

# Preview of Award 1831937 - annual Project Report

## Cover

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- Principal Investigator

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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions) Robert J Miller

## 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 (you must provide information for at least one of the 4 categories below)?**

Major Activities:

We continued collecting data for a core group of long-term integrated measurements with the goal of quantifying climate, disturbance, and inorganic and organic subsidies to and from giant kelp forests and their effects on kelp forest community structure, productivity and dynamics. Other major activities for each research theme follow below.

*Theme 1a. Community and ecosystem consequences of climate variability, disturbance and pathways of recovery:* We are now documenting community recovery after discontinuing the annual removal of giant kelp in our long-term disturbance experiment. We continued collecting and analyzing data from our ongoing 19-year kelp forest community time series at 11 reefs and used it to: (1) explore the extent to which asynchronous species and spatial dynamics across multiple hierarchical levels of organization contribute to the regional stability of the kelp forest understory, and (2) place experimental results on urchin organic matter processing into a long term context. To examine how variability in giant kelp biomass shifted community structure and assembly in a metacommunity context, we conducted surveys of ~220 species at 71 transects across 18 sites in the SBC. We selected sites across a gradient of kelp variability estimated using our Landsat kelp biomass dataset. In an initial analysis of the data, we find support for the idea that historical patterns in disturbance alter the structure of communities, consistent with the long-term experimental results. However, community state is also strongly correlated with substrate, kelp biomass at more recent time lags (<1 year), and the biomass of consumers (urchins). We are currently working to disentangle these drivers of kelp forest community structure and hope to explore how dispersal, niche filtering, and biotic interactions influence kelp forest community assembly.

*Theme 1b. Ecological consequences of fishing:* Quarterly sampling of community structure and NPP in experimental plots was completed at two reefs protected from fishing and three reefs unprotected from fishing. Densities of the extensively fished spiny lobster were assessed at these reefs and lobster fishing effort is being measured twice per

month during the fishing season. Past SBC LTER lobster data along with spatial fisheries catch data has been analyzed to evaluate reserve effects on lobster populations and spillover to the fishery.

*Theme 1c. Sources and utilization of recycled nitrogen:* The uptake kinetics of urea, ammonium and nitrate by kelp is being measured in a series of laboratory experiments to determine whether kelp has the capacity for surge uptake of recycled nitrogen that may have pulsed availability. Studies of the efflux of ammonium from sediments using field samples and laboratory experiments were completed as were field and laboratory studies of the excretion rates of ammonium and urea from benthic reef invertebrates. We published a paper demonstrating that spiny lobsters and sea stars are disproportionately important as contributors of recycled ammonium.

*Theme 2A. Effects of kelp on physical and chemical fluxes:* 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 these two kelp forests for the duration of SBC IV. We plan to estimate residence times through the MK and AQ kelp forests by evaluating the temporal lag of temperature changes inside versus outside the forests. Reviewers felt that two sites is not enough replication for this theme. We considered adding a third site, but ultimately decided to stick with 2 sites for 2 reasons: 1) the kelp forests change considerably over time, both seasonally and interannually, and therefore 2 sites should provide the range of variability in forest size and density that we need for generalization; and 2) instrumenting another site adequately would overstretch our inventory of instruments to the point of jeopardizing long-term data streams should instrument problems arise.

*Theme 2b. Effects of kelp on the processing and fate of dissolved organic matter:* We have conducted quarterly measurements of microbial community structure on kelp across a spatial gradient from the center to the edge of the kelp forest. We have also examined microbial communities on kelp at different depths and with age of fronds. 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:* We deployed standardized Calcification Accretion Units (CAUs) designed to quantify relative abundances of recruiting benthic organisms and net community  $\text{CaCO}_3$  deposition rates within and outside of the MK and AQ kelp forests, co-located with sensors measuring pH and DO (*Theme 2a*). We also caged adult purple sea urchins within and outside of the kelp forests at MK and AQ from late summer to early winter when adults are performing gametogenesis. Cages are co-located with pH sensors in order to capture the differential in abiotic exposures during gametogenesis. Caged urchins are being fed weekly to normalize feeding opportunity between the experimental groups. Upon collection from the field in December, urchins will be

spawned and larvae raised in culture to early pluteus stage under conditions that reflect low and high  $p\text{CO}_2$  conditions in the kelp forest. Larval epigenetic signatures will be evaluated to determine whether progeny are epigenetically primed based on the maternal environment.

*Theme 3a. Demographic connectivity and metapopulation dynamics of giant kelp:* We have begun monthly surveys at two long-term kelp forest sites, Mohawk reef and Arroyo Quemado, using monthly unmanned aerial vehicle (UAV) flights to characterize canopy dynamics on sub-meter scales. Using this new high spatial resolution time series, we will identify small-scale extinction events and relate local patterns of recolonization to connectivity and environmental factors. These surveys also mesh with the physical and chemical flux and kelp forest process studies conducted under Theme 2 at the same two sites. We have leveraged a different project funded by the DOE (PI Siegel) to acquire multispectral and hyperspectral sensors that are being used for these surveys and provide additional information about kelp tissue pigmentation, health and nitrogen content.

*Theme 3b. Trophic connectivity between kelp forests and beaches:* We continued to collect core measurements of variation in macrophyte wrack subsidies, wrack consumers, beach conditions and birds on six beaches located near SBC kelp forests. We are using these data to examine responses of consumer populations to variation in macrophyte wrack abundance, and to variation in donor ecosystem condition estimated by kelp forest (*Macrocystis pyrifera*) canopy biomass and sea surface temperature. We are also exploring responses of consumer populations to disturbance that alters beach habitats, including upper beach zones and sand supply.

*Theme 3c. Trophic connectivity between the coastal ocean and kelp forests:* Research during this reporting period focused on characterizing nearshore flows that transport coastal phytoplankton in the Southern California Bight using ROMS modeling and satellite-derived chlorophyll data. We plan to deploy SBC's Teledyne Webb G2 glider as a virtual mooring to quantify cross-shelf fluxes of suspended particles, chlorophyll and DO concentrations offshore of the MK and AQ kelp forests starting in spring 2020.

#### Specific Objectives:

The specific objectives of each research theme are as follows:

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

Test the prediction that more frequently disturbed kelp forests will have a more abundant and diverse assemblage of understory macroalgae and epilithic sessile invertebrates, and lower biomass of sea urchins and carnivorous invertebrates and fishes that use giant kelp for refuge or foraging habitat, using complementary comparative and experimental approaches.

*Theme 1b. Ecological consequences of fishing*

Experimentally investigate the effects of fishing on kelp forest structure and function using two of our long-term kelp forest study sites where fishing was banned in 2012 with the creation of marine protected areas (MPAs), and where we had been collecting data for a decade prior to MPA establishment.

*Theme 1c. Sources and utilization of recycled nitrogen*

Determine the extent to which the diel light cycle mediates the partitioning of the regenerated N supply between kelp and phytoplankton by quantifying the kinetics of regenerated N use by giant kelp and phytoplankton in light and dark in the laboratory and the field.

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

Attain a mechanistic understanding of how forest size and kelp density modulate the water entering a forest and its residence time within the forest as a basis for quantifying how kelp forests modify their physicochemical environment.

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

Quantify remineralization rates of kelp-derived DOM and its accumulation along a spatial gradient from within the forest to the waters offshore of it to provide an estimate of DOM export and the amount of kelp DOM available to kelp forest food webs via the microbial loop.

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

Evaluate 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,  $p\text{CO}_2$ , pH and  $\text{CaCO}_3$  saturation state ( $\Omega$ ).

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

Test how environmental factors and demographic connectivity via spore dispersal interact to control multiple components of kelp metapopulation dynamics, using unmanned aerial vehicle (UAV) flights to characterize canopy dynamics on sub-meter scales.

*Theme 3b. Trophic connectivity between kelp forests and beaches*

Determine the extent to which spatial and temporal variability in beach kelp wrack abundance and form (i.e., plants, fronds, blades) are synchronous with biomass fluctuations in nearby kelp forests, and examine how the timing, amount and form of wrack subsidy influence the community structure and ecosystem function of beaches.

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

Evaluate the delivery of phytoplankton to kelp forests, the processes responsible, and the response of sessile reef suspension feeders to this delivery and to different taxonomic groups of phytoplankton.

#### Significant Results:

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

Results from our long-term kelp removal experiment showed the frequency rather than severity of disturbance to giant kelp affected community guilds commensurate with their dependence on resources provided by kelp (Castorani et al. 2019). Additional analyses of these data revealed that asynchronous species dynamics stabilized the metacommunity of understory algae as a decline in the dominant species was compensated by increases in subdominant species, while synchronous spatial dynamics at the population and community levels destabilized the metacommunity (Lamy et al. 2019). In an analysis of our long-term annual data, we showed that the stability of understory algae and sessile invertebrates was positively and indirectly related to the stability of giant kelp, which primarily resulted from giant kelp's direct positive association with species richness. These results are in final revision in Ecology (Lamy et al in review).

