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Towards equity and justice in ocean sciences

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The global scientific community is currently going through a self-reckoning in which it is questioning and re-examining its existing practices, many of which are based on colonial and neo-colonial perceptions. This is particularly acute for the ocean research community, where unequal and unbalanced international collaborations have been rife. Consequently, numerous discussions and calls have been made to change the current status quo by developing guidelines and frameworks addressing the key issues plaguing our community. Here, we provide an overview of the key topics and issues that the scientific community has debated over the last three to four years, with an emphasis on ocean research, coupled with actions per stakeholder groups (research community, institutions, funding agencies, and publishers). We also outline some key discussions that are currently missing and suggest a path forward to tackle these gaps. We hope this contribution will further accelerate efforts to bring more equity and justice into ocean sciences.

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IS THE OCEAN SCIENCE COMMUNITY EQUITABLE?

Globally, there are growing calls for the scientific community to dismantle and reform its business-as-usual practices based on unbalanced and unequal international partnerships between researchers from high-income economies in the Global North and low to middle-income economies in the Global South¹. Known as *parachute science*^{2,3}, this colonial model of research perpetuates and widens inequalities, provides little to no tangible benefit to researchers from under-resourced countries, and often overlaps with and impacts locally-led efforts. This is prevalent in ocean science, where international collaborations are the norm, given the expensive and complex nature of operations, the connected nature of our oceans, and the global threats (e.g., climate change, pollution, transnational fisheries) they face today^{4,5}. Ignoring social inequities in conservation can result in social harms but also undermines local expertise, thereby hindering the potential for conservation success⁶.

The global COVID-19 pandemic exposed geographic inequalities in healthcare access and vaccine distribution. At the same time, grassroots social movements such as Black Lives Matter highlighted systemic racism rooted in colonial and neo-colonial perceptions. These played a significant role in the collective shift in perspective, forcing many of us in the research community to take a hard look at how we have and continue operating².

Consequently, since 2020, there has been a plethora of publications addressing those issues. For example, an online search on the Scopus database using terms related to ocean equity and justice indicated that 60% of publications were published in the last ~3.5 years (Fig. 1). Apart from literature, during the same period, there were numerous webinars held, as well as round-table events at workshops and conferences, including high-level events such as the United Nations (UN) Oceans conference, which specifically focussed on finding solutions that would help achieve diversity, equity and inclusivity (DEI) in the ocean space. This is significant given that high-level conferences are non-equitable by their very nature and must be

transformed into more inclusive meetings where location, modality, leadership and participation enable diversity and equity of voice^{7,8}. The UN Decade of Ocean Science attempts to support efforts to bring more equity and justice into the ocean through its statement 'leave no one behind'. It provides i) a focus for funders to support diverse participation in ocean stewardship (e.g., [AXA Research Fund](#)), ii) a platform for networking and publicity (e.g., [Empowering Women in Hydrography](#); [ECOP DEI Initiative](#)), iii) an opportunity to advertise successes (e.g., [MeerWissen podcast of African early-career researchers](#)) and iv) guidance for best-practices⁹. However, only time will tell if these initiatives develop into a legacy of more equitable science.

The present authorship has led or been involved in many efforts to improve equity in ocean science but struggled to keep track of the latest developments. Hence, it is important to review the latest discussions around these topics. We hope that researchers interested in achieving ocean equity and justice can use this as an initial resource to learn more about these subjects and the voices leading the conversations around them. Furthermore, we identify aspects that have not yet been addressed or deserve more attention and discussion and suggest a path to tackle these gaps.

HOW CAN WE MAKE THE OCEAN RESEARCH COMMUNITY MORE EQUITABLE AND JUST?

