UC SAN DIEGO UNDERGRADUATES AND THE OCEAN DISCOVERY INSTITUTE COLLABORATE TO FORM A PILOT PROGRAM IN CULTURALLY RESPONSIVE MENTORING

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ABSTRACT. The geoscience workforce, particularly in ocean sciences, lacks diversity. Implementing culturally responsive teaching and mentoring practices throughout the K–university pipeline is one way to help increase diversity in the field. Here, we describe initial results and lessons learned from a pilot course developed by Scripps Institution of Oceanography through a partnership between the University of California San Diego (UCSD) and the Ocean Discovery Institute (ODI), a local nonprofit that provides opportunities for low-income K–12 youths to learn about oceanography. The goals of the pilot course are to educate a racially diverse group of UCSD undergraduates in culturally sensitive mentoring practices and provide opportunities for them to apply their newly acquired skills while working with K–12 students at ODI. The undergraduates prepared and implemented lessons designed to demystify the college experience for their mentees. Through classroom experience and weekly journal reflections, undergraduates developed confidence and improved their ability to mentor youth.

INTRODUCTION

The geosciences workforce continues to be the least diverse of the STEM disciplines, with white people holding 90% of the professional positions in these fields (AGI, 2016; Bernard and Cooperdock, 2018). Those earning doctorates in ocean sciences, a subset of geosciences, are primarily white males, without much change in diversity over the last 40 years (Bernard and Cooperdock, 2018; NSF, 2016). The lack of diversity stems from many factors, including social and educational inequities as well as institutionalized and systemic racism (Marin-Spiotta et al., 2020). A diverse workforce leads to increased productivity (Freeman and Huang, 2014) and innovation (Swartz et al., 2019) by providing different perspectives to the process of finding solutions to questions and challenges.

As our educational systems attempt to mitigate the effects of past discriminatory educational practices and increase diversity in the STEM fields, there is growing awareness of the need for culturally responsive teaching and mentoring of historically underrepresented students interested in the geosciences. Striving for a culturally rich and diverse workforce that better represents the demographics of the United States requires geoscience educational programs to offer more inclusive pathways. The STEM pipeline encompasses educational experiences from K–12 through higher education that either provide opportunities or limit learning and growth in STEM fields (i.e., "leaks" in the pipeline; Hinton et al., 2020). Using the term "pathways" acknowledges that multiple trajectories may lead to success in these fields (Cannady et al., 2014) and shifts the metaphor from filling an academic and workforce gap to putting "STEM experiences to work in the service of youth development" (Lyon et al., 2012, p. 49). Culturally responsive mentoring of Black, Indigenous, or People of Color (BIPOC) students leads to higher academic performance and improved well-being, sense of belonging, self-efficacy, and science identity (the self-categorization of one's self as a "science" person) (DuBois et al., 2002; Yong et al., 2020; Graham et al., 2022;).

Much of the mentoring literature regarding STEM pathways focuses on the university level, citing that early exposure and research training for underrepresented students are essential for preventing leaks within the pipeline in higher education (Hernandez et al., 2013; Crews, 2019; Hinton et al., 2020). More research is now examining the pathways, beginning with primary and secondary schooling. Youth mentoring in STEM, such as in after-school programs and summer camps, affords opportunities for students with no previous exposure to STEM to increase social interactions and learn about STEM concepts (Lyon et al., 2012; Reid-Griffin, 2019). Youth mentoring best practices include training mentors; securing commitments from mentors; respecting the family, class, and culture of involved youth; focusing on relationship building; and providing access to mentorship support (Anastasia et al., 2012). To improve access to higher

education, Packard (2016) encourages being intentional about mentoring in STEM, especially regarding identifying and creating awareness of the goals and intentions of mentoring initiatives. Being intentional also includes developing K–12 students academically, increasing their capacity to learn, and encouraging persistence in STEM.

Prioritization of supportive allyship and culturally responsive mentoring is key to addressing diversity, equity, and inclusion issues in the geosciences (Montgomery and Page, 2018; McGill et al., 2021; Graham, 2022). Ladson-Billings's (1995) work on culturally relevant practices in education included three components: (1) academic success that is not based on cultural deficit models of school failure (e.g., lowering expectations for students of color due to a bias that they cannot achieve high standards); (2) cultural competence, which locates excellence within the context of the students' community and cultural identities; and (3) critical consciousness, which challenges inequitable schools and social structures. Weiston-Serdan's (2017) research on critical mentoring builds on these practices by taking a youth-centric approach to mentoring that requires critical consciousness, resistance to deficit-based notions of youth, and recognition from mentors that racism and oppression exist and impact the lives of mentees.

