance. Existing filtration devices are often non-regenerable, exhibit limited sorption kinetics, and rely on complex manufacturing processes making them difficult to deploy in a timely manner in remote environments. These challenges necessitate the on-site development of filter materials with superior performance through advanced techniques such as additive manufacturing.

Ionic liquids are a versatile class of materials with negligible volatility, high thermal stability and tunable chemical properties that have great potential for gas filtration applications. However, the practical use of pure ionic liquids in gas filtration is limited by poor gas diffusion through the bulk phase, especially in applications requiring high gas flow rates. Our work with acetate-based ionic liquids demonstrates that incorporating ionic liquids onto nanoporous supports minimizes these drawbacks. We have shown that $[C_2mim][Ac]$ and $Mg_4[OAc]_{10}[C_2mim]_2$ supported onto activated carbon are effective for sulfur dioxide removal from contaminated air. Results of this work, including our efforts on additive manufacturing of acidic gas filtration media, will be presented.

A unique instrument for observing the deepest parts of the global ocean

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[3] JAMSTEC

SOEST has developed an instrument capable of making physical, biological, and chemical oceanographic observations of waters in the deep ocean trenches. The deep ocean trenches are isolated geological features with depths greater than 6,000 meters or 19,600 feet. The deepest point in the global ocean is the Challenger Deep in the Mariana Trench, which is 11,000 meters or 36,000 feet deep. Regions with water depths between 6,000 and 11,000 meters are known as the hadal zone. Very little is known about the circulation, mixing, chemical properties, and biological communities in the hadal water column, even though it spans 45% of the ocean's total depth range. We know from the handful of observations to-date that the deep ocean trenches are not quiescent puddles isolated from the abyssal ocean, rather they have been found to have surprisingly short water renewal (residence) times and genetic connectivity between neighboring, yet bathymetrically isolated, trenches. We have developed a 11 km depth rated Hadal Water Column Profiler (HWCP) which collects vertical profiles of temperature, conductivity, dissolved oxygen, turbulent mixing, current velocity, 200 kHz acoustic backscatter, video, and includes a small trace metal clean water sampler. The free-falling, 4 meter long, HWCP is capable of multiple profiles a day, even to 11 km depth allowing underlying physical processes to be investigated. The unique to SOEST instrument will provide the means to substantially increase understanding of one of the most under sampled regions in the global ocean. It will enable the first direct measurements of turbulent mixing in the deep ocean trenches, allow for exploration of flow, trench ventilation mechanisms, and midwater biological communities shedding light on biological connectivity, and enable the identification of nepheloid layers created by turbidity flows that are likely common and important.

DAY 2 SESSION 5: SOEST in the Pacific Islands: From Ridge to Reef to Ridge

Cold pools, Breezes, and Monsoons: Propagating Convection over New Guinea

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Near the island of New Guinea, thunderstorms and rain clouds often start over mountains in the afternoon and then move toward the coast. Surprisingly, many of these storms seem to "jump" across the shoreline and regenerate over the ocean at night, sometimes traveling hundreds of kilometers offshore. This study uses satellite rainfall data and specialized computer simulations to uncover how different "density currents" in the lower atmosphere—including daily winds flowing between land and sea ("land-sea breezes") and cooler air spreading out from rainstorms ("cold pools")—work together to push storms far into the ocean. During the daytime, cooler air from the sea breeze flows onshore until evening, creating a gap in the migrating storm. After sunset, the wind direction reverses, and a land breeze forms; if it merges with pockets of cool, rainy air, it can carry enough moisture out to sea to form new storms. Ocean waters that are relatively warm provide extra energy and moisture, further supporting overnight rainstorms far from land. Our findings help explain why some coastal areas experience heavy rain at odd hours and offer clues for improving weather and climate models in tropical regions, where accurate rainfall forecasts are critical.

From Seabirds to Sewage: Investigating Terrestrial Nutrient Enrichment to Coral Reefs

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Global climate change is causing the rapid degradation of coral reefs, but the local environmental conditions that reefs are exposed to can influence coral's resilience to climate change. Coral reefs are responding differently to terrestrial nutrient enrichment from natural vs. anthropogenic sources, however it is unclear if there is something inherently different about these enrichment sources, or if the ecological context that these reefs are exposed to is responsible for these differences. In a novel experiment, we dosed corals with either seabird guano or wastewater effluent to directly compare how they respond to these different nutrient sources while under thermal stress. While corals in each treatment exhibited signs of bleaching, we saw different responses during the recovery phase. Corals enriched with seabird guano showed a greater capacity for recovery than corals enriched with wastewater effluent. Our data suggests that not all enrichment is created equal, remote reefs exposed to natural sources of enrichment are capable of rapid recovery post-bleaching, but reefs around populated islands exposed to anthropogenic enrichment remain in a degraded state post-bleaching. These results help explain differences in reef trajectories, reefs around remote islands are showing long-term stability even with more frequent disturbance events, whereas reefs around populated islands continue to decline after disturbances.

Cradle to Grave: Museum and Video Archives Reveal Diverse Nursery Functions of Deep-Sea Corals and Sponges

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Deep-sea coral and sponge ecosystems face threats from climate change, fisheries, offshore infrastructure, and potential mining. US and international conservation policies highlight the role of deep-sea corals and sponges as nursery habitats as a key reason for their protection. Despite this, we know little about the range of species that attach their eggs to deep-sea corals and sponges. Egg associations are often overlooked and difficult to identify when filmed and collected, but these data are essential to guide management and predict the consequences of habitat loss. Here we explore the Smithsonian Department of Invertebrate Zoology (NMNH-IZ) collections and SOEST's Deep-Sea Animal Research Center (DARC) video annotation database to expand and refine the list of known egg associates of deep-sea corals and sponges. We manually searched the NMNH-IZ and Department of Vertebrate Zoology Division of Fishes collections for eggs attached to invertebrate substrates. Tissue samples from eggs, or egg cases when no embryo was present, were sequenced for DNA barcoding and genome skimming to make identifications. The most common eggs found were those of mollusks (31), snailfish (14), and catsharks (44). Cephalopod eggs were individually hung from thin coral branches, while gastropod eggs were laid in clusters along the branch axis. Snailfish eggs were laid in clusters along thin coral branches. Catshark eggs were attached to a variety of substrates via the coiling tendrils. Hosts included coral genera such as *Chrysogorgia*, *Paragorgia*, and *Acanella*. Sequencing results provide more granular identifications and help us hypothesize patterns of host specificity. DARC's annotations spanning hundreds of video surveys contextualize many of these samples. Documenting this service provided by deep-sea corals and sponges will help identify the animals most vulnerable to habitat loss, and those that may be able to adapt to a change in available nurseries. By combining SOEST and Smithsonian resources we have advanced biodiversity knowledge in one of the most widespread and fragile ecosystems on Earth.