To address our objective, we performed a scoping review of scholarly literature and online resources focusing on ocean equity and justice. However, broader equity discussions from other fields were included if they applied to the ocean research community. The list of references cited is non-exhaustive, instead we selectively present references that provide novel critical perspectives or introduce new concepts. For ease of navigation, we organise literature findings across five broad themes: "Reshaping education, perceptions, attitudes, and working environments", "Rebalancing partnerships and collaborations", "Science analysis and publication", "Strengthening capacity", and "Networking and

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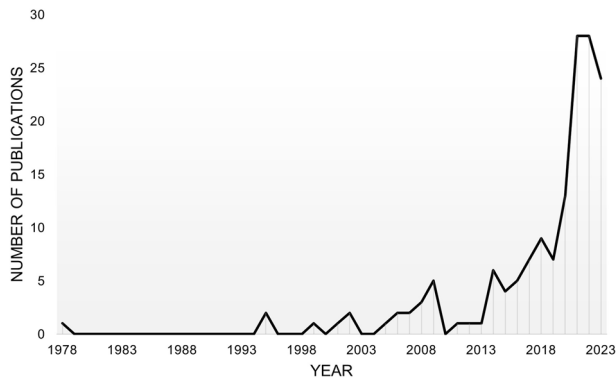


Fig. 1 Ocean equity related publications over time. Number of peer-reviewed publications in Scopus (<https://www.scopus.com>) that had either one of the following keywords in their abstract, title and/or keywords section (“ocean equity”, “ocean justice”, “marine justice”, “blue justice”) or the following combination of keywords in their title (“colonial science”, “ethical”, “equality”, “equity”, “justice”, “inclusivity”, “parachute science”, “racism”, “underrepresented”; in combination with either “ocean”, “marine”, and “deep sea”). Only searches in the title were used for the latter combination of keywords, to minimise false positive results. Total number of publications = 154. Date accessed: 02.08.2023.

public engagement”, with additional sub-divisions within each theme. A concise summary in Table 1 is linked with a series of actions across different sectors (Research Community, Institutions, Funding Agencies, and Publishers) that we believe would help change the status quo.

Reshaping education, perceptions, attitudes, and working environments

Justice and equity can only be achieved if the appropriate support systems are in place to remove barriers and bias, and existing policies are reevaluated and redesigned to ensure zero tolerance towards harassment and discrimination of all minority and underrepresented groups.

Anti-racist interventions. Racial and ethnic discrimination results in the marginalisation and continued active exclusion of Black, Indigenous, and People of Colour (BIPOC) in the ocean sciences¹⁰. Conscious and unconscious biases around individual capacity related to place of origin and racial or ethnic background limit the contributions of some, while also unfairly elevating those in positions of power and privilege. Metrics of success should meaningfully represent an individual’s capacity to resolve our existing planetary and ocean challenges¹¹. Educating oneself on the history of racism and discrimination, and acknowledging racist history and barriers, while reflecting on individual positionality and using individual privilege to advocate for and create opportunities for those from underrepresented groups is a first yet significant step^{12,13}. Funders can ensure funding does not exacerbate unequal power dynamics by requesting DEI statements and evaluating their impact, increasing opportunities for more diverse grant reviewers, and removing barriers for such efforts (e.g., providing remuneration). Publishers can also request DEI statements and create opportunities by including open calls for more diverse reviewers and editors while being mindful of the ‘Minority Tax’ (i.e., the burden placed on ethnic minority faculty to fix the DEI problem)¹⁴. Further, offering mentorship through the review process can also alleviate barriers to participation.

Be inclusive of Lesbian, Gay, Bisexual, Transgender, Queer, Intersex and Asexual (LGBTQIA+) researchers. Much like with anti-racist interventions, actively supporting and promoting researchers from

these minority groups as speakers, collaborators, reviewers, editors, and lecturers based on their capacity broadens the conversations and our opportunities to drive change¹⁵. Using appropriate language during the article submission process and allowing for invisible name changes retrospectively can go a long way to preserve the dignity of transgender researchers^{16,17}. It is also essential that codes of conduct include unambiguous anti-harassment and anti-bullying policies that unequivocally protect all underrepresented groups.

