Ocean and Society
2024 • Volume 1 • Article 9328
https://doi.org/10.17645/oas.9328

COMMENTARY

Open Access Journal

Building Successful International Summer Schools to Enhance the Capacity of Marine Early Career Researchers

Christopher Cvitanovic [1,2], Jessica Blythe [3], Ingrid van Putten [4,5,6], Lisa Maddison [5], Laurent Bopp [7], Stephanie Brodie [4], Elizabeth A. Fulton [2,4], Priscila F. M. Lopes [8,9], Gretta Pecl [10,5], Jerneja Penca [11], and U. Rashid Sumaila [12,13]

[1] School of Business, University of New South Wales Canberra, Australia
[2] Centre for Marine Science and Innovation, University of New South Wales, Australia
[3] Environmental Sustainability Research Centre, Brock University, Canada
[4] Commonwealth Scientific and Industrial Research Organisation, Australia
[5] Centre for Marine Socioecology, University of Tasmania, Australia
[6] Wageningen Economic Research, Wageningen University & Research, The Netherlands
[7] LMD/IPSL, CNRS, Ecole Normale Supérieure, Paris Sciences & Lettres University, France
[8] Department of Ecology, Federal University of Rio Grande do Norte, Brazil
[9] Research Institute of the University of Bucharest, University of Bucharest, Romania
[10] Institute for Marine and Antarctic Studies, University of Tasmania, Australia
[11] Mediterranean Institute for Environmental Studies, Science and Research Centre Koper, Slovenia
[12] Institute for the Oceans and Fisheries and the School of Public Policy and Global Affairs, University of British Columbia, Canada
[13] Department of Agricultural Economics and Rural Development, University of Pretoria, South Africa

Correspondence: Christopher Cvitanovic (c.cvitanovic@unsw.edu.au)

Submitted: 23 September 2024 **Accepted:** 1 October 2024 **Published:** 24 October 2024

Issue: This commentary is part of the issue "The Outliers: Stories of Success in Implementing Sustainable Development Goal 14" edited by Sarah Lothian (University of Wollongong) and Bianca Haas (University of Wollongong), fully open access at https://doi.org/10.17645/oas.i402

Abstract

The development of informal science learning programs is a key strategy for supplementing traditional training for early career researchers (ECR). Within the marine sector, there has been a proliferation of international summer schools (a form of informal science learning program) to support ECRs to develop the networks, skills, and attributes needed to tackle ocean sustainability challenges and support the attainment of the Sustainable Development Goals (e.g., collaboration across disciplines, policy engagement, etc.). Yet, there exists very little evidence on the impact generated by such informal science learning programs or the design strategies that can confer their success. This commentary seeks to address this knowledge gap by considering the successful biennial Climate and Ecosystems (ClimEco) marine summer school series that has run since 2008. Specifically, we draw on the perspectives of lecturers and organisers, in combination with a survey of ClimEco participants (n = 38 ECRs) to understand the drivers and motivations of ECRs to attend summer schools, the types of outcomes and impacts that summer schools can have for marine ECRs, and the

key factors that led to the successful attainment of these impacts, outcomes, and benefits. In doing so, we develop guidance that would enable global summer school convenors to effectively support the next generation of marine researchers to advance ocean sustainability.

Keywords

early career researchers; informal science learning programs; interdisciplinary; ocean sustainability; postgraduate; SDG 14; transdisciplinary

1. Introduction

The UN Decade of Ocean Science for Sustainable Development (2021–2030) calls for the science we need for the ocean we want, particularly to achieve the SDGs. This initiative underscores the importance of cultivating a new generation of scientists capable of addressing the complex and interconnected challenges facing marine social-ecological systems. Scientists must, among other things, have the ability to work across disciplinary boundaries (Kelly et al., 2019; Sumaila, 2024), build trusted relationships to engage with policy and practice (Cvitanovic et al., 2016, 2021; Evans & Cvitanovic, 2018), and collaborate with a wide range of non-academic actors and knowledge systems (Penca et al., 2024). This is evident in the global growing demand for diverse, equitable, interdisciplinary, and transdisciplinary research and researchers (e.g., Pennino et al., 2021), which is also increasingly used as a key metric of career success by funding agencies, academic institutions, and selection committees for prestigious awards (de Vos et al., 2023). Consequently, there is an urgent need to build the capacity of early career researchers (ECRs) to meet these evolving expectations and ensure the development of marine scientists equipped to tackle the pressing issues of the 21st century (Brodie et al., 2022; Hildebrand, 2019; Shellock et al., 2023).