In 2021, Scripps Institution of Oceanography (SIO), through the University of California San Diego (UCSD), developed a pilot mentoring program that included teaching a group of undergraduates about culturally responsive mentoring practices. During the program, undergraduates mentored a cohort of Ocean Discovery Institute (ODI) youth interested in potential careers in STEM. ODI is a nonprofit organization that uses ocean science education to engage low-income, ethnically, and racially diverse youth, many of whom are refugees and immigrants (94% of students living near ODI experience poverty; https://oceandiscoveryinstitute.org/). The pilot course on which this study is based is supported by a UCSD Changemaker Faculty Fellowship that is designed to develop new community-engaged courses. Our course was modeled after the established Partners At Learning program within the UCSD Department of Education Studies, which includes experiential learning via a practicum, critical reflection, and partnerships within the local community (https://palprogram.ucsd.edu/).

Here, we describe this collaborative mentoring project undertaken by undergraduates at UCSD and students at ODI. The community-engaged course was designed to improve the pathway for diverse students into ocean sciences through multiple spheres of mentoring between K–12 students and undergraduates, undergraduates and the teaching assistant (TA), faculty and students, and faculty and ODI leaders (Figure 1). The mentoring program also shows undergraduates how to be supportive mentors as they progress toward their future careers. Unlike many traditional STEM mentoring programs, the curriculum in

