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Generación SEA: Binational Youth Engagement to Cultivate Sense of Place, Respect Multiple Ways of Knowing, and Develop Future Ocean Leaders

ACTIVITIES AND PROGRAM MODELS

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ABSTRACT

Youth leadership is an essential part of navigating the changing Ocean. With future leaders coming from varied backgrounds and headed in various directions, development programs which build Ocean literacy through multiple ways of knowing, embodied practices, and sense of place are crucial. Transboundary collaboration is another key feature to support Ocean health, maximizing benefits and justice where seascapes span power asymmetries. Generación SEA is a binational youth program to develop Ocean leaders through powerful educational experiences in the Ocean and classroom, supporting teenagers from Mexico and the USA in the cross-border Cali-Baja region. Here, we explain Generación SEA's background and motivations, then detail the program steps, accompanied by reflections on the process and its legacy. This grassroots program breaks ground in building Ocean literacy through experiential learning at leading institutions, consolidated with embodied practices, while centring youth voice in a binational context. We hope that sharing this project will spread this approach for extension and development in other contexts.

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BACKGROUND

Ocean degradation is one of the great challenges of our time, with impacts and solutions cutting across many aspects of society, ecology, economy, and culture (Boyle & Gentili 2025; Frazão Santos et al. 2022; Lacroix et al. 2016). Training and supporting various leaders who take many paths and speak to many audiences will be key to Ocean sustainability, requiring a cross-cutting ethic of care for the Ocean (Auster et al. 2009). Collective action is important in producing environmental solutions and requires collective literacy-building (Ardoin et al. 2023; Boyle et al. in review; Soffietti et al. 2025). Marine conservation needs multi-scalar solutions across land and sea (Wedding et al. 2024, 2025) and spanning jurisdictions (Wedding et al. 2026), including where these cross borders (Scott et al. 2024).

Young people have made essential contributions to Ocean health but need tailored support to bring out their best (Fernandez 2025). Many of today's youth care deeply about the Ocean and intersecting issues of environment and justice but rarely have the chance to participate in decision-making: they need specific pathways and opportunities (Devenport et al. 2021). Youth leadership in marine conservation can reach across society, both within their families and in their wider communities (Hartley et al. 2021). The creativity of young people can help to communicate complex ideas to their peers and wider communities and empowering them to lead from their own context can support innovation (Boyle & Copley 2022; Wright-Arora et al. 2024). Youth empowerment should be considered an essential part of Ocean futures across sectors (Siringi et al. 2019).

Experience-based learning is vital for such youth empowerment and training, particularly on environmental topics (Ballantyne & Packer 2009). Experiential learning effectively supports teenage learners, particularly for environmental issues and when led outside of formal learning environments (Jose et al. 2017). Environmental education helps connect people to nature (Liefländer et al. 2013), which helps them better protect it (Mackay & Schmitt 2019) while supporting deeper engagement and wellbeing (Maloney et al. 2026; Murray et al. 2023). Co-production is an important way to help bring youth voice into conservation and to engage people in emotionally and intellectually challenging topics, including in embodied ways (Boyle et al. in review; Boyle & Copley 2022; Wilhelm et al. 2026).

Sense of place describes the emotional, cultural, and social links people form in relation to space, fundamental in motivating conservation and demanding a holistic (ecological, psychological, sociocultural, political, and economic) view in environmental education (Ardoin 2006). Coastal areas produce many intangible benefits for local communities, including a strong sense of place and identity closely linked to marine environments (Ainsworth et al. 2019). Sense of place can be difficult to capture and build at sea, active place-making and intimate connection to the Ocean needs to be accounted for and celebrated within marine conservation (Gee & Siedschlag 2020). Individual values and place-based knowledges are needed alongside science to effectively plan just conservation in marine and coastal zones (Boyle et al. 2026; Wedding et al. 2024). Working with youth 'in place' can promote wellbeing and sustainability (McRuer & Zethelius 2017).

