Preview of Award 1831937 - annual Project Report

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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)
Daniel C Reed

Accomplishments

* What are the major goals of the project?

The Santa Barbara Coastal LTER (SBC LTER) is an interdisciplinary research and education program established in April 2000 with the goal of developing a predictive understanding of how

environmental drivers interact with terrestrial and oceanic processes to alter material flows and influence the ecology of coastal ecosystems. SBC LTER's principal study domain is the semi-arid coast and nearshore waters of the Santa Barbara Channel in southern California, and its diverse and productive marine forests of giant kelp (Macrocystis pyrifera) serve as the focal study ecosystem. Analyses of our long-term data have identified many of the environmental drivers and ecological processes underlying the production and community dynamics of kelp forests. Still to be determined are the ecosystem consequences of wave disturbance and fishing that alter the area and architecture of giant kelp forests, the processes that sustain kelp growth during warm, low nitrate conditions, the ecological and evolutionary consequences of kelp-induced changes in pH and dissolved oxygen, and the degree to which climate variability influences forest persistence and trophic subsidies to and from kelp forests. These and other unknowns form the basis of the overarching question that motivates our proposed research: "How do natural and human drivers influence giant kelp dynamics and alter the long-term structure and function of kelp forest ecosystems?". The research proposed to address this question is integrated in a conceptual framework that focuses on the causes and ecological consequences of the dynamics of a relatively short-lived foundation species in a setting of long-term climate change and human use, and is organized in three inter-related themes:

Theme 1 - Environmental drivers of kelp persistence and community structure

Theme 2 - Dynamic biophysical coupling in kelp forest ecosystems

Theme 3 - Spatial dynamics and connectivity of kelp forests and adjacent ecosystems.

* What was accomplished under these goals and objectives (you must provide information for at least one of the 4 categories below)?

Major Activities:

Theme 1. Environmental drivers of kelp persistence and community structure

Theme 1a. *Community and ecosystem consequences of climate variability, disturbance and pathways of recovery*

We initiated a finer-scale long-term experiment to quantify the role of competition for space as a key process governing community structure and recovery in kelp forests. The experiment is designed to measure the effects of giant kelp in mediating competition between sessile invertebrates and understory macroalgae at 10 kelp forest sites using paired circular plots (8 m radius) of two treatments: kelp removal and control. Smaller paired plots (~0.5 m^2) with and without understory algae removed have been nested within the larger kelp control and kelp removal plots to isolate the effects of giant kelp on competition between understory macroalgae and sessile invertebrates. This experiment was delayed by the COVID-19 pandemic, but has been completely deployed as of September 2021.

Theme 1b. Ecological consequences of fishing

In 2012 we initiated a new time series on lobster abundance, size and fishing effort in response to the designation of the MPAs. We combined these data with landings data obtained from the CA Dept of Fish and Wildlife (CDFW) to show that the MPAs have resulted in an increase in spiny lobster within the MPAs which has benefited the commercial lobster fishery outside of the MPAs through spillover, an often asserted but seldom documented phenomenon.

Theme 1c. Sources and utilization of recycled nitrogen

We quantified the kinetics of regenerated N use by giant kelp and phytoplankton in light and dark in the laboratory (Smith et al. 2021). Urea uptake by giant kelp decreased 3–12% in darkness (relative to in light) compared to a 66–85% decline for phytoplankton. Similar differences were observed for ammonium and nitrate, suggesting that light intensity and photocycles influence the outcome of competition for N between giant kelp and phytoplankton. These results support the conclusion that giant kelp uses multiple forms of N to sustain year-round growth. Kelp's consistent capacity to acquire N during both day and night may help offset its low uptake rates relative to phytoplankton and increase its ability to compete for N during periods of low N availability.

Theme 2. Dynamic biophysical coupling in kelp forest ecosystems

Theme 2a. Effects of kelp on physical and chemical fluxes

To address this aim, we have augmented our long-term kelp forest sites at Mohawk (MK) and Arroyo Quemado (AQ) with additional physical and chemical sensors to quantify the residence time and carbonate chemistry of water within the kelp forest. MK and AQ are well suited for this purpose because many SBC core measurements are made at these sites. Moreover, the difference in size between these two kelp forests (AQ is ~5 times larger than MK) coupled with high seasonal and inter-annual variability in kelp abundance will allow us to examine how residence time varies with kelp forest architecture and alongshore current speed.

Theme 2b. Effects of kelp on the processing and fate of dissolved organic matter

Quantifying remineralization rates of kelp-derived DOM and its accumulation along a spatial gradient from within the kelp forest to the waters outside of it will provide an estimate of kelp DOM available to kelp forest food webs via the microbial loop vs DOM exported from the kelp ecosystem. Microbial remineralization experiments are being conducted seasonally on DOM released directly from kelp, and on DOM that accumulates in the surface waters (within the kelp forest and up to 1000 m offshore) to determine degradation rates and bioavailability. We have begun using a new high-throughput system for measuring microbial respiration that has made these experiments much more tractable.

Theme 2c. Ecological and evolutionary consequences of kelp-induced changes in seawater chemistry

The massive and dense biomass of giant kelp forests has the potential to significantly alter water chemistry via photosynthesis and respiration. We are investigating the potential for giant kelp to influence the eco-evolutionary dynamics of kelp forest metazoans by examining the consequences of kelp forests as modifiers of seawater properties including DO, pCO_2, and pH in a warmer future, using calcifying sea urchins as model species.

Theme 3. Spatial dynamics and connectivity of kelp forests and adjacent ecosystems

Theme 3a. Demographic connectivity and metapopulation dynamics of giant kelp

To characterize canopy dynamics on sub-meter scales, identify small-scale extinction events and relate local patterns of recolonization to connectivity and environmental factors, we have initiated high-resolution monitoring of select kelp forests along the Santa Barbara coastline using small unoccupied aerial systems (sUAS; quadcopter drones). A recently released 10-band multispectral imager from MicaSense has reflectance bands that can be used to estimate the concentration of chlorophyll and nitrogen content based on our laboratory reflectance timeseries and field validation tests. Starting in February 2021, we began monthly timeseries of 10-band sUAS flights at the Mohawk and Arroyo Quemado kelp forests to examine the dynamics of canopy biomass and physiological condition and relate these changes to demographic and environmental processes.

Theme 3b. Trophic connectivity between kelp forests and beaches

To evaluate connectivity and synchrony between beaches and kelp forests, we are collecting detailed data on the abundance of kelp wrack at our five study beaches, quantifying smaller blades and fronds as well as whole plants. We are also developing methods to use sUAS imagery to get a more spatially comprehensive and rapid estimate of wrack abundance that could be collected in tandem with the kelp forest imagery in Theme 2a used to assess the level of synchrony between kelp standing biomass and kelp wrack abundance and flux, and the subsequent connectivity between subtidal kelp forests and intertidal beaches.

Theme 3c. Trophic connectivity between the coastal ocean and kelp forests

In spring 2021 we began a focused research campaign to better understand the linkage between phytoplankton and reef suspension feeders. Over 2-week periods each season, we are collecting concurrent field measurements at MK and AQ, along with measurements offshore, using SBC's Teledyne Webb G2 glider to quantify cross-shelf fluxes and onshore delivery of phytoplankton to kelp forests and reef suspension feeders that will be contextualized at larger spatial scales through analysis of available satellite data. On the reefs, we are investigating the response of suspension-feeding invertebrates to the supply and taxonomic composition of phytoplankton. Three days per week during each two-week period each season, water samples for chlorophyll, POC, and phytoplankton community composition are being collected in the kelp forest, augmented

by near-continuous chlorophyll measurements by moored in situ fluorometers. On a subset of the same days, suspension feeders are also sampled for gut contents to evaluate feeding selectivity as compared with available phytoplankton assemblages. To supplement microscope counts of phytoplankton, we will analyze water and gut content samples using DNA metabarcoding techniques.

Specific Objectives:

Theme 1. Environmental drivers of kelp persistence and community structure

Theme 1a. *Community and ecosystem consequences of climate variability, disturbance and pathways of recovery*

Further analysis of our long term kelp disturbance experiment revealed that understory macroalgae partly compensated for canopy NPP losses and this effect magnified with increasing habitat quality. Disturbance-driven increases in understory NPP were still rising after 5–10 years of disturbance, demonstrating the value of long-term experimentation for understanding ecosystem responses to changing disturbance regimes (Castorani et al. 2021).

Theme 1b. Ecological consequences of fishing

We are using data from other long-term monitoring programs in the region to address questions about effects of fishing on kelp forests. Trophic cascades are often hypothesized to be major drivers of kelp forest community structure, with fishing reducing predation on sea urchins that then overgraze kelp to form barrens. To test this idea we examined the effect of older MPAs established in 2002 on the two abundant species of urchins in our region: the heavily fished red urchin Mesocentrotus franciscanus, and the virtually unfished purple urchin Strongylocentrotus purpuratus, using data collected since 1984 by the National Park Service in the Channel Islands. Our analyses revealed that after 15 years of protection from fishing, purple urchin populations and kelp abundance were unaffected by reserves, while red urchin biomass significantly increased (Malakhoff and Miller 2021). These results revealed the overwhelming direct effect of protecting fished species in marine reserves over indirect effects that are often predicted, but seldom clearly documented.

Theme 1c. Sources and utilization of recycled nitrogen

We tested whether the benthos is a potentially significant source of locally regenerated N to kelp forests during otherwise low-nutrient oceanographic conditions. Permeable marine sediments are biogeochemically active and may contribute substantial quantities of dissolved nutrients to support primary production in coastal regions. Measured reservoirs and exchange rates of NH_4^+ suggest that marine sediment provides a significant source of nitrogen to the water column and may help to offset high nitrogen demand by giant kelp during periods of high productivity in the summer (Lowman et al., in preparation).

Theme 2. Dynamic biophysical coupling in kelp forest ecosystems

Theme 2a. Effects of kelp on physical and chemical fluxes

We are working to develop residence time estimates that are a function of stratification, kelp forest area, and kelp density. In prior research we estimated water residence time in the kelp forest at Mohawk Reef to be ~1 hour based on mean velocities and forest area, but more recent estimates derived from observed changes in dissolved oxygen were several times longer. Our ongoing research on this topic strives to quantify spatial and temporal scales of variation in seawater properties (i.e., temperature, salinity, and dissolved oxygen) inside, outside and offshore of the kelp forest as it varies naturally through time in its footprint area and kelp density.

Theme 2b. Effects of kelp on the processing and fate of dissolved organic matter

The microbial community living on kelp itself may use kelp DOM and influence kelp physiology and condition. In marine microbial communities, assembly order can shape the rate of organic matter processing, especially when pioneer taxa "unlock" substrates for subsequent arrivals. To address such phenomana graduate students Sevan Esaian and An Bui (Wilbanks and Moeller labs) are investigating community assembly of the kelp microbiome through time and over depth. Their results suggest that deeper blade communities do assemble over time, while surface blades tend to track ambient conditions. In-progress analysis is identifying taxa that drive these shifts in community composition.

Theme 2c. Ecological and evolutionary consequences of kelp-induced changes in seawater chemistry

Ph.D. candidate Logan Kozal provide evidence that maternal condition influences the performance of the progeny For example, larvae from mothers conditioned outside the kelp forest exhibited higher thermal tolerance that those conditioned within the forest, likely reflecting the higher variability in temperature there (Kozal et al. in prep). In addition, larvae spawned from mothers conditioned inside kelp forests exhibited longer spicules per unit body size, regardless of developmental treatment. These findings reproducibly demonstrate that *in situ* environmental variation in the SBC can alter larval biocalcification via transgenerational plasticity. We are now preparing to assess gene expression and perform analysis of DNA methylation in the progeny from the larval crosses; to do so, graduate student Sam Bogan developed a bioinformatic pipeline for the project; this product has been publicly shared on Github (Bogan and Strader 2021).

Theme 3. Spatial dynamics and connectivity of kelp forests and adjacent ecosystems

Theme 3a. Demographic connectivity and metapopulation dynamics of giant kelp

New work is investigating the finer-scale patterns and drivers of resistance and resilience of giant kelp populations throughout the region. We have continued to use the

hyperspectral aerial imagery collected by NASA's AVIRIS sensor from 2013-2015 to examine the physiological condition of the kelp canopy in the Santa Barbara Channel. We found that the condition of the kelp canopy is related to the availability of seawater nitrate on the regional scale (1 km) but that patterns on the local scale (20 m) are related to kelp frond senescence and demographic patterns (Bell & Siegel *in revision*).

Theme 3b. Trophic connectivity between kelp forests and beaches

Species diversity and resource partitioning by beach detritivores may affect species coexistence and ecosystem function. By measuring individual consumption rates of four talitrid species on five macrophyte species in the laboratory and field we discovered that these abundant consumers do not partition wrack resources, making them potentially functionally redundant. Additional laboratory and field experiments that manipulated richness of six common species of invertebrate detritivores showed no effect on kelp consumption; instead, species identity and body size drove variation in kelp consumption rates (Emery et al. 2021). These results show that beach detritivore species are not functionally redundant and that the disproportionate loss of larger talitrid species by coastal urbanization heavily impacts ecosystem function.