Traditional academic training programs, such as those for Masters and PhD degrees, often fall short of equipping ECRs with the full suite of skills necessary to address the complex challenges of contemporary marine science (Andrews et al., 2020). They typically emphasize the norms and methodologies of a singular scientific discipline (although we do note the emergence of a range of postgraduate programs that aim to reverse this trend), which may limit researchers' ability to work across various fields and collaborate effectively beyond their area of expertise. Moreover, traditional postgraduate science curricula frequently overlook the development of essential "soft skills"—such as communication, teamwork, and stakeholder engagement—that are critical for undertaking research needed in modern times.

Informal science learning programs (ISLPs), developed outside of core training and degree programs, can fill this early career training and development gap. Participation is voluntary and they are structured towards achieving desired skills and/or attributes (e.g., Moskel et al., 2021). In the context of marine education, international summer schools have emerged as key ISLPs to support ECR's skills development (e.g., Aguilar-Manjarrez & de Viçose, 2018; Singh et al., 2024). However, little scholarship exists on marine summer schools, particularly in terms of best practices for program development to ensure lasting and enduring outcomes and impacts for participants (Penca, 2021).

In this Commentary, we seek to fill this gap, using the long-standing Integrated Marine Biosphere Research (IMBeR) ClimEco summer school series as a case study. Specifically, we draw on the perspectives of a group of

ClimEco lecturers and organisers (the authors), combined with a survey of ClimEco participants (n = 38 ECRs), to understand the drivers and motivations of ECRs to attend summer schools, the types of outcomes and impacts that summer schools can generate for marine ECRs, and the key factors that led to attaining these benefits. In doing so, we aim to provide guidance for convenors of other global summer schools to help them design effective programs that build the capacity of ECRs to advance ocean sustainability.

2. The Short History of ClimEco

The IMBER (see Hofmann et al., 2015 for a history of the project) first organised the biennial Climate and Ecosystems ("ClimEco") summer schools for marine ECRs when its focus shifted to include human dimensions. The location of the summer school changes every year, bringing into collaboration a local co-organiser and bringing opportunities to ECRs in regions which can struggle to access events due to, for example, limited funding. The first ClimEco summer school was held in 2008 in Ankara, Turkey, and the most recent in Koper, Slovenia in 2023. Over this 16-year period, six ClimEco summer schools have been held in six countries (one was held online during the Covid-19 pandemic).

Each ClimEco summer school focuses on a topic relating to global change and human and ocean systems (van Putten et al., 2021). The topic is chosen by the organiser and convenor, who also co-ordinates the development of the program. Disciplinary experts are invited to lecture relevant sections. Altogether, 40 lecturers volunteered (some more than once) about 10 days each for each event. The ClimEco summer schools were attended by 445 ECRs from 68 countries (Figure 1 shows the last five summer schools—for which full data was available).

