CSU The California State University
COUNCIL ON OCEAN AFFAIRS, SCIENCE & TECHNOLOGY (COAST)

Dr. Kenneth H. Coale Graduate Scholar Awards
AY 2023-2024 Application Form
Application Deadline: Wednesday, January 24, 2024, 5:00 p.m. PST

Please read the information on Dr. Kenneth H. Coale Graduate Scholar Awards on the COAST Webpage Announcement for full details and instructions.

Submit this form (which includes the Advisor Sign-Off Form) as both a Word document and a PDF file named as follows: *LastName_FirstName_App.docx* and *LastName_FirstName_App.pdf*. Submit both files as attachments, along with your **Department Commitment Form** (if needed) in **ONE** email to graduate@share.calstate.edu. **Please note**: A signature is required from your advisor on the **Advisor Sign-Off Form** only in the PDF version of your application that you submit. Your Advisor must submit your LOR to gradletter@share.calstate.edu separately.

Student Applicant Information

First Name:	Nicole	Last Name:	Vanelli
CSU Campus:	Long Beach	Student ID#:	
Email:		Phone:	
Degree Program:		Degree Sought (e.g., MS, PhD):	MS
Matriculation Date (mm/yy):		Anticipated graduation date (mm/yy):	
GPA in Major Courses:		Thesis-based? (Y/N):	Y

Advisor Information

First Name:	Christine	Last Name:	Whitcraft
CSU Campus:	Long Beach	Department:	Biology
Email:		Phone:	

Research Project Title: Testing Vegetation Effects on Sedimentation as a Measure Resilience to Sea-Level Rise

Project Keywords (5-7 keywords related to your project): vegetation, sedimentation, resilience, climate change, sea-level rise

Budget Summary (must add up to $4,000)

Award amount directly to awardee (through financial aid): $4,000

Award amount to Department (DCF required for department funding):

The information on this page is for COAST use only and will not be shared with potential reviewers.

Have you previously received a COAST Graduate Student Research Award? (Y/N) N

If yes, please provide year(s) of award(s):

Committee Members (Required)

Name	Department	Campus

CSU Suggested Reviewers (Required): Suggested reviewers must be from the CSU. Do not suggest any reviewers from your campus or reviewers with a potential conflict of interest.

Name:		
CSU Campus:		
Department:		
Email:		

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Please refer to the **Award Announcement** for detailed instructions on the information required for each of the following sections. All the boxes below will expand as you type.

Project Description (65 points total): 1,500-word maximum; any text over this limit will be redacted

Project Description

I. Problem Statement and Background Information

Coastal salt marshes are valuable ecosystems that are vulnerable to the effects of climate change, particularly sea-level rise (SLR). These marshes perform a multitude of ecosystem functions for humanity as well as other organisms (Barbier et al. 2011). Globally, coastal wetlands have been reduced in size and quality due to a variety of human activities including development, hydrologic changes, and invasive species (Pendleton et al. 2012). Long-term protection of these systems will depend on informed management interventions that allow for adequate wetland accretion and upland migration to promote resilience.

Understanding the processes (hydrodynamics, sediment supply, aboveground processes and belowground processes) that enable marshes to keep pace with SLR is key in predicting how resilient an ecosystem is and how best to manage for SLR. My data collection and project will focus on two of these key processes: sediment supply and above ground processes. Sediment supply is key as wetlands must build soil elevation at a rate faster than or equal to the rate of SLR to survive in their existing locations without retreating inland (Reed, 1995). Sediment inputs are a function of sediment availability in the estuary, the duration of tidal inundation, and trapping efficiency of tidal wetland vegetation (Buffington et al. 2020).

The literature supports the idea that vegetation slows water and traps sediment (Mudd et al. 2010 and sources within). However, few studies have tested this manipulatively in the field, and those that have tested the relationship have mixed results (Schultze et al. 2022- no effect of vegetation, Xu et al. 2022 - intermediate density yields the maximum sedimentation). In addition to varying with overall plant cover and species composition, it is likely that sedimentation rate will vary with plant arrangement (clumped versus sparse distributions). For instance, a quadrat could be 50% open, 50% vegetated, but all vegetation is clumped into one section. A quadrat with evenly distributed vegetation can still result in the same 50% open designation.