Listening to Seismic Waves to See What's Hiding Beneath Hawai'i

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Volcanoes typically form when magma rises from deep in the Earth and erupts at the surface. However, not all magma completes this journey. In some cases, it may partially solidify within the Earth's outer shell, creating what geologists call magmatic underplating— a dense layer of frozen magma at the boundary between the crust and mantle. For many years, Hawaii was considered a classic example of this process, based on early seismic studies that suggested a thick layer of solidified magma beneath the islands. Recent seismic research, however, paints a different picture. Instead of a broad, continuous underplate, the evidence points to smaller, scattered pockets of magma. This difference matters because magma storage deep underground affects how we understand the strength of tectonic plates, the growth of volcanoes, and the long-term stability of island chains. My research uses advanced computer models to test different scenarios for what lies beneath Hawaii and compares them with modern seismic data. These results help clarify whether magmatic underplating is truly present beneath the Hawaiian Ridge, or whether magma storage there is more localized and short-lived.

DAY 2 SESSION 6: New Frontiers in Ocean, Earth, and Space Science

Material-based Hydrogen Storage for Sustainable Energy Systems

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The advancement of clean energy technologies is crucial to reducing the world's reliance on greenhouse gas-producing fuels. The effective storage of hydrogen remains a hurdle for the widespread use of hydrogen energy technologies. Hydrogen is conventionally stored as compressed gas, but these systems can be bulky and difficult to implement. Material-based hydrogen storage is a promising alternative to compressed gas storage systems, in which hydrogen gas absorbs and integrates into the structure of a material. These materials have the potential for high hydrogen capacities at lower operating pressures than compressed gas systems. For example, the Li-Mg-N-H system ($Mg(NH_2)_2$:2LiH) is one of the most promising material-based systems as it can reversibly store up to 5.5 wt% hydrogen at moderate operating conditions, but it requires improvements to its kinetics to enable practical use.

Additives, such as potassium hydride or metal borohydrides, have been utilized to improve the hydrogen storage properties of the Li-Mg-N-H system. Our current work explores the effect of boron-based additives (e.g. $Mg(BH4)_2$, $LiBH_4$, MgB_2, LaB_6) as well as their cooperative effects with potassium hydride on improving the hydrogen cycling behavior of the Li-Mg-N-H system. The results from hydrogen desorption studies indicate that combinatory additives (e.g. KH+$LiBH_4$) enable lower hydrogen desorption temperatures and increased hydrogen capacity. Our results advance the understanding of the performance of hydrogen storage materials, which supports the transition to more sustainable and resilient energy systems.

Wave Energy Converter Research and Control Strategies for a floating Oscillating Water Column at the Hawaii Marine Energy Center (HMEC)

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Offshore sensors, navigation aids, and future aquaculture sites need steady, low-maintenance power, but batteries and fuel resupply are costly. At UH's Hawai'i Marine Energy Center (HMEC) within the Hawai'i Natural Energy Institute (HNEI), we are working on developing and testing next generation wave energy devices while also supporting the U.S. Navy's Wave Energy Test Site (WETS). One such ongoing research effort focuses on enhancing the performance of Halona, a floating Oscillating Water Column (OWC) device named after the Halona Blowhole on Oahu, designed to deliver reliable power to offshore systems. Halona uses an impulse turbine rated at 100 W to convert wave-induced airflow into electricity, with research centered on optimizing control strategies that consider hydrodynamics, turbine dynamics, site-specific sea states, and hardware durability. We compare two complementary control approaches: adjusting the turbine to match the device's "breathing," and tuning the device's motion to the waves. A wave-to-wire digital twin lets us evaluate options before deployment and informs hardware choices. Bench testing of the turbine and an alternative hydraulic power-take-off complements the modeling. The goal is reliable power for offshore systems—environmental monitoring, communications, and security—especially for remote and island communities. Supported by recent U.S. Department of Energy funding and work at the Navy's WETS, this talk will share the design rationale, lessons learned, and early test results, along with the path to ocean validation. By integrating modeling, lab work, and at-sea trials, we aim to increase efficiency, reduce maintenance, and accelerate practical wave-energy solutions that strengthen ocean-based economies.

Deep-sea mining discharge can disrupt midwater food webs

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The Clarion-Clipperton Zone hosts extensive beds of polymetallic nodules across the abyssal seafloor, attracting significant interest for commercial deep-sea mining. Previous research has examined the impacts of nodule harvesting on benthic ecosystems. However, some companies propose discharging excess mine waste from nodule extraction into the lower mesopelagic and upper bathypelagic zones. Although deep-sea mining may cause metal toxicity, noise, and disruption of microbial community structure and function, this study focuses on potential impact to the food web of the unique midwater zooplankton and micronekton communities.

We use compound-specific isotope analysis of amino acids to identify the size fractions of background detrital particles that form the base of the food web and sustain nutrition across depths. We find that particles >6 µm constitute at least half of the food web base for 30 of the 46 animals sampled at the proposed discharge depths. Mining-associated particles in this size fraction are nutritionally deficient compared to natural background material, posing a serious threat to food web integrity. At these depths, 53% of zooplankton taxa are particle feeders, 60% of micronekton are zooplanktivores, and 37.5% are pelagic micronektonivores feeding on smaller zooplanktivores and zooplankton. Critically, the poor nutritional quality of mining discharge may lead to starvation and bottom-up ecosystem impacts with potentially severe consequences for resident fauna. Understanding food web composition around potential discharge depths is essential to protect faunal communities and to guide policy decisions on deep-sea mining and waste disposal.

Identifying Needs for Addressing Contaminants of Emerging Concern in Hawai‘i

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Hawai‘i’s ecosystems and communities face increasing threats from contaminants of emerging concern (CECs), including pesticides, pharmaceuticals, and microplastics. CECs encompass a broad range of chemicals that are not routinely monitored, pose a real or suspected threat to human and ecosystem health, and are poorly understood. These pollutants may jeopardize native species, contaminate local waterways and food systems, and, in turn, disrupt community well-being and island stewardship efforts. Hawai‘i Sea Grant is therefore collaborating with state and federal agencies, researchers, and community organizations to develop a comprehensive needs assessment for managing CECs in Hawai‘i and the U.S.-Affiliated Pacific Islands. This guide identifies threats and drivers of CEC contamination unique to the Pacific, highlights past, current, and future opportunities for expanding regional monitoring, and presents a series of case studies from the continental U.S. and beyond. By integrating scientific expertise, regional insights, and models from other regional and international frameworks, this effort aims to guide best practices for prioritizing contaminants, evaluate monitoring gaps, and inform management decisions. The needs assessment aims to provide a flexible set of approaches for how to respond to CECs under different resource scenarios, to help inform future regional management efforts. A proactive, interdisciplinary framework can empower decision-makers to implement science-based policies that safeguard native biodiversity, protect ecosystem services, and promote food and water security. Additionally, it fosters collaboration that bridges policy and research to strengthen Hawai‘i’s resilience against emerging pollution threats and work towards equitable access to clean water and healthy environments.