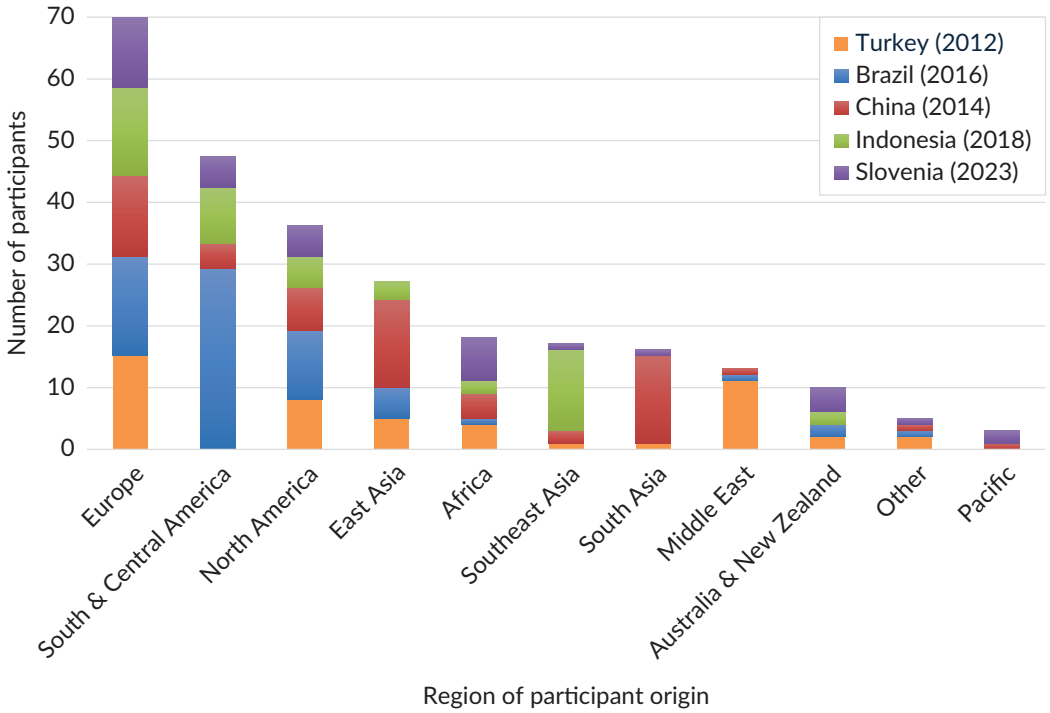

Figure 1. The summer school participants by region according to the location and year, across the last five in-person ClimEco summer schools for which data was available (held in Turkey, Brazil, China, Indonesia, and Slovenia).

The geographic, disciplinary, and gender distribution of attendees is intentionally balanced. Nevertheless, work remains to be done because the attendees from the Pacific are significantly unrepresented (Figure 1). The organiser (in collaboration with the local co-organisers) undertakes administrative and logistical tasks, including promotion, communication with applicants, budget management, and fundraising (sponsorship for specific summer school events and travel support).

3. Why Do ECRs Attend International Summer Schools?

As described in the introduction (Section 1), ISLPs (in this case summer schools) are designed to provide structured learning towards a specific goal and outcome. It is therefore important to first understand what motivates ECRs to attend international summer schools, as this has implications for their design, and thus the guidance suggested later in this commentary.

The 38 survey participants mentioned 81 motivations to attend which could be grouped into seven main themes (Figure 2): one did not respond, and the remainder provided between one to four motivations. Thematic analysis of the responses indicated that most attend summer schools to "network" (n = 22). However, the purpose of networking varied. Some aimed to network with their peers or find potential collaborators, some to network with people from other cultures/countries, others simply to increase their network, and some specifically wanted to network with lecturers.

The next most mentioned motivation to attend ClimEco was to increase skills and expand horizons (n = 17), or interest in a particular topic (most common were climate change, social science research methods, science communication and engagement, environmental justice, and sustainability; n = 17). Many wanted to gain interdisciplinary skills (n = 11). Others had personal drivers for attending, such as scouting for career opportunities and building their reputations. Some were attracted by the lecturers or wanted to visit the place where the summer school was held.