In this context, Tijuana-based Kilómetro Uno, in partnership with San Diego-based Un Mar de Colores, introduces Generación SEA: a youth climate resilience academy taking place in communities and ecosystems of both sides of the USA-Mexico border, making it a truly cross-border initiative. At Generación SEA, our mission is to fortify coastal resilience in the Cali-Baja (California, USA, and Baja California, Mexico) region by empowering the next generation to lead climate action and environmental stewardship, with borders offering opportunities as well as barriers (Aburto-Oropeza et al. 2018). Cali-Baja is well-suited to this approach as a global innovation mega-region (Pérez Núñez & Serrano Santoyo 2020) where diverse social-environmental issues intersect and cross-border collaboration is needed (Aburto-Oropeza et al. 2018), particularly on coastal issues (Le Alvarado et al. 2024).

Ocean literacy is key for supporting Ocean health, and can be built through education, cultural connections, technological innovation, and knowledge exchange (Boyle et al. in review; Kelly et al. 2022), all found in Generación SEA. Through a series of expert-led educational workshops, hands-on experiences, and collaborations with local organizations, our participants are equipped to tackle critical coastal challenges including erosion, pollution, biodiversity loss, and impacts of climate change.

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MOTIVATION

The program originated from recognizing the shared need for opportunities, tools, and inspiration to start a career as a young changemaker, acknowledging and celebrating the diversity of careers and approaches for social and environmental impact. Gathering the experience of two youth-founded, youth-focused NGOs (non-governmental organizations) at the frontlines of marine conservation and coastal resilience in Tijuana and San Diego, we wanted to provide young people with the tools we gained through trial-and-error, helping them kickstart their pathways to Ocean leadership. Working binationally creates many challenges but we believe these are outweighed by the advantages (Aburto-Oropeza et al. 2018), particularly in encouraging and facilitating cross-border collaboration from the start of our Ocean leaders' journeys. Underpinning our approach is the need to connect with the coasts, generating sense of place as well as providing positive experiences, often for the first time for our students.

In this article, we detail why and how we delivered the first year of Generación SEA, hoping to demonstrate best practice for youth empowerment, environmental education, and cross-border collaboration.

> "Generación SEA is a program that acknowledges the value of science but also recognizes the people and organizations at the forefront of the environmental struggle.
>
> A program that values what is learned inside the classroom as much as what is learned outside, in contact with nature.
>
> A program that gives equal weight to the knowledge of an 'expert' and the knowledge of our Indigenous and local communities.
>
> A program where a session of surfing, kayaking, or hiking is the best tool for reinforcing learning.
>
> At Kilómetro Uno, we will continue to do everything possible to open doors and pave the way for future generations of environmental leaders."

PROGRAM

We selected 24 youth participants (12 from Tijuana and 12 from San Diego) for an immersive, ten-week experiential learning program. Participants were recruited through an extensive in-person outreach campaign conducted in high schools across Tijuana and San Diego, coordinated with school staff, alongside NGO partners, volunteer networks, and social media. Applicants completed an application form collecting demographic information, along with a short essay or video outlining their interest in climate change and their motivation to participate in the academy. Participants engage in expert-led workshops, hands-on fieldwork, outdoor education, and skill-building across diverse coastal landscapes. Specifically, the Academy takes place across Tijuana, Rosarito, Ensenada, San Diego, Imperial Beach, La Jolla, Oceanside, and Paradise Valley to learn about and experience the watershed, wetlands, coastline, marine protected areas, Kumeyaay lands, and kelp forests of the Cali-Baja region (Table 1).

Generación SEA is directed at 15–18-year-olds, an age gap Kilómetro Uno and Un Mar de Colores recognise as crucial based on their own experiences in environmental education programs. This age group also experience the 'adolescent dip' in nature connection (Price et al. 2022), and are at a key point for considering future career paths. Participants are selected from communities along the Cali-Baja region, prioritizing those most affected by climate change, environmental degradation, and socio-economic disparities. This includes marginalized neighborhoods, low-income populations, and other vulnerable groups facing disproportionate risks and impacts from environmental hazards and socio-economic inequities. The breakdown of participants and session leads also reflects the importance of representing women in Ocean leadership (Gissi et al. 2018). The average participant was a 17-year-old girl from a public high school in Tijuana.