My objectives are to manipulatively test relationship between sedimentation rate and vegetation assemblages, determine if clumped or spread-out vegetation assemblages of the same percent cover affects sedimentation, determine if duration of inundation affects sedimentation, and to gain understanding on how sedimentation affects overall resilience of a coastal wetland in the face of climate change. I hypothesize that clumped versus evenly dispersed vegetation will result in differing sedimentation rates. My second hypothesis is that higher sedimentation rates will lead to accretion and overall higher elevation marsh plains, thus increasing the overall SLR resilience of an estuary.

II. Project Approach

Site Selection

Seal Beach. Seal Beach National Wildlife Refuge (SNBWR) is a protected wetland managed by US Fish & Wildlife and located in the Naval Weapons Station in Seal Beach, CA. This concretization of rivers combined with the dense development of the surrounding area leads to a low-flow, sediment-starved environment (Rosencranz et al. 2016). The study will take place in a sampling station within the Naval Weapons station adjacent to the visitor's center (Figure 1).

Tijuana River. Tijuana River Estuary is part of a nation-wide system of reserves funded by the National Oceanic and Atmospheric Association (NOAA) entitled the National Estuarine Research Reserve System (NERRS). Tijuana River Estuary has the opposite problem from Seal Beach in which there is a large sediment supply within the water column of the Tijuana River. The study site will take place slightly north of the largest sediment deposition location, and just south of the Tijuana River NERR sentinel sites (Figure 1)

Site comparisons: To understand why results may differ between sites, I will characterize key parameters (elevation, sediment supply).

Figure 1. Study sites. Tijuana River site (left) and Seal Beach site (right)

Elevation using SETs and RTK GPS measurements. Surface elevation tables (SETs) are a mechanism to measure marsh plain elevation. Both Seal Beach and Tijuana River Estuary have established SETs and long-term elevational datasets. SETs will be used to place the experiment in middle marsh elevations that are comparable between sites (SBNWR, TRNERR). Another tool that will confirm comparable elevational profiles between sites is a Trimble Real-time Kinematics device (RTK) that uses satellites to get an accurate elevation in-situ. This tool will measure elevations initially, bit it will also be used at the end of the study to confirm if there has been elevational change after a known period of sedimentation. Real-time elevations could potentially be plotted with sedimentation values to see if there is a correlation between elevation and accretion.

Sediment Supply- turbidity and total suspended sediment. Turbidity and total suspended sediment (TSS) are a measure of sediment supply. These metrics refer to how much sediment is being carried from the tidal creeks within the water column that could be deposited onto the marsh surface. Both SBNWR and TRNERR have water quality data loggers that keep track of turbidity levels. To verify turbidity measurements from the loggers and to determine total suspended sediment, I will collect water column samples of a known volume from the main channels near the deployed water quality logger, filter them using the vacuum system into glass fiber filters where they will be dried at 50°C and weighed to get a sediment weight per volume of water filtered.

Sediment characteristics- grain size and organic matter. To help place the experiment and to compare between sites, I will gather sediment samples from the top 6cm of the marsh surface at each proposed experimental location. Grain-size will be determined in-lab using a hydrometer following Boyoucos 1962. Grain size is an important feature to measure because it informs about flow and settling rate of the system. Larger grain sizes indicate higher flow, whereas smaller grain sizes are easier to move and indicate lower flow (Christiansen et al. 2000). Organic matter will be determined by calculating percent organic matter per sediment core from values determined through net weight loss upon ignition.

Experimental Design

I plan to establish two 1x1m quadrats of equal percent cover in a clumped formation and in an evenly dispersed arrangement at two different inundation levels (Figure 2). The percent cover will stay constant at 50%, with the clumped and evenly dispersed assemblages being representative of the natural mid-marsh vegetation (Figure 3). Plots will be weeded down to reach 50% open at each site. This will occur at two levels of inundation, one at the lowest elevation of mid-marsh, and one at the highest elevation of mid-marsh. This elevation will be confirmed with a Trimble RTK. The lower elevation levels simulate sea-level rise with a longer inundation period than the higher elevations. A control plot will be established adjacent to each manipulative plot that is close to 100% cover of the natural marsh vegetation (Figure 3). To maintain 50% cover clumped and evenly dispersed, regular weeding will occur. There will be 10 replicates at each elevation, with two treatments, and a control for every pair of plots.