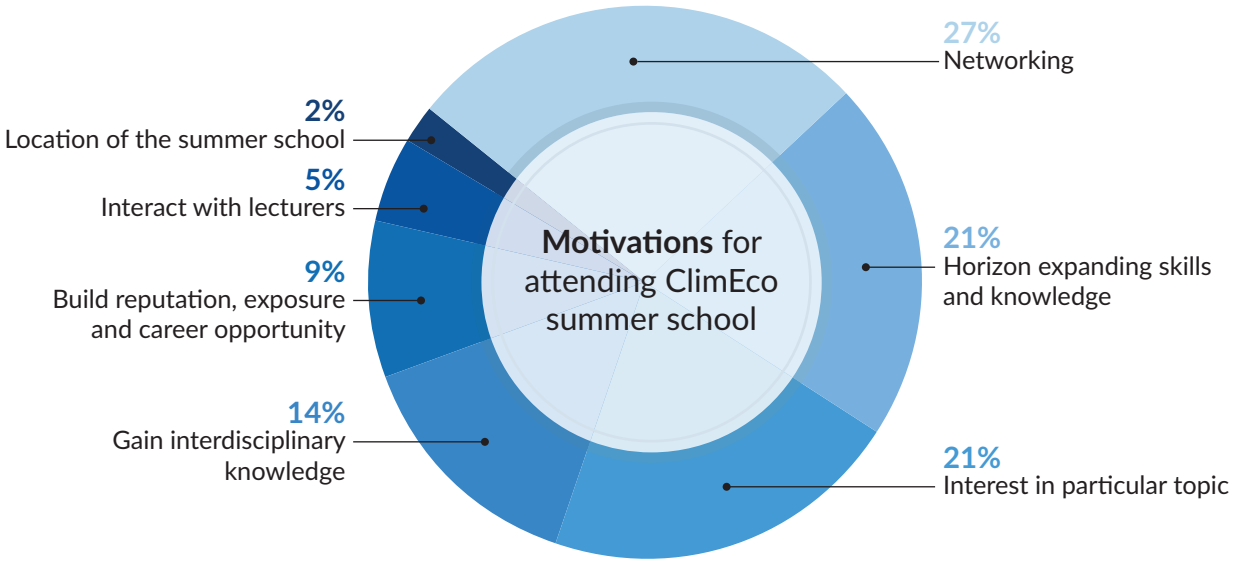

Figure 2. Motivations of participants for attending ClimEco summer schools.

4. What Benefits Occurred as a Result of Attending ClimEco?

4.1. Benefits Derived From Attending a ClimEco Summer School

Networking was the most frequently reported benefit of attending ClimEco (based on $n = 33$ that completed this question of the survey, Figure 3). Participants developed both personal and professional connections, with one noting, "I'm still in touch with some of my fellow participants, we have a WhatsApp group where we exchange useful information about events or opportunities." Another mentioned the importance of building "connections with other senior academics I would've been too shy to try and create in another setting [e.g., a conference]."

The second most reported benefit was learning ($n = 30$). Participants mentioned learning about marine social science ($n = 6$), new places and cultures ($n = 4$), ecosystem modelling ($n = 3$), interdisciplinary marine science ($n = 3$), knowledge mobilization ($n = 3$), careers paths ($n = 1$), climate research ($n = 1$), oceanography ($n = 1$), and academic publishing ($n = 1$), among other topics.

The remaining benefits were split across three themes. Six respondents identified an increased appreciation for equity, diversity, and inclusion in marine research. For example, one participant noted that the summer school allowed them to "accept and understand the differences in cultural habits and thought processes from researchers of different latitudes," while another stated that they gained an "increased awareness of challenges faced by minorities in academia and fieldwork." Six respondents identified an increased appreciation for equity, diversity, and inclusion in marine research as a benefit. For example, one participant shared "I was able to take a break from the stress of my program." Finally, six participants valued the opportunity to share their research and receive receive feedback from their peers and lecturers on their research during the poster session.

Although networking was a motivation to attend for many participants, it was an unexpected benefit for some ($n = 12$) who responded that they had not anticipated its value. One shared, "7 years later I still lean on

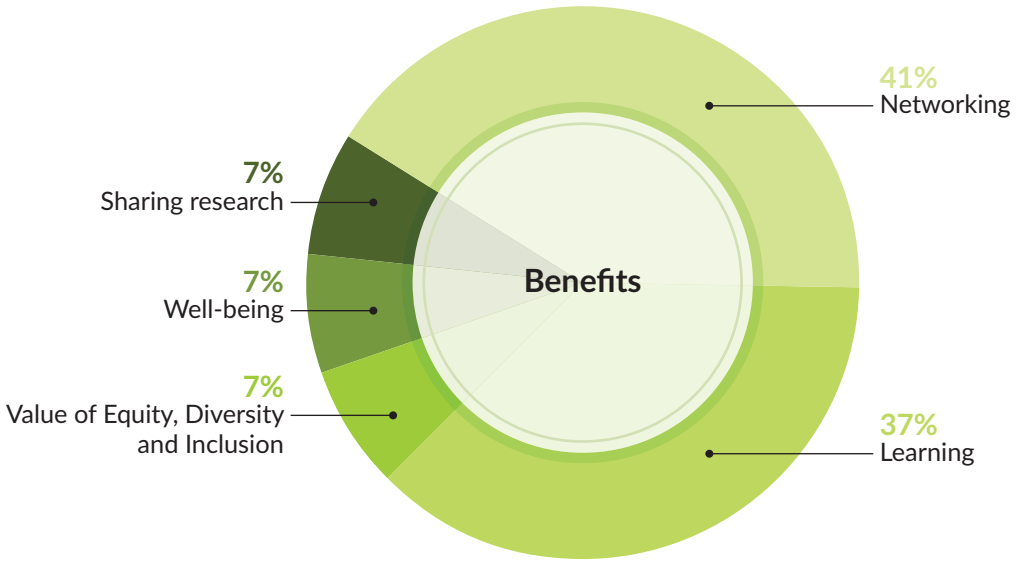

Figure 3. Summary of the benefits derived from attending the ClimEco summer school.