##### *Theme 1b. Ecological consequences of fishing*

In 2018 we quantified lobster biomass within two marine reserves to test whether trap yield increased outside these reserves due to spillover. Results showed that catch per trap increased by 125–465% deep inside reserves, by 223–331% at sites  $\leq 1$  km outside reserve boundaries, and did not increase at control sites. This study is the first to demonstrate spillover benefits for the southern CA lobster fishery and exemplifies the ongoing monitoring and evaluation needed to assess the efficacy of marine reserves as fishery management tools worldwide. A manuscript reporting these results is in preparation.

##### *Theme 1c. Sources and utilization of recycled nitrogen*

We coupled ammonium excretion rates with our 18-year time series of the standing biomass of benthic macroinvertebrates to create a time series of excretion rates at two of our study sites, allowing us to assess consumer-mediated nutrient dynamics (CND) across a wide range of conditions. The ammonium supplied by reef invertebrates dropped following the mass mortality of sea stars due to disease during a prolonged period of extreme warming. However, a coincident increase in the abundance of the California spiny lobster, likely in response to both reduced fishing and a warmer ocean, compensated for much of the recycled ammonium lost to sea star mortality. Both lobsters and sea stars are widely recognized as key predators that can profoundly influence community structure in benthic marine systems. Our study is the first to demonstrate their importance in nutrient cycling, thus expanding their roles in the ecosystem (Peters et al. 2019).

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

Physical and chemical measurements inside and outside two kelp forests began this year and results were not available at the time of this report.

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

Microbial communities in kelp forests may be structured by the availability of kelp DOM, and characterizing patterns in the unique microbial communities associated with the kelp canopy is critical to developing a comprehensive understanding of the mechanisms shaping kelp forest microbiomes. Using 16S rRNA gene sequencing, we characterized the bacterial and archaeal communities associated with giant kelp at two LTER study reefs. Our results indicate that kelp-associated microbial communities are altered in the presence of epiphytic bryozoans, and reflect changes previously observed in other studies of stressed macroalgae, suggesting pathogenesis that may have implications for kelp health. These results have been submitted to *Limnology and Oceanography Letters*.

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

We profiled dissolved oxygen (DO) and pH with high spatiotemporal resolution at one of our long-term kelp forest sites, Mohawk Reef (Hoshijima and Hofmann 2019). Both DO and pH were more predictably variable inside of the kelp forest environment, and adult sea urchins inside the kelp forest produced more protein-rich eggs that developed into more pH-resilient embryos. In laboratory studies of sea urchins, we examined the potential for the environment to mediate both plasticity in DNA methylation and phenotypes in early stages (Strader et al. 2019), and maternal provision to offspring (Wong et al. 2019). Adult urchins were acclimated during gametogenesis to upwelling or non-upwelling conditions representative of their kelp forest habitat. Progeny were raised in either high or low pCO<sub>2</sub> treatments. Differences in condition experienced by mothers were associated with differentially methylated genes in the offspring, but no effects on gene methylation in the progeny (Strader et al. 2019). Developing embryos whose mothers were conditioned to simulated upwelling conditions were greater in body size, but this effect was no longer evident by the echinopluteus stage (Wong et al. 2019). These laboratory studies provide insight into how transgenerational effects may function in nature.

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

To evaluate the effect of the 2014-15 heat wave on giant kelp populations, we used a time series of satellite imagery to examine giant kelp canopy biomass before, during, and after the heatwave across southern and Baja California (Cavanaugh et al. 2019). We examined spatial patterns in resistance, i.e., the initial response of kelp, and resilience, i.e., the abundance of kelp 2 years after the heatwave ended. The heatwave had a large and immediate negative impact on giant kelp near its southern range limit in Baja. In contrast,

the impacts of the heatwave were delayed throughout much of the central portion of our study area, while the northern portions of our study area, including the SBC LTER study sites, exhibited high levels of resistance and resilience to the warming. Our results highlight the resilient nature of giant kelp, but also point to absolute temperature thresholds that are associated with rapid loss of kelp forests.

*Theme 3b. Trophic connectivity between kelp forests and beaches*

To investigate how intertidal consumers may partition macrophyte wrack resources on sandy beaches, we measured individual consumption rates of four beach amphipod species on five macrophyte species in laboratory and field trials. The results demonstrate that a suite of co-occurring amphipod species rely heavily on kelp wrack and do not partition wrack resources (Michaud et al. 2019). In another experimental study, amphipods consuming giant kelp produced elevated dissolved concentrations of ammonium and nitrate that may be utilized by beach microbes or exported offshore by tidal flushing, highlighting the role of intertidal consumers in maintaining important ecosystem functions, such as organic matter processing and nutrient regeneration (Lowman et al. 2019).

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

Analyses of ROMS solutions and satellite-derived chlorophyll show a strong connection between vertically advected water and chlorophyll. A persistent eddy in the Santa Barbara Channel appears to entrain upwelled water, delaying its exit from the region and potentially fueling higher phytoplankton productivity and delivery to the nearshore. Observations of coccolithophore populations from microscopy and flow cytometry, surface current data derived from high-frequency radar, and satellite ocean color imagery were used to track the population dynamics of a massive bloom in the Santa Barbara Channel during the ocean warm event of 2014-15. This *E. huxleyi* bloom reached cell concentrations up to  $5.7 \times 10^6$  cells per liter and a maximum spatial extent of 1,220 km<sup>2</sup>. The warm anomaly likely contributed to the development of this bloom and this could increase in the future (Matson et al. 2019).

Key outcomes or Other achievements:

During the past year, SBC scientists published 26 journal articles, and one book chapter. SBC scientists currently have two additional journal articles in press and five journal manuscripts in review. SBC graduate students produced four doctoral dissertations. A complete list of SBC publications and presentations can be found at: <https://sbclter.msi.ucsb.edu/publications/>. A total of 208 SBC datasets including time series and short-term studies are now in the SBC data catalog. Since Sept 2018, 4 datasets were newly added and 76 (90% of the time series) datasets were updated.

We are continuing to use our long-term data to follow the recovery of kelp forest and sandy beach ecosystems from an unprecedented warming event that occurred in 2014-2015 combined with a multi-year drought of unprecedented magnitude and a strong El



Nino event in 2015-2016. The warming event was characterized by high mortality of key consumers affected by disease (sea stars and urchins) and the El Nino was associated with a historically significant loss of sandy beach habitat and biota. Long term data collected by SBC are being used to document the ecological consequences of these changes and to better understand recovery dynamics of these linked ecosystems. Regional analyses of the resistance and recovery of giant kelp using SBC's 35-year Landsat kelp time series by investigators Cavanaugh, Bell, Castorani and Reed were recently featured in a special issue of *Frontiers in Marine Science* titled "Advances in understanding marine heatwaves and their impacts". This year, SBC investigators also published a study of the unprecedented bloom of *Emiliana huxleyi* along the California coast during the warm anomaly. Observations of coccolithophore populations from microscopy and flow cytometry, surface current data derived from high-frequency radar, and satellite ocean color imagery were used to track the population dynamics of the bloom in the Santa Barbara Channel. The bloom reached very high cell concentrations and a spatial extent of 1,220 km<sup>2</sup>, due to the rare cooccurrence of warm water, water column stratification, and an extensive preceding diatom bloom. The results provide insight into possible future events in the region, and exemplified a research approach that is likely to be useful for understanding the evolution of coastal phytoplankton bloom events in general.

SBC continues to be a leading contributor to the Kelp Ecosystem Ecology Network (KEEN) <http://www.kelpecosystems.org/e>, which was founded by former SBC post doc Jarrett Byrnes. KEEN is an association of ~ 70 marine scientists from around the globe interested in assessing the impacts of global change on kelp forests. Its primary objectives are to: (1) unify past kelp forest data sets from a wide variety of sources to examine the effects of different drivers of global change, (2) coordinate parallel experiments aimed at determining how kelp systems will change in the future, and (3) develop standardized sampling protocols to create a unified global kelp forest community dataset for public use. The latter objective relies extensively on sampling protocols developed by SBC.

Other key research outcomes and achievements by SBC from the past year are listed in "Accomplishments".

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

Education and training are tightly integrated into all aspects of SBC LTER research. During the past year (year 1 of SBC IV), 6 postdoctoral fellows, 25 graduate students, 6 REU students, 119 undergraduate students and 10 high school students participated in SBC research and outreach activities. REU students work closely with SBC researchers on a wide range of topics and many choose to pursue an advanced degree following their undergraduate education. A number of SBC investigators and graduate students also mentored REU students in the Global Change Biology program at UCSB. UCSB undergraduates have a high propensity to get involved in sponsored research and SBC programs contribute substantially to this trend. In addition to gaining research experience, many undergraduates earn academic credit or receive monetary compensation for participating in SBC research as interns and honors students. This year 24

students participated in SBC's undergraduate research training program. Students in the program actively assist in the collection, processing and analysis of core data. In the first term, students read primary literature to gain a foundation in core research areas, key findings, current research objectives and methods of the SBC LTER. Next, students gain hands on laboratory and field research experience. Post-graduation, many SBC student participants are accepted into graduate studies, begin careers in their field or obtain highly competitive internships.

The focus of SBC's mentoring and training of postdoctoral scientists is on providing them with strong interdisciplinary skills, professional development opportunities, and the experience, and support required for them to transition to career faculty positions. In addition to the specific training associated with the SBC project, postdoctoral scientists are mentored through grant proposal development and writing and the job application and interview process by SBC investigators and via access to UCSB's resources for postdoctoral scientists.