Theme 3c. Trophic connectivity between the coastal ocean and kelp forests

Understanding variability in phytoplankton production and community structure is important for understanding dynamics of kelp forest food webs. In an effort to do this, we created a 22-year monthly time series of the relative abundance of five distinct phytoplankton groups in the SBC by combining 12 years of high performance liquid chromatography phytoplankton pigment concentrations with bio-optical models and 10 additional years of bio-optical observations (Catlett et al. 2021). Our observations indicated that nanophytoplankton groups respond most rapidly to seasonal upwelling, followed by diatoms, and then by picophytoplankton as the water column stratifies in the summer. On decadal time scales, dinoflagellate blooms are associated with the warm phase of the North Pacific Gyre Oscillation and advection of Southern California Bight source waters into the SBC.

Significant Results:

Theme 1. Environmental drivers of kelp persistence and community structure

Theme 1a. *Community and ecosystem consequences of climate variability, disturbance and pathways of recovery*

An undergraduate (now graduate) student, Raine Detmer (Moeller lab), developed and analyzed a model of the effects of variable storm regimes on giant kelp population dynamics and of the cascading effects on kelp-mediated competition between benthic organisms. Simulations of severe storm regimes resulted in a greater abundance of understory macroalgae and a lower abundance of sessile invertebrates than did milder regimes. The model's predictions were consistent with empirical data from our 20-yr

time series of community dynamics, suggesting that interannual variability in disturbance that affects giant kelp abundance can have strong consequences for benthic community structure (Detmer et al. 2021).

Theme 1b. Ecological consequences of fishing

Despite a 35% reduction in fishing area, increases in lobster populations inside the two newly established MPAs resulted in a 225% increase in total catch after 6 years, demonstrating MPAs benefitted the fishery overall (Lenihan et al. 2021). This study was coauthored by a CDFW biologist who promoted the results to her agency, an example of SBC LTER's growing connection with local resource managers.

Theme 1c. Sources and utilization of recycled nitrogen

We paired taxon-specific ammonium excretion rates of fishes and invertebrates with time series data of taxon-specific biomass collected during our 10-year kelp removal experiment to assess the effects of increased frequency of kelp disturbance on ammonium excretions and macroalgal N demand. We found that increased disturbance to giant kelp in experimental removal plots reduced fish biomass and the amount of excreted ammonium in kelp removal plots relative to control plots that experienced less frequent disturbance. The amount of ammonium excreted by benthic consumers in control plots was sufficient to support ~ 45% of the N demand of understory macroalgae and ~ 10% of the N-demand of all macroalgae (giant kelp + understory combined), suggesting that consumer excretion, in addition to sediment fluxes, is important in helping sustain macroalgal growth during stratified periods (Peters et al., in prep).

Theme 2. Dynamic biophysical coupling in kelp forest ecosystems

Theme 2a. Effects of kelp on physical and chemical fluxes

We are using the inside-outside paired instrumentation at MK and AQ to better resolve details of the flow through the kelp canopy. For example, on July 29, 2021, we conducted several hours of in situ surveys around and offshore of a portion of Mohawk Reef. A REMUS 600 ran 675 m-long cross-shore transects to within 50 m of the kelp forest while an instrumented surfboard was paddled around the kelp forest and RGB UAS imagery was collected hourly. We observed a gradual warming of surface waters of the kelp forest through the morning. When detrended, a reversal of the local temperature gradient was evident and several important processes were revealed. Significant gradients can be formed at the scale of the kelp forest in as little as a couple hours, indicating that our field-intensive studies are warranted and likely to observe significant features. Filaments of low-temperature water exiting through gaps in the kelp forest suggest the structure of the kelp canopy is an important determinant of residence time.

Theme 2b. Effects of kelp on the processing and fate of dissolved organic matter

To begin resolving spatial gradients in dissolved organic compounds, bacterioplankton communities and associated microbial activity as water moves through a kelp forest, graduate student Chance English (Carlson lab) conducted cross-canopy sampling at Arroyo Quemado reef in February 2021. Results to date show that DOC concentrations, bacterial abundance and bacterial respiration were significantly higher inside the kelp forest, suggesting that DOM released by kelp may be consumed and recycled rapidly within the forest, enhancing bacterial growth and fueling the microbial loop. To determine whether microbial assemblages sourced from within the kelp canopy process organic substrates at greater rates than background microbial assemblages, a microbial remineralization experiment was conducted at Arroyo Quemado in February 2021. Monitoring changes in oxygen and bacterial abundance within the treatments demonstrated that bacteria inoculum from inside the canopy grew at higher rates and respired organic matter faster than that from outside of the forest. Further, bacteria sourced from inside the canopy maintain elevated respiration rates when grown with DOC sourced from outside the kelp canopy. The microbial assemblages in close proximity to kelp and associated DOM production may alter the bacterial community to one capable of turning over DOC at a higher rate regardless of its source.

Theme 2c. Ecological and evolutionary consequences of kelp-induced changes in seawater chemistry

In laboratory experiments, we found that elevated pCO_2 conditions predicted for coastal environments in the future adversely impacted the early development of the red sea urchin *M. franciscanus* while moderate warming improved growth and thermal tolerance. Further investigation revealed between-treatment differential expression of genes related to cellular stress response, transmembrane transport, metabolic processes, and regulation of gene expression. Temperature contributed significantly to variance in gene expression, which was also correlated to the embryo phenotypes. On the other hand, the transcriptomic response to $pCO_2$was relatively muted (Wong and Hofmann 2021).

Theme 3. Spatial dynamics and connectivity of kelp forests and adjacent ecosystems

Theme 3a. Demographic connectivity and metapopulation dynamics of giant kelp

We have developed an automated method for processing these data and examined the effects of tides and currents on sUAS-based estimates of kelp canopy area (Cavanaugh et al. 2021).

Theme 3b. Trophic connectivity between kelp forests and beaches

SBC Investigators Dugan, Page, and Melack participated in a Coastal Vulnerability Assessment of the Santa Barbara area that relied on SBC LTER data to synthesize projected changes in climate, coastal erosion and flooding, watershed runoff and impacts to sandy beaches and coastal salt marshes. The group identified potential climate change-related tipping points for coastal systems and found that tipping points for beaches and wetlands could be reached with just 0.25 m or less of SLR (~ 2050), with > 50%

subsequent habitat loss that would degrade overall biodiversity and ecosystem function (Barnard et al. 2021).

Theme 3c. Trophic connectivity between the coastal ocean and kelp forests

Understanding variability in phytoplankton production and community structure is therefore important for understanding dynamics of kelp forest food webs. In an effort to do this, we created a 22-year monthly time series of the relative abundance of five distinct phytoplankton groups in the SBC by combining 12 years of high performance liquid chromatography phytoplankton pigment concentrations with bio-optical models and 10 additional years of bio-optical observations (Catlett et al. 2021). Our observations indicated that nanophytoplankton groups respond most rapidly to seasonal upwelling, followed by diatoms, and then by picophytoplankton as the water column stratifies in the summer. On decadal time scales, dinoflagellate blooms are associated with the warm phase of the North Pacific Gyre Oscillation and advection of Southern California Bight source waters into the SBC.

Key outcomes or Other achievements:

LTER Network cross site projects

Former SBC post doc and present Associate Investigator Thomas Lamy, now faculty at the French National Research Institute, participated in a cross-site working group to synthesize the general relationships between metacommunity parameters and stability across a diverse range of ecosystems. Several products resulted: Wang et al (2019) developed a partitioning framework of variability and synchrony measures across spatial scales and organizational levels. Lamy et al. (2019) used this new approach on SBC's long term community data to show that species insurance can stabilize community biomass. Further work found that spatial asynchrony reduced variability in metacommunity biomass of SBC macroalgae (Lamy et al. 2021). Record et al. (2021) described how LTER data could inform metacommunity theory and applications.

Former SBC postdoc Max Castorani, now Investigator and faculty at UVA, where he is also a PI on VCR LTER, participated in a cross-site working group using LTER data from several sites including SBC to integrate population and community approaches to synchrony to understand drivers of ecosystem stability. A paper is in press (Walter et al. 2021) concluding that stability is more strongly related to richness synchrony than to species richness itself.

SBC Co-PI Reed is leading an LTER synthesis paper on the long-term effects of climate change on coastal ecosystems. The study includes five other coastal LTER sites, Florida Coastal Everglades, Georgia Coastal Ecosystems, Moorea Coral Reef, Plum Island Ecosystems, and Virginia Coast Reserve. The paper is in revision at *BioScience*.

Co-PI Reed, PI Miller, and SBC Investigators Castorani and Rassweiler participated in a cross-site synthesis effort to show the importance of long-term data collection and

experiments for addressing ecological questions with implications for policy (Iwaniek et al. 2021).

Margaret O'Brien, SBC's former lead Information manager and current IM advisor, is a co-PI helping to lead the EMERGENT synthesis working group, which is advancing efforts to harmonize molecular information for microbial taxa, streamlining their use in syntheses with related ecosystem level data and spurring future microbial ecology research at LTER sites.

Non-LTER cross-site and broader scale research

SBC Investigators Dugan, Page, and Melack participated in a Coastal Vulnerability Assessment of the Santa Barbara area that relied on SBC LTER data to synthesize projected changes in climate, coastal erosion and flooding, watershed runoff and impacts to sandy beaches and coastal salt marshes (Meyer et al. 2019). The group identified potential climate change-related tipping points for coastal systems and found that tipping points for beaches and wetlands could be reached with just 0.25 m or less of SLR (~ 2050), with > 50% subsequent habitat loss that would degrade overall biodiversity and ecosystem function (Barnard et al. 2021).

SBC Investigator Cavanaugh expanded the capabilities of our kelp Landsat dataset to the entire globe by partnering with Zooinverse to develop a web-based citizen science project (Floating Forests) that uses the efforts of volunteers to analyze Landsat imagery of giant kelp from across the world. More than 2 million classifications of > 500,000 images by nearly 6,000 volunteers have been completed to date.

* What opportunities for training and professional development has the project provided?

SBC LTER contributes substantially to undergraduate involvement in research at UCSB. During the past year 7 postdoctoral fellows, 35 graduate students, 3 REU students and 71 additional undergraduate students participated in SBC research. Each year 20-30 undergraduate students receive academic credit to participate in an SBC research training program that runs the entire academic year. Students in the program actively participate in the collection, processing and analysis of core data and many develop their own independent research projects. REU students work closely with SBC researchers on a wide range of topics and most choose to pursue an advanced degree following their undergraduate education. Opportunities for training in public education and student mentoring arise from SBC's partnership with the REEF, which is also designed to provide UCSB undergraduates majoring in Aquatic Biology with training in communicating their knowledge of marine ecology in an educational format. SBC graduate students, post docs and research staff actively participate in this aspect of undergraduate training, which engaged 30-60 undergraduate interns annually for the REEF during the past three years. In a collaboration with SBC graduate student Xochitl Clare, we hosted two *REEFlections* annual symposia. *REEFlections* provides an opportunity for undergraduates who work both at the REEF and in a research lab under a graduate student or post-doc mentor to communicate their work to UCSB faculty, staff, students, and community members.

In 2021, SBC LTER Education Coordinator and LTER EOC Co-chair, Scott Simon, co-taught an undergraduate course on Coastal-based Literacies, that utilized the science of the SBC LTER to highlight the significance of science in "Our Maritime Community".

SBC graduate student and postdoctoral training are coordinated with several graduate programs on the UCSB campus to promote opportunities for interdisciplinary training in ecology, physiology, geology, geography, hydrology, oceanography, and coastal policy. This enables valuable cross-training on environmental issues pertaining to coastal ecosystems, provides a common language for communicating scientific information on these issues, and contributes to the creation of a diverse scientific community of students and postdocs that fosters respect and appreciation for other disciplines. Graduate seminars hosted by SBC faculty, the SBC Annual All Scientist Meeting and SBC workshops on key research themes served to engage SBC graduate students in the culture and diverse research offered by SBC. A student-organized cross-site LTER graduate student symposium with Moorea Coral Reef and California Current Ecosystem LTERs and the triannual LTER Network's All Scientist Meeting serve to expose SBC graduate students to the research and career opportunities offered throughout the Network.

* Have the results been disseminated to communities of interest? If so, please provide details.

We are committed to sharing our research results with resource managers, decision makers, stakeholders, and the general public who are interested in applying our findings to policy issues concerning natural resources, coastal management, and land use. To this end SBC researchers actively use their expertise and data to inform these entities to the betterment of society. Below are some examples of the broader benefits of SBC research in the past year of SBC IV.

- SBC LTER data and studies are showing the effects of marine reserves on ecosystems and fishing. New work showing spillover bolsters the case for marine reserves as management tools and may help improve the design of future reserves and networks.
- SBC LTER expertise and data on patterns and drivers of kelp productivity is informing the possibility of kelp farming for biofuels off the coast of CA. DOE is funding several projects on this topic; one is using SBC LTER data to develop a model for kelp farm siting.
- SBC investigators Dugan, Melack, Page and Reed worked with USGS and Scripps Institution of Oceanography researchers to provide local city and county officials with a vulnerability assessment of coastal ecosystems to climate change.
- SBC investigators and students are collaborating with the Bureau of Ocean Energy Management, to assess factors affecting the spread and ecological impact of the invasive bryozoan *Watersipora subtorquata*, which is rapidly increasing at SBC study sites.
- SBC investigators serve as science advisers for public and non-governmental agencies tasked with managing coastal resources.

* What do you plan to do during the next reporting period to accomplish the goals?

Theme 1. Environmental drivers of kelp persistence and community structure

Theme 1a. *Community and ecosystem consequences of climate variability, disturbance and pathways of recovery*

We initiated a finer-scale long-term experiment to quantify the role of competition for space as a key process governing community structure and recovery in kelp forests. This experiment was delayed by the COVID-19 pandemic, but has been completely deployed as of September 2021. In the next year we will begin monitoring it and doing preliminary analyses of the results.