and work with the network I met at this summer school. As an ECR, I was rather naive about the importance of networking [before the summer school]." The next unexpected benefit was the relaxed atmosphere (n = 7). One respondent noted: "My experience of academic [sic] was very rigid…but ClimEco was an extremely warm and welcoming environment that opened my eyes to alternative ways of working in this field." Another indicated that the atmosphere made it "easy to have informal talks and ask questions." Four participants also expressed surprise at how much they learned at the school.

Career opportunities were the most significant outcome of participating in ClimEco, with 16 respondents citing benefits such as heightened job awareness, academic visits, roles on marine science committees, and opportunities for conference presentations. Additionally, some secured postdoctoral, PhD, or Masters positions as a result of attending. The second most common outcome was joint academic publications (n = 7). Eleven survey respondents reported no outcomes as yet.

Summer school participants created an early-career networking platform to build on the connections and collaborations outlined above by establishing the Interdisciplinary Marine Early Career Network (IMECaN), designed to extend the goals of the summer schools. It provides a sustainable platform for early-career marine researchers to foster collaborations, receive training in areas not typically covered by formal education, and access leadership opportunities—particularly for researchers from developing nations. Interdisciplinary Marine Early Career Network now includes members from 103 countries and delivers impactful events and research outputs.

5. Benefits From a Lecturer's Perspective

The lecturers, particularly those who attended multiple summer schools (i.e., the authors), also felt they personally benefited from the experience. We were variously motivated by desires to help expand capacity, give back to the field, and gain exposure to new fields and cultures (and typically a combination of these and more). These desires were often exceeded, noting that we personally benefitted from the exposure to the breadth of disciplines covered in the summer schools (due to the convention that the lecturers attend all lectures as much as possible). We also built new collaborations across disciplines and the lecturer network. Seeing alumni leading impactful research and accessing capability became more straightforward as summer schools, and courses inspired by them, grew in number.

6. How to Build Effective International Interdisciplinary Summer Schools

Attending ClimEco summer schools has led to a range of outcomes and impacts for participants, making ClimEco an example of a successful ISLP, a "bright spot." As highlighted throughout the literature (e.g., Cvitanovic & Hobday, 2018; Karcher et al., 2022), the study of such bright spots can provide important lessons that can be replicated in other contexts (i.e., other summer schools and ISLPs). In this section, we draw from survey respondents, and our own experiences and knowledge as lecturers, to provide guidance for organisers of other marine-focused ISLPs. In doing so, we note that a range of approaches to building successful summer school are likely applicable depending on the topic, goals, and context beyond those outlined here.

The guidelines (presented in the following sections) follow three temporal stages: planning and preparation; implementation; and post-summer school. The overall success of a summer school starts at least 12 months

earlier, and the time and effort involved in planning and preparation should not be underestimated. The success is very much linked to the people involved. Lecturers should not be selected solely on their international standing, but rather for their reputation as collaborative, understanding, passionate (for people and education), and engaging individuals (noting that, in the case of ClimEco, convenors and lecturers worked on a voluntary basis). Lecturer characteristics significantly impact the learning environment. Finally, by design and following the best practices in the field (de Vos et al., 2023), ClimEco intentionally sought to consider and support diversity and equity across all aspects, including actively seeking opportunities for ECRs from the Global South and creating avenues to support their participation through sponsorship, visa applications, and other logistical support.