Eradicate gender discrimination. Minority groups are not the only groups that face discrimination in ocean sciences. While women make up 39% of the ocean science research population¹⁸, they face challenges related to promotions, unequal pay and opportunities while also facing safety issues in the field¹⁹. Support systems and programmes should be designed to encourage the long-term participation of women and other underrepresented groups in ocean sciences. There is also a growing body of work showing strong gender bias in authorship and who is being cited^{11,20,21}.

Ensure safe working practices. Safe working practices and spaces are fundamental rights that should be equally afforded to all researchers. However, incidents of harassment and bullying are still reported in ocean science and are more likely to affect women^{22,23} or other underrepresented groups, especially when working in remote locations or isolated settings such as on a vessel^{19,24}. Laboratories, projects, expeditions etc., should develop codes of conduct that provide clear guidelines for expected behaviour that are disseminated for endorsement amongst all team members to ensure unequivocal buy-in. These codes should outline mandatory, safe, and confidential mechanisms for the reporting and handling of incidents of racism, sexism and other forms of discrimination^{19,23}.

Rebalancing partnerships and collaborations

Making space for and supporting all forms of knowing and all partners to work towards a common end goal equitably is imperative to increasing justice in ocean sciences.

Co-development and co-production of international scientific projects. This is necessary to maximise beneficial outcomes for all parties involved. To be successful, engagement between international and local collaborators should start well in advance of research or fieldwork commencing to ensure time to build trust, share information, co-design the research, equitably allocate funding and identify needs and priorities on the ground that could benefit from the collaboration^{25,26}. This truly collaborative approach must continue post-fieldwork through all subsequent stages of the project, including data analysis, publication of results and dissemination of findings²⁷.

Equitable and power-balanced partnerships require time, resources, and commitment from all sides as well as flexible models of work that permit adaptation to changing aspects such as organisational needs, timelines, and outputs²⁷. Consequently, institutions should reward researchers engaging in such practices the same way they reward other scholarly work, and specific training should be provided with resources in place to support transition in research practices and the challenges that are encountered. Funding agencies should encourage and support truly co-designed projects with dedicated funds that allow knowledge exchange activities to occur.

Respect for Indigenous and local knowledge. Most established research methods in ocean science have their roots in Western philosophy and thinking due to centuries of Euro-American colonialism. This has led to a wealth of knowledge residing in

Table 1. An overview of recent literature around ocean equity and justice organised across five themes and further sub-divisions (issues) therein.

Themes	Issue	Recommended Reading	Actions per stakeholder group	Institutions	Funding Agencies	Publishers
Reshaping education, perceptions, attitudes, and working environments	Anti-racist interventions	10,12,13	<p>Research Community</p> <ul style="list-style-type: none"> Educate oneself on the history of racism and discrimination. Acknowledge racist history and barriers. Reflect on your individual positionality and resulting power dynamics. Advocate for and actively create opportunities for your BIPOC, LGBTQIA+, disabled, and female colleagues, even when this means personally stepping aside/turning down opportunities. Develop and implement codes of conduct that set standards and include unambiguous harassment and bullying policies. Encourage professional societies to fully integrate diversity, equity, and inclusion (DEI) into their policies and standards. Promote individuals from underrepresented groups through awards, invited talks, keynote lectures at conferences etc. Develop and implement codes of conduct with zero tolerance to harassment and discrimination 	<ul style="list-style-type: none"> Diversify and broaden the curriculum. Adopt inclusive metrics of success when it comes to student admissions, and hiring and promoting staff, that move away from citations and impact factors. Provide anti-racist and sexism training for staff. Establish mandatory, safe, and confidential mechanisms for the reporting and handling of incidents. Develop institutional policies on diversity, equity, and inclusion, with systems to hold staff accountable, particularly those in power. Develop and implement codes of conduct with zero tolerance to harassment and discrimination. Routinely collect gender-disaggregated data to evaluate progress towards gender equity. Remove gender disparities by reevaluating existing selection, evaluation, promotion, and nomination procedures. Actively remove structural inequities. Address unequal access to resources. Ensure that the burden of producing a more equitable community does not fall unfairly on those it is meant to serve. 	<ul style="list-style-type: none"> Adopt inclusive metrics of success when it comes to awarding grants, that move away from citations and impact factors. Dedicate funds for underrepresented and marginalised groups. Ensure grants disbursed do not create/exacerbate existing unequal power dynamics between researchers in the Global North vs. South. 	<ul style="list-style-type: none"> Limit conscious and unconscious biases in peerreview by adopting double-blind peerreview. Assemble a diverse editorial board. Editors should spend extra time to make sure invited reviewer composition is balanced and diverse. Adopt gender-neutral language throughout the submission, editing, and review process. Collect information about personal characteristics (e.g., gender, race or ethnicity and any disabilities), when submitting or peer-reviewing manuscripts, to understand more about representation among authors and reviewers. Journals should monitor and review the demographic characteristics of accepted articles to identify potential publication bias. Journals should consider different open access fee systems.
	Be inclusive of LGBTQIA+ researchers	16,17,71				
	Eradicate gender discrimination	11,17,20,21,23,72				
	Ensure safe working practices	19,23,24				