SBC graduate student and postdoctoral training are coordinated with several programs on the UCSB campus to promote opportunities for interdisciplinary graduate 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 across disciplines. SBC graduate students and postdocs were first authors on 15 journal articles and gave 8 papers at national conferences this year. This year four SBC graduate students completed their PhD degrees. 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.

Ten SBC graduate students and three SBC postdoctoral scientists participated in the 2018 LTER All Scientist meeting in Asilomar, California. The graduate students presented posters and participated in numerous ASM workshops. The three postdocs each presented results and co-led and guided discussions at workshops, including a workshop on integrating microbes into long term research (James), a workshop on using drones in long term ecological research (Bell) and a workshop on eco-evolutionary dynamics co-led by Investigator Hofmann (Strader)

Opportunities for training in public education and student mentoring arise from SBC's partnership with UCSB's teaching aquarium, the REEF, which is also designed to provide UCSB undergraduates majoring in Aquatic Biology with training in communicating their marine ecology knowledge. The REEF features SBC LTER research and provides a wide range of training and professional development opportunities. A total of 69 undergraduate interns were trained in this rigorous and pedagogically sound program this year. The REEF also serves as a teaching facility for UCSB courses in Earth Sciences, Ecology Evolution & Marine Biology, English and Teacher Ed programs through the Gevirtz Graduate School of Education and for many area colleges including Cal Lutheran University, California State University Channel Islands, and local community colleges. One of the joint goals of the SBC LTER and the REEF programs is to provide UCSB undergraduates majoring in Aquatic Biology, with a solid foundation in marine ecology and research. REEF training provides them with the basis for communicating this knowledge in an educational format. To that end, The REEF develops its

*Oceans-to-Classrooms* curriculum around a number of research programs at UCSB and SBC LTER is the most significant contributor to this endeavor. Support from the SBC Schoolyard LTER program has allowed the REEF to obtain teaching supplies and equipment for curriculum as well as provide salaries for professional staff and undergraduate internships. SBC graduate students, research staff, and post-docs also train REEF interns, which, in turn, enhances their training as laboratory and field assistants and research divers for SBC research.

**\* How have the results been disseminated to communities of interest?**

SBC's Schoolyard LTER (sLTER) program is organized around a theme of kelp forest ecology. Curriculum is developed for, and delivered through, UCSB's Marine Science Institute's Research Experience & Education Facility (REEF) and its Oceans-to-Classrooms (O<sub>2</sub>C) curricula. We focus on long-term connections with local, regional and state schools through partnerships that include on and off, campus programs. Our approach supports an integrated program that spans academic year activities, as well as summer programs, and includes undergraduate and graduate students, K-12 teachers and students, the UC Community and the general public. SBC-based curriculum is rich in STEM content and meets Next Generation Science Standards (NGSS), Common Core State Standards, as well as NOAA's Climate, and Ocean, Literacy Principles. O<sub>2</sub>C and the REEF served >23,000 visitors this year, through on-campus programs, outreach visits to schools, and community events. This included visits by primary and secondary schools from numerous southern, and central, California counties, as well as students from Arizona, New Mexico and Colorado. Additionally, we served students from Taiwan. This year sLTER specific program content reached almost 13,000 students in grades PreK-12. On-campus efforts communicated SBC research to UCSB undergraduate and graduate students (See Training and Development section). We continue to develop and adapt marine science lesson plans that engage students with learning about the local marine environment in the context of the SBC LTER. These lessons incorporate ongoing SBC research and include working with SBC data. The program is developed to build student's skills in scientific inquiry through activities that move from structured or guided investigation to open-ended inquiry and experimentation. It also includes a combination of school-based activities, field trips, and on-campus experiences that immerse students in the environment of a college campus.

1. Focused sLTER Programming:

This year, sLTER continued to focus on partnership programs, 1) American Association of University Women's (AAUW) Tech Trek Program and 2) Santa Barbara Unified School District.

Tech Trek is an on-campus residential science and math summer program designed to develop interest, excitement and self-confidence in young women entering the eighth grade. Tech Trek is part of an interdisciplinary partnership involving science, technology, engineering, and math departments at UCSB through the Office of Education Partnerships (OEP). The goal of OEP is to build college-going communities that improve student learning, increase college-going rates in underrepresented populations, and provide equal access to higher education for California's diverse students. In working with Tech Trek, SBC SLTER engaged 160 girls from junior high and middle schools from San Luis Obispo, Santa Barbara, Ventura, Kern and Los Angeles counties, representing a diverse range of socioeconomic and demographic groups. During a weeklong residency at UCSB, students participated in "core" science courses. This year the

program focused on solutions to three real-world challenges, Ocean Exploration and Climate Change, Sustainable Foods, and What to Do With Decommissioned Oil Rigs. Participants enrolled in a “core” class based on their interests: Physics, Math, Engineering, or Marine Science. Students also engaged in a number of place-based, hands-on, activities that promoted concept application and citizenship, including a boat trip to SBC Kelp Forest study sites and SBC-based Floating Lab that focused on marine ecology and ecosystem services. We are now seeing former program participants enrolling in UCSB. This year UCSB graduate students in Chemistry, and Marine Science developed curriculum around their work and engaged the girls.

SBC’s partnership with O<sub>2</sub>C and the REEF completed another very successful year in teacher professional development, as well as academic support in participant classrooms. We remain committed to equipping educators with the tools to teach ocean and environmental science, foster science literacy, and cultivate the next generation of ocean stewards. UCSB began developing a significant relationship with the UCSB Learning Centers. First, hosting a Summer Teacher Professional Development workshop that focused on the importance of place-specificity, the kelp forest. Second, developing specifically designed curricula, using SBC science, for students. As part of that effort, we hosted a targeted PD with the UCSB’s Orfaea Children’s Center pre-school teachers and provided them with appropriate SBC content, set up a special SBC aquarium in their greeting area, and are working with the teachers on a curriculum, “The ABCs of the SBC.”

2. SBC co-hosted a booth with MCR-LTER at the 2019 Santa Barbara Earth Day Festival to raise public awareness about LTER research. The festival had >37,000 visitors. Booth activities included a kelp holdfast dissection and a virtual kelp forest (VKF) tour in which SBC students and staff acted as 'dive buddies' for children who toured the forest and collected data on kelp forest biota. With help from investigator Hofmann and SBC graduate, and undergraduate, students, VKF was featured at this year’s World Oceans Day, hosted at the SBMNH Sea Center for ~2,800 visitors.

3. In Spring 2019, we took SBC organisms, via the Mobile REEF, to the Sierra Nevada Aquatic Research Lab, in Mammoth Lakes, Ca. in support of their outreach effort, in collaboration with their director, Dr. Carol Blanchette and the continuation of SBC’s contribution to the LTER Children’s Book Series *The Golden Forest* (Blanchette and Dugan 2017). To date, we’ve distributed and utilized over 600 copies as teaching tools for our SLTER program. We also work in strategic partnership with over 150 Jr High School girls in collaboration with the American Association of University Women’s *Tech Trek*, a math and science summer program designed to develop interest and self-confidence in young women. A highlight, again, this year, was the use of *The Golden Forest* in the Marine Ecology Core class, in conjunction with explorations of the beach and the REEF (aquarium) that focused on SBC research and kelp forest ecology.

5. SBC investigators and students contributed to stories in the press.

SBC study reveals frequency of ecological disturbance outweighs its severity over the long term in giant kelp forests

<https://www.news.ucsb.edu/2018/019242/giant-killers>

SBC researchers piece together an overlooked source of nutrients in Southern California kelp forests

<https://www.news.ucsb.edu/2019/019506/search-missing-nitrogen>

SBC scientists determine cause of an unusual algal bloom

<https://www.news.ucsb.edu/2019/019509/turquoise-water-california>

SBC research finds biodiversity stabilizes kelp forest ecosystems far more than expected

<https://www.news.ucsb.edu/2019/019457/studying-stability-under-sea>

<https://phys.org/news/2019-05-biodiversity-key-kelp-forest-health.html>

<https://www.futurity.org/kelp-forests-biodiversity-2067032/>

SBC scientists discover an important, overlooked role of sea urchins in kelp forest ecosystems

<https://www.news.ucsb.edu/2019/019538/sloppy-sea-urchins>

<https://www.futurity.org/sea-urchins-kelp-forests-2106812/>

<https://thepetridish.my/2019/07/28/sloppy-sea-urchins/>

SBC scientists test marine life responses to climate change

<https://www.independent.com/2019/01/17/tough-urchins-and-future-fisheries/>

Research reveals some of Southern California's most iconic and popular beaches have lost most of their biodiversity

<https://www.news.ucsb.edu/2019/019566/urbanization-beach>

[https://www.noozhawk.com/article/the\\_urbanization\\_of\\_southern\\_californias\\_beaches](https://www.noozhawk.com/article/the_urbanization_of_southern_californias_beaches)

<https://dornsife.usc.edu/uscseagrant/sg-blog/>

6. SBC Investigator Santoro produced a video on kelp microbiology in collaboration with the Smithsonian Institution

<https://www.youtube.com/watch?v=U9kzjI1IwTQ&t=5s>

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

We will continue research, education and outreach activities as planned.