Theme 1b. Ecological consequences of fishing

In the next year we plan to do further analyses of long-term data from inside and outside marine preotected areas to inform on the indirect effects of fishing beyond trophic cascades.

Theme 1c. Sources and utilization of recycled nitrogen

We predict N regeneration rates in the water column will vary with the structure of planktonic communities and associated shifts in remineralization processes. In the coming months we will begin testing this prediction by quantifying seasonal rates of N regeneration in the water column (this research was delayed by COVID). Water column regeneration rates will be determined at the three kelp forests where kelp NPP and oceanographic properties are measured as part of our long-term studies. Monthly measurements of concentrations of urea, ammonium, nitrate, POC, PON and phytoplankton chlorophyll a will be augmented with rate measurements of urea and ammonium regeneration in spring, summer and fall, with particular emphasis on the stratified summer periods when the relative contribution of recycled N to kelp N demand should be highest. Isotope pool dilution will be used to quantify microbial urea and ammonium regeneration. An SBC graduate student, Natalie Dornan (Santoro lab), will be leading this research.

Theme 2. Dynamic biophysical coupling in kelp forest ecosystems

Theme 2a. Effects of kelp on physical and chemical fluxes

In the next year we will be working to develop residence time estimates that are a function of stratification, kelp forest area, and kelp density.

Theme 2b. Effects of kelp on the processing and fate of dissolved organic matter

The microbial assemblages in close proximity to kelp and associated DOM production may alter the bacterial community to one capable of turning over DOC at a higher rate regardless of its source. Future work will include the monitoring of initial microbial assemblages using 16s rRNA gene metabarcoding to identify the initial and responding community along transects and in experiments.

Theme 2c. Ecological and evolutionary consequences of kelp-induced changes in seawater chemistry

To continue testing whether kelp-induced changes in the environment influence the provisioning of offspring by sea urchins via parental effects, we are continuing in situ experiments using caged and fed adult purple sea urchins within and outside of the kelp forests at MK and AQ from late summer to early winter when adults undergo gametogenesis. Cages will be co-located with pH sensors in order to capture differential abiotic exposures during gametogenesis.

Theme 3. Spatial dynamics and connectivity of kelp forests and adjacent ecosystems

Theme 3a. Demographic connectivity and metapopulation dynamics of giant kelp

In the next year we will continue investigating the use of a sUAS mounted hyperspectral imager and 10-band multispectral imager to measure canopy biomass and physiological condition of SBC kelp forests. Starting in February 2021, we began monthly timeseries of 10-band sUAS flights at the Mohawk and Arroyo Quemado kelp forests to examine the dynamics of canopy biomass and physiological condition and relate these changes to demographic and environmental processes. These surveys will be continued over the coming year and augmented as needed to validate the use of additional sensors.

Theme 3b. Trophic connectivity between kelp forests and beaches

To evaluate connectivity and synchrony between beaches and kelp forests, we are collecting detailed data on the abundance of kelp wrack at our five study beaches, quantifying smaller blades and fronds as well as whole plants. We are also developing methods to use sUAS imagery to get a more spatially comprehensive and rapid estimate of wrack abundance that could be collected in tandem with the kelp forest imagery in Theme 2a used to assess the level of synchrony between kelp standing biomass and kelp wrack abundance and flux, and the subsequent connectivity between subtidal kelp forests and intertidal beaches.

Theme 3c. Trophic connectivity between the coastal ocean and kelp forests

In the coming year, to supplement microscope counts of phytoplankton, we will analyze water and gut content samples using DNA metabarcoding techniques. This campaign will begin to define whether kelp forest food webs rely on specific groups of phytoplankton more than others and the physical drivers and transport processes that deliver these crucial trophic resources to the reef.

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The results in the NSF Public Access Repository will include a comprehensive listing of all journal publications recorded to date that are associated with this award.

- Jaramillo, EduardoDugan. (2021). Ranking the ecological effects of coastal armoring on mobile macroinvertebrates across intertidal zones on sandy beaches. *Science of The Total Environment*. 755 (P2) . Status = Deposited in NSF-PAR doi:https://doi.org/10.1016/j.scitotenv.2020.142573 ; Federal Government's License = Acknowledged. (Completed by Reed, null on 12/04/2021) Full text Citation details
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- Aguilera, Rosana and Melack, John M.. (2018). Relationships Among Nutrient and Sediment Fluxes, Hydrological Variability, Fire, and Land Cover in Coastal California Catchments. *Journal of Geophysical Research: Biogeosciences*. 123 (8) 2568 to 2589. Status = Deposited in NSF-PAR doi:10.1029/2017JG004119 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
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- Fitzgerald, Sean P. and Wilson, Jono R. and Lenihan, Hunter S.. (2018). Detecting a need for improved management in a data-limited crab fishery. *Fisheries Research*. 208 (C) 133 to 144. Status = Deposited in NSF-PAR doi:10.1016/j.fishres.2018.07.012 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Michaud, Kristen M. and Emery, Kyle A. and Dugan, Jenifer E. and Hubbard, David M. and Miller, Robert J.. (2019). Wrack resource use by intertidal consumers on sandy beaches. *Estuarine, Coastal and Shelf Science*. 221 (C) 66 to 71. Status = Deposited in NSF-PAR doi:10.1016/j.ecss.2019.03.014 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Dauhajre, Daniel P. and McWilliams, James C.. (2019). Nearshore Lagrangian Connectivity: Submesoscale Influence and Resolution Sensitivity. *Journal of Geophysical Research: Oceans*. . Status = Deposited in NSF-PAR doi:10.1029/2019JC014943 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Arkema, Katie K. and Samhouri, Jameal F.. (2019). Living on the Edge: Variation in the Abundance and Demography of a Kelp Forest Epibiont. *Diversity*. 11 (8) 120. Status = Deposited in NSF-PAR doi:10.3390/d11080120 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Strader, M.E. and Wong, J.M. and Kozal, L.C. and Leach, T.S. and Hofmann, G.E.. (2019). Parental environments alter DNA methylation in offspring of the purple sea urchin, Strongylocentrotus purpuratus. *Journal of Experimental Marine Biology and Ecology*. 517 (C) 54 to 64. Status = Deposited in NSF-PAR doi:10.1016/j.jembe.2019.03.002 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Kröncke, Ingrid and Neumann, Hermann and Dippner, Joachim W. and Holbrook, Sally and Lamy, Thomas and Miller, Robert and Padedda, Bachisio Mario and Pulina, Silvia and Reed, Daniel C. and Reinikainen, Marko and Satta, Cecilia T. and Sechi, Nicola and Soltwedel, Thomas and Suikkanen, Sanna and Lugliè, Antonella. (2019). Comparison of biological and ecological long-term trends related to northern hemisphere climate in different marine ecosystems. *Nature Conservation*. 34 311 to 341. Status = Deposited in

NSF-PAR doi:10.3897/natureconservation.34.30209 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details

- Cavanaugh, Kyle C. and Reed, Daniel C. and Bell, Tom W. and Castorani, Max C. and Beas-Luna, Rodrigo. (2019). Spatial Variability in the Resistance and Resilience of Giant Kelp in Southern and Baja California to a Multiyear Heatwave. *Frontiers in Marine Science*. 6 . Status = Deposited in NSF-PAR doi:10.3389/fmars.2019.00413 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- King, PG. (2018). Valuing beach ecosystems in an age of retreat. *Shore and beach*. 86 (4) 45-59. Status = Deposited in NSF-PAR Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019) Full text Citation details
- Smith, Jason M. and Brzezinski, Mark A. and Melack, John M. and Miller, Robert J. and Reed, Daniel C.. (2018). Urea as a source of nitrogen to giant kelp (*Macrocystis pyrifera*): Urea use by giant kelp. *Limnology and Oceanography Letters*. 3 (4) 365 to 373. Status = Deposited in NSF-PAR doi:10.1002/lol2.10088 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Castorani, Max C. N. and Reed, Daniel C. and Miller, Robert J.. (2018). Loss of foundation species: disturbance frequency outweighs severity in structuring kelp forest communities. *Ecology*. 99 (11) p. 2442-2454. Status = Deposited in NSF-PAR doi:10.1002/ecy.2485 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Goodridge, Blair M. and Hanan, Erin J. and Aguilera, Rosana and Wetherley, Erin B. and Chen, Ying-Jung and D'Antonio, Carla M. and Melack, John M.. (2018). Retention of Nitrogen Following Wildfire in a Chaparral Ecosystem. *Ecosystems*. 21 (8) 1608 to 1622. Status = Deposited in NSF-PAR doi:10.1007/s10021-018-0243-3 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Lowman, Heili E. and Emery, Kyle A. and Kubler-Dudgeon, Lila and Dugan, Jenifer E. and Melack, John M.. (2019). Contribution of macroalgal wrack consumers to dissolved inorganic nitrogen concentrations in intertidal pore waters of sandy beaches. *Estuarine, Coastal and Shelf Science*. 219 (C) 363 to 371. Status = Deposited in NSF-PAR doi:10.1016/j.ecss.2019.02.004 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Peters, Joseph R. and Reed, Daniel C. and Burkepile, Deron E.. (2019). Climate and fishing drive regime shifts in consumer-mediated nutrient cycling in kelp forests. *Global Change Biology*. 25 (9) 3179 to 3192. Status = Deposited in NSF-PAR doi:10.1111/gcb.14706 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Yorke, Christie E. and Page, Henry M. and Miller, Robert J.. (2019). Sea urchins mediate the availability of kelp detritus to benthic consumers. *Proceedings of the Royal Society B: Biological Sciences*. 286 (1906) 20190846. Status = Deposited in NSF-PAR doi:10.1098/rspb.2019.0846 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Wong, Juliet M. and Kozal, Logan C. and Leach, Terence S. and Hoshijima, Umihiko and Hofmann, Gretchen E.. (2019). Transgenerational effects in an ecological context: Conditioning of adult sea urchins to upwelling conditions alters maternal provisioning

and progeny phenotype. *Journal of Experimental Marine Biology and Ecology*. 517 (C) 65 to 77. Status = Deposited in NSF-PAR doi:10.1016/j.jembe.2019.04.006 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019) Full text Citation details

- Myers, Monique R. and Barnard, Patrick L. and Beighley, Edward and Cayan, Daniel R. and Dugan, Jenifer E. and Feng, Dongmei and Hubbard, David M. and Iacobellis, Sam F. and Melack, John M. and Page, Henry M.. (2019). A multidisciplinary coastal vulnerability assessment for local government focused on ecosystems, Santa Barbara area, California. *Ocean & Coastal Management*. 104921. Status = Deposited in NSF-PAR doi:10.1016/j.ocecoaman.2019.104921 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019) Full text Citation details
- Emery, Brian and Washburn, Libe. (2019). Uncertainty Estimates for SeaSonde HF Radar Ocean Current Observations. *Journal of Atmospheric and Oceanic Technology*. 36 (2) 231 to 247. Status = Deposited in NSF-PAR doi:10.1175/JTECH-D-18-0104.1 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
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- Lamy, Thomas and Wang, Shaopeng and Renard, Delphine and Lafferty, Kevin D. and Reed, Daniel C. and Miller, Robert J.. (2019). Species insurance trumps spatial insurance in stabilizing biomass of a marine macroalgal metacommunity. *Ecology*. 100 (7) . Status = Deposited in NSF-PAR doi:10.1002/ecy.2719 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Yorke, CE and Hanns, B and Shears, N and Page, HM and Miller, RJ. (2019). Living kelp versus plankton as food sources for suspension feeders. *Marine Ecology Progress Series*. 614 21 to 33. Status = Deposited in NSF-PAR doi:10.3354/meps12906 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Schooler, Nicholas K. and Dugan, Jenifer E. and Hubbard, David M.. (2019). No lines in the sand: Impacts of intense mechanized maintenance regimes on sandy beach ecosystems span the intertidal zone on urban coasts. *Ecological Indicators*. 106 (C) 105457. Status = Deposited in NSF-PAR doi:10.1016/j.ecolind.2019.105457 ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019) Full text Citation details
- Lenihan, H.S., S.P. Fitzgerald, D.C. Reed, J.K.K. Hofmeister, and A.C. Stier. In press. Increasing spillover enhances southern California spiny lobster catch along marine reserve borders. Ecosphere.. Status = AWAITING_PUBLICATION.
- Emery, K, V Kramer, N Schooler, K Michaud, DM Hubbard, R Miller, JE Dugan Habitat partitioning by mobile intertidal invertebrates of sandy beaches shifts with the tides. Ecosphere. Status = AWAITING_PUBLICATION.