Table 1 continued

Themes	Issue	Recommended Reading	Actions per stakeholder group	Research Community	Institutions	Funding Agencies	Publishers
Rebalancing partnerships and collaborations	Co-development and co-production of scientific projects	9,25–27,30	<ul style="list-style-type: none"> Start engagement with collaborators early. Invest time and commit long-term. Come with an open mind and respect knowledge and advice from local partners. 	<ul style="list-style-type: none"> Provide career recognition for scientists that engage with different stakeholders and partners. Foster collaborations between those in the Global North and South, setting positive examples (and guidance) for students. Ensure co-design processes and principles are taught at universities. 	<ul style="list-style-type: none"> Encourage co-developed and co-produced projects. Fund proposal writing workshops that include all partners. Fund local researcher participation in local and international conferences. Support salary compensation and training of local teams to ensure meaningful inclusion. 	<ul style="list-style-type: none"> Mandate that publications on the Global South by those in the Global North include authors from those geographies (e.g., Conservation Letters policy on this) 	
Science analysis and publication	Respect for Indigenous and local knowledge	10,29–31,73	<ul style="list-style-type: none"> Develop qualifying assessments for individuals and research groups to demonstrate 'cultural literacy' in relation to fieldwork sites. Always consider the inclusion of Indigenous scholars from those geographies who are better placed to interpret culture, but also say when it is not appropriate to publish something that is sacred to Indigenous Peoples. Respect FPIC (Free, Prior and Informed Consent) processes, and Indigenous knowledge systems. Ensure that knowledge is not taken, repurposed and/or exploited in ways that can be damaging. 	<ul style="list-style-type: none"> Provide training on colonial histories and how their legacy impacts conservation today. 	<ul style="list-style-type: none"> Require applicants to show competency, or safeguard mechanisms that are in place to protect the rights of Indigenous peoples. 	<ul style="list-style-type: none"> Global analyses should consider non-English literature. Make abstracts available in the local language where the study is based. 	
Science analysis and publication	Consider non-English languages	31–34	<ul style="list-style-type: none"> Assemble multilingual research teams to tackle global research questions. Highlight and award literature written in non-English languages. 			<ul style="list-style-type: none"> A diversity statement should appear before the references in a manuscript as per Biomedical Engineering Society journals. 	
Diversity of Literature Cited	Diversity of Literature Cited	20,35,74	<ul style="list-style-type: none"> Check whether your reference lists are gender-balanced: (e.g., https://github.com/dalejn/cleanBib; <a 270="" 71="" 945="" 961"="" data-label="Page-Footer" href="https://chrome.google.com/webstore/detail/citation-transparency/cepnbdhbaljgacaddghhcgajphbcf7hj=en;https://postlab.psych.wisc.edu/gcbialyzer/). Educate yourselves on the work of minority scientists relevant to your study and consider proactively citing more work by minority scientists as an act of reparative justice and affirmative action in citational practices. Add a citation diversity statement in submitted manuscripts. </td> <td></td> <td></td> <td></td> </tr> </tbody> </table> </div> <div data-bbox=">npj Ocean Sustainability (2023) 25				