Spatial and Temporal Dynamics of Deep-Sea Coral-Associated Epifaunal Communities

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The structural complexity provided by shallow-water coral reefs supports diverse and balanced ecosystems. Along with their shallow-water counterparts, deep-sea corals act as eco-system engineers at depths of hundreds to thousands of meters, driving biological diversity and shaping community composition. While deep-sea corals are known to host many species, these associations remain poorly understood, and coral associated epifaunal (organisms living on or attached to the coral colony) communities have been rarely characterized. Impact assessment and ecological restoration efforts following the 2010 Deepwater Horizon oil spill in the Gulf of Mexico provided a unique opportunity to annually monitor deep-sea coral communities at differ-ent sites for the past 14 years, producing invaluable time series of imagery data. The abundance and diversity of organisms living on the corals was assessed at each site from high-resolution images of > 300 individual coral colonies. Coral's size and morphology effect on epifauna abun-dance and diversity was also evaluated to clarify the role of deep-sea corals as habitat for other species. Through these analyses, we show that colony size, depth and geographic location drive differences in epifaunal community structure. Establishing a baseline understanding of the epi-faunal communities associated with octocorals, we clarify the role of deep-sea corals in driving diversity patterns in the deep sea. This approach could be applied to the Pacific, where octocor-als are key ecosystem engineers on seamounts, notably within Papahānaumokuākea National Marine Sanctuary, a region of exceptional cultural and biological significance in the Hawaiian ar-chipelago. Improving our understanding of the diversity of species associated with deep-sea corals, even in different geographic contexts, this research creates a strong foundation under-scoring the need for informed management of ecologically and culturally important deep-sea coral ecosystems.

DAY 1 POSTERS

Applying a Pacific Islands region-specific carbonate budgets approach to O‘ahu coral reefs

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Abstract: The net carbonate production rate, or carbonate budget, of a coral reef estimates the balance between gross production and erosion of calcium carbonate ($CaCO_3$). Census-based methodologies used to assess coral reef carbonate budgets produce a single representative functional health metric (i.e., net carbonate production rate) and additional reef health indicators (e.g., coral cover, diversity, rugosity). Here, we report a multi-site assessment of census-based coral reef carbonate budgets for O‘ahu, Hawai‘i. To do so, we developed a species- and genera-specific coral growth rates database for calculating coral $CaCO_3$ production rates within the Pacific Islands region and applied it to seven coral reef sites around O‘ahu. Additionally, we tested metrics of percent coral cover, coral diversity, and structural complexity as predictors for reef framework growth and erosion. As changes in regional and global climates continue to exacerbate natural and anthropogenic stressors on coral reef ecosystems in the Pacific, quantifying reef functional status and identifying taxa important for carbonate budgets are essential for effective coral reef management.

Integrating passive acoustic data from slow-moving uncrewed systems into cetacean distribution models

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Passive acoustic monitoring (PAM) offers an essential tool for understanding the distribution and ecology of cetaceans in the Pacific Islands, where we face a vast study area with challenging survey conditions. Integrating PAM data from slow-moving uncrewed platforms, such as underwater gliders and drifting buoys, into quantitative modeling frameworks can expand our ability to assess species across broad spatial and temporal scales. However, first we must understand how platform movement affects effort and animal detectability. The slow, variable movement of both platforms introduces uncertainty in acoustic effort calculations, while sensor position and local environmental conditions directly impact detection of sounds. Therefore, we are developing a simulation-based framework to evaluate how 4D platform movement influences acoustic detectability. The simulations generate detectability metrics as functions of sensor range and environmental covariates, which form the basis for a dynamic species distribution model built on a zero-inflated occupancy process. This model combines simulated detectability with real-world acoustic detections from gliders and drifters, along with remotely sensed oceanographic data. As a case study, we apply this framework to sperm whales, an ecologically important and widespread species in the Pacific Islands. Their deep-diving behavior and distinct echolocation clicks make them well-suited for acoustic detection and spatial modeling. By explicitly accounting for platform movement and detectability, this work advances new methods for integrating PAM data into stock assessments using cutting-edge technologies to create a robust, transferable approach for cetacean research throughout the Pacific Islands.

From Sediment to Sequence: Linking Habitat and Dietary Genomics of ʻAmaʻama (Native Hawaiian Striped Mullet) for Restoration of Indigenous Aquaculture Systems

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Hawaiʻi's reliance on imported foods leaves us vulnerable to food chain disruptions while disconnecting communities from customary subsistence systems. Revitalizing Native Hawaiian aquaculture (loko iʻa) enhances local food security and promotes the health of nearshore ecosystems. At Heʻeia Fishpond, where the Indigenous-led organization Paepae o Heʻeia has been restoring infrastructure and removing invasive species since the early 2000s, we conducted a comprehensive investigation into the habitat and dietary preferences of the Hawaiian striped mullet (ʻamaʻama, *Mugil cephalus*) and invasive mullet (kanda, *Osteomugil engeli*). Our co-designed study combined opportunistic stomach content sampling from ʻamaʻama harvested for consumption with sediment core analyses across wet and dry seasons (grain size, organic carbon, DNA metabarcoding, and stable isotopes). Spatial and seasonal mapping revealed significant variability in water quality, nutrient flow, sediment grain size, and organic content across the pond. DNA metabarcoding of gut and sediment samples enabled high-resolution dietary analysis. 18S rDNA data showed strong diet partitioning: juvenile ʻamaʻama diets were dominated by diatoms most abundant in specific zones, reflecting diverse benthic community structure. Adults shifted towards dinoflagellates, prominent in South sites. Kanda exhibited the broadest dietary range, composed of diatoms, dinoflagellates, and unclassified animal taxa across all zones. Digenea tapeworms were observed in kanda and juvenile ʻamaʻama, which may indicate shared foraging locations. Analyses of 23S rDNA and COI gene sequences for stomach samples are underway and will provide additional resolution on algal and invertebrate diet components. These findings highlight the importance of integrating Indigenous knowledge, place-based stewardship, and advanced environmental monitoring to inform restoration and management practices that support the sustainable health of loko iʻa systems in Hawaiʻi.