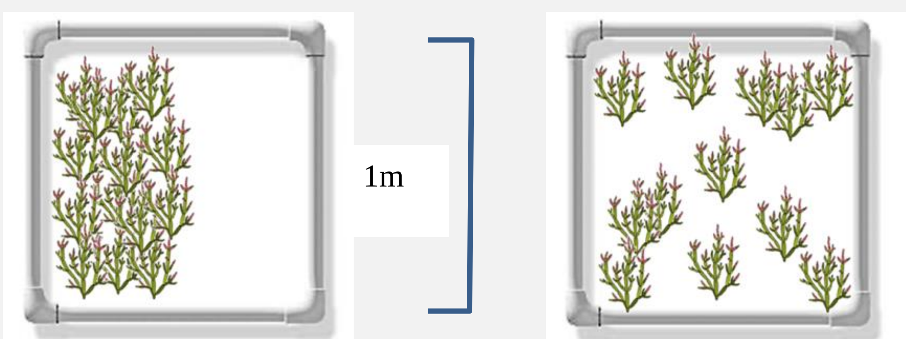

Figure 3. Two 1x1m quadrats in a 50% vegetated clumped formation (left) and in a 50% vegetated evenly dispersed formation (right). *Salicornia pacifica* is pictured here, a hydrophyte that dominates the mid-marsh in Southern California.

Response Variables

Short-term sedimentation rate and sediment characteristics:

Sediment tiles are a tool used to measure short-term sediment deposition and sediment characteristics (Smith et al. 2021). These are 10cm x10cm tiles that are placed within the quadrat flush with the marsh surface. Each week, these tiles will be scraped and rinsed with deionized water (DI) and the sediment will be dried, weighed, and processed for organic matter content and grain size (Smith et al. 2021). This process will result in a weekly sedimentation value.

Long-term sediment accretion:

The feldspar horizon technique is a way to measure sedimentation over a longer period than the tiles. Feldspar is laid in a 1cm thick layer atop the sediment surface of each 1x1 m quadrat (Mitsch et al. 2014). Feldspar will be laid upon establishing the plots in a marked corner of the experimental block. On a monthly basis, a 3x3x6cm core will be taken from the plot and accumulated sediment atop the white feldspar layer will be measured, dried, and weighed to obtain a mm/month accretion value.