Licenses

Other Conference Presentations / Papers

- Kraskura, K, CL Jerde, EJ Eliason (2021). *Active and resting metabolic rate scaling relationships in fishes across ecologies, salinity, and body shapes 61, E482-E483*. INTEGRATIVE AND COMPARATIVE BIOLOGY. Virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Kyle Emery and Nick K Schooler and Jenifer E Dugan and David M Hubbard and Kyle Cavanaugh (2018). *Assessing the recovery and resilience of sandy beach consumers following a major disturbance (poster)*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Castorani, M.C.N. (2018). *Coastal connectivity: A population perspective from two temperate marine LTER sites*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Comstock, J., Santoro, A., Carlson, C. (2020). *Comparison of bacterioplankton community structure across extraction methods and filter type. AtlantECO Workshop on standard sampling methods for microbiomes in November 2020.*. AtlantECO Workshop on standard sampling methods for microbiomes. virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Michaud, K and KK Emery and J Dugan and R Miller (2018). *Differential use of wrack resources provides niche separation in intertidal consumers on California beaches (poster)*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Castorani, M.C.N., S.L. Harrer, R.J. Miller, and D.C. Reed. (2021). *Disturbance structures canopy and understory productivity along an environmental gradient: evidence from a 10-year experiment at Santa Barbara Coastal LTER.*. 106th Annual Meeting of the Ecological Society of America.. Virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Hofmann GE (2018). *Ecological-evolutionary dynamics in long-term ecological research in marine ecosystem*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Kozal, LC and U Hoshijima and GE Hofmann (2018). *Environmental Variability and Transgenerational Plasticity in the Santa Barbara Channel 2018 (poster)*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Dugan, JE, S Hamilton, K. Neumann, M. Colwell, D. Hubbard, D. Robinette, K. Lindquist, K. Nielsen, J. Marin-Jarrin, J. Madden, M. Ladd (2020). *Evaluating performance of California's MPA network through the lens of sandy beach and surf zone ecosystems. Talk,*. Western Society of Naturalists Meeting. Virtual. Status = OTHER; Acknowledgement of Federal Support = No
- Chamorro, J. and L.C. Kozal and G.E. Hofmann (2018). *Exploring mechanisms of TGP in California mussels (Mytilus californianus)*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Libe Washburn and Paul Matson and Chris Gotschalk and David Siegel and Debra Iglesias-Rodriguez (2018). *Interpreting phytoplankton bloom development using high-frequency radar and satellite ocean color imagery (Poster)*. American Geophysical

Union. Washington, D.C., US. Status = OTHER; Acknowledgement of Federal Support = Yes

- Strader, M.E. and G.E. Hofmann (2019). *Intra- and transgenerational plasticity of DNA methylation in the purple sea urchin, Strongylocentrotus purpuratus*. ASLO 2019 Aquatic Sciences Meeting. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes
- Leach TS and GE Hofmann (2019). *Investigating the role of maternal conditioning on offspring performance and DNA methylation patterns in the purple sea urchin*. ASLO 2019 Aquatic Sciences Meeting. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes
- Jenifer E Dugan (2018). *Life on a sandy edge: conserving beach ecosystems in the face of rising seas*. 9th National Summit on Coastal and Estuarine Restoration and Management. Long Beach, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Castorani, M.C.N. and Reed, D.C. and Miller, R.J (2018). *Loss of foundation species: disturbance frequency outweighs severity for kelp forest biodiversity*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Castorani, M.C.N. and Reed, D.C. and Miller, R.J (2019). *Loss of foundation species: disturbance frequency outweighs severity in structuring kelp forest communities*. 12th International Temperate Reef Symposium. Hong Kong. Status = OTHER; Acknowledgement of Federal Support = Yes
- Cavanaugh, K.C, K.C. Cavanaugh, C.C Pawlak, T.W. Bell. (2020). *Mapping bull kelp refugia and the environmental drivers of their resilience along the north coast of California.*. Western Society of Naturalists Annual Meeting. Virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Libe Washburn and Brian Emery and A. Kirincich and Chris Gotschalk (2019). *Near-shore eddies detected by HF radar and their effects on kelp forest ecosystems*. Radiowave Oceanography Workshop. Victoria, BC, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes
- Dugan, JE and DM Hubbard and B Joab and NK Schooler and KE Emery and B Duke (2018). *Oil Spills on Sandy Beaches: Population responses of intertidal talitrid amphipods to the Refugio Beach Oil Spill, Santa Barbara County 2015*. SETAC North America 39th Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Joab, B and JE Dugan and DM Hubbard and B Duke and R Donohoe and G Baker (2018). *Polycyclic aromatic hydrocarbon uptake in three sandy beach invertebrate tissue types and porewater with corresponding forensic matches to source oil following the Refugio Beach Oil Spill, Santa Barbara County, 2015*. SETAC North America 39th Annual Meeting. Sacramento, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Dugan JE and DM Hubbard and KE Emery and R Miller and C Ohlmann and J. Madden (2018). *Quantifying ecological responses to trophic connectivity between sandy beaches and kelp forests (poster)*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

- Okamoto, D.K. (2021). *Recruitment and mortality in dynamic sea urchin barrens.*. Western Society of Naturalists. Virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Dugan, JE, DM Hubbard, KE Emery (2021). *Sandy beach ecosystems: long term studies of life on the edge. Invited presentation,*. First International Symposium on Coastal Ecosystems and Global Change,. Xiamen, China & Virtual. Status = OTHER; Acknowledgement of Federal Support = Yes
- Jenifer E Dugan (2018). *Santa Barbara Coastal LTER and Climate Change*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Jenifer E Dugan (2018). *Santa Barbara Coastal LTER: Organic Matter at the Sea & Sand Interface*. LTER All Scientists' Meeting. Pacific Grove, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Clare, X. and G.E. Hofmann (2019). *Snails on the menu? Using long-term ecological data to contextualize performance of a California kelp forest predator and emerging fishery species, K. kelletii.*. World Congress of Malacology. Monterey, CA. Status = OTHER; Acknowledgement of Federal Support = Yes
- Bisson, K. and S. Kramer and A. Fischer and D. Catlett and J. Allen and D. Siegel (2018). *Spatial patterns and optical analysis of wildfire-derived ash in the Santa Barbara Channel (poster)*. XXIV Ocean Optics Conference . Dubrovnik, Croatia. Status = OTHER; Acknowledgement of Federal Support = Yes
- Castorani, M.C.N. and T.W. Bell and L.W. Sheppard and J.A. Walter and D.C. Reuman (2019). *Spatial synchrony in giant kelp metapopulations: patterns, scales, and drivers*. 104th Annual Meeting of the Ecological Society of America. Louisville, KY. Status = OTHER; Acknowledgement of Federal Support = Yes
- Libe Washburn (2019). *The evolving role of surface-current measuring radar in coastal oceanography: New observations and technology developments*. Gordon Research Conference on Coastal Ocean Dynamics. Manchester NH. Status = OTHER; Acknowledgement of Federal Support = Yes
- Cavanaugh, K.C. and Bell, T. W. and J.G. Allen and D.A. Siegel (2018). *Three decades of variability in California's giant kelp forests from the Landsat satellites (poster)*. AGU Fall Meeting. Washington DC. Status = OTHER; Acknowledgement of Federal Support = Yes

Other Products

- *Audio or Video Products.*

  The SBC LTER YouTube channel provides videos of project seminars and research activities, The channel is shared through the SBC LTER website and can be accessed directly at this link: https://www.youtube.com/channel/UCF9VmuIO6jlzjrz8CnKc3eQ

- *Audio or Video Products.*

  The newly launched Virtual Reef for K-12 education highlights the ecosystems and research of the SBC LTER.It includes a YouTube channel with short videos on different

marine science topics made by UCSB undergraduates. This program has allowed our K-12 programming to reach diverse schools all over the world and engaged students in marine science during remote learning.

    - https://msi.ucsb.edu/education/oceans-to-classrooms/the-virtual-reef
- *Audio or Video Products.*

  We collaborated with the "Deep Look" program on public radio station KQED to produce a short video on beachhoppers, the major consumers of kelp wrack and a key element of sandy beach food webs. This video was aired on public broadcast in February 2021 and is available on the Deep Look webpage, the link:

  https://www.youtube.com/watch?v=zz8P8ig459g&feature=youtu.be

Other Publications

Patent Applications

Technologies or Techniques

Thesis/Dissertations

- Fitzgerald, SP. *Collaborative Research and Data-Limited Assessment of Small-Scale Trap Fisheries in the Santa Barbara Channel*. (2019). UC Santa Barbara. Acknowledgement of Federal Support = No
- Emery, B.. *Improved Methods for Oceanographic High Frequency Radars*. (2018). Mechanical Engineering, UC Santa Barbara. Acknowledgement of Federal Support = Yes
- Wong, J. *Investigating the Response of Sea Urchin Early Developmental Stages to Multiple Stressors Related to Climate Change*. (2019). UC Santa Barbara. Acknowledgement of Federal Support = Yes
- Yorke, CE. *Kelp as a trophic resource to reef food webs*. (2020). UC Santa Barbara. Acknowledgement of Federal Support = Yes
- Lowman, H.E.. *Nutrient and organic matter cycling in the nearshore ocean and marine sediment of the Santa Barbara Channel.*. (2020). University of California, Santa Barbara. Acknowledgement of Federal Support = Yes
- Catlett, Dylan. *Phytoplankton community determinations and dynamics in the Santa Barbara Channel, CA*. (2021). University of California, Santa Barbara. Acknowledgement of Federal Support = Yes

Websites or Other Internet Sites

- *SBC LTER website*
  https://sbclter.msi.ucsb.edu/

This year we redesigned and updated our project website, with new content and images.

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Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Miller, Robert	PD/PI	3
Hofmann, Gretchen	Co PD/PI	1
Reed, Daniel	Co PD/PI	1
Siegel, David	Co PD/PI	1
Stier, Adrian	Co PD/PI	1
Bell, Tom	Co-Investigator	1
Brzezinski, Mark	Co-Investigator	1
Burkepile, Deron	Co-Investigator	1
Carlson, Craig	Co-Investigator	1
Castorani, Max	Co-Investigator	1
Cavanaugh, Kyle	Co-Investigator	1
Dugan, Jenifer	Co-Investigator	3
Eliason, Erika	Co-Investigator	1
Guerrini, Anita	Co-Investigator	0
Iglesias-Rodriguez, Debora	Co-Investigator	1
Lamy, Thomas	Co-Investigator	2
Lenihan, Hunter	Co-Investigator	1
MacIntyre, Sally	Co-Investigator	1
Melack, John	Co-Investigator	1
Moeller, Holly	Co-Investigator	1
Nidzieko, Nicholas	Co-Investigator	1
Ohlmann, J Carter	Co-Investigator	1
Okamoto, Daniel	Co-Investigator	1
Page, Henry	Co-Investigator	1
Rassweiler, Andrew	Co-Investigator	1
Santoro, Alyson	Co-Investigator	1
Schroeter, Stephen	Co-Investigator	1
Washburn, Libe	Co-Investigator	1

Name	Most Senior Project Role	Nearest Person Month Worked
Wilbanks, Elizabeth	Co-Investigator	1
Benitez-Nelson, Claudia	Faculty	1
Dauhajre, Daniel	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Herman, Gema	Postdoctoral (scholar, fellow or other postdoctoral position)	1
James, Anna	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Liang, Maowei	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Lowman, Heili	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Payandeh, Ali Reza	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Siple, Margaret	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Smith, Jason	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Strader, Marie	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Yorke, Christie	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Gotschalk, Chris	Other Professional	1
Hubbard, David	Other Professional	1
O'Brien, Margaret	Other Professional	4
Simon, Scott	Other Professional	6
Beresford, Laura	Technician	1
Doheney, Brandon	Technician	0
Dubel, Alexandra	Technician	0
Guillocheau, Nathalie	Technician	1
Halewood, Eliza	Technician	1
Halewood, Stuart	Technician	1
Harrer, Shannon	Technician	1
Johnson, Kaitlin	Technician	9
Jones, Janet	Technician	6
Kim, Sylvia	Technician	2
Mangino, Inez	Technician	1
Meyerhof, Matthew	Technician	0

Name	Most Senior Project Role	Nearest Person Month Worked
Moran, Christopher	Technician	1
Nelson, Clint	Technician	12
Ogawa, Jacob	Technician	3
Opalk, Keri	Technician	1
Purzer, Frankie	Technician	1
Romero, Eduardo	Technician	1
Salazar, David	Technician	3
Sampson, Sarah	Technician	1
Shea, Briette	Technician	0
Kui, Li	Staff Scientist (doctoral level)	8
Beckley, Billie	Graduate Student (research assistant)	1
Bogan, Samuel	Graduate Student (research assistant)	6
Brokaw, Ricky	Graduate Student (research assistant)	1
Bui, An	Graduate Student (research assistant)	6
Carberry, Luke	Graduate Student (research assistant)	1
Catlett, Dylan	Graduate Student (research assistant)	9
Cavanaugh, Katherine	Graduate Student (research assistant)	3
Cedano, Tiffany	Graduate Student (research assistant)	0
Chamorro, Jannine	Graduate Student (research assistant)	0
Clare, Xochitl	Graduate Student (research assistant)	3
de Leon Sanchez, Erin	Graduate Student (research assistant)	3
Detmer, Raine	Graduate Student (research assistant)	1
Difiore, Bart	Graduate Student (research assistant)	1
Doman, Natalie	Graduate Student (research assistant)	9
Eegholm, Nathalie	Graduate Student (research assistant)	6
Emery, Kyle	Graduate Student (research assistant)	6
English, Chance	Graduate Student (research assistant)	2
Esaian, Sevan	Graduate Student (research assistant)	1
Fitzgerald, Sean	Graduate Student (research assistant)	0
Goss, Hayley	Graduate Student (research assistant)	1
Hardison, Emily	Graduate Student (research assistant)	1
Huynh, Nicholas	Graduate Student (research assistant)	0
Johnston, Karina	Graduate Student (research assistant)	1
Kozal, Logan	Graduate Student (research assistant)	3
Kraskura, Krista	Graduate Student (research assistant)	6
Leach, Terence	Graduate Student (research assistant)	3