Table 1 continued

Themes	Issue	Recommended Reading	Actions per stakeholder group	Research Community	Institutions	Funding Agencies	Publishers
	Inclusive authorships	3,20,31,36	<ul style="list-style-type: none"> Engage with all persons involved in a project early on to identify publication involvement and assign responsibilities. Avoid having token authorships whereby international collaborators are included with minimal input to tick boxes. Be inclusive of work undertaken by junior staff, including interns, students, and research assistants. Stay up-to-date with the publishing landscape. Consider low-cost and free options for open access publishing (e.g., Diamond Open Access journals). Consider using pre-print servers such as bioRxiv.org to make your research immediately available. After acceptance, check if you can archive the accepted version of your manuscript. Many journals allow you to do that after an embargo period. Produce easy-to-understand summaries, infographics, story maps, exhibitions, Science Technology Engineering and Mathematics activities, to accompany your peer-reviewed work, to engage with the public. 	<ul style="list-style-type: none"> Mandate researchers that are part of collaborative projects to justify why local authors are not included. Penalise authors that engage in exclusionary and parachute science practices. Encourage and support publication in low-cost and free open access journals. Provide funds to support Article Processing Charges of Open Access journals. Support and encourage researchers to develop tailored communication outputs other than peer-reviewed papers for public engagement purposes. 	<ul style="list-style-type: none"> Encourage and support publication in low-cost and free open access journals. Allocate funds to support Open Access publishing for increased accessibility. Allocate funds for translation of abstracts and outreach material into local languages. Mandate dissemination of results particularly to communities in study areas. 	<ul style="list-style-type: none"> Requirement to have at least one in-country person in authorship (e.g., Conservation Letters example) both for fieldwork-based studies or meta-analyses / syntheses. Require inclusion and diversity statements for each submission. Lower the cost of Open Access fees to allow a wider pool of researchers (particularly early career scientists and those from the Global South) to publish and be visible. Establish a tiered structure of Open Access fees based on geography. Provide discounts / waivers for researchers to publish in open access journals based on nuanced metrics such as percentage of GDP invested in science and technology, to ensure greater benefit sharing. Provide free language services for non-native speakers in specific career stages and geographies, if warranted. This burden should not fall on the reviewers. Alternatively consider publishing articles with imperfect grammar if it does not do a disservice to the research conducted and the core message is clear. 	
Strengthening capacity	Invest in human capacity	1,2,45,75		<ul style="list-style-type: none"> More grants awarded to underrepresented researchers. Support non-native English speakers through the publication process. Acknowledge the importance of 'capacity-sharing'. Data should be deposited in the country where it was collected, and training and discussions on how to use these data should also be provided to local researchers. Capacity development initiatives should be driven by trainees' needs and timelines. 			