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## Products

### Books

### Book Chapters

- Guerrini, A Burnette, DR Dugan, JE (2018). Invisible landscapes: perception, heritage, and coastal change in Southern California. *Coastal Heritage and Cultural Resilience* Price, LL, Marchi, NE. Springer Nature. Switzerland. 23. Status = PUBLISHED; Acknowledgement of Federal Support = No ; Peer Reviewed = Yes ; DOI: [https://doi.org/10.1007/978-3-319-99025-5\\_2](https://doi.org/10.1007/978-3-319-99025-5_2).

### Inventions

### Journals or Juried Conference Papers

View all journal publications currently available in the [NSF Public Access Repository](#) for this award.

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.

- 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](https://doi.org/10.1016/j.ecolind.2019.105457) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [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](https://doi.org/10.1016/j.ocecoaman.2019.104921) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019 ) [Full text](#) [Citation details](#)
- Marks, Lindsay and Reed, Daniel and Holbrook, Sally. (2018). Life history traits of the invasive seaweed *Sargassum horneri* at Santa Catalina Island, California. *Aquatic Invasions*. 13 (3) 339 to 350. Status = Deposited in NSF-PAR [doi:10.3391/ai.2018.13.3.03](https://doi.org/10.3391/ai.2018.13.3.03) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019 ) [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](#)
- 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](https://doi.org/10.1016/j.jembe.2019.04.006) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/06/2019 ) [Full text](#) [Citation details](#)
- 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](https://doi.org/10.1029/2017JG004119) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
- Rassweiler, Andrew and Reed, Daniel C. and Harrer, Shannon L. and Nelson, J. Clint. (2018). Improved estimates of net primary production, growth, and standing crop of *Macrocystis pyrifera* in Southern California. *Ecology*. 99 (9) 2132 to 2132. Status = Deposited in NSF-PAR [doi:10.1002/ecy.2440](https://doi.org/10.1002/ecy.2440) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
- 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](https://doi.org/10.1016/j.fishres.2018.07.012) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
- Hoshijima, Umihiko and Hofmann, Gretchen E.. (2019). Variability of Seawater Chemistry in a Kelp Forest Environment Is Linked to in situ Transgenerational Effects in the Purple Sea Urchin, *Strongylocentrotus purpuratus*. *Frontiers in Marine Science*. 6 . Status = Deposited in NSF-PAR [doi:10.3389/fmars.2019.00062](https://doi.org/10.3389/fmars.2019.00062) ; 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](https://doi.org/10.1016/j.ecss.2019.03.014) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
- Matson, Paul G. and Washburn, Libe and Fields, Erik A. and Gotschalk, Chris and Ladd, Tanika M. and Siegel, David A. and Welch, Zoë S. and Iglesias-Rodriguez, M. Debora. (2019). Formation, Development, and Propagation of a Rare Coastal Coccolithophore Bloom. *Journal of Geophysical Research: Oceans*. . Status = Deposited in NSF-PAR [doi:10.1029/2019JC015072](https://doi.org/10.1029/2019JC015072) ; 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](https://doi.org/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](https://doi.org/10.3390/d11080120) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [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/lo12.10088](https://doi.org/10.1002/lo12.10088) ; 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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1098/rspb.2019.0846) ; 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](https://doi.org/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](https://doi.org/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](https://doi.org/10.3389/fmars.2019.00413) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [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](https://doi.org/10.1175/JTECH-D-18-0104.1) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
  - Feng, Dongmei and Beighley, Edward and Raoufi, Roozbeh and Melack, John and Zhao, Yuanhao and Iacobellis, Sam and Cayan, Daniel. (2019). Propagation of future climate conditions into hydrologic response from coastal southern California watersheds. *Climatic Change*. 153 (1-2) 199 to 218. Status = Deposited in NSF-PAR [doi:10.1007/s10584-019-02371-3](https://doi.org/10.1007/s10584-019-02371-3) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
  - 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](https://doi.org/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](https://doi.org/10.3354/meps12906) ; Federal Government's License = Acknowledged. (Completed by Reed, Daniel on 11/05/2019 ) [Full text](#) [Citation details](#)
  - Hargarten, H. L., M. I Johansson, D. C. Reed, N. C. Coelho, D. A. Siegel, F. Alberto. Seascape genetics of the stalked kelp *Pterygophora californica* and comparative population genetics in the Santa Barbara Channel. *Journal of Phycology*.. Status = AWAITING\_PUBLICATION.
  - Page, MR, RD Simons, SF Zaleski, RJ Miller, JE Dugan, DM Schroeder, 2019. Distribution and potential larval connectivity of the non-native *Watersipora* (Bryozoa) among harbors, offshore oil platforms, and natural reefs. *Aquatic Invasions*. Status = AWAITING\_PUBLICATION.

## Licenses

## Other Conference Presentations / Papers

- 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
- 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
- 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
- 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
- Miller RJ, KD Lafferty, T Lamy, L Kui, A Rassweiler, DC Reed, and HM Page (2019). *Giant kelp, Macrocystis pyrifera, increases faunal diversity through physical engineering*. International Temperate Reef Symposium. Hong Kong. Status = PUBLISHED; 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
- 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 = No
- 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
- 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

## Other Publications

## Patents

## 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*. (2019). UC Santa Barbara. Acknowledgement of Federal Support = Yes

## Websites

## Participants/Organizations

### What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
<a href="#">Miller, Robert</a>	PD/PI	2
<a href="#">Hofmann, Gretchen</a>	Co PD/PI	1
<a href="#">Reed, Daniel</a>	Co PD/PI	2
<a href="#">Siegel, David</a>	Co PD/PI	1
<a href="#">Stier, Adrian</a>	Co PD/PI	1
<a href="#">Bell, Tom</a>	Co-Investigator	1
<a href="#">Brzezinski, Mark</a>	Co-Investigator	1
<a href="#">Burkepile, Deron</a>	Co-Investigator	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Carlson, Craig</a>	Co-Investigator	1
<a href="#">Castorani, Max</a>	Co-Investigator	1
<a href="#">Cavanaugh, Kyle</a>	Co-Investigator	1
<a href="#">Dugan, Jenifer</a>	Co-Investigator	3
<a href="#">Eliason, Erika</a>	Co-Investigator	1
<a href="#">Guerrini, Anita</a>	Co-Investigator	1
<a href="#">Iglesias-Rodriguez, Debora</a>	Co-Investigator	1
<a href="#">Lenihan, Hunter</a>	Co-Investigator	1
<a href="#">MacIntyre, Sally</a>	Co-Investigator	1
<a href="#">Melack, John</a>	Co-Investigator	1
<a href="#">Moeller, Holly</a>	Co-Investigator	1
<a href="#">Nidzieko, Nicholas</a>	Co-Investigator	1
<a href="#">Ohlmann, J Carter</a>	Co-Investigator	1
<a href="#">Okamoto, Daniel</a>	Co-Investigator	1
<a href="#">Page, Henry</a>	Co-Investigator	1
<a href="#">Rassweiler, Andrew</a>	Co-Investigator	1
<a href="#">Santoro, Alyson</a>	Co-Investigator	1
<a href="#">Schroeter, Stephen</a>	Co-Investigator	2
<a href="#">Washburn, Libe</a>	Co-Investigator	2
<a href="#">Wilbanks, Elizabeth</a>	Co-Investigator	1
<a href="#">Benitez-Nelson, Claudia</a>	Faculty	0
<a href="#">Herman, Gema</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	1
<a href="#">James, Anna</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	2
<a href="#">Lamy, Thomas</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	1
<a href="#">Smith, Jason</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	1
<a href="#">Strader, Marie</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	9
<a href="#">Yorke, Christie</a>	Postdoctoral (scholar, fellow or other postdoctoral position)	6
<a href="#">Gotschalk, Chris</a>	Other Professional	2
<a href="#">Hubbard, David</a>	Other Professional	1
<a href="#">O'Brien, Margaret</a>	Other Professional	2