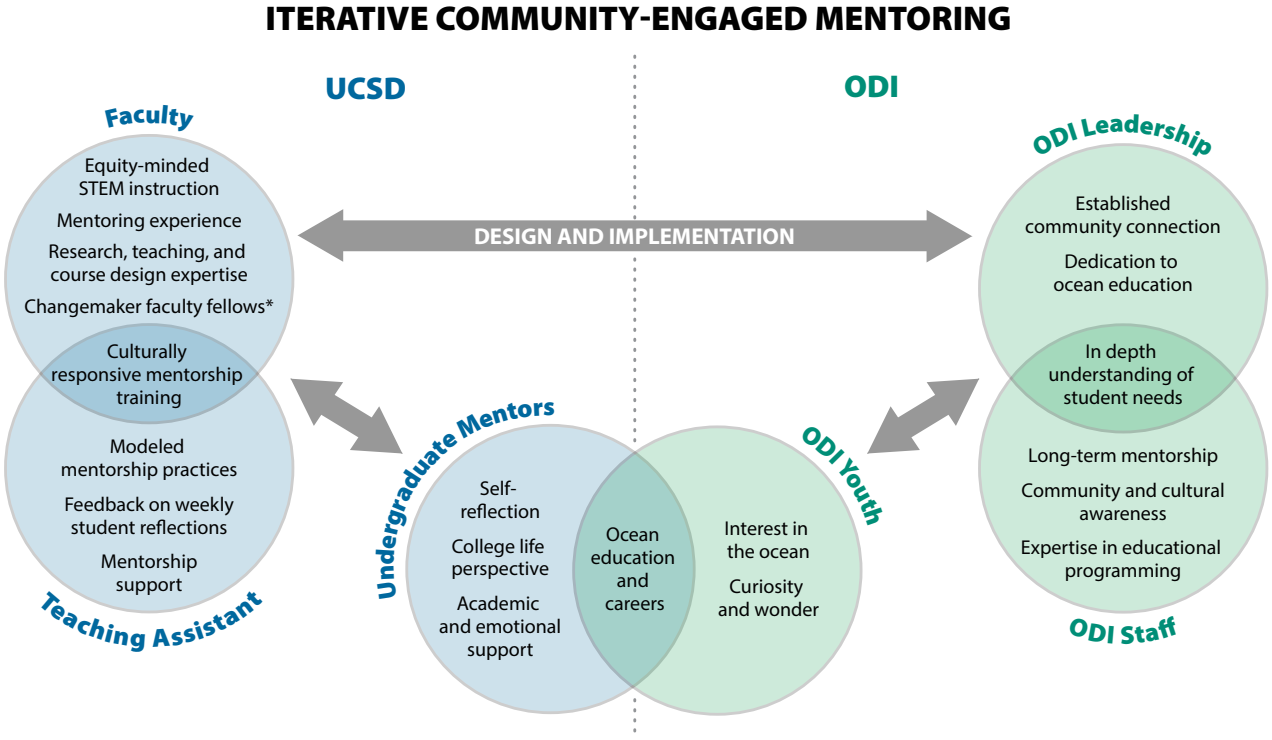

FIGURE 1. A model of the partnerships, collaborations, and lines of communication (represented by arrows) that made the culturally responsive mentoring program described here possible, with the key contributions of each group listed inside the Venn diagrams. *The Changemaker Institute is housed at the University of California San Diego (UCSD). ODI = Ocean Discovery Institute.

this course focuses on critical and culturally responsive mentoring, explicitly teaching undergraduates to address themes of implicit bias, anti-racism, and critical consciousness (Freire, 1970). Critical consciousness is a process that includes critical reflection and analysis of injustice in relation to existing social structures, emphasizing belief in collective effort to shift systems toward justice, engagement, and participation in social change efforts (Watts et al., 2011; Kornbluh et al., 2021). A curriculum fostering critical consciousness can increase academic engagement and achievement (Cammarota, 2007).

Our partnership with ODI was based on open communication between the faculty at UCSD and the leadership at ODI to best address the needs of the ODI youth. This iterative model of curriculum design required constant adaptation as we received feedback from ODI and our undergraduates. Iterative refers to the process of designing with community partner feedback, using inquiry to guide both undergraduate and youth learning, gathering feedback from the community partner, and shifting and adapting to meet the objectives of all stakeholders (Ryan et al., 2017). Figure 1 illustrates the dynamic relationship between the instructors at UCSD, the TA, and the undergraduates. A direct line of communication between the staff at ODI, undergraduates, the TA, and instructors at UCSD informed curriculum changes. The intentional collaborative planning and feedback mechanisms were designed to adapt to the needs of the community partner, thereby improving the interactions between the undergraduates and the youth at ODI.

METHODS

An Institutional Review Board (IRB) was approved by UCSD to study how the undergraduate mentors perceived the course and their corresponding application of what they learned while mentoring ODI youth. Qualitative methods were selected to analyze the pilot course because we wanted to observe student learning processes and analyze student work through an existing culturally relevant mentoring framework (Corbetta, 2003). Although future studies will incorporate ODI youth perspectives longitudinally, due to a quick turnaround of the Changemaker Fellowship, an IRB that involved children could not be obtained in time for the rollout of the pilot program. Thus, in this first study, we investigated undergraduate and faculty processes (e.g., how did we coordinate and plan with our nonprofit partner?) and undergraduate perceptions (e.g., what did they learn through the culturally responsive mentoring curriculum?). Data collected were meeting notes exchanged among faculty and TA that documented procedural steps in curriculum design, discussions of student responses to the curriculum, and undergraduate journal entries and course evaluations that were close-coded to culturally responsive pedagogy (Saldaña, 2015). Through observation and student-written reflections, we documented learning in the following areas: culturally responsive mentoring awareness; embracing diversity in STEM; and acquiring organization, collaboration, and teaching skills. Undergraduate consent was obtained, and written reflections have been de-identified.

Instructors and Course Participants

Two faculty members and one TA facilitated the course in the spring quarter of 2021. UCSD students who enrolled in the course were juniors or seniors majoring in STEM disciplines. Two white and eight racially or ethnically diverse mentors participated. As per ODI's recommendations, we intentionally recruited students of color as mentors as they wanted the mentors to reflect the diversity of their youth population. The youth involved in our community-engaged pilot course were enrolled in ODI's after-school STEM program and consisted of 12 third through fifth graders, 20 ninth graders, 10 tenth graders, and five eleventh graders for a total of 47 students.

Course Design

All aspects of the course design were planned collaboratively with our community partner at ODI to meet their students' needs. Before the pilot began, we met weekly for a month with ODI staff for feedback and recommendations. During our first week of class, ODI staff guest-lectured about ODI's historical context and goals for supporting learners within the City Heights community. Additionally, as the undergraduates developed lessons for the ODI youth, ODI staff provided coaching on connecting to the different grade levels and perspectives of the mentees. ODI staff also provided feedback to our mentors about the topics that most interested their youth.