Generación SEA's partnership network embodies diversity in gender, geography, discipline, and culture. Including Indigenous, academic, governmental, and community-based voices connects participants with mentors who reflect many identities and lived experiences. This

WEEK	LOCATION	THEME	OUTDOOR ACTIVITY	PARTNERS
1	University of California San Diego (UCSD) Eighth College, La Jolla, USA	**Orientation:** Hosted for students and their families, we detailed program structure, values, and safety protocols	Surfing	UCSD Recreation, Black Like Water, Paddle for Peace, and UCSD Eighth College staff
2	El Colegio de la Frontera Norte (COLEF), Tijuana, Mexico	**Climate Change and its impact on Coasts & Oceans:** Binational coastal challenges and community-driven resilience	Hiking	Led by Juan Manuel Esteves and Gabriela Muñoz (COLEF), Napoleón Gudiño (IIO), and Waylon Matson (4 Walls International)
3	Scripps Institution of Oceanography, La Jolla, USA	**Marine Biology and Conservation:** Marine ecosystems, biodiversity, and conservation strategies	Beach walk	Octavio Aburto and Isabel Rivera-Collazo (Scripps), along with Nancy Renner (Birch Aquarium)
4	Universidad Autónoma de Baja California (UABC), Ensenada, Mexico	**Nature Based Solutions:** Explored habitat restoration and ecosystem services through fieldwork and dialogue	Tidepooling	Facultad de Ciencias Marinas (UABC). Facilitated by Paulina Filz (UABC) and Rodrigo Beas (MexCal)
5	Tijuana River National Estuarine Research Reserve (TRNERR), Imperial Beach, USA	**Climate Justice, Advocacy, and Public Policy:** Equity, governance, and frontline climate leadership	Birdwatching	Marce Gutiérrez-Graudins (Azul), TRNERR staff, Youth4Climate, and Mayor Paloma Aguirre of Imperial Beach
6	Paradise Valley Farm, Valley Center, USA	**Indigenous Ecological Knowledge and its role in mitigating climate change:** Indigenous knowledge systems, healing practices, and land stewardship	Beaver dam construction	Lacey Cannon (Indigenous Regeneration) and Juan Reynoso (The Queer Sol Collective)
7	Cross-Cultural Center, UCSD, La Jolla, USA	**Communications for Climate Change:** Strategic storytelling	Photography and surfing	Diandra Marizet (Intersectional Environmentalist) and filmmaker Manolo Mendieta (Spunco Films)
8	CETYS Universidad, Tijuana, Mexico	**Green & Blue Economy:** Sustainable fisheries, regenerative entrepreneurship, and circular economy practices.	Restoration (tree planting)	Sasha Calder (Resilience Impact Agency), Octavio López (Nación Verde), Luis Robles (SEPESCA), and members of Tijuana Río Conecta Initiative
9	Oceanside, USA	**Urban Planning:** Equitable infrastructure and adaptation planning	Beach day (volleyball and swimming)	Darbi Berry (San Diego Regional Climate Collaborative), Destiny Preston (California Transportation Commission), and Alex Paige Klein (Coastal Adaptation Consultant)
10	Universidad Iberoamericana Tijuana. Tijuana, Mexico	**Capstone Presentations & Graduation**	Beach day and sunset	Universidad Tecnológica de Tijuana (Luis Vargas), TRNERR (Ana Eguiarte), and the Walter Munk Foundation for the Oceans (Mary Munk)

Table 1 The timetable and plan for the inaugural Generación SEA program.

collaborative, plural model is essential to Generación SEA's mission of supporting youth to advance Ocean literacy, restore ecosystems, and lead climate solutions throughout the Cali-Baja region. By embracing the perspectives and addressing the needs of various communities, our project promotes equity, resilience, and sustainability, ultimately benefiting all residents and fostering a more inclusive and resilient future for the Cali-Baja region.