Name	Most Senior Project Role	Nearest Person Month Worked
Madden, Jessica	Graduate Student (research assistant)	1
Malakhoff, Katrina	Graduate Student (research assistant)	3
McDonald, Adriane	Graduate Student (research assistant)	3
Michaud, Kristen	Graduate Student (research assistant)	6
Peters, Joey	Graduate Student (research assistant)	1
Ritger, Amelia	Graduate Student (research assistant)	3
Sainz, Jade	Graduate Student (research assistant)	1
Schuelke, Taruna	Graduate Student (research assistant)	3
Snyder, Jordan	Graduate Student (research assistant)	6
Sugano, Cailan	Graduate Student (research assistant)	0
Tye, Cecily	Graduate Student (research assistant)	1
VanderZee, David	Graduate Student (research assistant)	1
Welch, Zoe	Graduate Student (research assistant)	1
Wong, Juliet	Graduate Student (research assistant)	0
Zenteno, Jose	Graduate Student (research assistant)	1
Adamson, Carter	Undergraduate Student	0
Aguila, Zoe	Undergraduate Student	0
Aguilera, Andrea	Undergraduate Student	0
Ajina, Alia	Undergraduate Student	0
Amundsen, William	Undergraduate Student	0
Anderson, Ellyse	Undergraduate Student	0
Anderson, Claire	Undergraduate Student	0
Andrada, Nico	Undergraduate Student	1
Anujarerat, Stephanie	Undergraduate Student	0
Aplin, Ally	Undergraduate Student	1
Atkins, Micaiah	Undergraduate Student	1
Bagla, Anshika	Undergraduate Student	0
Bakhdanyan, Alex	Undergraduate Student	0
Baldwin, Daniel	Undergraduate Student	0
Ballard, Cassidy	Undergraduate Student	1
Barton, Tyler	Undergraduate Student	0
Bawa, Simran	Undergraduate Student	0
Bechtel, Jacob	Undergraduate Student	1
Becker, Megan	Undergraduate Student	0
Beltran, Nelson	Undergraduate Student	0
Blasco, Gordon	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Boborci, Madigan	Undergraduate Student	0
Boyle, Sarah	Undergraduate Student	1
Bradley, Tori	Undergraduate Student	0
Brown , Maddie	Undergraduate Student	1
Bruggemann, Thea	Undergraduate Student	0
Bryant Williams, Dominique	Undergraduate Student	0
Cajilig-McDonald, Lauren	Undergraduate Student	0
Cam, Jefferson	Undergraduate Student	0
Campbell, Chandler	Undergraduate Student	0
Cantrell, Zach	Undergraduate Student	0
Capittifenton, Lucy	Undergraduate Student	1
Chan, Iris	Undergraduate Student	0
Chen, Jamie	Undergraduate Student	0
Childs, Jeffrey	Undergraduate Student	0
Clarke, Madison	Undergraduate Student	0
Colucci, Makenna	Undergraduate Student	0
Combs, Annie	Undergraduate Student	0
Cook, Kassandra	Undergraduate Student	0
Cowan, Sarah	Undergraduate Student	0
Culpepper, Peter	Undergraduate Student	0
Curry, Stephen	Undergraduate Student	0
Daniel, Tyler	Undergraduate Student	1
Deardorff, Ella	Undergraduate Student	0
Deas, Evan	Undergraduate Student	0
Delmarsh, Ila	Undergraduate Student	0
Deng, Junyu	Undergraduate Student	1
Deyana, Gorman	Undergraduate Student	0
Dezzani, Alecia	Undergraduate Student	0
Ditzler, Hannah	Undergraduate Student	0
Dorji, Shey	Undergraduate Student	0
Dugan, Emmaline	Undergraduate Student	0
Dyck, Taylor	Undergraduate Student	0
Ear, Jenny	Undergraduate Student	0
Elbayar, Samantha	Undergraduate Student	0
Ellman, Samantha	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
English, Torreyann	Undergraduate Student	0
Evans, Thomas	Undergraduate Student	0
Fields, Ashton	Undergraduate Student	1
Foshay, Bergan	Undergraduate Student	1
Fyfe, Caroline	Undergraduate Student	0
Gallagher, Jordan	Undergraduate Student	0
Galles, Charlie	Undergraduate Student	0
Galvan, Journ	Undergraduate Student	0
Garcia, Diana	Undergraduate Student	0
Garcia, Luis	Undergraduate Student	1
Garoufalias, Nikko	Undergraduate Student	1
Girling, Ivan	Undergraduate Student	0
Godzik, Mikolai	Undergraduate Student	1
Goldston, Aiko	Undergraduate Student	0
Gonzales, Elise	Undergraduate Student	0
Gording, Tess	Undergraduate Student	0
Gorgas, Maya	Undergraduate Student	0
Grant, Sabrina	Undergraduate Student	1
Gray, Ciara	Undergraduate Student	0
Greenslade, Annie	Undergraduate Student	0
Hakanson, Alexander	Undergraduate Student	0
Hargrove, Lindsey	Undergraduate Student	0
Hausrath, Isabel	Undergraduate Student	0
Hernandez, Marisol	Undergraduate Student	0
Hill, Allison	Undergraduate Student	0
Holbrook, Jack	Undergraduate Student	0
Huang, Paul	Undergraduate Student	0
Iskander, Joshua	Undergraduate Student	0
Jawetz, Sean	Undergraduate Student	0
Jennings, Lauren	Undergraduate Student	0
Johnson, Lucy	Undergraduate Student	0
Jolish, Coby	Undergraduate Student	1
Jones, Steven	Undergraduate Student	0
Jonie, Garcia	Undergraduate Student	0
Juengling Bean, Eva	Undergraduate Student	0
Katsiouleris, Dimitri	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Katsiovleris, Dimitri	Undergraduate Student	0
Kaur, Sami	Undergraduate Student	0
Keeling, Lukas	Undergraduate Student	0
Kelton, Allison	Undergraduate Student	0
Kern, Iris	Undergraduate Student	0
Kernkamp, Charles	Undergraduate Student	0
Kirby, Timothy	Undergraduate Student	1
Koolmees, Wyatt	Undergraduate Student	0
Krebs, Karina	Undergraduate Student	0
Krotine, Kimberly	Undergraduate Student	0
Lam, Rachel	Undergraduate Student	1
LaManna, Renee	Undergraduate Student	0
Lao, Chihei	Undergraduate Student	0
Larrondo, Joey	Undergraduate Student	1
Lawrence, Catherine	Undergraduate Student	0
Le, Katherine	Undergraduate Student	0
LeDonne, Tasi	Undergraduate Student	0
Lin, Forest	Undergraduate Student	1
Lin, Justin	Undergraduate Student	0
Listori, Mykala	Undergraduate Student	0
Lombardo, Mia	Undergraduate Student	0
Loo, Emmaline	Undergraduate Student	0
Manalo, Zoe	Undergraduate Student	0
Martinka, Arielle	Undergraduate Student	1
Mattos, Isaiah	Undergraduate Student	1
Mayne, Noah	Undergraduate Student	0
McEligot, Lizzi	Undergraduate Student	1
McNeill, David	Undergraduate Student	0
Meoni, Mirabella	Undergraduate Student	0
Mita, Stephane	Undergraduate Student	1
Moran, Tristen	Undergraduate Student	0
Moreno, Luiza	Undergraduate Student	1
Morrison, Seamus	Undergraduate Student	1
Ngo, Katie	Undergraduate Student	0
Nortier-Tilly, Cassiel	Undergraduate Student	0
O'Brien, Alex	Undergraduate Student	1

Name	Most Senior Project Role	Nearest Person Month Worked
Ochoa, Jacob	Undergraduate Student	0
Oda, Kai	Undergraduate Student	1
Packard, Ian	Undergraduate Student	0
Pampeyan, Kristin	Undergraduate Student	0
Parks, Emily	Undergraduate Student	0
Patil, Ashwini	Undergraduate Student	0
Penn, Cameron	Undergraduate Student	1
Perez, Yanelyn	Undergraduate Student	0
Pettit, Andrew	Undergraduate Student	0
Piozet, Tim	Undergraduate Student	0
Platonoff, Kristina	Undergraduate Student	0
Plewe, Gabi	Undergraduate Student	1
Plouffe, Kyler	Undergraduate Student	0
Powers, James	Undergraduate Student	0
Price , Sean	Undergraduate Student	0
Puchkova, Isabella	Undergraduate Student	1
Pyle, Brenden	Undergraduate Student	0
Rathle, Shane	Undergraduate Student	0
Reamey, Maya	Undergraduate Student	0
Reitman, Fred	Undergraduate Student	0
Riley, Katie	Undergraduate Student	0
Roberts, Claire	Undergraduate Student	0
Robles, Melanee	Undergraduate Student	0
Rollins, Sophia	Undergraduate Student	0
Ross, Vivian	Undergraduate Student	0
Ruggles, Logan	Undergraduate Student	0
Rupprecht, Andie	Undergraduate Student	0
Salsbury, Lauren	Undergraduate Student	0
Schauerman, Eileen	Undergraduate Student	0
Sheen, Esther	Undergraduate Student	1
Shei, Jessica	Undergraduate Student	0
Shelby, Ben	Undergraduate Student	0
Singleton, Hana	Undergraduate Student	0
Siu, Daniel	Undergraduate Student	0
Sloan, Katie	Undergraduate Student	0
Soglin, Tatiana	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Solvay, Margot	Undergraduate Student	0
Soto, Abraham	Undergraduate Student	0
St. Pierre, Zoe	Undergraduate Student	0
Stead, Courtney	Undergraduate Student	0
Tang, Irvin	Undergraduate Student	0
Ulloa, Gabbie	Undergraduate Student	0
Ulloa Gutierrez, Imanol	Undergraduate Student	0
Van de Wyngaerde, Kylie	Undergraduate Student	0
Van Gieson, Amir	Undergraduate Student	0
Vargas, Jennifer	Undergraduate Student	0
Vasquez, Jennifer	Undergraduate Student	0
Vega, Jessica	Undergraduate Student	0
Venkatachalam, Divyaa	Undergraduate Student	0
Venkatachalam, Divyaa	Undergraduate Student	2
Wachtell, Lauren	Undergraduate Student	0
Wagner, Theresa	Undergraduate Student	1
Wagner, Noah	Undergraduate Student	0
Walton, Miette	Undergraduate Student	0
Wellington, Bethlehem	Undergraduate Student	0
Whightsil, Lauren	Undergraduate Student	0
Wilds, Gabi	Undergraduate Student	1
Williams, Jonathan	Undergraduate Student	0
Witonsky, Lilly	Undergraduate Student	0
Yeung, Sammi	Undergraduate Student	1
Yocom, Mira	Undergraduate Student	0
Gerigk, Matthew	Research Experience for Undergraduates (REU) Participant	2
Keeling, Lukas	Research Experience for Undergraduates (REU) Participant	2
Santos, Julia	Research Experience for Undergraduates (REU) Participant	2

Full details of individuals who have worked on the project:

Robert J Miller
Email: miller@msi.ucsb.edu

Most Senior Project Role: PD/PI
Nearest Person Month Worked: 3

Contribution to the Project: Serves as project leader

Funding Support: NSF, Federal, State

Change in active other support: Yes cp-381972 (1).pdf

International Collaboration: Yes, france
International Travel: No

Gretchen E Hofmann
Email: hofmann@lifesci.ucsb.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Led the ecophysiology, ocean acidification, and epigenetics components of the project

Funding Support: State, Federal

Change in active other support: Yes Hofmann_CPS_Dev 2021.pdf

International Collaboration: No
International Travel: No

Daniel C Reed
Email: reed@lifesci.ucsb.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Lead on kelp forest ecosystem studies

Funding Support: NSF State

Change in active other support: No

International Collaboration: No
International Travel: No

David A Siegel
Email: davey@eri.ucsb.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Led oceanographic and remote sensing themes of project

Funding Support: State , Federal

Change in active other support: No

International Collaboration: No
International Travel: No

Adrian C Stier
Email: adrian.stier@lifesci.ucsb.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Co-led kelp forest food web and ecology research

Funding Support: State, Federal

Change in active other support: No

International Collaboration: Yes, french polynesia
International Travel: No

Tom Bell
Email: thomas.bell@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Investigates biomass dynamics in kelp forests, remote sensing

Funding Support: State

International Collaboration: No
International Travel: No

Mark Brzezinski
Email: brzezins@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Leads research on recycled nitrogen in kelp forests, Direct monthly monitoring of water chemistry at core kelp forests

Funding Support: State

International Collaboration: No
International Travel: No

Deron Burkepile
Email: deron.berkepile@lifesci.ucsb.edu

Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Recycled nitrogen in kelp forests

Funding Support: State

International Collaboration: No
International Travel: No

Craig Carlson
Email: carlson@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Leads research on organic matter dynamics in kelp forests

Funding Support: State

International Collaboration: No
International Travel: No

Max Castorani
Email: castorani@virginia.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Community and disturbance ecology of kelp forests, metapopulation dynamics

Funding Support: State

International Collaboration: Yes, mexico
International Travel: No

Kyle Cavanaugh
Email: kcavanaugh@geog.ucla.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Population dynamics of giant kelp and trophic connectivity between kelp forests and beaches

Funding Support: State

International Collaboration: No
International Travel: No

Jenifer Dugan
Email: j_dugan@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 3