For undergraduates enrolled in the pilot program, facilitating culturally responsive mentoring was a cyclical process of learning, preparing for mentoring sessions with ODI youth, and applying their knowledge on geoscience, with opportunities for reflection iteratively wrapped into all aspects of the course design (Figure 2). Oceanography undergraduates enrolled in the two-unit pilot course examined the root causes and impacts of inequalities in the STEM fields and engaged with teaching strategies and reflections on how to be culturally responsive mentors to elementary, middle, and high school-aged youth. Pre-class assignments (expected to take two to three hours per week) and one-half of each class session (one hour per week) were devoted to reading, listening to, and discussing relevant literature, podcasts, and case studies (see supplementary Table S1). The second half of the class (one hour per week) was divided between lesson planning and experiential mentoring.

Every other week, one group of undergraduates prepared a sample presentation on a topic that was planned collaboratively by the undergraduates and the UCSD faculty and TA, considering what would be most engaging and useful for the ODI students. Topics included "Preparing for College," "Campus Life,"

"Introduction to SIO," and "The Birch Aquarium"—lessons that helped model the life of college students majoring in STEM disciplines such as marine biology, geoscience, and oceanic and atmospheric sciences. Undergraduates then worked with their partners to design age-appropriate mini-lessons as well as icebreakers and games for their upcoming sessions with mentees, incorporating what they had learned both from the readings and class discussions and from their previous experiences. Each subsequent week, undergraduates met with their ODI mentees to facilitate games and icebreakers, give their prepared lessons, share topic-related personal experiences, and answer ODI student questions. After each session, the undergraduates reflected on their mentoring and experiences with the learning material, thus engaging in a critical aspect of culturally relevant practices (Howard, 2003; Figure 2). Remote mentoring was the mode of instruction for both the course and the mentoring experience due to COVID-19 restrictions that inhibited in-person learning.

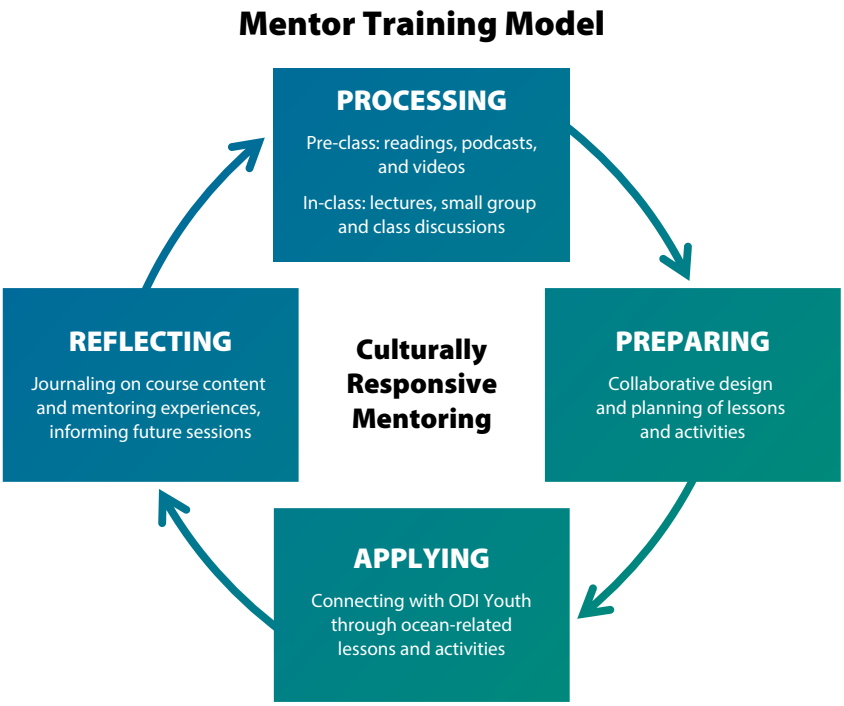

FIGURE 2. Learning instruction model of the piloted mentorship course.