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Simon, Scott</a>	Other Professional	12
<a href="#">Beresford, Laura</a>	Technician	1
<a href="#">Doheney, Brandon</a>	Technician	1
<a href="#">Dubel, Alexandra</a>	Technician	1
<a href="#">Guillocheau, Nathalie</a>	Technician	1
<a href="#">Halewood, Eliza</a>	Technician	1
<a href="#">Halewood, Stuart</a>	Technician	1
<a href="#">Harrer, Shannon</a>	Technician	1
<a href="#">Jones, Janet</a>	Technician	2
<a href="#">Madden, Jessica</a>	Technician	1
<a href="#">Meyerhof, Matthew</a>	Technician	5
<a href="#">Nelson, Clint</a>	Technician	12
<a href="#">Opalk, Keri</a>	Technician	1
<a href="#">Purzer, Frankie</a>	Technician	1
<a href="#">Romero, Eduardo</a>	Technician	1
<a href="#">Salazar, David</a>	Technician	3
<a href="#">Sampson, Sarah</a>	Technician	12
<a href="#">Shea, Briette</a>	Technician	1
<a href="#">Snyder, Jordan</a>	Technician	1
<a href="#">Kui, Li</a>	Staff Scientist (doctoral level)	10
<a href="#">Bui, An</a>	Graduate Student (research assistant)	1
<a href="#">Catlett, Dylan</a>	Graduate Student (research assistant)	3
<a href="#">Cavanaugh, Katherine</a>	Graduate Student (research assistant)	2
<a href="#">Cedano, Tiffany</a>	Graduate Student (research assistant)	12
<a href="#">Chamorro, Jannine</a>	Graduate Student (research assistant)	6
<a href="#">Clare, Xochitl</a>	Graduate Student (research assistant)	1
<a href="#">Difiore, Bart</a>	Graduate Student (research assistant)	3
<a href="#">Emery, Kyle</a>	Graduate Student (research assistant)	6
<a href="#">English, Chance</a>	Graduate Student (research assistant)	2
<a href="#">Esaian, Sevan</a>	Graduate Student (research assistant)	1
<a href="#">Fitzgerald, Sean</a>	Graduate Student (research assistant)	1
<a href="#">Hardison, Emily</a>	Graduate Student (research assistant)	1
<a href="#">Huynh, Nicholas</a>	Graduate Student (research assistant)	1
<a href="#">Kozal, Logan</a>	Graduate Student (research assistant)	2
<a href="#">Kraskura, Krista</a>	Graduate Student (research assistant)	4
<a href="#">Leach, Terence</a>	Graduate Student (research assistant)	2

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Lowman, Heili</a>	Graduate Student (research assistant)	11
<a href="#">Malakhoff, Katrina</a>	Graduate Student (research assistant)	6
<a href="#">Michaud, Kristen</a>	Graduate Student (research assistant)	6
<a href="#">Peters, Joey</a>	Graduate Student (research assistant)	12
<a href="#">Sugano, Cailan</a>	Graduate Student (research assistant)	3
<a href="#">VanderZee, David</a>	Graduate Student (research assistant)	1
<a href="#">Welch, Zoe</a>	Graduate Student (research assistant)	1
<a href="#">Wong, Juliet</a>	Graduate Student (research assistant)	1
<a href="#">Zenteno, Jose</a>	Graduate Student (research assistant)	1
<a href="#">Adamson, Carter</a>	Undergraduate Student	1
<a href="#">Aguila, Zoe</a>	Undergraduate Student	1
<a href="#">Amundsen, William</a>	Undergraduate Student	1
<a href="#">Anderson, Ellyse</a>	Undergraduate Student	1
<a href="#">Anderson, Claire</a>	Undergraduate Student	1
<a href="#">Andrada, Nico</a>	Undergraduate Student	1
<a href="#">Aplin, Ally</a>	Undergraduate Student	1
<a href="#">Atkins, Micaiah</a>	Undergraduate Student	1
<a href="#">Bagla, Anshika</a>	Undergraduate Student	1
<a href="#">Baldwin, Daniel</a>	Undergraduate Student	1
<a href="#">Ballard, Cassidy</a>	Undergraduate Student	1
<a href="#">Bawa, Simran</a>	Undergraduate Student	1
<a href="#">Beltran, Nelson</a>	Undergraduate Student	1
<a href="#">Blasco, Gordon</a>	Undergraduate Student	5
<a href="#">Boyle, Sarah</a>	Undergraduate Student	1
<a href="#">Bradley, Tori</a>	Undergraduate Student	1
<a href="#">Bruggemann, Thea</a>	Undergraduate Student	1
<a href="#">Bryant Williams, Dominique</a>	Undergraduate Student	1
<a href="#">Cajilig-McDonald, Lauren</a>	Undergraduate Student	1
<a href="#">Cam, Jefferson</a>	Undergraduate Student	2
<a href="#">Campbell, Chandler</a>	Undergraduate Student	1
<a href="#">Chan, Iris</a>	Undergraduate Student	1
<a href="#">Childs, Jeffrey</a>	Undergraduate Student	1
<a href="#">Clarke, Madison</a>	Undergraduate Student	1
<a href="#">Combs, Annie</a>	Undergraduate Student	1
<a href="#">Culpepper, Peter</a>	Undergraduate Student	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Curry, Stephen</a>	Undergraduate Student	1
<a href="#">Daniel, Tyler</a>	Undergraduate Student	1
<a href="#">Deardorff, Ella</a>	Undergraduate Student	1
<a href="#">Deas, Evan</a>	Undergraduate Student	1
<a href="#">Deyana, Gorman</a>	Undergraduate Student	1
<a href="#">Dezzani, Alecia</a>	Undergraduate Student	1
<a href="#">Dorji, Shey</a>	Undergraduate Student	1
<a href="#">Dugan, Emmaline</a>	Undergraduate Student	1
<a href="#">Ear, Jenny</a>	Undergraduate Student	1
<a href="#">Elbayar, Samantha</a>	Undergraduate Student	1
<a href="#">Ellman, Samantha</a>	Undergraduate Student	1
<a href="#">Fyfe, Caroline</a>	Undergraduate Student	1
<a href="#">Gallagher, Jordan</a>	Undergraduate Student	3
<a href="#">Galvan, Journ</a>	Undergraduate Student	1
<a href="#">Garcia, Diana</a>	Undergraduate Student	1
<a href="#">Girling, Ivan</a>	Undergraduate Student	1
<a href="#">Goldston, Aiko</a>	Undergraduate Student	1
<a href="#">Gonzales, Elise</a>	Undergraduate Student	3
<a href="#">Gorgas, Maya</a>	Undergraduate Student	1
<a href="#">Hargrove, Lindsey</a>	Undergraduate Student	1
<a href="#">Hausrath, Isabel</a>	Undergraduate Student	1
<a href="#">Hernandez, Marisol</a>	Undergraduate Student	1
<a href="#">Hill, Allison</a>	Undergraduate Student	1
<a href="#">Holbrook, Jack</a>	Undergraduate Student	3
<a href="#">Iskander, Joshua</a>	Undergraduate Student	1
<a href="#">Jennings, Lauren</a>	Undergraduate Student	1
<a href="#">Johnson, Lucy</a>	Undergraduate Student	1
<a href="#">Jones, Steven</a>	Undergraduate Student	1
<a href="#">Jonie, Garcia</a>	Undergraduate Student	1
<a href="#">Juengling Bean, Eva</a>	Undergraduate Student	1
<a href="#">Katsiovleris, Dimitri</a>	Undergraduate Student	1
<a href="#">Kaur, Sami</a>	Undergraduate Student	1
<a href="#">Keeling, Lukas</a>	Undergraduate Student	2
<a href="#">Kelton, Allison</a>	Undergraduate Student	1
<a href="#">Kernkamp, Charles</a>	Undergraduate Student	1
<a href="#">Koolmees, Wyatt</a>	Undergraduate Student	1



<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Krebs, Karina</a>	Undergraduate Student	3
<a href="#">Krotine, Kimberly</a>	Undergraduate Student	1
<a href="#">Lao, Chihei</a>	Undergraduate Student	1
<a href="#">Le, Katherine</a>	Undergraduate Student	5
<a href="#">LeDonne, Tasi</a>	Undergraduate Student	1
<a href="#">Lin, Justin</a>	Undergraduate Student	1
<a href="#">Loo, Emmaline</a>	Undergraduate Student	1
<a href="#">Mangino, Inez</a>	Undergraduate Student	1
<a href="#">Martinka, Arielle</a>	Undergraduate Student	1
<a href="#">Moreno, Luiza</a>	Undergraduate Student	2
<a href="#">Morrison, Seamus</a>	Undergraduate Student	1
<a href="#">O'Brien, Alex</a>	Undergraduate Student	6
<a href="#">Ochoa, Jacob</a>	Undergraduate Student	1
<a href="#">Oda, Kai</a>	Undergraduate Student	3
<a href="#">Ogawa, Jacob</a>	Undergraduate Student	2
<a href="#">Packard, Ian</a>	Undergraduate Student	1
<a href="#">Pampeyan, Kristin</a>	Undergraduate Student	1
<a href="#">Parks, Emily</a>	Undergraduate Student	1
<a href="#">Patil, Ashwini</a>	Undergraduate Student	1
<a href="#">Perez, Yanelyn</a>	Undergraduate Student	1
<a href="#">Pettit, Andrew</a>	Undergraduate Student	1
<a href="#">Piozet, Tim</a>	Undergraduate Student	1
<a href="#">Platonoff, Kristina</a>	Undergraduate Student	1
<a href="#">Plouffe, Kyler</a>	Undergraduate Student	1
<a href="#">Powers, James</a>	Undergraduate Student	1
<a href="#">Pyle, Brenden</a>	Undergraduate Student	5
<a href="#">Rathle, Shane</a>	Undergraduate Student	1
<a href="#">Reamey, Maya</a>	Undergraduate Student	1
<a href="#">Reitman, Fred</a>	Undergraduate Student	1
<a href="#">Roberts, Claire</a>	Undergraduate Student	1
<a href="#">Robles, Melanee</a>	Undergraduate Student	1
<a href="#">Rollins, Sophia</a>	Undergraduate Student	1
<a href="#">Ross, Vivian</a>	Undergraduate Student	1
<a href="#">Shei, Jessica</a>	Undergraduate Student	1
<a href="#">Shelby, Ben</a>	Undergraduate Student	1
<a href="#">Singleton, Hana</a>	Undergraduate Student	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#">Siu, Daniel</a>	Undergraduate Student	1
<a href="#">Soglin, Tatiana</a>	Undergraduate Student	1
<a href="#">Solvay, Margot</a>	Undergraduate Student	1
<a href="#">Soto, Abraham</a>	Undergraduate Student	1
<a href="#">St. Pierre, Zoe</a>	Undergraduate Student	1
<a href="#">Stead, Courtney</a>	Undergraduate Student	1
<a href="#">Tang, Irvin</a>	Undergraduate Student	1
<a href="#">Ulloa, Gabbie</a>	Undergraduate Student	1
<a href="#">Van Gieson, Amir</a>	Undergraduate Student	1
<a href="#">Vasquez, Jennifer</a>	Undergraduate Student	1
<a href="#">Vega, Jessica</a>	Undergraduate Student	1
<a href="#">Venkatachalam, Divyaa</a>	Undergraduate Student	2
<a href="#">Wagner, Theresa</a>	Undergraduate Student	1
<a href="#">Wagner, Noah</a>	Undergraduate Student	1
<a href="#">Walton, Miette</a>	Undergraduate Student	1
<a href="#">Wellington, Bethlehem</a>	Undergraduate Student	1
<a href="#">Whightsil, Lauren</a>	Undergraduate Student	1
<a href="#">Williams, Jonathan</a>	Undergraduate Student	1
<a href="#">Witonsky, Lilly</a>	Undergraduate Student	1
<a href="#">Wossenseged, Faeben</a>	Undergraduate Student	1
<a href="#">Zhao, Rick</a>	Undergraduate Student	1
<a href="#">Battle, Andre</a>	High School Student	1
<a href="#">Campbell, Rosie</a>	High School Student	2
<a href="#">Donohoe, Jake</a>	High School Student	1
<a href="#">Gans, Molly</a>	High School Student	1
<a href="#">Klanfer, Jordan</a>	High School Student	1
<a href="#">Lambert, Bryce</a>	High School Student	1
<a href="#">Perelman, Shane</a>	High School Student	1
<a href="#">Sherry, Justine</a>	High School Student	1
<a href="#">Stivers, Louise</a>	High School Student	1
<a href="#">Wachtell, Lauren</a>	High School Student	1
<a href="#">Delmarsh, Ila</a>	Research Experience for Undergraduates (REU) Participant	3
<a href="#">Ditzler, Hannah</a>	Research Experience for Undergraduates (REU) Participant	4
<a href="#">Jawetz, Sean</a>	Research Experience for Undergraduates (REU) Participant	3