Develop the capabilities of Fire Risk Forecasts and Assessment Based on the Operational Island-Scale Models

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The numerical model guidance provided by the National Centers for Environment Prediction (NCEP) with a grid size ~20 km is inadequate to resolve Hawaii's island-scale and coastal weather. Back in late 1990, we initiated research requested by the US Forest Service (USFS) and the National Weather Service Honolulu Forecast Office (NWS HFO) that has since developed into well validated island-scale high-resolution (< 3 km) models in support of fire weather forecasts and NWS daily operations. In recent years, our efforts have been supported by the PacIOOS/NOAA (https://www.pacioos.hawaii.edu/) to support a series of ocean, wave and coastal environmental models for ocean safety and wave energy forecasts.

Since 2008, our twice daily 72-h output from two different models have been approved by NCEP and ingested into the NWS HFO Advanced Weather Interactive Processing System (AWIPS), where it is available operationally to provide additional numerical guidance for island-scale and coastal weather conditions In collaboration with NWS and USFS, our models have been proven as useful tools for the prediction of extreme events, including the weather that drove the recent West Maui fires. Yet, further advances are required to protect life and property.

We will outline the current status, capabilities of our models, and our plans to provide better products derived from model output, especially for fire risk outlooks. Our plans for future model development and improvements include the development of the integrated atmosphere/fire models for fire risk assessments. In addition, we are collaborating with NASA JPL to use their satellite-derived 1-km offshore wind data to improve high resolution wind modeling that will benefit offshore wind energy assessments as well as fire weather forecasting. Moreover, data from the NISAR mission, successfully launched on 30 July 2025, can be used to measure soil moisture and surface water on land and to observe wind vectors around the Hawai'i near-shore marine domain at a high resolution (10–100 m).

Methodological Challenges in Amphibious Receiver Function Analysis be-neath the Alaska Peninsula

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The Alaska Peninsula represents a tectonically complex margin where the Pacific Plate subducts beneath the North American Plate, generating intense volcanism and seismicity. Receiver function (RF) analysis of teleseismic events provides critical constraints on crustal structure of the subducting and overriding plates. The Alaska Amphibious Community Seismic Experiment deployed 75 ocean-bottom seismometers (OBS) and 30 land stations across a 700 km × 250 km region, encompassing the Shumagin, Semidi, and Kodiak megathrust segments. Combined with existing networks, this provides > 130 stations for RF analysis.

We analyze 141 teleseismic events (M≥6.0, 30°-100°) using time-domain iterative deconvolution. OBS-derived RFs face unique challenges from elevated noise and complex reverberations from the water column and sediment layers. Here we discuss procedures to identify and analyze high quality receiver functions from OBS data. This includes signal-to-noise ratio assessment, back-azimuthal coverage analysis, and examination of data quality over the time of the deployment. We also explore the viability of relatively novel techniques to mitigate sediment and/ or water reverberations. This comprehensive approach to amphibious RF analysis aims to establish best practices for crustal imaging in subduction zones while characterizing the Alaska Peninsula's along-strike structural variations.

The Hawai‘i Marine Energy Center (HMEC): Advancing Marine Energy Solutions for Hawai‘i and the Islands of the Pacific

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The Hawaii Natural Energy Institute (HNEI) recently received funding from the U.S. Department of Energy's Water Power Technologies Office to formalize the work of HNEI's ocean renewable energy group by establishing the Hawaii Marine Energy Center (HMEC), which now operates as a research group within HNEI. HMEC is one of four National Marine Energy Centers and is charged with 1) advancing several new or expanded research initiatives, 2) enhancing marine energy-relevant test infrastructure and ocean test sites, 3) developing educational initiatives, with emphasis on a series of short courses on marine energy, as well as K-12 and community college outreach, 4) working with DOE and the other NMECs to establish an HMEC-regional and a national strategic vision around marine energy advancement, and 5) establishing a Pacific regional center of expertise and outreach focused on marine energy.

HMEC will present an overview of these initiatives, including a high-level look at various wave energy conversion concepts being developed, research of relevance to wave energy resource characterization, and a look at our vision to expand these advancements to the islands of the Pacific through thoughtful community engagement. A brief overview of HNEI's work in support of the U.S. Navy's Wave Energy Test Site (WETS), off Marine Corps Base Hawaii on Oahu's windward side, will also be provided, as this work over the past decade has proven highly valuable in giving HMEC unique insights into the practical challenges of making the challenging field of wave energy conversion a reality. Lastly, a brief look at past and future work on ocean thermal energy conversion (OTEC) in Hawaii and elsewhere will be provided, as this form of renewable energy is gaining a renewed level of focus and may be highly relevant to island communities across the Pacific.

New and autonomous technology for measuring nutrients and trace metals in sea water samples.

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A novel miniaturized instrument, programmable flow injection (pFI), is being developed at the School of Ocean and Earth Science Technology (SOEST) to provide rapid, low-volume measurements of nutrients and trace metals in ocean water samples and can be used at sea in real time[1,2,3]. Chemical distributions (tracers) are key indicators of biological, chemical, and physical oceanographic processes, yet current instrumentation is large, produces significant amounts of waste, and is user dependent[4]. Large numbers of nutrient and tracer measurements are needed to make meaningful conclusions about the ocean. Obtaining high resolution data is especially difficult in remote locations or coastal waters, where conditions often change rapidly[5]. We have developed several pFI techniques that use classical spectrophotometric technology to determine various nutrients and trace metals in sea water[6,7]. These techniques, which can be used shipboard, use typical sample volumes of 600 µL and can produce results in less than 2 minutes, while simultaneously generating significantly less waste than continuous segmented flow systems[2,3]. Its modular design also allows a spectrophotometric flow cell and fluorescence detector to be combined into a single setup[8]. This presentation aims to showcase how this methodology was applied across a range of oceanographic research cruises, including the Hawaiian Ocean Timeseries Station ALOHA, the Southern Ocean Timeseries, and the Arctic Ocean. It will also be deployed as part of the Hadal sampler project to identify the locations of Hadal trench ventilation processes through the chemical tracers that they produce[9]. In this case, the ability to make rapid shipboard measurements will permit the shipboard sampling program to be adapted in real time as locations of elevated concentrations are identified.