RESULTS

Culturally Responsive Mentoring Awareness

As the quarter progressed, the undergraduates' perspectives were influenced by class readings regarding problems associated with implicit bias and deficit ideology in education that perpetuate the idea that some students, based on gender, socioeconomics, or race, can "catch up" academically while others cannot (Gorski, 2011). These students became more critically conscious of the inequities that impact the pathways into the geosciences, demonstrating through their journal entries an increased awareness of the importance of culturally responsive mentoring. One undergraduate mentor wrote, "It is important for us to remember this [bias] in our mentorship because we are just as susceptible as teachers to fall into deficit ideology. This ideology is socialized into all of us, and we must make a conscious effort to dismantle it and remove it from our thoughts and interactions with others… Each mentee is an individual, with unique interests, needs, experiences, and perspectives. We…undergo the most personal growth when we enter mentorship without preconceived notions about what the interactions or mentees will be like."

In addition to dismantling deficit ideology, undergraduates recognized that their mentees may have already felt the sting of bias. After a conversation about college planning with a mentee, one student wrote, "In our own mentoring, it is critically important to appreciate our students' strengths and curiosities…our students are probably beginning to understand the prejudices and scornful gazes they face in life; I hope that encouraging them to pursue big dreams and start planning for college is a way to counteract that fear and discomfort."

Undergraduates also recognized the importance of gaining cultural and historical knowledge of their partner communities, as demonstrated in this reflection: "By learning more about others' cultural heritage and being aware of past and present instances of discrimination or injustice…we give ourselves as mentors a better framework for understanding and responding to the needs of the mentees." Another undergraduate spoke of the importance of collaboration and communication, stating, "Specifically with environmental issues, the effects of climate change ultimately impact us all, and to fully understand the scope of the effects, people need to be open-minded and be willing to listen to others and their stories."

Embracing Diversity in Oceanography Mentoring

Undergraduates emphasized the importance of focusing on relationship development and embracing the diversity of their mentees. For example, they took the initiative to honor their mentees' culture and language by creating dual Spanish-English presentation slides and preparing to engage with their mentees in bilingual conversation after learning that many mentees were most confident participating in Spanish. As one undergraduate recognized, "I feel that I understand the lives and experiences of our students better, and hopefully I can incorporate that

understanding into my communication to better address their needs." Another recognized the need for a diversity and inclusion curriculum stating, "I wish this course was required for science majors… I feel like the major requirements don't include a proper 'diversity in STEM' curriculum or class. All of the topics we addressed could be useful to any scientist entering the field." Undergraduates also recognized that centering on the needs of youth takes practice. One wrote, "Putting aside my own interests to instead focus on the needs of the mentees was one of the hardest parts of this quarter, but also the best lesson that I learned. Thinking about this in the context of future research, I think that utilizing similar techniques of responding to the needs of the community instead of only my own curiosity or interests would be a really good starting point."

> "Unlike many traditional STEM mentoring programs, the curriculum in this course focuses on critical and culturally responsive mentoring, explicitly teaching undergraduates to address themes of implicit bias, anti-racism, and critical consciousness."

Acquiring Organization, Collaboration, and Teaching Related Skills

We observed our undergraduates developing organization, collaboration, and teaching skills as a result of the iterative design process that relied on seeking and receiving continuous input from the community partner. To ensure that ODI's needs were being met throughout the quarter, the faculty, TA, and ultimately the undergraduates, modified the content and its delivery mid-quarter based on the feedback received. One undergraduate observed that those experiences can be enhanced when utilizing the expertise of partners by saying, "The drawing game that Student X led during the icebreaker section of the high school Zoom meeting was also a big hit! We had one student turn on his camera and show us his drawing, which was the first time any of them had turned on their camera or mic in the large group setting like that! I'm really glad that the ODI staff members asked us to include a large group icebreaker activity each week, and my peer's idea for this week was a really fun one."

Flexibility and "in the moment" teaching were perceived as important preparation. "Each person has their own set of interests and needs and questions," understood one undergraduate, "and having the interaction a bit less structured allowed me to answer way more questions than if I had been just running through my prepared presentation. I was able to take my plan and modify it for the needs of the person in front of me, and I think that was a super valuable experience for the both of us."