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
<a href="#"><u>LaManna, Renee</u></a>	Research Experience for Undergraduates (REU) Participant	4
<a href="#"><u>Rupprecht, Andie</u></a>	Research Experience for Undergraduates (REU) Participant	2
<a href="#"><u>Van de Wyngaerde, Kylie</u></a>	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:** 2

**Contribution to the Project:** Lead investigator

**Funding Support:** NSF, Federal

**International Collaboration:** No

**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:** Leads research on ecological and evolutionary consequences of kelp-induced change in seawater chemistry

**Funding Support:** State, Federal

**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:** 2

**Contribution to the Project:** Kelp forest community ecology

**Funding Support:** private, state

**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:** coastal ocean and kelp forest research

**Funding Support:** State

**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:** Kelp forest community research

**Funding Support:** State

**International Collaboration:** No  
**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](mailto: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](mailto: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](mailto: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](mailto: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:** 1

**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

**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 Nidziko**

**Email:** nidziko@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:** 2

**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:** 2

**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:** 0

**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 receive support from the project, although we have supported maintaining her trap in past years.

**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:** 2

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

**Funding Support:** Federal

**International Collaboration:** No

**International Travel:** No

**Thomas Lamy**

**Email:** thomas.lamy27@gmail.com

**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Kelp forest ecology and biology

**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:** 1

**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:** 9

**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:** 6

**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:** 2

**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:** No

**International Travel:** No

**Margaret O'Brien**

**Email:** mob@msi.ucsb.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 2

**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](mailto:simon@msi.ucsb.edu)

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 12

**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](mailto: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](mailto:bdoheny13@gmail.com)

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 1

**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](mailto:adubel@bio.fsu.edu)

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 1

**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

**Janet Jones**

**Email:** ja\_jones@lifesci.ucsb.edu

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 2

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

**Funding Support:** Federal

**International Collaboration:** No

**International Travel:** No

**Jessica Madden**

**Email:** jessicamadden831@gmail.com

**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:** NSF, Federal, State

**International Collaboration:** No

**International Travel:** No

**Matthew Meyerhof**

**Email:** mmeyerhof@bren.ucsb.edu

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 5

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

**Funding Support:** NSF

**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

**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 TCO<sub>2</sub> 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:** 12

**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:** 1

**Contribution to the Project:** data analysis for seawater nutrients

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Jordan Snyder**

**Email:** jordan\_snyder@ucsb.edu

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 1

**Contribution to the Project:** data collection and analysis of ocean, reef DOM

**Funding Support:** Federal

**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:** 10

**Contribution to the Project:** serves as information manager for project

**Funding Support:** NSF, 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:** 1

**Contribution to the Project:** community ecology and climate change

**Funding Support:** state

**International Collaboration:** No

**International Travel:** No

**Dylan Catlett**

**Email:** dsc@ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 3

**Contribution to the Project:** coastal phytoplankton ecology

**Funding Support:** federal

**International Collaboration:** No

**International Travel:** No

**Katherine Cavanaugh**

**Email:** kccavanaugh@ucla.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Remote sensing of kelp forests

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Tiffany Cedano**

**Email:** tcedeno@umail.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 12

**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:** 6

**Contribution to the Project:** Physiological response to ocean climate

**Funding Support:** State

**International Collaboration:** No

**International Travel:** No

**Xochitl Clare**

**Email:** xochitl.clare@lifesci.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Physiological responses to ocean climate

**Funding Support:** state, federal

**International Collaboration:** No

**International Travel:** No

**Bart Difiore**

**Email:** bart.difiore@lifesci.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Kelp forest ecology and biology

**Funding Support:** state

**International Collaboration:** No

**International Travel:** No

**Kyle Emery**

**Email:** kyle.emery@ucsb.edu

**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**

**Email:** cje@ucsb.edu

**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**

**Email:** sevanesaian@ucsb.edu

**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**

**Email:** Spfitzgerald@ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Trap fishery biology and management

**Funding Support:** state

**International Collaboration:** No

**International Travel:** No

**Emily Hardison**

**Email:** emily.hardison@lifesci.ucsb.edu

**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**

**Email:** nicholasquhuynh@gmail.com

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 1

**Contribution to the Project:** kelp forest DOM and microbial ecology

**Funding Support:** state, federal

**International Collaboration:** No

**International Travel:** No

**Logan Kozal**

**Email:** logan.kozal@lifesci.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Physiological responses to ocean climate

**Funding Support:** state, federal

**International Collaboration:** No

**International Travel:** No

**Krista Kraskura**

**Email:** krista.kraskura@lifesci.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 4

**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**

**Email:** [terence.leach@lifesci.ucsb.edu](mailto:terence.leach@lifesci.ucsb.edu)

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Physiological responses to ocean climate

**Funding Support:** state, federal

**International Collaboration:** No

**International Travel:** No

**Heili Lowman**

**Email:** [Heili.lowman@ucsb.edu](mailto:Heili.lowman@ucsb.edu)

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 11

**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

**Katrina Malakhoff**

**Email:** [kmalakhoff@ucsb.edu](mailto:kmalakhoff@ucsb.edu)

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 6

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

**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**

**Email:** jpeters@ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 12

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Cailan Sugano**

**Email:** csugano@ucsb.edu

**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

**International Collaboration:** No

**International Travel:** No

**David VanderZee**

**Email:** david.vanderzee@lifesci.ucsb.edu

**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**

**Email:** zoe.welch@lifesci.ucsb.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**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:** 1

**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**

**Email:** jzenteno@bren.ucsb.edu

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Zoe Aguila**

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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

**William Amundsen**

**Email:** amundsen752@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

**Ellyse Anderson**

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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

**Claire Anderson**

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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

**Nico Andrada**

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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

**Ally Aplin**

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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

**Micaiah Atkins**

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**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Processed biotic 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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Daniel Baldwin**

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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

**Cassidy Ballard**

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**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Processed biotic samples in the laboratory

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

**Simran Bawa**

**Email:** bawa@ucsb.edu

**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

**Nelson Beltran**

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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

**Gordon Blasco**

**Email:** gordonblasco@gmail.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 5

**Contribution to the Project:** Study of kelp nitrogen sources

**Funding Support:** none

**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**

**Email:** victoriabradley@gmail.com

**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

**Thea Bruggemann**

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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

**Dominique Bryant Williams**

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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

**Lauren Cajilig-McDonald**

**Email:** laurenmcdonald@comcast.net

**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

**Jefferson Cam**

**Email:** j\_cam@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 2

**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**

**Email:** chandlercamp@optonline.net

**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

**Iris Jane Chan**

**Email:** irisjchan@ucsb.edu

**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

**Jeffrey Childs**

**Email:** jchilds@ucsb.edu

**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

**Madison Clarke**

**Email:** madimakesart@gmail.com

**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

**Annie Combs**

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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