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Economic and social dimensions of small boat fishing in the Pacific Islands region

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Federal fisheries management measures affect small boat fishing activity and the communities that rely on small-scale fishing for subsistence, income, cultural perpetuation, and social ties. Several federal mandates require an evaluation of the economic and social impacts of fishery management decisions, including the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, the Regulatory Flexibility Act, and Executive Order 12866 (Regulatory Planning and Review). Among the economic data collections for NOAA Fisheries programs, the NOAA Pacific Islands Fisheries Science Center uniquely characterizes both the economic and social dimensions of small boat communities through small boat fishing cost-earnings surveys. In this poster presentation, we outline the structure and results of these survey efforts in American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. First, NOAA staff network with fishing communities to identify active small boat fishers. Federal contractors then survey fishers through in-person interviews conducted every 5–10 years. We then analyze the survey data using statistical functions within the R programming language in R Studio. Finally, we publish the results in NOAA administrative reports which serve as a key resource to inform federal fisheries management actions and alternatives, and provide findings back to fishing communities through brochures and fishery management council presentations. Our results highlight the importance of small boat fishing for local food security, income, community ties, personal identity, and cultural perpetuation. Furthermore, these reports provide a socioeconomic characterization of regional fisheries, markets, and fishing communities. They also support the inclusion of economic and social science dimensions into fisheries manageme

Assessing coastal groundwater resources and their vulnerabilities facing sea level rise, climate change, and human actions

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Many Pacific Islands depend on groundwater as their primary water source, a fragile resource threatened by sea-level rise, climate change, pollution, and over-pumping. Effective management of groundwater resources necessitates their characterization. We use geochemistry and hydrological methods to identify the sources and age of groundwater, map groundwater flow paths, and quantify interactions between surface water, groundwater, and the ocean. Our work involves collaborating with local communities to understand and address the challenges of diminishing and increasingly saline and polluted coastal groundwater. A significant portion of our efforts is directed toward studying coastal springs and their impact on coastal water quality and groundwater-dependent ecosystems.

These projects offer valuable opportunities for students to engage in topics such as local water resources, water quality, sustainability, and coastal ecosystems. We educate a workforce that is sensitive to the unique cultural and environmental settings of the Pacific Islands.

Using multi-marker eDNA metabarcoding to characterize pelagic ecosystem species composition in the Central North Pacific

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Pelagic ecosystems, dominated by midwater fishes in the epi- and mesopelagic zones, constitute the largest ecosystem type on earth. However, these vast habitats remain poorly studied, with less than 1% of the pelagic realm sampled. Establishing holistic baselines and depicting the complexity of these ecosystems is essential for monitoring community changes over time and understanding the energy transfer across trophic levels. As a comprehensive analysis, we combine environmental DNA (eDNA) metabarcoding (six assays: MiFish, 16SFish, COI, 18S, Ceph18S, and 16SCeph) with traditional trawl (IK and MOCNESS net samples) and acoustic surveys to assess species composition across trophic levels and taxonomic phyla at the ecosystem scale. Our study, conducted from 2022 to 2024 in the Central North Pacific around the Hawaiian Archipelago, collected eDNA samples from the surface to 1000m, targeting dynamic oceanic features such as the epipelagic mixed layer and both shallow and deep scattering layers. While the end goal is to characterize the abundance, composition, and distribution of mesopelagic squid, crustaceans, and fish, this presentation will focus on the last, disentangling variation across spatial and vertical scales. The resulting species datasets will provide a foundation for exploring spatial and depth-related variability and advancing ecosystem-based management strategies. Holistic approaches such the one employed here enhance biological monitoring and improves our ability to assess ecosystem status at large scales. Coupling eDNA with established oceanographic surveys represents a transformative step in characterizing and monitoring whole pelagic ecosystems.

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Trends and pathways of the contributions of Southeastern Subtropical Pacific water to the Equatorial Undercurrent

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The Pacific Equatorial Undercurrent (EUC) plays a crucial role in shaping tropical Pacific thermal structure by transporting subsurface waters eastward to the equatorial eastern Pacific and feeding the upwelling in the cold tongue. In this way, the EUC water plays a key role in shaping both the mean climate of the tropical Pacific, and its variability, e.g, the El Niño-Southern Oscillation. The EUC water has been found to have several primary sources in the off-equatorial Pacific, with the water reaching the EUC in 2-50 years via interior and/or western boundary pathways, transporting the spiciness of off-equatorial water to the equatorial Pacific. Substantial interannual-to-decadal variations in the sources and pathways have been observed in observational and modeling studies, yet long-term trends remain underexplored due to limited record lengths and insufficient evaluation of climate model skill in simulating EUC water sources and pathways. Using an offline particle tracer scheme and ocean reanalysis datasets, we find that the primary off-equatorial source of the EUC is the southeastern subtropical Pacific (SESP). During 1979–2023, we identify an increasing trend in the contribution of this source to the western-central Pacific portion of the EUC, alongside a decreasing trend in its contribution to the eastern Pacific portion. Furthermore, we find a deepening trend in the water pathway from SESP into the EUC, along with a westward shift in the pathway towards the eastern Pacific portion of the EUC during 2003-2022. We attribute the trends in the SESP source to increased mixed layer depth and vertical downward pumping. The westward shift trend in the pathway is due to accelerated southwestward currents in SESP, driven by increased southwest trades over the region. The identified trends may contribute to the strengthened equatorial Pacific zonal sea surface temperature gradient by allowing for enhanced water mixing along the pathway and cooling of the EUC core.

Whale and Dolphin Research in the Pacific Islands Region

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The Cooperative Institute for Marine and Atmospheric Research, in collaboration with the NOAA Fisheries Pacific Islands Fisheries Science Center's Cetacean Research Program (CRP), conducts population studies on whales and dolphins across the Central and Western Pacific, including Hawai'i, Guam and the Commonwealth of Northern Mariana Islands, American Samoa, Palmyra and Johnston Atolls, and Wake Island. Our research focuses on identifying and cataloging species presence, assessing the size and health of populations, and evaluating the impact of human activities on these marine mammals. To achieve these objectives, we employ a diverse array of methods. These include visual and passive acoustic surveys conducted from ships and small boats that incorporate oceanographic sampling to measure environmental conditions. We study individual animals and populations using photographic identification, satellite telemetry, and genetics through tissue biopsies and environmental DNA from the water. We utilize towed, moored, and free-floating hydrophones for collecting acoustic data to investigate species presence alongside, or in the absence of, visual observations. In addition, we are working towards using acoustic data to determine the number of animals present. We also integrate modern technologies like underwater gliders for collecting acoustic and oceanographic data, drones (unmanned aerial systems) for collecting aerial imagery, and artificial intelligence and machine learning to analyze photographic and acoustic data. The CRP actively engages with students and researchers from various universities, government agencies, and non-profit organizations. The overarching goal of our collaborative research is to contribute to the protection, effective management, and recovery of whale and dolphin populations in the Pacific Islands Region.