The curriculum was devised to cover a breadth of key issues concerning the modern and changing Oceans, with support from university and institute staff and environmental educators. The program was developed based on Kilómetro Uno's experience in founding and scaling an NGO, as well as the founders' graduate-level academic training, reflecting the needs identified during the organization's own development and drawing on the experiential and practice-based knowledge of NGOs and community actors working in coastal and border regions. The curriculum adopts an interdisciplinary approach integrating scientific knowledge, communication, public policy, and Indigenous knowledge systems, alongside community-based and practitioner-led perspectives. It also engages a climate justice lens while incorporating immersive, nature-based experiences that foster personal connection, wellbeing, and long-term stewardship of the natural environment.

The program spans nine core themes, equipping participants with a strong foundation in: climate change and its coastal impacts, marine biodiversity conservation, nature-based solutions, Indigenous ecological knowledge, climate justice, the blue economy, urban planning,

advocacy and public policy, and climate communications (Table 1). Our participants connect to the ecosystems they are learning to protect through outdoor activities like surfing, hiking, tidepooling, and birdwatching, establishing an embodied emotional connection to ground their journey in Ocean literacy and personal empowerment (Figure 1). These direct experiences not only reinforce classroom knowledge but inspire a deep sense of place and responsibility.



Figure 1 Generación SEA's approach and commitment, outlining our core tenets of experiential learning, community engagement, and advocacy, underpinned by personal connection.

PROGRAM GOALS

- Enhance Basic Climate Resilience Knowledge: Equip our youth with a comprehensive understanding of climate resilience principles and the interconnectedness of social and climate issues.
- Foster Cross-Border Collaboration: Create a community of young leaders from the San Diego/Tijuana region who are informed, interconnected, and passionate about their shared environment.
- Empower Youth Leadership: Develop the skills necessary for participants to lead community-based climate action projects, supported by a tailored Climate Resilience advocacy toolkit.
- Strengthen Community Engagement: Build robust connections with local stakeholders to enhance community resilience and prepare participants for future roles in environmental science and conservation.

The program features lectures, panels, hands-on sessions, and field trips in collaboration with the leading research institutions, NGOs, and activists from both sides of the border (Table 1). Generación SEA is powered by a dynamic coalition of over 40 professionals and more than 20 organizations across Mexico and the United States, working together to deliver a rich, interdisciplinary learning experience. This binational alliance includes scientists, policy experts, community organizers, creatives, educators, Indigenous leaders, and entrepreneurs, all committed to empowering youth leadership for resilience in the Cali-Baja region.

Designed to build youth capacity for environmental resilience, the program's content ranges from biodiversity science to mental health, public policy to storytelling, and climate justice to Ocean safety (Table 1). A typical session includes a lecture from a subject expert, a hands-on outdoor activity to reinforce learning, and a discussion led by project coordinators to develop the participants' critical points of view (Figure 2). Collaborating with technical specialists, NGOs, and community leaders provides appropriate and up-to-date content, encouraging dialogue with participants. Sessions run by experienced outdoor guides also ensures thorough safety protocols throughout and proper guidance and training for activities new to participants. Having a consistent team of group leaders encourages co-learning while also building trust and relationships, which can help guide participants out of their comfort zones while also improving safety. The final session showcases capstone projects developed throughout the program, supporting experiential learning and applying lived and learned understandings toward local environmental challenges.

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Figure 2 Photos from the Generación SEA sessions reflecting the kinds of activities groups took part in: **a)** tidepooling, **b)** photo taken by a student during the photography session, **c)** birdwatching, **d)** filmmaking, **e)** invertebrate study, **f)** visiting algae facilities, **g)** surfing, **h)** whale-watching.

For example, during Week 4's Nature-Based Solutions session at the Universidad Autónoma de Baja California (UABC), Ensenada campus, participants began with a brief lecture on the Cali-Baja kelp-forest ecosystem by Rodrigo Beas, professor and researcher at UABC's Facultad de Ciencias Marinas and co-founder of MexCal (Managing Ecosystems Across the Californias). Postgraduate students then led a tour of the kelp and oyster hatchery laboratories, followed by a guided tide-pooling exploration and intertidal ecosystem monitoring practice facilitated by MexCal (Figure 2). The day concluded with a short talk on Nature-Based Solutions by researcher and postgraduate student Paulina Filz and an introspective team-building activity to strengthen bonds within the Generación SEA cohort.