DISCUSSION

The pilot course facilitated discussion of inequities in STEM, leaving the undergraduates committed to bringing this awareness into their future careers. Stelter et al. (2021), assert that effective STEM mentor training includes the following: building the awareness of disparities in STEM career achievement, facilitating mentor roles that promote STEM outcomes, and nurturing behaviors that promote mentees' positive attitudes about STEM. Additionally, the pilot course created opportunities for undergraduates to grow as teachers and learners. This supports findings that undergraduate STEM mentors show gains in organizational skills, STEM content knowledge, preparedness to teach, and program engagement (Nelson et al., 2017). Future research is needed to expand upon and support Stelter et al.'s findings through mixed methods that further analyze our course design and the impact on all constituents.

The students that ODI supports, like many other marginalized populations, rarely experience significant science engagement and outreach (Aschbacher et al., 2010), and opportunities to witness science modeled by people representative of the diversity in their community are rare due to the demographic profile of the geoscience student body and workforce. Having mentors that resemble the ethnicity and race of students with an interest in science has been associated with higher academic performance and increased persistence in college, particularly for members of high-need groups (Myers et al., 2010). Recognizing the value of this research, and the need within our ODI community, our goal moving forward is to continue to recruit diverse mentors.

Using reflective educational practices, such as journaling, the faculty and TA were able to document the undergraduates' journeys through self-awareness of the unjust practices in our education system and the need for change. As the course progressed, the undergraduates' mentoring skills improved as they began

to understand critical consciousness. In a review of mentoring literature, Albright et al. (2017) argue that critical consciousness can develop in mentors through facilitation that directly addresses inequities, requires self-reflection about identity, and holds space for dialogue about poverty, privilege, and systems of oppression. Further longitudinal research is needed to investigate how long undergraduates retain their interest in social justice STEM topics and whether or not undergraduates remain engaged in mentoring relationships in the future.

Our experiences with this pilot program reinforced the need for building flexibility at the institutional level because community partners' research questions and programmatic needs are ever-evolving in practice. These open lines of communication and respect ensure a truly collaborative relationship when planning community-based learning opportunities.

Although it was not assessed or measured, we think that having diverse undergraduates mentor ODI youth by sharing their college experiences helped to support ODI's mission of inviting all youth, regardless of their demographics, to believe that they too could be ocean scientists. Though our pilot course design did not include structured polling of the undergraduates after their participation, we have self-reporting from five of our 10 participants, all of whom mentioned that their participation influenced their future career paths, and at least one of them has continued to work directly with our community partner. In future iterations, we plan to formally poll undergraduates after completion of the course to assess the impacts of their participation.

LESSONS LEARNED AND FUTURE PLANS

Although our pilot course syllabus included references to some aspects of pathway building, it left out critical conversations about the process of learning itself. Future iterations of the course will encourage mentors to think about the nature of learning as a cultural process (Nasir et al., 2006). This includes challenging mentors to consider diverse epistemologies and sense-making in science education (Bang and Medin, 2010; Bang et al., 2017). During the pilot, our undergraduates focused on listening as a form of building relationships. In the future, we want undergraduates not only to listen but also to notice how mentees are making sense of learning and to welcome different ways of expressing science knowledge (i.e., storytelling and art) in their mentoring sessions (Warren et al., 2001). The many ways of building relationships highlight the importance of partnering with experts in the fields of education and pedagogy to design a course focused on best practice in mentoring.

In terms of research, in future iterations of this course, undergraduates and mentees will be formally assessed to determine whether the mentoring program had any long-term impact. As the course further develops, we will include mentee/protegee focus groups and in-the-moment engaged youth reflections, as well as field observations on the interactions between mentors and mentees. We also will design opportunities for our students to travel to City Heights and engage with the community more directly, something that we did not have an opportunity to do due to COVID-19 restrictions.

This mentoring model would not have been possible without a strong partnership between UCSD and an established community partner that allowed the pilot to have an immediate impact on undergraduates. Utilizing an iterative and adaptive model in the course design allowed for the integration of feedback from the community partner, ensuring that the mentorship course supported ODI objectives. Along with our UCSD undergraduates, we learned that community-engaged courses require flexibility, persistence, and cooperation. We will continue to strive to create more opportunities to be community-engaged in our course design.

Although we appreciate that the large-scale inequities in our existing educational system require wide-ranging, systemic fixes, we hope this program will inspire many undergraduates at UCSD to become community advocates for culturally responsive mentoring in education and the field of geosciences.

SUPPLEMENTARY MATERIALS

The supplementary materials are available online at https://doi.org/10.5670/oceanog.2023.104.

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