6.1. Planning a Summer School

The following are considerations to guide the planning of summer schools:

- Have a dedicated organiser: The organiser is the primary point of contact. They have experience in organising events, excellent leadership, and interpersonal skills.
- Engage a convenor: The organiser invites a convenor to drive the event (someone well-regarded in their field, collegial, engaging, and enthusiastic). The convenor largely sets the tone of the summer school. They must commit to volunteering a significant amount of time.
- Choose an interesting and attractive location (and finalize size): Secure a venue early in the process with the help of a local academic who can also contribute to teaching. Ideally, the location is accessible and in a low-income country/region where (this type of) learning opportunity is typically less available. The capacity of the venue dictates the size of the summer school. We found just the right size to allow for both diversity and manageability was 60–65 students and 8–10 lecturers (the optimal ratio appears to be one lecturer to five to seven students).
- Secure facilities: An effective summer school requires a plenary room (preferably with movable tables and chairs), two to three separate rooms for group activities, space for coffee breaks and lunch, an indoor/outdoor area with sufficient wall space for a poster session, outdoor spaces, and a private room for prayer or other personal needs. Windows and natural sunlight are important. An assortment of accommodations (hotels, hostels, student housing, and local homes willing to take in students) close to the venue or with easy transport is ideal.
- Secure funding: Lack of funding limits ECRs, particularly from low-income countries, from attending international events. Even though a registration fee can be charged (see below) to cover costs, the organiser, convenor, and lecturers should apply for grants (e.g., philanthropic organisations, NGOs, and government agencies) for travel support for participants. A central collection point should be set up to receive registration fees, book, and pay for sponsored participants' travel and accommodation, and to pay various vendors and suppliers (e.g., hotels and caterers).
- Choose the topic and draft the program: The organiser and convenor select the topic and draft a preliminary program. Eight days may be the optimal length although some attendees recommended 10–14 days with some free days midway. Balance theoretical and practical sessions, consider trade-offs between depth and breadth of topics, and include at least 50% interactive activities. Ideally, interactive activities foster small group participation, with attendees learning together, sharing skills, and having fun. Laughter and play is a key ingredient to learning.

- Select an inspiring team of lecturers with diverse disciplinary backgrounds: The organiser and convenor invite lecturers with the required expertise that are known for their collaboration and collegiality. The lecturing team must have diverse disciplines, nationalities, genders and career stages, and be available throughout the summer school (i.e., all lecturers are present at all times, even on days they are not teaching).
- Advertise and call for applicants: Develop a flyer and create a website (with location, topic, themes, lecturers, and local committee) at least eight months before the summer school. Promote the summer school, "Save the Date" (seven months), and call for applications (six months), via networks, mailing lists, and social media. The ClimEco application asked for name, email, gender, pronouns, career stage, institution, discipline, nationality, country of residence, CV, and 300-word motivation for wanting to attend.
- Select participants: Use a fair and transparent selection process. A ClimEco selection committee comprised of the organiser, convenor, and two to three lecturers, scored each application (3 = *highly suitable*, 2 = *suitable*, and 1 = *unsuitable*). The top candidates were selected, and any other candidates were discussed collectively (in order of their score). Diversity in gender, career stage, discipline, and country of residence was also taken into account.
- Finalise program: All lecturers contribute to finalising the program, based on their specific expertise and proposed innovative topics and formats. The program is published at least two weeks before the summer school.
- Provide information via a conference app: Information on arrival and departure logistics, accommodation options, program and infrastructure, and cultural information should be included. A conference app (e.g., Whova), where lecturers and participants can upload profiles and interact will be useful. The program, suggested reading material, and surveys (pre- and post-summer school), can be posted on the app.
- Set up registration: Online registration with payment of registration fees, acts as proof of attendance. If fees are required, they should be reasonable ensuring a no-cost balance.
- Embed local logistics: Local ECRs/students can be asked to assist with a local organisation (e.g., in lieu of registration fees) and can recommend facilities, source flip charts and poster boards, and assist with field trips (coordinating timing, transport, entrance fees, guides, catering, etc.).
- Book travel and accommodation: The organiser books travel and accommodation for the lecturers. Early booking will result in cheaper rates. The organiser pre-books rooms for participants in a range of accommodation options (differently priced). Participants then confirm and pay for their bookings. Participants staying close together, within walking distance of the venue, facilitate informal networking.

6.2. Implementing a Summer School

The following are considerations for running the summer school:

- The convenor sets the tone: In the opening address, the convenor should set a friendly, accessible, interactive, and welcoming tone and outline expectations (including equity, fairness, and justice principles). The convenor "opens" and "closes" each day. Learning people's names and addressing them by their names during discussions is important.