Participant safety was ensured through structured protocols implemented across all activities, particularly field-based and cross-border components. Protocols included supervised group participation through a buddy system, mandatory check-in and check-out procedures, and continuous staff oversight. For binational travel, participants were accompanied by program staff throughout border crossings, with required documentation verified in advance and coordination with parents or guardians when applicable. Basic first-aid capacity was maintained on-site, with escalation procedures for medical emergencies, including activation of local emergency services and notification of parents or guardians. Participants provided relevant medical information, and emergency contact records were maintained. Incident reporting and communication protocols were established to document and respond to safety concerns.

Each of the ten academy sessions is co-facilitated by experts and institutions working across the border and hosted in diverse ecosystems and communities throughout the Cali-Baja region (Figure 3).

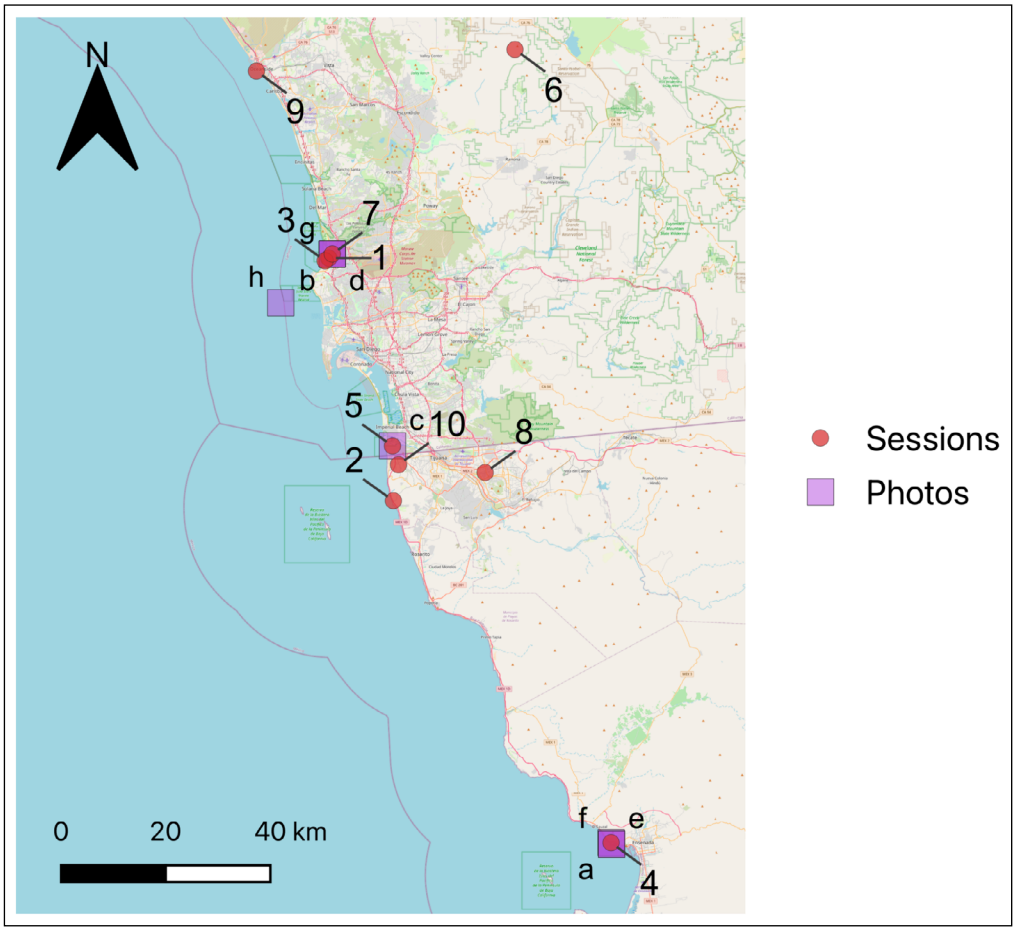

Figure 3 The geographic spread of the sessions within Cali-Baja, labelled with session numbers. The locations of the photos from Figure 2 are also included here.