Contribution to the Project: Trophic connectivity between kelp forests and beaches, project coordinator

Funding Support: NSF, Federal state

International Collaboration: Yes, australia, chile
International Travel: No

Erika Eliason
Email: erika.eliason@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Ecological physiology and fishing

Funding Support: State

International Collaboration: No
International Travel: No

Anita Guerrini
Email: anita.guerrini@oregonstate.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 0

Contribution to the Project: environmental and landscape history

Funding Support: none

International Collaboration: No
International Travel: No

Debora Iglesias-Rodriguez
Email: iglesias@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Coastal ocean and kelp forest connectivity

Funding Support: State

International Collaboration: No
International Travel: No

Thomas Lamy
Email: thomas.lamy27@gmail.com
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 2

Contribution to the Project: Kelp forest ecology and biology

Funding Support: Federal

International Collaboration: No
International Travel: No

Hunter Lenihan
Email: lenihan@bren.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Fisheries biology, ecology and management

Funding Support: State

International Collaboration: No
International Travel: No

Sally MacIntyre
Email: sally@eri.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Physical -biological coupling in kelp forests

Funding Support: State

International Collaboration: No
International Travel: No

John Melack
Email: john.melack@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Recycled nitrogen in kelp forests and trophic connectivity

Funding Support: State

International Collaboration: No
International Travel: No

Holly Moeller
Email: holly.moeller@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Recycled nitrogen in kelp forests and dissolved organic matter dynamics

Funding Support: State

International Collaboration: No
International Travel: No

Nicholas Nidzieko
Email: nidzieko@ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Leads research on effects of kelp on physical and chemical fluxes

Funding Support: State

International Collaboration: No
International Travel: No

J Carter Ohlmann
Email: carter@eri.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Trophic connectivity between kelp forests and beaches

Funding Support: Federal

International Collaboration: No
International Travel: No

Daniel Okamoto
Email: dokamoto@bio.fsu.edu,
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Urchin settlement studies

Funding Support: none

International Collaboration: No
International Travel: No

Henry Page
Email: page@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Trophic connectivity between kelp forests and beaches and the coastal ocean

Funding Support: Private, Federal

International Collaboration: No
International Travel: No

Andrew Rassweiler
Email: rassweiler@bio.fsu.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Ecological consequences of fishing in kelp forests and kelp forest community and disturbance ecology

Funding Support: State

International Collaboration: No
International Travel: No

Alyson Santoro
Email: asantoro@ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Recycled nitrogen in kelp forests and dissolved organic matter dynamics

Funding Support: State

International Collaboration: No
International Travel: No

Stephen Schroeter
Email: schroete@ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Urchin settlement studies

Funding Support: State

International Collaboration: No
International Travel: No

Libe Washburn
Email: libe.washburn@ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Advised and helped design new mooring hardware. Assisted and advised on mooring operations. Assisted with project planning. Helped develop SBC LTER oceanographic research directions. Continued analysis and synthesis of data from SBC LTER cruises. Led analysis and interpretation effort on paper describing use of HF radar data for quantifying development of phytoplankton blooms

Funding Support: State

International Collaboration: No
International Travel: No

Elizabeth Wilbanks
Email: elizabeth.wilbanks@lifesci.ucsb.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Microbial metabolism and biogeochemistry

Funding Support: State

International Collaboration: No
International Travel: No

Claudia Benitez-Nelson
Email: benitezn@mailbox.sc.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Dr. Benitez-Nelson maintains a deep sediment trap in the Santa Barbara Channel and collaborates with SBC LTER investigators regularly on topics relevant to phytoplankton and carbon cycling.

Funding Support: SBC LTER does not currently recieve support from the project, although we have supported maintaining her trap in past years.

International Collaboration: No
International Travel: No

Daniel Dauhajre
Email: ddauhajre@atmos.ucla.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Ocean circulation and modeling

Funding Support: Federal

International Collaboration: No
International Travel: No

Gema Herman
Email: gemahmbio@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Lead data analyses and papers

Funding Support: Federal

International Collaboration: No
International Travel: No

Anna James
Email: ajames@lifesci.ucsb.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Dissolved organic matter dynamics in kelp forests

Funding Support: Federal

International Collaboration: No
International Travel: No

Maowei Liang
Email: maowei.liang@virginia.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Plant community and ecosystem ecology

Funding Support: federal

International Collaboration: No
International Travel: No

Heili Lowman
Email: Heili.lowman@ucsb.edu

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Coastal biogeochemistry, nutrient cycling, transport and processing of organic matter.

Funding Support: NSF, state

International Collaboration: Yes, canada
International Travel: No

Ali Reza Payandeh
Email: alip@ucsb.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Physical Oceanography

Funding Support: Federal

International Collaboration: No
International Travel: No

Margaret Siple
Email: siplem@ucsb.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Population ecology and fisheries

Funding Support: Federal

International Collaboration: No
International Travel: No

Jason Smith
Email: smith.jason.michel@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Recycled nitrogen in kelp forests

Funding Support: Private

International Collaboration: No
International Travel: No

Marie Strader
Email: stradermarie@gmail.com

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Urchin epigenetics

Funding Support: NSF

International Collaboration: No
International Travel: No

Christie Yorke
Email: ceyorke@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Kelp forest ecology and biology

Funding Support: private

International Collaboration: No
International Travel: No

Chris Gotschalk
Email: gots@lifesci.ucsb.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Processed data from moorings and monthly water sampling. Maintained databases. Assisted investigators with data analysis issues and programming questions. Advised and consulted with information technology staff.

Funding Support: NSF, Federal

International Collaboration: No
International Travel: No

David Hubbard
Email: hubbard@lifesci.ucsb.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: assisted with sandy beach core monitoring

Funding Support: Federal, state

International Collaboration: Yes, australia, chile
International Travel: No

Margaret O'Brien
Email: mob@msi.ucsb.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 4

Contribution to the Project: data and information management for project

Funding Support: Federal

International Collaboration: No
International Travel: No

Scott Simon
Email: simon@msi.ucsb.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 6

Contribution to the Project: Coordinate SBC education and outreach activities, develop and maintain relevant partnerships, train undergraduate outreach support

Funding Support: State

International Collaboration: No
International Travel: No

Laura Beresford
Email: lauraberesford@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with field research and sample processing for sandy beaches

Funding Support: Federal, state

International Collaboration: No
International Travel: No

Brandon Doheney
Email: bdoheny13@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: Assist with field research and diving surveys for kelp forests and reefs

Funding Support: Federal

International Collaboration: No
International Travel: No

Alexandra Dubel
Email: adubel@bio.fsu.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: data analysis

Funding Support: Federal

International Collaboration: No
International Travel: No

Nathalie Guillocheau
Email: nathalie@eri.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: data collection and analysis

Funding Support: Federal

International Collaboration: No
International Travel: No

Eliza Halewood
Email: wallner@lifesci.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Manage DOM samples and lab processing

Funding Support: Federal

International Collaboration: No
International Travel: No

Stuart Halewood
Email: halewood@eri.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: assist with oceanographic instruments and moorings

Funding Support: Federal

International Collaboration: No
International Travel: No

Shannon Harrer
Email: harrer@msi.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assist with data analyses

Funding Support: NSF

International Collaboration: No
International Travel: No

Kaitlin Johnson
Email: kaitlin_johnson@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 9

Contribution to the Project: Kelp forest ecology and biology

Funding Support: federal

International Collaboration: No
International Travel: No

Janet Jones
Email: ja_jones@lifesci.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 6

Contribution to the Project: Data Collection/Analysis of seawater samples

Funding Support: Federal

International Collaboration: No
International Travel: No

Sylvia Kim
Email: sylvia_m_kim@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 2

Contribution to the Project: Phytoplankton ecology

Funding Support: federal

International Collaboration: No
International Travel: No

Inez Mangino
Email: inez@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Matthew Meyerhof
Email: mmeyerhof@bren.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: data collection; equipment/instrument maintenance; data analysis

Funding Support: NSF

International Collaboration: No
International Travel: No

Christopher Moran
Email: christophermoran@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Marine instrumentation and sensors

Funding Support: federal

International Collaboration: No
International Travel: No

Clint Nelson
Email: c_nelson@lifesci.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 12

Contribution to the Project: Lead SBC Field research activities for kelp forests and nearshore ocean

Funding Support: NSF

International Collaboration: No
International Travel: No

Jacob Ogawa
Email: jacobogawa@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 3

Contribution to the Project: Scientific Scuba diver,Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Keri Opalk
Email: kerilynno@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Phytoplankton and Carbon Cycling Sampling and Analysis, Optimized TCO2 system

Funding Support: Federal

International Collaboration: No
International Travel: No

Frankie Purzer
Email: fpuerzer7412@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities

Funding Support: Federal

International Collaboration: No
International Travel: No

Eduardo Romero
Email: romero@msi.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Designed and fabricated parts used on components of moorings. Assisted Salazar and Washburn in coordinating field sampling. Assisted with preparation of

instruments for field deployments. Participated in SCUBA diving to deploy instruments. Assisted with instrument repairs. Participated in monthly water sampling

Funding Support: Federal

International Collaboration: No
International Travel: No

David Salazar
Email: Salazar@msi.ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 3

Contribution to the Project: Coordinated field sampling. Oversaw preparation of instruments for field deployments and oversaw instrument downloading from instruments and uploading to database. Operated research launch for mooring deployments and other field sampling. Kept project records, and oversaw instrument calibrations, and arranged instrument servicing. Participated in monthly water sampling

Funding Support: Federal

International Collaboration: No
International Travel: No

Sarah Sampson
Email: srsampson@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with LTER kelp forest fieldwork, and trained LTER students in research activities and data entry

Funding Support: NSF

International Collaboration: No
International Travel: No

Briette Shea
Email: brietteshea@ucsb.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: data analysis for seawater nutrients

Funding Support: NSF

International Collaboration: No
International Travel: No

Li Kui
Email: li.kui@ucsb.edu
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 8

Contribution to the Project: serves as information manager for project

Funding Support: NSF, Federal

International Collaboration: No
International Travel: No

Billie Beckley
Email: billiebeckley@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: disturbance ecology, kelp forests

Funding Support: federal

International Collaboration: No
International Travel: No

Samuel Bogan
Email: snbogan@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: processing seawater samples from field study

Funding Support: NSF

International Collaboration: No
International Travel: No

Ricky Brokaw
Email: rbrokaw@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Ocean transport of materials to kelp forests

Funding Support: federal

International Collaboration: No
International Travel: No

An Bui
Email: an.bui@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Trait-based surveys and modeling of macroalgae

Funding Support: Federal, NSF, state

International Collaboration: No
International Travel: No

Luke Carberry
Email: lcarberry@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Physical oceanography and phytoplankton

Funding Support: federal

International Collaboration: No
International Travel: No

Dylan Catlett
Email: dsc@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: coastal phytoplankton ecology

Funding Support: federal

International Collaboration: No
International Travel: No

Katherine Cavanaugh
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Remote sensing of kelp forests

Funding Support: NSF

International Collaboration: No
International Travel: No

Tiffany Cedano
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: nutrient utilization by giant kelp

Funding Support: NSF

International Collaboration: No
International Travel: No

Jannine Chamorro
Email: jdchamorro@ucsb.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Physiological response to ocean climate

Funding Support: State

International Collaboration: No
International Travel: No

Xochitl Clare
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Physiological responses to ocean climate

Funding Support: federal, NSF

International Collaboration: No
International Travel: No

Erin de Leon Sanchez
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: marine invertebrate ecology Theme 2C

Funding Support: federal

International Collaboration: No
International Travel: No

Raine Detmer
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Mathematical modeling of macroalgal dynamics and storm effects

Funding Support: federal

International Collaboration: No
International Travel: No

Bart Difiore
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Kelp forest ecology and biology

Funding Support: state

International Collaboration: No
International Travel: No

Natalie Doman
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Conducted nutrient analyses

Funding Support: State UCSB, NSF

International Collaboration: No
International Travel: No

Nathalie Eegholm
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Assisted with oceanographic modeling

Funding Support: NSF

International Collaboration: No
International Travel: No

Kyle Emery
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Beach ecosystem responses to kelp subsidies

Funding Support: NSF, state

International Collaboration: No
International Travel: No

Chance English
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: kelp forest DOM and microbial ecology

Funding Support: Federal, state

International Collaboration: No
International Travel: No

Sevan Esaian
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: kelp microbiome and ecosystem drivers

Funding Support: NSF

International Collaboration: No
International Travel: No

Sean Fitzgerald
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Trap fishery biology and management

Funding Support: state

International Collaboration: No
International Travel: No

Hayley Goss
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Ecological connectivity

Funding Support: federal

International Collaboration: No
International Travel: No

Emily Hardison
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: the creation of a nitrogen budget for the Santa Barbara Area

Funding Support: none

International Collaboration: No
International Travel: No

Nicholas Huynh
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: kelp forest DOM and microbial ecology

Funding Support: state, federal

International Collaboration: No
International Travel: No

Karina Johnston
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Beach ecosystems and restoration, climate adaptation

Funding Support: federal

International Collaboration: No
International Travel: No

Logan Kozal
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Physiological responses to ocean climate

Funding Support: federal, NSF , State

International Collaboration: No
International Travel: No

Krista Kraskura
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Physiological responses to ocean climate, body size effects on metabolism and thermal tolerance in fish

Funding Support: NSF

International Collaboration: No
International Travel: No

Terence Leach
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Physiological responses to ocean climate