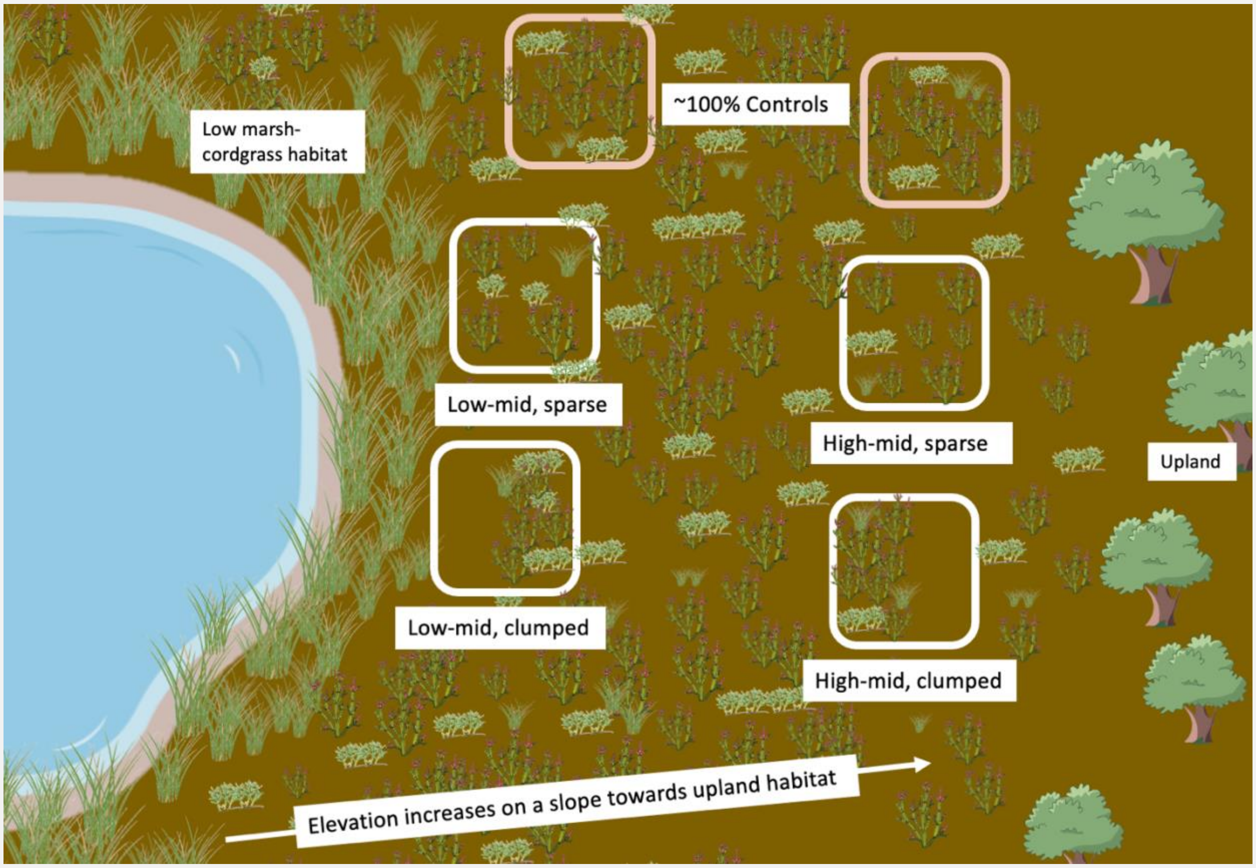

Figure 4. Experimental design.

Statistical Analysis

Data will be tested for assumptions of normality and equal variance. Assuming the data meets assumptions, a three-way ANOVA will be conducted for site (SBNWR, TRNERR), marsh elevation (low-mid, high-mid), and treatment (clumped, sparse). Because there will likely be site differences, I will then conduct a two-way ANOVA within site between marsh elevation and treatment followed by Tukey's tests. If data do not meet assumptions, non-parametric ANOVAs or permutational ANOVAs will be used. To deal with the inherent autocorrelation in values measured through time (weekly (tiles) and monthly (feldspar) data) I will explore repeated measures ANOVA and Wilcoxon tests with continuity correction.