CAPSTONE PROJECT

The program culminates with a joint session with the participants from the San Diego and Baja California groups. Guided by Kilómetro Uno and partners, the groups will be divided into four binational teams of six participants. Participants design actionable solutions to regional climate-related challenges through interdisciplinary teamwork and community engagement. Over six hours, teams develop and present their proposed solution to a panel that chooses the winning project. The winning project team receives an Ocean Safari Experience to connect with our vibrant sealife and a year of mentorship to realize their idea. The projects are assessed for research skills, solution design, community engagement, project planning, presentation and advocacy, strategy, creativity and teamwork (full rubric available in the handbook, Appendix 1).

LEGACY

This innovative program strengthens resilience in the Cali-Baja region by empowering and building the capacity of the next generation of binational environmental leaders. Leaders who will not hesitate to collaborate across borders and will be thoroughly prepared to implement environmental solutions. It also strengthens resilience in the region by developing new knowledge on youth engagement and binational collaboration, leveraging new partnerships among research institutions, NGOs, activists, filmmakers, photographers, and artists.

In addition, Kilómetro Uno have co-produced a Toolkit on Climate Resilience Advocacy specifically developed for the Cali-Baja region (see Appendix 2), in collaboration with the 24 program participants. Such co-design initiatives are highly effective at consolidating experiential learning (Boyle et al. 2026; Boyle & Copley 2022; Metcalfe et al. 2022). Together, we provide recommendations for future youth engagement initiatives. Lastly, Kilómetro Uno and Un Mar

de Colores produced varied social media content[1] and a short documentary on Generación SEA to inspire other binational communities to replicate the initiative and attract additional funding to make the Academy a fixed and core program in the Cali-Baja region.

REFLECTIONS

The inaugural cohort successfully developed impactful projects focused on nature restoration, Ocean-bound plastic interception, sustainable kelp innovations, and textile waste reduction, benefiting from expert mentorship and robust community engagement. These projects represent real, scalable solutions to the environmental challenges affecting coastal communities in the Cali-Baja region.

The winning team, Vida Nativa (four youth from Tijuana and two from San Diego), received two prizes: an Ocean Safari experience in San Diego, California, and a one-year mentorship from Kilómetro Uno and Un Mar de Colores. For all six students, it was their first time seeing a whale; for two, it was also their first time on a boat.

Vida Nativa is a youth-led initiative addressing coastal erosion and marine litter through habitat restoration, community cleanups, and education in high-impact areas across Tijuana and San Diego (see Appendix 3). The team have led their first activities, fundraising by selling homemade baked goods at their high schools. Their first events, for Tijuanita mi Ciudad and Centro Cultural Tijuana, used games and workshops to focus on native coastal plants and attracted 1200 participants (Figure 4). They are also building capacity by attending environmental networking events in Tijuana and participating in Kilómetro Uno's environmental-education workshops and beach cleanups. With mentorship from Kilómetro Uno and Un Mar de Colores, they have submitted their first grant applications.



Figure 4 Photos from Vida Nativa's activities since graduating from Generación SEA.

The measurable impact of Generación SEA's 2024 cohort underscores the program's effectiveness: 100% of participants increased their understanding of climate change and were inspired to engage in environmental action proactively; 85% enhanced their knowledge of marine biodiversity; 69% gained insight into nature-based solutions; 75% deepened their appreciation for Indigenous Ecological Knowledge; 77% reported feeling more prepared for local climate action, and 69% expressed greater confidence in leading community projects. In just our first year, Generación SEA alumni have received the highest distinction in their high schools and been accepted to study marine and environmental sciences at top universities including the University of California, Santa Barbara, our partner insititutes (Scripps and UABC), and a full scholarship to Boston University. Alumni have also received an internship with the Salk Institute, been recognised with the Municipal Youth Award by Tijuana's Municipal Youth Institute, become general coordinator of the 2026 Baja California Youth Climate Summit (Cumbre Climática Juvenil Baja California 2026), and selected as part of the Mexican youth delegation attending the 2025 UNFCCC COP30 in Brazil. The Generación SEA project itself was also awarded the North American Association for Environmental Education's Global E-STEM Awards Excellence Prize, which recognizes excellence in established environmental education programs. While our participant feedback surveys demonstrate that Generación SEA improved participants' Ocean literacy, we have the good fortune of outstanding young people flying the flag for our program as alumni. Many participants have continued working on their initiatives or engaged in environmental leadership opportunities since completing the academy.