- Maximise the physical space: A diversity of "spaces" and constructions are needed (i.e., a U-shape lecture room and sufficiently large breakout rooms to allow people to move around). Flipcharts/whiteboards should also be available.
- Create a "safe space": Maximise learning and networking by making participants feel comfortable to engage and ask questions. Create a safe space to share research experiences (both positive and negative). Personal anecdotes help to normalise sharing without fear of judgment. Always account for different cultures and religions, for example, by providing a private prayer room.
- Balance lectures and workshops: Participant feedback recommends equal proportions of lectures and interactive activities each day. ClimEco held lectures in the morning and other activities after lunch (when "tiredness" is more likely to set in). Lectures provide the foundation theory for the day's theme. Interactive activities reinforce the morning's theoretical learnings, and/or provide practical skills for career development, such as: how to write a policy brief, how to write a winning grant application, how to write papers and choose a publisher, and how to build an online profile.
- Plan a range of networking events: Include several networking events throughout the summer school. For example, at the end of the first day, ClimEco would have an "ice-breaker" poster session in an informal setting with drinks and snacks and a more formal sit-down dinner on the final night.
- Ensure time for informal networking: Informal networking is important, e.g., morning and afternoon coffee breaks (30 minutes) and lunch (1–1.5 hours). Some evenings must be free to allow participants opportunities for self-organised fun. Physical activity during the lunch period also helped the afternoon mood and sharpened minds for the after-lunch sessions.
- Include a field trip: Intensive and immersive daily learning can be very tiring. ClimEco held a field trip midway through the summer schools for lecturers and participants, to a local tourist attraction or the beach (providing a break and a great opportunity for informal networking).

6.3. Following on From a Summer School

The following are considerations for what to do after the completion of the summer school:

- Support ongoing networking and dialogue between participants: Establish a mechanism for participants to continue their interactions after the summer school. Maintain an email list or set up a dedicated online space. ClimEco uses a WhatsApp group chat (on an opt-in basis) to achieve this.
- Create a community: Organisers can also facilitate ongoing network and learning opportunities through a dedicated ECR network (this, however, can be costly and time-consuming and requires ongoing support). The Interdisciplinary Marine Early Career Network was established by a group of past ClimEco participants and lecturers and has been highly successful.
- Gather feedback: Participant feedback is an important mechanism for improvement. Feedback immediately following the summer school focuses on understanding participants' experiences, while mid- to longer-term responses (6–12 months later) should consider outcomes and impacts. The latter can demonstrate "success," to help secure future funding for future summer schools.

7. Conclusions

In this commentary, we have reflected on the ClimEco Summer School series to generate guidance for organisers/convenors of global summer schools (and other ISLPs) to help them train the next generation of

marine researchers to successfully tackle the challenges posed by ocean sustainability. We posited that the success of such events depends on the *people* involved, which is a recurrent theme throughout the commentary (i.e., the main motivation for attending was networking, the main benefit derived related to networking and relationship building, and networking was an unexpected benefit for those not initially motivated by it). The key design principles rest largely on having a team of organisers, convenors, and lecturers who create a positive environment for networking while learning to work in an interdisciplinary way to solve the diversity of marine issues occurring this century.

Acknowledgments

We thank the survey participants for completing the survey. We also thank IMBeR for the opportunity to be involved in, learn from, and synthesize lessons from the ClimEco summer school series. Particular thanks to all the local hosts who provided the venues, and to the sponsors who supported ClimEco over the years by providing travel support for participants or who made a contribution to the ice-breakers or summer school dinners. Thanks also to all the lecturers who volunteered their time and support to participants over the years. P. Lopes thanks CNPq for a productivity grant (302365/2022–2) and the Romanian Ministry of Research, Innovation and Digitalization, within PNRR-III-C9–2022-I8 for a grant (760054—JUST4MPA). J. Penca reports support by the Slovenian Research Agency P5–0453. U. R. Sumaila thanks the Social Science and Humanities Research Council of Canada for its support of the Solving FCB Partnership hosted by the University of British Columbia.

Conflict of Interests

The authors declare no conflict of interests.

Data Availability

Data is not publicly available to protect participants, in accordance with research ethics approval. For further information or access to the data, please contact the lead author.