Table 1 continued

Themes	Issue	Recommended Reading	Actions per stakeholder group	Research Community	Institutions	Funding Agencies	Publishers
	Invest in infrastructure capacity (including low-cost technology options)	31,44,45,47,76,77	<ul style="list-style-type: none"> Adopt / develop low-cost technologies for data collection and processing that are accessible to all. 	<ul style="list-style-type: none"> Develop shared equipment facilities at the national, regional, and global level. 	<ul style="list-style-type: none"> Support projects that develop high tech but low-cost technology. Allocate project funds specifically for purchasing equipment that can be donated to project partners at the end of the project. 		
Networking and public engagement	Widen participation of networking and scientific dissemination opportunities	48-50 ; UN ECOP DEI Initiative (https://www.ecopdecade.org/diversity-equity-and-inclusivity/)	<ul style="list-style-type: none"> Consider holding online meetings or making in-person meetings online accessible (hybrid). Research Societies should consider holding meetings - where relevant - in different geographies to encourage regional participation. Provision of logistical and financial support to prospective conference organisers to encourage bids from underrepresented regions. Provide funding support to those in financial need. If sufficient funds are available then provide an automatic discount to certain categories (e.g., based on career stage or geography). If funds are limited and an application process is required, ensure process is respectful of applicants. 				
	Decolonise the ocean narrative/ Local Ocean Champions	51,53-56,72	<ul style="list-style-type: none"> Recognize and highlight the work of underrepresented researchers. Recognise that diversity is a superpower that comes in a range of forms (e.g., cognitive diversity) that can lead to improved problem-solving, innovation, and accuracy. Understand that the legitimate inclusion of underrepresented groups, and the size of the group leads to more accurate interpretation and decision. Be aware of the 'diversity-innovation paradox'. 			<ul style="list-style-type: none"> Recognize and highlight the work of underrepresented researchers. This could include invited reviews, and commentary on current ocean issues. 	
<p>Actions to help change the status quo are provided per stakeholder group and presented by theme rather than issue to avoid repetition in case of overlaps. Note professional societies are considered under Research Community.</p>							

Indigenous and local communities often being undervalued or overlooked with detrimental consequences for the marine environment and missed opportunities for innovative solutions^{28,29}. Acknowledging this intellectual power imbalance is an important and necessary first step. However, alone this is insufficient, and additional actions must be taken to ensure all pools of knowledge and ways of knowing are considered³⁰. For example, researchers should conduct qualifying assessments for individuals to demonstrate 'cultural literacy' about fieldwork locations¹⁰ and research topics. Research projects must consider the inclusion of Indigenous scholars from those foci who are better placed to interpret culture and historical context, and understand the significance of information. Indigenous scholars are also better able to identify when it is inappropriate to publish information or data sacred to Indigenous Peoples or communities. It is also important to ensure that when such knowledge is shared, it is not taken, repurposed and exploited in a way damaging to the knowledge providers or their culture and traditions.

Science analysis and publication

Making space for non-native English speakers by establishing inclusive practices, encouraging and rewarding diverse forms of science communication, and recognising and highlighting existing locally-led research and knowledge is imperative to achieving ocean justice and equity.

Consider non-English languages. Professional advancement in science is tied to publishing in English language peer-reviewed journals. For many in the Global South and other non-native speakers of English, this presents challenges. Creating opportunities to close the gap, and thereby support capacity growth of local partners is imperative. Publishing a local language summary as an accompaniment to a full paper in a peer-reviewed journal prevents assumptions that no work is being conducted locally³¹ and makes findings more accessible. In addition, international collaborations allow researchers to tap into non-English literature that is otherwise overlooked, and have been shown to result in better data products for conservation science^{32,33}. Alternatively, machine translation tools, while still not perfect, serve as both a short and long-term solution for making science more accessible and impactful³⁴.

Diversity of literature cited. Very often, science cites popular research or research published by scientists (largely men) in the Global North while overlooking knowledge bases from other geographies^{20,35}. Researchers should add a citation diversity statement, actively educate themselves on the work of under-represented local scientists in their relevant fields of study and cite them, and check for gender balance in reference lists.

Inclusive authorships. To avoid the exclusion of authors from papers³, authorship should recognise and credit all contributors and also reflect contributions that extend beyond the usual data collection, analysis and writing stages³⁶. A more inclusive approach to authorship recognises and values diverse contributions and contributors without whom the work could not have occurred²⁰. The emphasis on an equitable process rather than system and equality, results in authorship lists that recognise non-traditional authorship roles (field and research assistants), and consider intersectional social standing³⁷.