1 https://www.youtube.com/playlist?list=PLHzYX65iWAFmCpiHmMJGNBrHKMOol3902.

With funding secured for the 2026 program in collaboration with UC San Diego Extended Studies and the support of the San Diego Foundation, The International Community Foundation the North American Association of Environmental Education and the UMI Fund, we see many ways to build on the success of this first program to continue supporting youth leaders. Generación SEA 2026 builds on the successes of the first program, introducing extensive systems thinking approaches and bringing in alumni as contributors and peer mentors. The bilingual, binational character of this project is a great strength for cross-border collaboration, but many youth leaders were unable to participate due to limited English or Spanish fluency or restrictions on crossing the border. Alongside bilingual materials, live translation during sessions could alleviate some of the linguistic challenges, albeit at a cost, though other limitations are beyond the scope of our team and present significant safeguarding issues. We also hope to produce equitable opportunities for a wider range of participants through programming in Mexico for participants who cannot cross the border and cannot speak English, while maintaining a binational lens. Border restrictions impacted families' attendance at welcome and graduation ceremonies, and some participants had never crossed the border before. These challenges are heightened in a time of increased immigration raids and persecution, where mobility and data handling present greater risks for undocumented people and their families. Further programming could also benefit from deeper engagement with local Indigenous communities, both in terms of supporting positive outcomes for them and the wealth of knowledge they hold regarding the land and sea. Beyond planned initiatives to engage more participants and partners from Indigenous communities, we plan to further support Indigenous engagement with the program as our partnerships, resourcing, and outreach network extends over time.

Engaged and sensitive programming from NGOs and community groups is fundamental in resisting hostility from the state (Karandikar et al. 2026; Kirby & Roose 2025), in this case continuing to support cross-border social-environmental work needed to tackle issues which span the Cali-Baja region. We therefore see great potential in developing national programs which are more accessible to a wider section of society in both countries. These national programs offer something different and could interface with binational initiatives, increasing understanding of each other's opportunities and challenges, building networks with deep roots and broad branches.

CONCLUSION

While challenging to develop and remarkably successful in its delivery, we believe Generación SEA can serve as a template for other cross-border youth environmental initiatives. We hope that sharing our approach will lead to more of these kinds of immersive, experiential programs, and more future environmental leaders. A broad coalition of actors came together to make this possible and would have been impossible without extensive partnership working. While we try to secure stable funding, we hope to hear from other similar initiatives and work towards a bigger network of practice. Co-produced youth training without borders is essential to empower the environmental leaders we desperately need, and we hope Generación SEA has got you thinking about what you can do in your own region.

DATA ACCESSIBILITY STATEMENT

The data underlying this article are not publicly available because they include sensitive information relating to minors who participated in the Generación SEA program, as well as personal reflections, survey responses, and project materials that could compromise participant privacy or confidentiality if shared openly. Given the binational context of the program and the inclusion of youth from communities that may face heightened social and mobility-related vulnerabilities, public release of these materials could pose additional risks. The article is therefore based on aggregated findings, program documents, and author reflections rather than publicly deposited individual-level data. Requests for limited access to de-identified materials may be considered by the corresponding author on a case-by-case basis, subject to ethical, legal, and safeguarding considerations.

ADDITIONAL FILES

The additional files for this article can be found as follows:

- **Appendix 1.** Generación SEA course handbook with full details of the materials and sessions (English). ENGLISH Generación SEA Orientation Handbook (4).pdf. DOI: https://doi.org/10.5334/cjme.150.s1
- **Appendix 2.** Climate Resilience advocacy toolkit, co-produced with Generación SEA alumni (Español). On Canva. DOI: https://doi.org/10.5334/cjme.150.s2
- **Appendix 3.** The handbook for Vida Nativa, the team behind the winning capstone project (Español). Semblanza.pdf. DOI: https://doi.org/10.5334/cjme.150.s3

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COMPETING INTERESTS

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