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About the Authors

Christopher Cvitanovic is a transdisciplinary marine scientist at UNSW Canberra and Deputy Director of the UNSW Centre for Marine Science and Innovation. His research focuses on advancing the theory and practice of knowledge exchange at the interface of science and policy to support the governance of marine systems. He has almost 20 years of experience working at the interface of marine science, policy, and practice to enable evidence-informed decision-making, including 10 years of experience working for the Australian government, and then as a knowledge broker for CSIROs Climate Adaptation Flagship.

Jessica Blythe is an associate professor at Brock University in Canada with expertise in ocean equity, blue justice, adaptation to climate change, and transformations to sustainability. Her research is motivated by questions such as: How do diverse groups and communities experience and respond to environmental change? What explains their differential capacities for adaptation and transformation? What supports the transformations needed to achieve more equitable and sustainable societies? Her empirical work has been based in Malawi, Mozambique, Solomon Islands, Australia, and Canada.

Ingrid van Putten is a senior research scientist with Wageningen Economic Research at the Wageningen University & Research. She is an adjunct professor at the Centre for Marine Socioecology, University of Tasmania. Her research focuses on understanding resource users' behaviour and finding tractable ways to influence their behaviour and reduce risks in coupled marine social-ecological systems. She has over 170 peer-reviewed publications, including in top-tier journals.

Lisa Maddison is a freelance consultant specialising in interdisciplinary marine science project management and events coordination. She successfully managed Integrated Marine Biosphere Research (IMBeR), an international marine science initiative for over 16 years. She focuses on capacity building for students and early career researchers, particularly from the Global South.

Laurent Bopp is a CNRS research scientist at the Ecole Normale Superieure and Deputy Director of the Institut Pierre Simon Laplace (IPSL). His research focuses on climate change, impacts on marine ecosystems, and the global carbon cycle. He was the lead author of the last IPCC report and has co-authored more than 250 scientific publications.

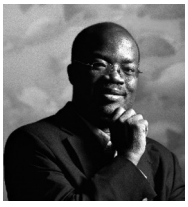
Stephanie Brodie is a marine ecologist with a wide-ranging interest in biogeography, fisheries, and climate change. Her expertise lies in utilising quantitative analyses and diverse data sets to tackle critical questions in marine conservation. Passionate about applied research, Stephanie is committed to understanding the impact of anthropogenic stressors, including plastic pollution, on the environment and the communities that rely on them. Her work aims to contribute to sustainable solutions for preserving marine biodiversity and supporting resilient coastal communities.

Elizabeth A. Fulton is CSIRO's research domain leader for integrated oceans stewardship and the blue economy. She is also the Deputy Director at the Centre of Marine Socioecology, a centre focusing on transdisciplinary, equitable, and sustainable solutions to the problems facing coasts and oceans. Beth has off more than 20 years of work developing various system modelling tools for looking at marine ecosystems, sustainability, and climate adaptation.

Priscila F. M. Lopes is an associate professor at the Federal University of Rio Grande do Norte (Brazil) with over 15 years of interdisciplinary research. She focuses on small-scale fisheries, socio-ecological resilience, and integrating fishing communities into fair conservation efforts. Her work explores how Local Ecological Knowledge can inform scientific conservation.

Gretta Pecl is a professor of marine ecology at the Institute for Marine and Antarctic Studies and director of the Centre for Marine Socioecology at UTAS. She was a lead author for the IPCC AR6 report, has extensive expertise on the impact of climate change on natural systems and on developing adaptation options for fisheries and aquaculture, and has a strong passion for science communication and engagement with the public.

Jerneja Penca is a senior research associate at the Science and Research Centre Koper, where she heads the Mediterranean Institute for Environmental Studies. Her work focuses on governance for sustainability at land and sea, transnational environmental law, and the science-policy interface. She currently serves as the lead author for the IPBES Transformative Change Assessment and MedECCC Water-Food-Energy Nexus Assessment.



U. Rashid Sumaila is a University Killam Professor and Canada Research Chair (Tier 1) in Interdisciplinary Ocean and Fisheries Economics at the University of British Columbia's Institute for the Oceans and Fisheries and the School of Public Policy and Global Affairs. He was also named an "extraordinary professor" by the University of Pretoria in 2024. His research focuses on bioeconomics, marine ecosystem valuation, and the analysis of global issues such as fisheries subsidies and climate change.