Using Climate Models to Assess the Impact of Common Refrigerants

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As global temperatures rise due to increasing greenhouse gas emissions, the demand for cooling systems such as refrigeration and air conditioning continues to grow. Common refrigerants such as hydrofluorocarbons (HFCs) are potent greenhouse gases, with global warming potentials much greater than that of carbon dioxide. This results in a cycle where rising temperatures increase the use of cooling systems, which in turn release more greenhouse gases and further increase warming. A better understanding of how HFCs influence the climate is necessary for assessing their impacts and breaking this cycle. In this study, we use the Community Earth System Model (CESM2) to better understand the physical and chemical effects of HFCs on the atmosphere. Specifically, we aim to understand their contribution to global radiative forcing and their interactions with other chemicals in the air.

The Impact of Multilingual Abstracts on the Global Citation Footprint of Research

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English language dominance in scientific publishing creates significant barriers for both readers and researchers who are less proficient in English. As a result, research becomes less accessible to scientists in regions with low English proficiency, thereby skewing the global dissemination and application of new scientific findings. While some journals provide translated abstracts to mitigate this, the effect of this practice on citations patterns remains largely unexamined. This study quantifies the impact of multilingual abstracts on the reach and visibility of scientific articles.

To address this gap we developed a reproducible computational pipeline which links articles, identified by their DOI, to the presence or absence of translated abstracts on journal pages and verifying translation languages. For each article, we then retrieved all citing works and their corresponding institutional affiliations from the Dimensions and the OpenAlex API. This process allowed us to construct a large-scale dataset to systematically compare citation counts and the geographic patterns for both translated and non-translated articles.
Our preliminary analyses reveal that the presence of a translated abstract, particularly into Spanish and Chinese, is associated with a significant increase in total citation counts. Furthermore, translated articles exhibit a wider geographic distribution of citing authors, with the greatest gains in visibility occurring within regions where the language of translation is natively spoken.

This study demonstrates a scalable methodology for analyzing the impact of science communication strategies. The results provide strong evidence that abstract translation is an effective tool for broadening the global reach of scientific knowledge. For a school like SOEST, whose research has profound international relevance, such practices could be critical for enhancing cross-border collaboration and ensuring our findings inform research and policy on a global scale.

Understanding Benthic Biodiversity and Abundance patterns in the Musician Seamounts : A Forgotten Symphony North of Hawai'i

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As we continue to explore the deep-sea, imagery data are being collected faster than can be analyzed, and valuable processed deep-sea datasets are currently not being used to their full potential. The Musician Seamount Chain (MSC), located north of the Main Hawaiian Is-lands and Papahānaumokuākea National Marine Sanctuary, exhibit exceptionally high abun-dance and biodiversity of benthic taxa, such as sponges and deep-sea corals. However, no quanti-tative analysis has yet taken place to characterize these seamount communities. This study aims to leverage existing datasets to further our understanding of ecologically, commer-cial-ly, and culturally valuable benthic communities on the MSC as well as potential biological and environmental drivers of community composition. A total of 58 video transects extract-ed from annotated remotely operated vehicle (ROV) dives from the 2017 NOAA Okeanos Ex-plorer EX1708 expedition were used to assess species presence and abundance across depth bins of 250m ranging from of 250-3000m. Effects of terrain and environmental factors such as substrate type, temperature, oxygen and salinity on community composition was also tested through multi-variate statistical analysis. Preliminary findings show high abundances of key habitat forming taxa such as different genra of Octocorallia and Hexactinellida with significant differences in community composition between and within seamounts associated with substrate composition and depth.. This study is one of the first to establish an ecologi-cal baseline on poorly known seamount habitats. While the MSC have been relatively spared from human activities in compari-son to other seamount chains in the region, they are still vulnerable to climate change and poten-tial human impacts.

Windows into the Deep: Annotating Under-explored Deep-Sea Ecosystems in the Midst of Climate Change

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Despite advances in ocean exploration, the rapid pace of climate change is outpacing research into deep-sea ecosystems. Our work annotating video from remotely operated vehicle dives and baited drop cameras documents marine life in previously unexplored habitats, underscoring the need to continue exploration to establish baseline data. The health of deep-sea ecosystems supports biodiversity, ecosystem functions and services, and shallow water ecosystem resilience. Without greater understanding of these fragile habitats, we risk losing irreplaceable marine resources, disrupting food webs, and overlooking novel species with potential for advances in science, technology and medicine. Furthermore, the data produced is essential for characterizing deep-sea areas prior to human impact and importantly, for guiding informed management to protect these marine resources.

Synthesis of nanoscaled doped magnesium diboride for hydrogen storage technologies

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Metal borides have great diversity in topology and morphology due to the presence of multi-center boron bonding. The diversity in properties makes metal borides particularly interesting for applications in catalysis, superconductivity, and hydrogen-based technologies. Nanoscaling is a method used to further enhance the useful properties of metal borides such as improved hydrogen absorption kinetics. However, synthesizing nanoscaled metal borides is challenging due to their chemical inertness. The top-down, common, approach to nanoscaling involves initially synthesizing bulk metal borides, albeit at high temperatures (> 600oC) followed by processing of the bulk materials to nanoscale level using techniques such as ultrasonication and ball milling.

This work investigates the bottom-up synthesis approach of nanoscaled doped magnesium diborides through a combination of mechanochemistry and moderate temperature annealing. The purpose of doping was to further improve the hydrogen absorption properties. The doped boride materials were synthesized from the reactions of magnesium bromide or magnesium chloride with different borohydrides including lithium borohydride and sodium borohydride, in the presence of select dopants (e.g. magnesium, graphene and graphite). The results of these synthesis studies and the characterizations of the nano-scaled magnesium diboride will be presented.

A Quarter Century of MODVOLC Time-Averaged Discharge Rates for Mount Etna and Other Basaltic Volcanoes

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As volcanism may be considered synonymous with heat, the MODVOLC system utilizes thermal infrared satellite data from MODIS instruments to monitor the eruptive state of active volcanoes in near-real-time. This automatic hot-spot detection system is used here as the primary data source. We present a 25-year (2000–2024) record of MODVOLC lava discharge rates for Mount Etna volcano in Sicily, Italy. Examples are given for large flank eruptions occurring in 2001, 2002–2003, 2004–2005, and 2008–2009 and for the subterminal effusive activity of 2006, 2014 and 2017. Derived volumes for these eruptions range from 39×10^6 m^3 to 66×10^6 m^3. Such values correspond favorably to earlier estimates determined in the field or from other satellite data. Given this similarity of results, we then apply the same approach to the analysis of selected eruptions on five other basaltic volcanoes. Inversion of MODVOLC-derived time averaged discharge rates and volume data for Mount Etna eruptions provides an estimated magma chamber dimensions to be ~2.6 to 2.8 km in radius with an estimated total volume between ~80-90 km^3, located at approximately 5–7 km depth.