Make research visible and discoverable. Eighty percent of academic research is publicly funded or funded through charities, but most articles are locked behind paywalls³⁸. This blocks access to scientists and practitioners who are best placed to use the research in beneficial ways³⁹. This in turn hinders scientific progress as it is difficult to build and resolve in the absence of foundational knowledge. While open-access publishing presents a

viable solution, there is a need to ensure that the burden of payment does not fall on those that are unable to pay and that models exist to overcome these challenges³⁸. Article Publishing Charges (APCs) in prestigious journals with a wide public reach are often so high that they are only affordable by better-resourced researchers. For example, the APC fee for a single, high-impact journal can cost the equivalent of many months' salary for researchers in the Global South⁴⁰, thus hampering research visibility of poorly funded researchers—often early career and Global South researchers—who opt to then publish in less visible journals—if at all^{41,42}. This then leads to a disparity in research profiles⁴³. To overcome these costs, institutions and funders can encourage and support research publication in Diamond Open Access journals that are community-driven, academic-led, and academic-owned publishing initiatives that do not charge fees from authors or readers⁴². Transforming the traditional publishing system is necessary. Thus, continued dialogue and negotiations between institutions, funders and academic publishers is a way of advancing towards solutions. Further, researchers should be required to prepare easy-to-understand summaries of their publications for sharing on social and traditional media to broaden the audience and increase visibility and potential use. Aside from peer-reviewed publications, researchers should explore whether producing additional locally tailored communication outputs (e.g., infographics, story maps, exhibitions, Science Technology Engineering and Mathematics (STEM) activities) will, in some cases, be more appropriate and impactful.

Strengthening capacity

Recognising existing capacity and investing in partners, partnerships, and infrastructure ensures projects are best equipped to drive sustainable and impactful change.

Invest in human capacity. Successful projects acknowledge the importance of 'capacity-sharing'¹, where locals lead with their knowledge on the ground and existing priorities, and technical capacity is enhanced through collaboration with the outside team^{44,45}. Reframing the term capacity-building creates space for more equity in partnerships and acknowledges, recognises and maximises the use of skill sets available within the team. Projects should also incorporate efforts to actively build the technical capacity of researchers from underrepresented communities and coastlines based on their needs through increased availability of grants and training programmes. Furthermore, while data should be deposited in the country where it was collected, training and discussions on how to use these data maximally should also be provided to local researchers. Funding should be secured to support analysis and data usage locally to ensure long-term project sustainability.

Invest in infrastructure capacity (including low-cost technology options). Ocean research is often inequitably focused in areas where marine infrastructure availability is highest^{3,46}. The co-development of research facilities and low-cost tools with the community of practitioners allows a broader segment of scientific society to contribute, explore and discover while also breaking down barriers unnecessarily placed on individuals based on where they come from⁴⁷. A co-designed approach also facilitates ease of local repair and adaptation when needed. This could be improved by conducting field tests of prototypes in conjunction with teams from less equipped countries⁴⁷. Additionally, mentorship on entrepreneurship and innovation could encourage the use of existing infrastructure to develop technologies from locally available resources.

Networking and public engagement

Engaging the diversity of voices and capacities contributes to ocean conservation and ensures access to scientific knowledge,

and networks that inevitably drive equity and justice in the ocean sciences.

Widen participation in networking and scientific dissemination opportunities. Conferences are traditionally conducted in the Global North at times best suited for the scientific community from that part of the world. Unfortunately, this precludes the participation of researchers from the Global South, who are most often inequitably hindered by expensive attendance fees, [visa issues](#), travel and accommodation costs. Online-only or online-accessible (hybrid) meetings are an effective way to widen participation compared to in-person-only conferences with an increase in participation of 33–74% and increased geographic representation of 28–38%^{48–50}. However, they are not a panacea and should not completely replace in-person meetings that provide face-to-face interactions that are important for building long-lasting relationships. A more effective way to widen participation would be to host meetings in low and middle-income economies⁴⁹ (e.g., International Symposium on Deep-Sea Corals in 2019 in Cartagena, Colombia; International Marine Conservation Congress in 2018 in Sarawak, Malaysia; International Congress for Conservation Biology in 2023 in Kigali, Rwanda) with logistical and financial support provided as necessary to participating researchers and institutions.