**Peter Culpepper**

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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

**Stephen Curry**

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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

**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:** 1

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Gorman Deyana**

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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

**Alecia Dezzani**

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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

**Shey Dorji**

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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

**Emmaline Dugan**

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**Most Senior Project Role:** Undergraduate Student

**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

**Jenny Ear**

**Email:** ear.jenny@gmail.com

**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

**Samantha Elbayer**

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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

**Samantha Ellman**

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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

**Caroline Fyfe**

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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

**Jordan Gallagher**

**Email:** jordanpgallagher@gmail.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 3

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Journ Galvan**

**Email:** journgalvan@umail.ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**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

**Diana Garcia**

**Email:** dianaagarcia@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

**Ivan Girling**

**Email:** ivan.girling@gmail.com

**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

**Aiko Goldston**

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**Most Senior Project Role:** Undergraduate Student

**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

**Elise Gonzales**

**Email:** efgonzales@pipeline.sbccc.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 3

**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

**Maya Gorgas**

**Email:** mgorgas15@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:** NSF

**International Collaboration:** No

**International Travel:** No

**Lindsey Hargrove**

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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

**Isabel Hausrath**

**Email:** hausrathi@gmail.com

**Most Senior Project Role:** Undergraduate Student

**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

**Marisol Hernandez**

**Email:** myh@ucsb.edu

**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

**Allison Hill**

**Email:** ahill2349@outlook.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

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

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

**Jack Holbrook**

**Email:** jrh@ucsb.edu

**Most Senior Project Role:** Undergraduate Student  
**Nearest Person Month Worked:** 3

**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

**Joshua Iskander**

**Email:** iskander@ucsb.edu

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

**Contribution to the Project:** Processed biotic samples in the laboratory

**Funding Support:** none

**International Collaboration:** No  
**International Travel:** No

**Lauren Jennings**

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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

**Lucy Johnson**

**Email:** bostonblue101@yahoo.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

**Steven Jones**

**Email:** stevenjones@ucsb.edu

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

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Eva Juengling Bean**

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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

**Dimitri Katsiovleris**

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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

**Sami Kaur**

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**Most Senior Project Role:** Undergraduate Student  
**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

**Lukas Keeling**

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**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 2

**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:** 1

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Wyatt Koolmees**

**Email:** wkoolmees@umail.ucsb.edu

**Most Senior Project Role:** Undergraduate Student  
**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

**Karina Krebs**

**Email:** karina\_krebs@umail.ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 3

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Kimberly Krotine**

**Email:** kkrotine@ucsb.edu

**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

**Chihei Lao**

**Email:** chihei@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

**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



**Katherine Le**

**Email:** katherineleyq@gmail.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 5

**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**

**Email:** ledonnetasi@gmail.com

**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

**Justin Lin**

**Email:** justin\_lin@ucsb.edu

**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

**Emmaline Loo**

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**Most Senior Project Role:** Undergraduate Student

**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

**Inez Mangino**

**Email:** inez@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**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

**Arielle Martinka**

**Email:** ariellemartinka@ucsb.edu

**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

**Luiza Moreno**

**Email:** luizaarm@gmail.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 2

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Seamus Morrison**

**Email:** seamusmorrison@ucsb.edu

**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

**Alex O'Brien**

**Email:** ajobrien@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 6

**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**

**Email:** jakeochoa97@gmail.com

**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

**Kai Oda**

**Email:** kaioda141@gmail.com

**Most Senior Project Role:** Undergraduate Student

**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

**Jacob Ogawa**

**Email:** jacobogawa@gmail.com

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 2

**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:** 1

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Emily Parks**

**Email:** emilyehx@gmail.com

**Most Senior Project Role:** Undergraduate Student

**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

**Ashwini Patil**

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**Most Senior Project Role:** Undergraduate Student

**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

**Yanelyn Perez**

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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

**Andrew Pettit**

**Email:** andrewpettit@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Processed biotic samples in the laboratory

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

**Tim Piozet**

**Email:** timpiozet@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

**Kristina Platonoff**

**Email:** platanoffk@gmail.com

**Most Senior Project Role:** Undergraduate Student

**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

**Kyler Plouffe**

**Email:** kplouffe@ucsb.edu

**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

**James Powers**

**Email:** jamespowers@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**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

**Brenden Pyle**

**Email:** brendanpyle@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 5

**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:** 1

**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:** 1

**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:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Claire Roberts**

**Email:** claireannroberts@gmail.com

**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

**Melanee Robles**

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**Most Senior Project Role:** Undergraduate Student

**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

**Sophia Rollins**

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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

**Vivian Ross**

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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

**Jessica Shei**

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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

**Ben Shelby**

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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

**Hana Singleton**

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**Most Senior Project Role:** Undergraduate Student

**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

**Daniel Siu**

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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

**Tatiana Soglin**

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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

**Margot Solvay**

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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

**Abraham Soto**

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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

**Zoe St. Pierre**

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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

**Courtney Stead**

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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

**Irvin Tang**

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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

**Gabbie Ulloa**

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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

**Amir Van Gieson**

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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

**Jennifer Vasquez**

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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

**Jessica Vega**

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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

**Divyaa Venkatachalam**

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**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 2

**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

**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**

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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

**Miette Walton**

**Email:** miette.walton@gmail.com

**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

**Bethlehem Wellington**

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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

**Lauren Whightsil**

**Email:** laurenwhightsil@ucsb.edu

**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

**Jonathan Williams**

**Email:** jonathantaylorwilliams@gmail.com

**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

**Lilly Witonsky**

**Email:** lwitonsky@ucsb.edu

**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

**Faeben Wossenseged**

**Email:** faeben@ucsb.edu

**Most Senior Project Role:** Undergraduate Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** assisted with data collection, sample analyses

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

**Rick Zhao**

**Email:** rickzhao1998@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

**Andre Battle**

**Email:** andrebattle915@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Rosie Campbell**

**Email:** rosiescampbell@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 2

**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

**Jake Donohoe**

**Email:** jakewd2002@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Molly Gans**

**Email:** mollyoliviagans@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Jordan Klanfer**

**Email:** jrklanfer@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Bryce Lambert**

**Email:** brycelambert1214@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Shane Perelman**

**Email:** shanepere18100@student.lvusd.org

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Justine Sherry**

**Email:** sjustine2002@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Louise Stivers**

**Email:** louisemstivers@gmail.com

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities

**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Lauren Wachtell**

**Email:** wachtell@sbcglobal.net

**Most Senior Project Role:** High School Student

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Outreach activities



**Funding Support:** Coastal Fund, NOAA BWET

**International Collaboration:** No

**International Travel:** No

**Ila Delmarsh**

**Email:** iladelmarsh@ucsb.edu

**Most Senior Project Role:** Research Experience for Undergraduates (REU) Participant

**Nearest Person Month Worked:** 3

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Year of schooling completed:** Freshman

**Home Institution:** UC Santa Barbara

**Government fiscal year(s) was this REU participant supported:** 2019

**Hannah Ditzler**

**Email:** hannahditzler@ucsb.edu

**Most Senior Project Role:** Research Experience for Undergraduates (REU) Participant

**Nearest Person Month Worked:** 4

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Year of schooling completed:** Junior

**Home Institution:** UC Santa Barbara

**Government fiscal year(s) was this REU participant supported:** 2019

**Sean Jawetz**

**Email:** sjawetz@gmail.com

**Most Senior Project Role:** Research Experience for Undergraduates (REU) Participant

**Nearest Person Month Worked:** 3

**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  
**Year of schooling completed:** Junior  
**Home Institution:** UC Santa Barbara  
**Government fiscal year(s) was this REU participant supported:** 2019

**Renee LaManna**

**Email:** lamannarenee@gmail.com

**Most Senior Project Role:** Research Experience for Undergraduates (REU) Participant

**Nearest Person Month Worked:** 4

**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  
**Year of schooling completed:** Junior  
**Home Institution:** UC Santa Barbara  
**Government fiscal year(s) was this REU participant supported:** 2019

**Andie Rupprecht**

**Email:** andierupp@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. 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  
**Year of schooling completed:** Sophomore  
**Home Institution:** UC Santa Barbara  
**Government fiscal year(s) was this REU participant supported:** 2019

**Kylie Van de Wyngaerde**

**Email:** kylierae.vdw@gmail.com

**Most Senior Project Role:** Research Experience for Undergraduates (REU) Participant

**Nearest Person Month Worked:** 2

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

**Funding Support:** NSF

**International Collaboration:** No

**International Travel:** No

**Year of schooling completed:**

**Home Institution:**

**Government fiscal year(s) was this REU participant supported:**

**What other organizations have been involved as partners?**

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

**Partner's Contribution to the Project:**

Collaborative Research

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

**What other collaborators or contacts have been involved?**

Nothing to report

## Impacts

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

Ecological theory predicts mechanisms favoring the stability of ecosystems, but because natural ecosystems are complex, it is difficult to predict how their variability scales across space and levels of organization. The species-insurance hypothesis predicts that asynchronous dynamics among species should reduce variability and the spatial-insurance hypothesis predicts that asynchronous spatial dynamics among either local populations or local communities should also be a stabilizing force. In combination, both species and spatial insurance should reduce variation in metacommunity biomass over time, yet are rarely considered together in natural systems. Building from an LTER working group on stability, we partitioned the extent that species insurance and spatial insurance reduced the annual variation in macroalgal biomass at the SBC LTER study sites. Spatial insurance was weak, presumably because large-scale oceanographic processes in the study region led to high spatial synchrony at both population- and community-level biomass. Species insurance was stronger due to asynchronous dynamics among the metapopulations of a few common species. Our results illustrate how species insurance can



stabilize aggregate community properties in natural ecosystems where environmental conditions vary over broad spatial scales, and represent a relatively rare attempt to test ecological theory using long-term data from natural communities (Lamy et al. 2019).