Bio-Inspired Coastal Engineering

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Imitating systems in nature, also called bio-inspired engineering, is fundamental to human adaptation. For example, indigenous people of the Arctic learned to hunt seals on the ice with harpoons by imitating the white polar bear. Although seals are careful and watchful in repose, the hunters hid themselves behind a screen of bear fur and advanced inch by inch in the fashion of the natural predator. Besides behavioral studies, analysis of engineered structures like bee hives' honeycombs have influenced contemporary designs. Human construction techniques can exhibit positive characteristics that were not written down and did not pass into contemporary professional engineering. Some of these works are perpetuated as a vernacular understood by local builders, and some, such as the resilient forms built from stone, remain in place. The Coastal Engineering Manual states that features that were originally encountered in the examination of stone relics found along coastlines have proven so useful that they have been incorporated in modern port designs (2007 Ch. 2, pg. 1). An important topic in coastal engineering research is erosion mitigation. The coastlines are both challenging to stabilize and sensitive habitats for important species. In the Pacific islands, a particular hand-built rock sill is frequently found along sheltered coastlines. These massive stone structures function as traps and enclosures, imitating natural lagoons where a shallow water ecosystem is established and enhanced. In this project we propose a program of wave flume tests to examine the response of these hand-built traditional rock sills to various forcings and characterize their stability.

Selenium in Impact in the health of people in Hawaii

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Selenium (Se) is an essential micronutrient required for antioxidant defense, healthy reproductive processes, and overall metabolic health. In Hawai'i, Se is present in the volcanic soils of the Big Island and across the other islands, including Maui and Kaua'i, as well as water, and crops, entering the food sources through plants, seafood, and livestock animals. Adequate Se supply defends our bodies against oxidative stress and contributes to overall health. Nevertheless, Se has a narrow margin between deficiency and toxicity, making balance critical. Se-deficiency can lead to inflammation, impaired antioxidant activity, and disrupted metabolism. Excessive intake of Se may also induce oxidative stress and disruption of metabolism.

In Hawai'i, the importance of Se is particularly apparent. The population's mildly elevated selenium status is assumed to be a result from the combined influence of volcanic soils, ocean water, local crops, seafood, and dietary supplements. Health consequences connected with higher Se levels include increased oxidative stress and metabolic disturbances, raising concern for long-term health outcomes. At the same time, Se can also act as a pollutant. Research has shown that volcanic activity releases high discharges of Se, leading to environmental accumulation that can impact water systems and ecosystems. For communities in Hawaii, these dual challenges of potential excess exposure and environmental pollution emphasize the need for careful monitoring and policies to protect and support both human health and the environment.

Ecological Role of a Resilient Coral in Honolulu Harbor: Invasive or Pioneer?

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Harbor *Porites* is a taxonomically ambiguous and unusually resilient coral found in high abundance in Honolulu Harbor, an environment hostile to most corals due to severe pollution, sedimentation, and human activity. The success of this little-understood species in such degraded conditions raises questions about its ecological role, including whether it may spread beyond the harbor and threaten native corals as an invasive species, or whether it could support reef growth within the harbor as a pioneer species.

To assess its invasive potential, we conducted a pairwise competition experiment with five common Hawaiian corals. Harbor *Porites* was consistently dominated by other species, showed dominance only against another stress-tolerant species, and interacted neutrally with the closely related *Porites lobata*. These outcomes suggest that it is not highly aggressive and may be limited to degraded environments where competition is reduced.
To assess its pioneer potential, we conducted settlement experiments with larvae of several coral species, testing whether Harbor *Porites* skeleton could serve as settlement substrate and whether chemical cues from live colonies influence settlement. The skeleton was found to be suitable, and in some cases preferred, while chemical cues showed limited effect. These findings suggest that Harbor *Porites* may act as a pioneer by stabilizing substrate and facilitating larval recruitment in Honolulu Harbor.

Overall, Harbor *Porites* is unlikely to pose an invasion risk to healthy reefs, but may function as a pioneer species in degraded habitats, where reduced competition allows it to establish and promote reef growth. Understanding the ecological functions of such resilient corals can inform management decisions and guide restoration strategies in degraded environments.

Using a 20-year time series to understand larval habitat and seasonality of four billfish species in West Hawai'i's "Kona Hotspot"

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Larval fish and other ichthyoplankton are largely understudied across the Hawaiian Archipelago, despite the area's likely importance as a spawning ground, and billfishes are no exception. Details about spawning timing and larval habitat can serve as important first steps toward understanding the environmental factors that drive fish abundance, distribution and thus recruitment variability. Furthermore, identifying essential habitats used by larval and juvenile fishes has become a critical component of Ecosystem-Based Fisheries Management (EBFM) especially for commercially important fisheries species. Researchers from six different organizations have come together to examine the spatial and temporal variability in larval distribution and abundance of four target billfish species (Blue Marlin *Makaira nigricans*, Striped Marlin *Kajikia audax*, Shortbilled Spearfish *Tetrapturus angustirostris*, and Swordfish *Xiphias gladius*) that are known to spawn in waters off West Hawai'i. This project leverages an underutilized 20-year (1997–2018) time series of neustonic ichthyoplankton collections from West Hawai'i and beyond that has recently been reinvigorated by the Pacific Islands Fisheries Science Center (PIFSC). We compiled a metadataset consisting of collection information for 770 samples from 19 research expeditions spanning 1997 to 2018. A total of nearly 1900 billfish larvae were collected from 6' IKMT and 1m Neuston net trawls as a part of this sampling effort. We obtained species level IDs for larvae that were only identified to family (Istiophoridae) in the collection using genetic barcoding methodology from Hyde et al. 2005. Those, combined with morphologically identified larvae, were examined and yielded species-specific specimen metrics, ratios of billfish community composition by location and temporal variability. This work creates a fundamental baseline of larval billfish presence, density, and associated habitat characteristics off West Hawai'i. This baseline will improve stock assessments related to spawning and recruitment and could also support future efforts to explore impacts of changing ocean conditions on preferred larval habitat.

Advancing Recovery of Endangered Corals: Integrating Monitoring, AI-assisted Identification, Species Distribution Modeling, and Heat Stress Tolerance

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Fifteen Indo-Pacific reef coral species are listed as threatened under the Endangered Species Act (ESA; 79 FR 53851; NMFS 2014), five of which extend their ranges into US waters. While these corals are subject to multiple global and local threats, they were listed primarily due to the threat of ocean warming and ocean acidification, which continue to worsen. The Indo-Pacific Coral Recovery Plan (under development) outlines Recovery Criteria and Recovery Actions to guide the recovery and eventual de-listing of the listed corals, while also identifying several challenges to recovery, including: (1) limited data on current population distributions and their environmental drivers, (2) challenges in species identification, (3) gaps in knowledge of demographic rates, and (4) limited understanding of species-specific resilience to ocean warming. This project focuses on addressing these challenges by obtaining crucial data for recovery planning on two of the endangered taxa: *Acropora globiceps* and *Isopora crateriformis*, through a wide variety of approaches. These include establishing fixed sites to monitor coral colony growth, survivorship, and recruitment, creating automated image analysis tools to detect corals from large databases of existing underwater imagery, developing species distribution models, and experimentally testing heat stress tolerance and adaptive capacity. Here we present the progress made by NOAA and CIMAR in the first year of the project, and the upcoming plans for year two of our research.