Funding Support: state, federal

International Collaboration: No
International Travel: No

Jessica Madden
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with field researchand sample processing for sandy beaches

Funding Support: NSF, Federal, State

International Collaboration: No
International Travel: No

Katrina Malakhoff
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Effects of marine management on sea urchins

Funding Support: NSF

International Collaboration: No
International Travel: No

Adriane McDonald
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: processing seawater samples from field study

Funding Support: NSF

International Collaboration: No
International Travel: No

Kristen Michaud
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Invasive species in kelp forests

Funding Support: NSF

International Collaboration: No
International Travel: No

Joey Peters
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: consumer mediated nutrient cycling in kelp forests

Funding Support: NSF

International Collaboration: No
International Travel: No

Amelia Ritger
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Community and population ecology

Funding Support: federal

International Collaboration: No
International Travel: No

Jade Sainz
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Marine aquaculture

Funding Support: federal

International Collaboration: No
International Travel: No

Taruna Schuelke
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: microbiology and genomics

Funding Support: NSF

International Collaboration: No
International Travel: No

Jordan Snyder
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Remote sensing of kelp forests

Funding Support: Federal

International Collaboration: No
International Travel: No

Cailan Sugano
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Physiological responses to ocean climate

Funding Support: Federal

International Collaboration: No
International Travel: No

Cecily Tye
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Coastal physical oceanography

Funding Support: federal

International Collaboration: No
International Travel: No

David VanderZee
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Sandy beach and surf zone ecology

Funding Support: State UCSB

International Collaboration: No
International Travel: No

Zoe Welch
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Nearest Person Month Worked: 1

Contribution to the Project: marine plankton physiology and biogeochemistry

Funding Support: NSF

International Collaboration: No
International Travel: No

Juliet Wong
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: impacts of ocean acidification and ocean warming on the early developmental stages of marine invertebrates

Funding Support: NSF

International Collaboration: No
International Travel: No

Jose Zenteno
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Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Fishery biology and aquaculture

Funding Support: none

International Collaboration: No
International Travel: No

Carter Adamson
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Alia Ajina
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

William Amundsen
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Claire Anderson
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Stephanie Anujarerat
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Ally Aplin
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Outreach activities, Assisted with kelp forest laboratory, field and data activities.

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Micaiah Atkins
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Anshika Bagla
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Alex Bakhdanyan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Daniel Baldwin
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Cassidy Ballard
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Tyler Barton
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Simran Bawa
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jacob Bechtel
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Megan Becker
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Nelson Beltran
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Gordon Blasco
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Study of kelp nitrogen sources

Funding Support: none

International Collaboration: No
International Travel: No

Madigan Boborci
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Sarah Boyle
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Invert Settlement Project, Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Tori Bradley
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Maddie Brown
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Thea Bruggemann
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Dominique Bryant Williams
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Lauren Cajilig-McDonald
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jefferson Cam
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Worked on design, fabrication, and assembly tasks for various lab development projects. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Chandler Campbell
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Zach Cantrell
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Lucy Capittifenton
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Iris Jane Chan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jamie Chen
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Jeffrey Childs
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Madison Clarke
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Makenna Colucci
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Analysis of LTER images

Funding Support: none

International Collaboration: No
International Travel: No

Annie Combs
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Kassandra Cook
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Sarah Cowan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Analysis of LTER images

Funding Support: none

International Collaboration: No
International Travel: No

Peter Culpepper
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Stephen Curry
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Tyler Daniel
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Invert Settlement Project, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Ella Deardorff
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Evan Deas
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Ila Delmarsh
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: modeling of wave driven kelp transport from kelp forests to beaches

Funding Support: NSF

International Collaboration: No
International Travel: No

Junyu Deng
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Gorman Deyana
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Alecia Dezzani
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Hannah Ditzler
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Invert Settlement Project, Scientific Scuba Diver, Assisted with kelp forest laboratory, field and data activities. Utreach

Funding Support: NSF

International Collaboration: No
International Travel: No

Shey Dorji
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Emmaline Dugan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Taylor Dyck
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jenny Ear
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Samantha Elbayar
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Samantha Ellman
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Torreyann English
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Thomas Evans
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Ashton Fields
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Bergan Foshay
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest data activities

Funding Support: none

International Collaboration: No
International Travel: No

Caroline Fyfe
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Charlie Galles
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Journ Galvan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Diana Garcia
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Luis Garcia
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Nikko Garoufalias
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Ivan Girling
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Scientitic Scuba Diver, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Mikolai Godzik
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Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Aiko Goldston
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Elise Gonzales
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Fish Gut Content Analysis Project, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Tess Gording
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Analysis of LTER images

Funding Support: none

International Collaboration: No
International Travel: No

Maya Gorgas
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Sabrina Grant
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Ciara Gray
Email: ciaragray@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Annie Greenslade
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Alexander Hakanson
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Analysis of LTER images

Funding Support: none

International Collaboration: No
International Travel: No

Lindsey Hargrove
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Isabel Hausrath
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Marisol Hernandez
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Allison Hill
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory, entered and checked data

Funding Support: none

International Collaboration: No
International Travel: No

Jack Holbrook
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Paul Huang
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Joshua Iskander
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed biotic samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Sean Jawetz
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Worked on design, fabrication, and assembly tasks for various lab development projects. Participated in field tests of drone research vehicles.

Funding Support: NSF

International Collaboration: No
International Travel: No

Lauren Jennings
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Lucy Johnson
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Coby Jolish
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Steven Jones
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed biotic samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Garcia Jonie
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Dimitri Katsiouleris
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Analysis of LTER images

Funding Support: none

International Collaboration: No
International Travel: No

Dimitri Katsiovleris
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Sami Kaur
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Lukas Keeling
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Allison Kelton
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Iris Kern
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Charles Kernkamp
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Timothy Kirby
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Wyatt Koolmees
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Karina Krebs
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: data collection; sample analysis; equipment/instrument maintenance

Funding Support: NSF

International Collaboration: No
International Travel: No

Kimberly Krotine
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Rachel Lam
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Renee LaManna
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Scientific Scuba diver, Fish Gut Content Analysis Project, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Chihei Lao
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples, volunteered at outreach events

Funding Support: none

International Collaboration: No
International Travel: No

Joey Larrondo
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest data activities

Funding Support: none

International Collaboration: No
International Travel: No

Catherine Lawrence
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: State UCSB

International Collaboration: No
International Travel: No

Tasi LeDonne
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Mia Lombardo
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Zoe Manalo
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Arielle Martinka
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Nearest Person Month Worked: 1

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Isaiah Mattos
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Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Noah Mayne
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Lizzi McEligot
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

David McNeill
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Mirabella Meoni
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Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Stephane Mita
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Tristen Moran
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Luiza Moreno
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Seamus Morrison
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Katie Ngo
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Cassiel Nortier-Tilly
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Alex O'Brien
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with oceanographic field data collection. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Jacob Ochoa
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Kai Oda
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Scientific scuba diver, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Ian Packard
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Kristin Pampeyan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Emily Parks
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Ashwini Patil
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Cameron Penn
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest data activities

Funding Support: none

International Collaboration: No
International Travel: No

Yanelyn Perez
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Andrew Pettit
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed biotic samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Tim Piozet
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Kristina Platonoff
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Gabi Plewe
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Kyler Plouffe
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

James Powers
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Sean Price
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Isabella Puchkova
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Brenden Pyle
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Worked on design, fabrication, and assembly tasks for various lab development projects. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Shane Rathle
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Maya Reamey
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Fred Reitman
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Katie Riley
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Claire Roberts
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Scientific scuba diver, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Melanee Robles
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Sophia Rollins
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Worked on design, fabrication, and assembly tasks for various lab development projects. Participated in field tests of drone research vehicles.

Funding Support: NSF

International Collaboration: No
International Travel: No

Lauren Salsbury
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Eileen Schauerman
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Esther Sheen
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Jessica Shei
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Ben Shelby
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Hana Singleton
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed biotic samples

Funding Support: none

International Collaboration: No
International Travel: No

Daniel Siu
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Katie Sloan
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Tatiana Soglin
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Margot Solvay
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Abraham Soto
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Zoe St. Pierre
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Courtney Stead
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Irvin Tang
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Invert Settlement Project, Assisted with kelp forest laboratory, field and data activities.

Funding Support: NSF

International Collaboration: No
International Travel: No

Gabbie Ulloa
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Imanol Ulloa Gutierrez
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Kylie Van de Wyngaerde
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: implanted heart rate loggers into lobsters and outplanted them inside and outside the kelp forest, outreach activities

Funding Support: NSF

International Collaboration: No
International Travel: No

Amir Van Gieson
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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jennifer Vargas
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Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jennifer Vasquez
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Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Jessica Vega
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Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

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Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with oceanographic field data collection. Participated in field tests of drone research vehicles.

Funding Support: none

International Collaboration: No
International Travel: No

Divyaa Venkatachalam
Email: divyaa.venkat@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Assisted with instrument mainentance. Conducted study of currents and distribution of invasive marine plant, watersipora

Funding Support: none

International Collaboration: No
International Travel: No

Lauren Wachtell
Email: lwachtell@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Processed samples in the laboratory, outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Theresa Wagner
Email: tcmwagner7@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: none

International Collaboration: No
International Travel: No

Noah Wagner
Email: noahwagner@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Miette Walton
Email: miette.walton@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Bethlehem Wellington
Email: bethlehemwellington@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Lauren Whightsil
Email: laurenwhightsil@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Gabi Wilds
Email: gwilds@umail.ucsb.edu,
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Jonathan Williams
Email: jonathantaylorwilliams@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Lilly Witonsky
Email: lwitonsky@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Outreach activities

Funding Support: Coastal Fund, NOAA BWET

International Collaboration: No
International Travel: No

Sammi Yeung
Email: samiiyeung@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with kelp forest laboratory, field and data activities.

Funding Support: None

International Collaboration: No
International Travel: No

Mira Yocom
Email: miralyna@ucsb.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisted with field sampling and processed samples in the laboratory

Funding Support: none

International Collaboration: No
International Travel: No

Matthew Gerigk
Email: matthewgerigk@ucsb.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Assisted with design and modificatiions of robotic surface vehicle. Assisted with mooring maintenance.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Sophomore
Home Institution: UCSB
Government fiscal year(s) was this REU participant supported: 2021

Lukas Keeling
Email: lukaskeeling7@gmail.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Assisted with oceanographic field data collection. Implemented drone-based video algorithm for measuring ocean currents

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: UCSB
Government fiscal year(s) was this REU participant supported: 2021, 2020

Julia Santos
Email: juliabeatriz@ucsb.edu
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 2

Contribution to the Project: Assisted with oceanographic field data collection. Developed small drifter for drone deployment.

Funding Support: NSF

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: UCSB
Government fiscal year(s) was this REU participant supported: 2020, 2021

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
American Assoc. University Women Tech Trek	Other Nonprofits	Santa Barbara, CA
California Dept of Fish and Wildlife	State or Local Government	Sacramento, CA
Scripps Institution of Oceanography	Academic Institution	La Jolla, CA
Southern California Coastal Ocean Observing System (SCCOOS)	Other Organizations (foreign or domestic)	La Jolla, California
The Bay Foundation	Other Nonprofits	Santa Monica, CA
US Geological Survey	Other Organizations (foreign or domestic)	Santa Cruz, CA
University of Auckland	Academic Institution	Auckland, New Zealand
University of California, Davis	Academic Institution	Bodega Bay, CA
University of California, Los Angeles	Academic Institution	Los Angeles, CA
University of California, Santa Cruz	Academic Institution	Santa Cruz, CA
University of Quebec a Montreal	Academic Institution	Monteral, Quebeck Canada
University of Wisconsin	Academic Institution	Milwalkee, WI
California Sea Grant Extension	Academic Institution	La Jolla, CA
Channel Islands National Marine Sanctuary	Other Organizations (foreign or domestic)	Santa Barbara, CA
Channel Islands National Park	Other Organizations (foreign or domestic)	Ventura, CA
City of Santa Barbara	State or Local Government	Santa Barbara, CA
County of Santa Barbara	State or Local Government	Santa Barbara, CA
Moss Landing Marine Laboratory	Academic Institution	Moss Landing, CA
Ocean Education Trust	Other Nonprofits	Kingston, RI
Santa Barbara Unified School District	School or School Systems	Santa Barbara, CA

Full details of organizations that have been involved as partners:

American Assoc. University Women Tech Trek

Organization Type: Other Nonprofits
Organization Location: Santa Barbara, CA

Partner's Contribution to the Project:
Financial support
Facilities

More Detail on Partner and Contribution: Tech Trek is a math/science camp designed to develop interest, excitement and self-confidence in young women who will enter eighth grade in the fall. It features hands-on activities in math, science and related fields. All sleeping, eating, instructional and recreational facilities are located on a university campus where camps are held. Tech Trek is an ongoing SBC Schoolyard partner.

California Dept of Fish and Wildlife

Organization Type: State or Local Government
Organization Location: Sacramento, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on fishery and oil spill studies

California Sea Grant Extension

Organization Type: Academic Institution
Organization Location: La Jolla, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on climate change and fisheries research

Channel Islands National Marine Sanctuary

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Santa Barbara, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate with SBC on oceanographic data collection and education activities

Channel Islands National Park

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Ventura, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Share and collaborate on long term data on kelp forest communities in the Santa Barbara Channel

City of Santa Barbara

Organization Type: State or Local Government
Organization Location: Santa Barbara, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

County of Santa Barbara

Organization Type: State or Local Government
Organization Location: Santa Barbara, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Moss Landing Marine Laboratory

Organization Type: Academic Institution
Organization Location: Moss Landing, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Ocean Education Trust

Organization Type: Other Nonprofits
Organization Location: Kingston, RI

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: NautilusLive! program, ; in-kind support, supply facilities and equipment, exchange personnel.