### **What is the impact on other disciplines?**

Nothing to report.

### **What is the impact on the development of human resources?**

Our project provides significant opportunities for scientific training in research at multiple levels. During the past year 119 undergraduate students, 6 REU students, 25 graduate students, and 5 post doctoral fellows were trained through substantial involvement in SBC research. The 6 REU students from 2018-19 worked closely with SBC researchers and graduate students on a wide range of topics. Many have plans to pursue an advanced degree following their undergraduate education. Additionally, SBC faculty investigators actively incorporate the activities and findings of SBC LTER research into their teaching and curriculum development, thereby extending the project's contributions to the broader student body. The active involvement of large numbers of undergraduate students in SBC research not only provides valuable undergraduate training, but also affords SBC's graduate students and postdocs with significant opportunities for mentorship training. In 2018-19, 24 UCSB undergraduate students received academic credit to participate in a structured SBC marine 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. The experience gained from such training has proven to be very important to SBC graduate students and postdoctoral fellows who routinely go on to academic positions where the training legacy from SBC LTER continues.

During this reporting period, former graduate student Dan Okamoto became an assistant professor at Florida State University, former postdoc Marie Strader became an assistant professor at Auburn University, and former graduate students Christie Yorke and Nick Schooler became postdocs at UCSB.

SBC LTER has entrained several new Assistant Professors as new investigators, facilitating their entry into interdisciplinary LTER research. One of these, Adrian Stier, is now a co-PI on the project.

Additional impacts on the development of human resources are achieved through SBC's extensive outreach programs (see Accomplishments), which primarily target K-12 students and teachers. These outreach programs, particularly the REEF, provide large numbers (71 in 2018-19) of undergraduate student interns with a solid foundation in marine ecology and training in communicating their knowledge in an educational format. The REEF utilizes SBC graduate students, research staff, and post-docs to train REEF interns, which, in turn, enhances their training as laboratory and field assistants for SBC research. SBC investigators and graduate students mentor middle and high school students in developing and executing science fair projects and conducting research each year.

SBC LTER has a significant scientific scuba diving program that trains several undergraduates and graduate students per year. This training enables students to do underwater field projects, and take the skills learned with them through their careers.

### **What is the impact on physical resources that form infrastructure?**

NSF funds awarded to SBC are being used to maintain a custom 22' research vessel that was specifically designed for diving and oceanographic research, and an autonomous ocean glider that is customized for coastal research. Both items were purchased with NSF funds awarded to SBC. Research groups collaborating with SBC have access to the vessel and glider for their research needs. Led by Investigators Hofmann and Washburn, SBC partners with other research programs (e.g. Southern California Ocean Observing System (SCOOS), California's Ocean Protection Council, the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO)) to maintain an extensive array of moored sensors that is providing spatially comprehensive high frequency data on ocean properties including currents, temperature salinity, chlorophyll, oxygen and pH.

### **What is the impact on institutional resources that form infrastructure?**

SBC LTER makes use of several shared research facilities on campus, making a significant positive impact on their sustainability. Most notable in this regard are the Marine Science Institute Analytical Laboratory (AL) and the UCSB Boating program. SBC LTER submits monthly water samples to the AL and students, postdocs, and investigators are also trained to run analyses, particularly stable isotope mass spectrometer analyses, which facilitates many theses and dissertations. In addition to the project's boat, SBC LTER makes frequent use of UCSB's small boat fleet for student research as well as our intensive annual monitoring program. SBC investigators, postdocs and students are active boat captains and participate in the governance of the program which benefits the wider University community.

### **What is the impact on information resources that form infrastructure?**

SBC's publicly available data holdings increased by 14% in total volume over the past year. Among the total of 208 archived datasets, 4 datasets were newly added and 76 (90% of the time series) datasets were updated since Sep 2018. As in the past, new datasets often represent data from students or postdoctoral scholars, specifically designed to meet journals' increasingly frequent requirement to post data along with research papers. All metadata are available in the XML specification Ecological Metadata Language (EML), with data and metadata uploaded regularly to the repository of the Environmental Data Initiative (EDI), where it becomes available to the LTER Network catalog. Our local infrastructure provides daily backup for all data. As documented in the 2018 SBCLTER proposal, only a limited part of the watershed study will continue. As a consequence, we completed the last update for 32 watershed study time-series datasets and changed the dataset status to "completed time-series" (no future updates anticipated).

The Information Management System (IMS) has been further enhanced and expanded in 2019. In addition to the human observational data (e.g. organism counts by divers or beach surveys),

the system is configured to accommodate all the instrument data from the watershed studies (precipitation, streamflow, and stream chemistry) and offshore ocean research (e.g. temperature, pressure, pH, Oxygen, Fluorescence, ADCP). As of today, we have successfully centralized the processing steps required for metadata storage, data package generation, data archiving, and regular maintenance for all SBCLTER data. The integration and merging of the workflows for various data types have significantly increased the efficiency of the data management tasks.

In addition to the data management, the SBCLTER information manager, Li Kui has started to take over the data processing for all the long-term datasets, to ensure high-quality data and metadata products for SBCLTER's signature data collections. In 2019, Li Kui has developed workflows for processing all the human observational data using the programming language R. This documents the detailed data processing steps, including initial figure visualization, errors/outliers' detections, time-series data compilation, and data format validation. The watershed and ocean instrument data processing tasks have been transferred from Chris Gotschalk (ocean group) and Matthew Meyerhof (watershed group) to Li Kui in 2019. We are working on standardizing the data processing procedures and data formatting for the signature data collections. In this process, Li Kui has been further involved in the experiment designs and guides technical staff to ensure the appropriate documentation and a reliable and practical protocol for raw sensor data backup and staging for processing.

In 2019, SBC LTER made upgrades to its website. Per Network policies, the network-identity URL (<https://sbc.lternet.edu>) redirects to the local server name (<https://sbclter.msi.ucsb.edu>). The new website uses a modern code base and design, based on Bootstrap 4 and all code is client-side to eliminate dependencies on application servers. Of particular note is our data catalog, which is based on the PASTA API provided by the EDI repository, and JavaScript code from BLE-LTER. For efficiency, material for dynamic pages (e.g., people-profiles, bibliography) is exported from SBC's metadata database, which also stores dataset metadata. Because SBC is a member of the LTER-core-metabase project, SBC's website templates and code could be used by another LTER site.

## **What is the impact on technology transfer?**

Two tools used by SBC LTER have recently been enhanced. The database managing metadata (<https://github.com/lter/LTER-core-metabase>) and an R package to generate EML documents (<https://github.com/BLE-LTER/MetaEgress>) have been adopted by the new site BLE LTER, who were actively involved in developing these new versions. Both the database and the R script were presented and introduced to a broader data science community at the Earth Science Information Partners (ESIP) 2019 annual meeting.

Parallel to the EML generation workflow used by SBCLTER, Li Kui also developed a data archive system that replaces the Postgres database with the Excel workbook because Excel is a more user-friendly program for small research groups. Li gave talks and webcam trainings to a few non-LTER research groups to provide data archive knowledge and skills. These workflows/scripts are posted on GitHub at <https://github.com/lkuiucsb/Excel-to-EML> for public access.

SBC LTER data is frequently used by synthesis groups to understand ecological trends at a longer temporal and larger spatial scale. As part of the data harmonization “ecocomDP” project at the Environmental Data Initiative (EDI), our community survey datasets were converted into ecocomDP format and used in synthesis publications. Our data are instrumental in: (1) helping to identify the best data formats, code, packaging patterns, metadata content, and vocabularies, and (2) building formal recommendations for data providers.

### **What is the impact on society beyond science and technology?**

A recent SBC LTER study showed that sea urchins can be important members of kelp forest food webs (Yorke et al. 2019). Although they are typically portrayed as antagonistic grazers in kelp forests, sea urchins can have a positive trophic role, capturing kelp litter before it is exported and making it available to a suite of benthic detritivores. The results got some press and interest from conservation groups, including the Bay Foundation in Santa Monica CA. A common strategy for kelp forest restoration along the west coast is smashing sea urchins; the results suggest that, apart from the limited scalability of such approaches, sea urchins are not always bad for kelp forest ecosystems. The results may also help change the public's perception of these ubiquitous grazers away from being the villain of the kelp forest.

SBC LTER data and studies are showing the effects of marine reserves on ecosystems and fishing. New work showing spillover is likely to bolster the case for marine reserves as management tools and may help improve the design of future reserves and networks.

## **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**

Nothing to report.

### **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.