A horizontal transmission of bacterial aggregates in sea anemone, a coral animal model

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Coral reefs are increasingly threatened by a range of environmental stressors. Climate change has led to rising sea surface temperatures, ocean acidification, and more frequent and severe coral bleaching events. A growing and often under-recognized threat to coral reef ecosystems is the emergence and spread of coral diseases. Disease outbreaks are becoming more frequent and widespread, yet the underlying causes, mechanisms of transmission, and ecological conse-quences remain poorly understood.

To develop effective strategies for coral reef conservation and restoration, it is imperative to deepen our understanding of coral health and the complex interactions between corals and their associated holobionts. My work focuses on bacterial clusters inside coral cells.

We use the coral model organism *Exaiptasia* to conduct experiments. The goal is to identify this bacterium and to determine how it spreads between hosts using molecular techniques. We found that the bacterium is *Endozoicomonas* and that the animal acquires it through the water column. This highlights the usefulness of animal models in studying the transmission modes of bacterial clusters in cnidarians.

The micronutrient Selenium impact in the cardiovascular system in Hawai'i

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Cardiovascular disease (CVD) is the leading cause of death in Hawai'i and a major public health concern, particularly for Native Hawaiians and Pacific Islanders who experience higher rates of death from heart disease and stroke. While lifestyle factors like diet and exercise are well-known, a less-discussed but important factor is the role of essential nutrients, such as the trace element selenium. Selenium (Se) is a mineral found in the soil and, as a result, in the foods we eat. It's a key ingredient for many of our body's vital functions. Most importantly for heart health, selenium is incorporated into special proteins called selenoproteins. These proteins act as powerful antioxidants, which are crucial for protecting our cells from damage caused by harmful molecules called free radicals. When our bodies are under stress, this "oxidative stress" can damage blood vessels and contribute to the development of heart disease. By helping to combat this process, Se plays a protective role. Research has shown a complex link between Se levels and heart health. In some regions of the world with very low Se in the soil, a severe deficiency can lead to a specific type of heart disease known as Keshan's disease. This has highlighted the critical importance of having enough Se for a healthy heart. However, having too much Se can also be harmful, and the relationship between Se intake and CVD risk appears to be a delicate balance—like a "sweet spot" where having a moderate amount is beneficial, but going too low or too high might increase risk. In Hawai'i, a key consideration for Se intake is the local diet, which often includes a significant amount of seafood. Fish are an excellent source of Se. While more research is needed to fully understand the specific role of Se in the local population, particularly among Native Hawaiians and Pacific Islanders, it's clear that this essential mineral is an important part of a heart-healthy diet. For residents of Hawai'i, enjoying a diet rich in a variety of local foods, including fish, is a great way to ensure a balanced intake of nutrients like Se that are vital for long-term health.

Effects of oceanographic conditions and longer-term climate patterns on the catch and by-catch rates in Hawai'i's longline fisheries

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Oceanographic conditions can affect fisheries performance and bycatch patterns both directly through small scale fluctuations in properties that fish respond to and longer-term processes that influence water mass patterns. We used fisheries observer data on catch rates for more than 20 species caught in the Hawai'i shallow-set and deep-set longline fisheries to identify how environmental variables drive the occurrence and catch rates of these species. We performed two broad sets of analyses: 1) modeling the associations between environmental variables and catch rates of each species using machine learning techniques, and 2) assessment of hypothesized mechanisms of longer-term (e.g., seasonal and interannual) oceanic drivers of catch rates of target species. Models for the shallow-set swordfish (a'u kū) fishery indicated that catch rates were partitioned by the North Pacific Transition Zone for many species, while catch rates for many species in the deep-set bigeye tuna ('ahi) fishery were partitioned by subsurface properties, namely temperature and dissolved oxygen. Further, larger scale atmosphere-ocean processes such as the Pacific Decadal Oscillation showed linkages to variability in swordfish catchability in the shallow-set fishery along the North Pacific Transition Zone. Interannual variability in catchability of bigeye tuna in the deep-set fishery appeared to be more closely associated with the North Pacific Gyre Oscillation (NPGO). The mechanisms linking the latter (bigeye catch to NPGO) remain uncertain, though we believe variability in subsurface dissolved oxygen may be playing a role. The collective goal of this work is to not only establish near-real-time connections between oceanographic conditions and catch rates for fisheries optimization, but also to identify patterns that may be useful for annual scale forecasting.

Bi-directional Relationship Between Selenium and Glucocorticoids

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Glucocorticoids (GCs) are a class of steroid hormones released by the adrenal gland during stress that serve an important pro-survival role. Synthetic GC medications are widely prescribed throughout the world due to their anti-inflammatory and immune-suppressive properties. Prolonged elevation of systemic GC levels, however, can lead to a myriad of adverse symptoms. Our lab has been studying the role of selenium and selenoproteins in the neurological and metabolic side-effects of GC administration using a combination of cell culture and mouse model experiments. So far, we have begun to uncover a bi-directional relationship between selenium and GCs. Firstly, GCs can alter selenium homeostasis and selenoprotein levels. Using a total reflection x-ray fluorescence (TXRF) spectrometer, we have detected altered selenium levels in tissues taken from mice administered corticosterone (CORT) orally, including a reduction in brain selenium levels. Western blot analysis has detected CORT-induced changes to selenoproteins in several tissues involved in energy metabolism. CORT-induced changes in selenoprotein levels can be recapitulated in cultured cells and we have begun to reveal the underlying mechanisms. Secondly, we have observed that providing mice with additional dietary selenium can blunt the obesogenic influence of GC administration. This protective effect only occurred in male mice, however, highlighting a stark sexual dimorphism. Similarly, selenium supplementation also confers protection to cultured cells against the cellular dysfunction caused by excessive GC exposure. Ongoing experiments seek to test our central hypothesis that alterations to selenium balance and utilization mediate the negative side-effects of long-term GC consumption. We predict that selenium-based intervention can help alleviate the adverse repercussions of GC therapy.

Mahalo nui loa

to all of the participants, volunteers, and supporters of the first SOEST Symposium!

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