Santa Barbara Unified School District

Organization Type: School or School Systems
Organization Location: Santa Barbara, CA

Partner's Contribution to the Project:
Financial support
Facilities

More Detail on Partner and Contribution: Collaborates to conduct Explore the Sea Summer Program and educational outreach for K-12 students

Scripps Institution of Oceanography

Organization Type: Academic Institution
Organization Location: La Jolla, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on climate assessment study and manuscripts

Southern California Coastal Ocean Observing System (SCCOOS)

Organization Type: Other Organizations (foreign or domestic)
Organization Location: La Jolla, California

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: SCCOOS: SBC partners with Scripps Institution of Oceanography, the University of Southern California, and Cal Poly San Luis Obispo as part of the Southern California Coastal Ocean Observing System (SCCOOS). SCCOOS has provided data and instrumentation to the SBC-LTER

The Bay Foundation

Organization Type: Other Nonprofits
Organization Location: Santa Monica, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on beach ecosystem research

US Geological Survey

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Santa Cruz, CA

Partner's Contribution to the Project:
In-Kind Support
Collaborative Research

More Detail on Partner and Contribution: collaborative research on kelp forest communities and coastal sediment inputs and dynamics

University of Auckland

Organization Type: Academic Institution
Organization Location: Auckland, New Zealand

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of California, Davis

Organization Type: Academic Institution
Organization Location: Bodega Bay, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of California, Los Angeles

Organization Type: Academic Institution
Organization Location: Los Angeles, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on modeling studies of nearshore oceanography and on kelp forest dynamics

University of California, Santa Cruz

Organization Type: Academic Institution
Organization Location: Santa Cruz, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Collaborate on kelp forest population research

University of Quebec a Montreal

Organization Type: Academic Institution
Organization Location: Monteral, Quebeck Canada

Partner's Contribution to the Project:
Other: Performed analyses

More Detail on Partner and Contribution: benthic sediment analyses for lignin content

University of Wisconsin

Organization Type: Academic Institution
Organization Location: Milwalkee, WI

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: collaborates on population genetics of kelp

Were other collaborators or contacts involved? If so, please provide details.

Nothing to report

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Impacts

What is the impact on the development of the principal discipline(s) of the project?

Project data and personnel contributed to a greater understanding of the general relationships between metacommunity parameters and stability across a diverse range of ecosystems, a key problem in contemporary ecology. Work in the past year found that spatial asynchrony reduced variability in metacommunity biomass of SBC macroalgae (Lamy et al. 2021). Record et al. (2021) described how LTER data could inform metacommunity theory and applications. Another LTER cross-site working group used LTER data from several sites including SBC to integrate population and community approaches to synchrony to understand drivers of ecosystem stability. A paper is in press (Walter et al. 2021) concluding that stability is more strongly related to richness synchrony than to species richness itself.

Trophic cascades are often hypothesized to be major drivers of community structure. To test this idea we examined the effect of older MPAs established in 2002 on the two abundant species of urchins in our region: the heavily fished red urchin *Mesocentrotus franciscanus*, and the virtually unfished purple urchin *Strongylocentrotus purpuratus*, using data collected since 1984 by the National Park Service in the Channel Islands. We hypothesized that urchin populations inside MPAs would be depressed by higher predation, benefiting kelp. Instead, our analyses revealed that after 15 years of protection from fishing, purple urchin populations and kelp abundance were unaffected by reserves, while red urchin biomass significantly increased (Malakhoff and Miller 2021). These results revealed the overwhelming direct effect of protecting fished species in marine reserves over indirect effects that are often predicted, but seldom clearly documented. Indirect effects due to marine reserves may eventually occur in kelp forests, but very effective predators, large reserves or extended time periods may be needed to induce them. These results are an important advance in an area of ecology that has significant implications for management and policy.

What is the impact on other disciplines?

SBC Investigators Dugan, Page, and Melack participated in a Coastal Vulnerability Assessment of the Santa Barbara area that relied on SBC LTER data to synthesize projected changes in climate, coastal erosion and flooding, watershed runoff and impacts to sandy beaches and coastal salt marshes (Meyer et al. 2019). The group identified potential climate change-related tipping points for coastal systems and found that tipping points for beaches and wetlands could be reached with just 0.25 m or less of SLR (~ 2050), with > 50% subsequent habitat loss that would degrade overall biodiversity and ecosystem function (Barnard et al. 2021).

What is the impact on the development of human resources?

Efforts to increase the participation of under-represented groups are achieved through our ongoing Schoolyard program, which targets middle school students in traditionally underserved, low-achieving schools (see Section VII. Outreach, education, training and benefits to society). We also link with campus programs devoted to increasing educational opportunities for low-income students and groups underrepresented in higher education. Since 2001, the number of domestic Underrepresented Minority (URM) undergraduate students at UCSB has increased by 89%, and in fall 2014 UCSB was recognized as a Hispanic Serving Institution (HSI) for achieving 25% Latino undergraduate enrollment. It is the first HIS in the prestigious Association of American Universities, which is an association of 62 leading research universities in the United States and Canada. Women and URM students, post docs and faculty participating in SBC have access to professional development training and mentoring in team science leadership, management, and proposal writing. This year, the Marine Science Institute and The Ocean Fund are starting an annual scholarship program for underrepresented students interested in scientific diving, with the goal of supporting them through the prerequisites of open water certification and practice dives; as the most active local scientific diving program at UCSB, SBC LTER has committed to incorporating these students into our field program to build their experience level.

What was the impact on teaching and educational experiences?

SBC partners with UCSB's Research Experience & Education Facility (REEF), a teaching aquarium and marine ecology educational facility for UCSB and K-12 schools and colleges in Santa Barbara and Ventura counties. SBC's Schoolyard LTER (sLTER) program is organized around a theme of kelp forest ecology and is developed around and delivered through the REEF's *Oceans-to-Classrooms* curricula. We focus on long-term connections with underserved, low-achieving schools that include year-round on- and off-campus programs. SBC sLTER curriculum is rich in STEM content, meets California State Science Standards, Common Core Standards and the Next Generation Science Standards as well as NOAA's Climate and Ocean Literacy Principles. Our programs reached >5800 students in grades K-12 in the past year, including visits by schools from numerous southern and central California counties as well as a group of students from Taiwan. During the pandemic we rapidly developed new remote content and utilized live distance learning strategies to deliver SBC-sLTER content beginning in Spring 2020. This included the creation of the *VirtualREEF* YouTube channel, and development of infrastructure needed to deliver live content from the REEF Aquarium. As of fall 2021, *VirtualREEF* had >3000 views, and we shared the science and marine life of the SBC with 48 different schools and groups including students in Chicago, Costa Rica and Colombia. We continue to develop and adapt marine science lesson plans that engage students with learning about the local environment by incorporating ongoing SBC research and working with project data with the goal of building skills in science through activities that move from structured or guided investigation to open-ended inquiry and experimentation.

While delivering SBC LTER content to the general public was challenging given the pandemic, we were able to provide SBC LTER content through our social media (YouTube, Facebook, Instagram) efforts. Between work at the REEF and school visits, the number of undergraduates working on the sLTER content and programs totaled 30. With the campus opening back up for Fall, we are currently recruiting an additional 20 undergrads to assist in our continued evolution as we move forward.

In the past year SBC collaborated with three partnership programs to deliver its sLTER content: 1) the American Association of University Women's Tech Trek Program, an on-campus summer residential science and math program designed to develop interest, excitement and self-confidence in young women entering the 8th grade 2) Santa Barbara County Education Office (SBCEO), and 3) UCSB's Gevirtz Graduate School of Education and the Harding University Partnership School (HUPS) with whom we collaborated on a Fourth/Fifth Grade published anthology, "Dive Deep into Writing," which included poetry, fiction, and non-fiction writings.

We remain committed to equipping educators with the tools they need to teach ocean and environmental science, foster science literacy, and cultivate the next generation of ocean stewards. We have continued developing a significant relationship with the UCSB Learning Centers. We continue to use our SBC LTER Schoolyard Series book, The Golden Forest, to broaden our K-12 outreach efforts. Our book highlights connections between giant kelp forest and sandy beach ecosystems and has been provided to hundreds of K-8 teachers as part of our partnership with the SBCEO to enhance science content knowledge. Other programmatic outreach efforts include: (1) developing SBC's Subtidal Field Guide and (2) annually hosting a booth at the Santa Barbara Earth Day Festival, to raise public awareness about LTER research. Our popular booth features a model of a kelp forest in which SBC students and staff act as 'dive

buddies' for children who tour the forest and collect data on kelp forest species using underwater dive slates, and a kelp holdfast dissection activity. In 2021, SBC participated in the Earth Day virtual festival.

What is the impact on physical resources that form infrastructure?

Research facilities on campus extensively used by SBC researchers also include a flow-through seawater system, small boat and diving operations, analytical chemistry instrumentation, and computational resources provided by MSI and the Earth Research Institute. Our research activities contribute significantly to justifying the continued support of this infrastructure by the University, which benefits students and other research and education endeavors.

What is the impact on institutional resources that form infrastructure?

SBC's research and education programs greatly benefit from and support infrastructure provided by UCSB's Marine Science Institute (MSI), which offers SBC participants efficient and friendly service in contracts and grants, personnel, budgets, purchasing, and travel, and expert analytical chemistry services via MSI's Analytical Laboratory. Our research activities contribute significantly to justifying the continued support of this infrastructure by the University, which benefits students and other research and education endeavors.

What is the impact on information resources that form infrastructure?

The data managed by the SBC Information Management System (IMS) are diverse, and include contributions from many scientific disciplines in the major ecosystems of our coastal area: watersheds, beaches, subtidal reefs, and oceans. The system supports products from all SBC's research approaches (e.g., long-term time-series, experiments and measurement-intensive process studies, synthesis/modeling), plus legacy studies and exogenous reference data. As the project matured during SBC IV the IMS adapted to new research themes. Several existing data packages were modified to accommodate higher frequency data (e.g. light, temperature, pH, oxygen), and new ongoing data packages were designed. Additionally, several scientific collaborators take advantage of SBC's well-established data management policies and practices, publishing their related data through our system, and SBC provides expertise and consultation for collaborators as they develop data management plans. With increasing frequency, the IMS is asked to post data specifically to accompany a paper or to meet other publication requirements.

Recent IM accomplishments and progress

- 2018-2021: Excel-to-EML: IM Li Kui created a simple metadata management system called "Excel-to-EML" that has been adapted by several research groups.
- 2019-2021: Data processing for the ongoing time-series datasets was transitioned to the IM team. The primary accomplishments included: a) logbooks documenting instrument deployment/retrieval and survey records; b) automated initial data QC by cross-checking logbook with sensor outputs; c) R or Matlab scripts for QA/QC and formatting for each ongoing dataset, and d) created scripts to push data into the publication pipeline.

What is the impact on technology transfer?

SBC LTER expertise and data on patterns and drivers of kelp productivity is informing the possibility of kelp farming for biofuels off the coast of CA. DOE is funding several projects on this topic; one is using SBC LTER data to develop a model for kelp farm siting.

What is the impact on society beyond science and technology?

- SBC LTER data and studies are showing the effects of marine reserves on ecosystems and fishing. New work showing spillover bolsters the case for marine reserves as management tools and may help improve the design of future reserves and networks.
- SBC LTER expertise and data on patterns and drivers of kelp productivity is informing the possibility of kelp farming for biofuels off the coast of CA. DOE is funding several projects on this topic; one is using SBC LTER data to develop a model for kelp farm siting.
- SBC investigators and students responded to the Refugio State Beach oil spill in May 2015 and worked with agencies to determine the impacts and advise on restoration. SBC LTER data was critical in documenting natural communities at impacted sites to calculate the Natural Resource Damage Assessment (NRDA) settlement finalized in 2020.
- SBC investigators Dugan, Melack, Page and Reed worked with USGS and Scripps Institution of Oceanography researchers to provide local city and county officials with a vulnerability assessment of coastal ecosystems to climate change.
- SBC investigators and students are collaborating with the Bureau of Ocean Energy Management, to assess factors affecting the spread and ecological impact of the invasive bryozoan *Watersipora subtorquata*, which is rapidly increasing at SBC study sites.
- SBC investigators serve as science advisers for public and non-governmental agencies tasked with managing coastal resources.

What percentage of the award's budget was spent in a foreign country?

Nothing to report.

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Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

The original schedule we planned for SBC's research campaigns was significantly affected by Covid. For the most part, covid shifted these campaigns over by 1.5-2 years. For the benthic competition experiments and the drone surveys in theme 3A, this is not too concerning from our

viewpoint because these were intended to be longer-term activities that would extend into the next cycle of SBC if not beyond. However it does push the other campaigns, 1B, 2B, 2C, 3B and 3C to the end of the project. This is not ideal, since it does not give us much time to plan for the renewal with all the results in hand that we'd like. As these campaigns proceed, we plan to adaptively manage them, doing analyses and reconsidering the timelines as results come in, to compensate for some of this effect. However, it may be that some of the same or similar topics continue into our renewal proposal for SBC V.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

Change in primary performance site location

Nothing to report.