References (0 points): no limit

References

- Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*, *81*(2), 169–193.
- Barbier, E. B. (2013). Economics, natural-resource scarcity and development (Routledge revivals): *Conventional and alternative views*. Routledge.
- Beck, M. W., Heck, K. L., Able, K. W., Childers, D. L., Eggleston, D. B., Gillanders, B. M.,Weinstein, M. P. (2001). The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates: a better understanding of the habitats that serve as nurseries for marine species and the factors that create site-specific variability in nursery quality will improve conservation and management of these areas. *Bioscience*, *51*(8), 633-641.
- Buffington, K. J., Goodman, A. C., Freeman, C. M., & Thorne, K. M. (2020). Testing the interactive effects of flooding and salinity on tidal marsh plant productivity. *Aquatic Botany*, *164*, 103231.
- California Coastal Commission (2018). Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal DevelopmentPermits.https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018 AdoptedSLRGuidanceUpdate.pdf
- Christiansen, T., Wiberg, P. L., & Milligan, T. G. (2000). Flow and sediment transport on a tidal salt marsh surface. *Estuarine, Coastal and Shelf Science*, *50*(3), 315-331.
- Craft, C., Clough, J., Ehman, J., Joye, S., Park, R., Pennings, S., Guo, H. and Machmuller, M. (2009), Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services. Frontiers in Ecology and the Environment, 7: 73-78. https://doi.org/10.1890/070219
- Mitsch, W. J., Nedrich, S. M., Harter, S. K., Anderson, C., Nahlik, A. M., & Bernal, B. (2014). Sedimentation in created freshwater riverine wetlands: 15 years of succession and contrast of methods. *Ecological Engineering*, *72*, 25-34. doi:10.1016/j.ecoleng.2014.09.116
- Mudd, S. M., D'Alpaos, A., & Morris, J. T. (2010). How does vegetation affect sedimentation on tidal marshes? Investigating particle capture and hydrodynamic controls on biologically mediated sedimentation. *Journal of Geophysical Research: Earth Surface*, *115*(F3).
- Raposa KB, Kutcher TE, Ferguson W, McKinney RA, Miller K, Wigand C. Evaluation of Plot-Scale Methods for Assessing and Monitoring Salt Marsh Vegetation Composition and Cover. Northeast Nat (Steuben). 2020 Mar 6;27(1):151-167. doi: 10.1656/045.027.0113. PMID: 33551633; PMCID: PMC7863630.
- Reed, D. J. (1995). The response of coastal marshes to sea-level rise: Survival or submergence?. *Earth Surface processes and landforms*, *20*(1), 39-48.
- Rosencranz, J.A., Ganju, N.K., Ambrose, R.F. *et al.* Balanced Sediment Fluxes in Southern California's Mediterranean-Climate Zone Salt Marshes. *Estuaries and Coasts* **39**, 1035–1049 (2016). https://doi.org/10.1007/s12237-015-0056-y
- Schulze, D., Jensen, K., & Nolte, S. (2022). Effects of small-scale patterns of vegetation structure on suspended sediment concentration and sediment deposition in a salt marsh. *Estuarine, Coastal and Shelf Science*, *278*, 108125.

- Smith, K. E. L., Terrano, J. F., Khan, N. S., Smith, C. G., & Pitchford, J. L. (2021). Lateral shoreline erosion and shore-proximal sediment deposition on a coastal marsh from seasonal, storm and decadal measurements. *Geomorphology*, *389*, 107829. doi:10.1016/j.geomorph.2021.107829
- Xu, Y., Esposito, C. R., Beltrán-Burgos, M., & Nepf, H. M. (2022). Competing effects of vegetation density on sedimentation in deltaic marshes. *Nature communications*, *13*(1), 4641.

Timeline (10 points total): 250-word maximum; any text over this limit will be redacted.
Please note: If you reference activities occurring prior to May 15, 2024, for context, be sure to clearly identify the activities an award would fund. **Requests for funds for expenses or work done prior to start date will result in your application being returned without review.**

I am a first-year graduate student with plans to begin my experiment in the summer of 2024. Firstly, in June 2024 I will finalize my experimental design and obtain necessary field site permissions for both Seal Beach and Tijuana River. Once permission has been granted, I will conduct site visits and communicate with managers to determine where plots will be established through the months of July and August. August and September of 2024 will be reserved for collecting background data on the sites and finalizing where the manipulative portion of the experiment will take place. The experiment will take place for one year from October 2024 to October 2025. These sites will be visited every month to collect feldspar measurements and weed down to 50% cover for the experimental plots. For one month during this year, I will travel to the field sites weekly to collect short-term sedimentation samples via sediment tiles. These samples will be processed in the spring/summer of 2025. Data will be analyzed towards the end of the experiment beginning in August 2025. Data analysis will continue in conjunction with the writing of my thesis, anticipating being finished by spring of 2026.

Need for Research (7 points total): 250-word maximum; any text over this limit will be redacted

Coastal wetlands provide services for humanity and other organisms including high primary productivity, carbon sequestration, nursery provision, water quality improvement, and protection from flooding and storms (Barbier et al. 2011; Craft et al 2011; Beck et al 2001). With rising sea levels and increased demand for coastal development, it is more important now than ever to implement practices that increase resilience. Over a third of the world's population is settled along the coasts (Barbier 2013). This population density makes it difficult for coastal wetlands to have sufficient room to retreat with SLR. With little room for upland migration, wetlands need to have proper measures in place to promote sedimentation that keeps pace with SLR. This includes understanding above-ground processes that make this sedimentation possible. Percent cover is the most universally accepted metric in wetland ecology that implies estuary health in regard to vegetation (Raposa et al. 2020). This project aims to manipulate vegetation cover to understand sediment trapping as a measure of resilience. The results will provide increased scientific understanding of the importance of vegetation in terms of resilience as well as provide a metric to quantify this resilience for managers, thus helping restore and maintain coastal wetlands. In an age of anthropogenic extinction, restoring and maintaining these fragile ecosystems that protect our coast and offer numerous ecosystem services must be prioritized.

Relevance to state of California (3 points total): 100-word maximum; any text over this limit will be redacted

While wetlands are threatened at a global scale, California wetlands are particularly vulnerable to SLR. Human development is concentrated along the coast, fragmenting these dynamic tidal systems, and thus increasing vulnerability to degradation. Lack of upland migration in overdeveloped coastal regions heightens the risk of marsh vegetation die-off due to increased inundation. Conservative estimates predict a 1.5-foot increase in SLR by 2060 (CCC 2018). The current state of small Southern California marshes renders them vulnerable to this extent of SLR. Coastal resilience and planning for how to increase it is being prioritized in California to maintain these valuable ecosystems.

Budget and Justification (15 points total)

Example Budget (to use this format, erase the content below and add additional rows as necessary; alternatively, you are welcome to create your own table):

Please note: Funds can only be requested for costs incurred ON or AFTER the project start date (May 15, 2024). Award funds may not be used for activities that occur prior to this date. **Requests for funds for expenses or work done prior to start date will result in your application being returned without review.**

Item/Description	Unit Price	Quantity	Amount to Awardee (via Financial Aid)	Amount to Department
Travel expenses	$3,600	1	$3,600	-
Wetsuit	$400	1	$400	-
		Subtotals:	*$4,000*	-
		Grand Total	**$4,000.00**	

Justification (250-word maximum; any text over this limit will be redacted):

As I begin my project, the primary expense for this project will be going towards travel to my field sites. Tijuana River is about two hours from CSU-Long Beach campus, and I will need to travel to this site at least once per month to collect long-term sedimentation data in the form of feldspar cores. One of these months I will have to travel to Tijuana River each week to collect short-term sedimentation data in the form of sediment tiles. Due to the frequency I will need to be traveling to this site and potentially spending the night, and I will most likely need to utilize my own vehicle. With elevated gas prices in California, I believe most of this award will be used towards travel expenses. Additionally, I will need to invest in a new wetsuit to conduct my research in. My current wetsuit is about four years old with a lot of wear and tear from the years of wetland research. I foresee this costing between $200 and $400 for a new 3ml wetsuit.

Application Deadline: Wednesday, January 24, 2024, 5:00 p.m. PST
Save as both a Word document and a PDF file named as follows:
***LastName_FirstName_App.docx* and *LastName_FirstName_App.pdf*.**
Submit both files as email attachments in ONE email (with other required forms) to graduate@share.calstate.edu.

Within 24 hours of application submission, you will receive a confirmation email from COAST. Please save this confirmation email for future reference. If you do not receive a confirmation email, please contact Kimberly Jassowski (kjassowski@csumb.edu) to ensure your application was received.

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Dr. Kenneth H. Coale Graduate Scholar Awards
AY 2023-2024 Advisor Sign-Off Form

To encourage you to engage with your CSU Advisor as you develop your application, **we require this form for all applications submitted to the Dr. Kenneth H. Coale Graduate Scholar Awards Program**. By signing this form, your advisor indicates that they have reviewed your application, provided guidance and input, and approved it for submission. All information except signatures must be typed. Electronic signatures are acceptable. **Please note:** A signature is required from your advisor on this **Advisor Sign-Off Form** in the **PDF version** of your application that you submit (the word document does NOT need to be submitted with a signature)

Please note: this form is NOT a substitute for a letter of recommendation (LOR). Your Advisor must submit your LOR to gradletter@share.calstate.edu separately.

Applicant Name:

Nicole Vanelli

CSU Advisor Information:

Name:	Christine Whitcraft	Phone:	
Department:	Biology	Email:	

I have reviewed my student's application and provided guidance and input. My signature below indicates my approval of the application.

CSU Advisor Signature: Christine Whitcraft

Date: **1/31/24**