Decolonise the Ocean Narrative/Local Ocean Champions. Seventy percent of coastlines are in the Global South. Realistically, if we are to manage and protect our ocean sustainably, we need to ensure that every coastline has a local champion that can support and engage in efforts to drive change for a healthy ocean of the future². Giving underrepresented groups a seat at the negotiating table ensures that the diversity of problems can be heard, and more importantly a diversity of solutions can be designed to address issues faced by communities across the globe which in turn contribute to society's resilience. Excluding voices from particular communities excludes the plurality of thinking when looking at an issue while also reducing our likelihood of resolving it⁵¹. Diversity is thus a 'superpower' that has long been overlooked. Cognitive diversity, which is shaped by factors including identity diversity (e.g., race, gender) has also been linked to better outcomes and can yield 'bonuses' such as improved problem-solving, innovation, and accuracy^{52,53}. It is also important to recognise that research direction can change and become increasingly valid if larger groups of underrepresented communities are legitimately incorporated⁵⁴. The 'diversity-innovation paradox', where underrepresented groups generate higher rates of novelty which is undervalued and does not translate into successful careers vis-a-vis majority groups, must be addressed through equitable recognition of contributions to avoid a replication of stratification in academia. Meaningful representation can challenge exclusion and advance social justice^{55,56}.

WHAT DISCUSSIONS ARE WE MISSING?

While there are many ongoing conversations on how to achieve different facets of ocean equity and justice, there are important aspects that urgently need to be addressed. The first is specific to the ocean research community, the second is broadly applicable to the field of conservation, the third relates to field-based disciplines, and the last applies across many fields where experience is a necessary step for career progress.

Increasing access to the ocean

In many coastal nations particularly in the Global South and low-income communities, in-water experiences are limited due to a fear around the ocean stemming from various sources, including folklore (traditionally referring to the ocean as the devil), a lack of

awareness about the ocean, the frequency of reported drownings as a result of a lack of swimming capacity or historical discrimination^{57,58}. This lack of access, which can be increased through immersive experiences at local beaches and swim training, prevents many people from diverse backgrounds from participating in marine conservation. To address the issues of equity and justice around our oceans it is important to recognise the role of in-water opportunities combined with ocean literacy for communities that are otherwise denied them.

Pay-to-volunteer/volunteer programmes

Here, students, graduates and early-career researchers predominantly from the Global North volunteer or pay to work in conservation projects run by international not-for-profit and for-profit organisations in the Global South. They typically volunteer their time and effort for weeks to months per project with no financial compensation but often have their accommodation and subsistence costs covered by the organisation. The fundamental issue is that the pay-to-volunteer model can create opportunities for organisations to prioritise profit-making over local conservation priorities, thereby perpetuating parachute science practices^{59,60}. Moreover, it can be exclusionary to nationals who cannot afford to work for free or pay to work⁵⁹, depriving them when it comes to future career opportunities⁶⁰. Furthermore, these schemes can exclude local scientists from participating when programmes only include overseas nationals.

That said, grassroots-level organisations with small working budgets to resolve large conservation challenges (particularly in the Global South) can and have benefited from the work of volunteers. This is particularly so if volunteers are skilled, can contribute meaningfully to conservation goals, work equitably with local teams and if the organisations do not depend on volunteers to sustain operations and workforce to achieve their objectives. In return, volunteers pay for these experiences over tourism because they feel they contribute to science while gaining a more interactive experience with the focal species⁶¹. We do not, therefore, argue that the pay-to-volunteer/volunteer model is inherently bad, but recognise that as the industry remains largely unregulated, there is opportunity for the exploitation of volunteers and a lack of focus on achieving conservation outcomes and impact. Further, it can also lead to the neglect of local needs, a hindering of work progress and the completion of unsatisfactory work⁶² (particularly due to the short-term nature of these opportunities)⁶³. Future work could systematically assess the pay-to-volunteer model, specifically in the marine space, to provide a balanced overview of its pros and cons, to understand what factors influence the shortcomings and offer clear guidelines for best practice.

People living with disabilities

The field of geosciences, of which ocean science is a part, is the least diverse of the academic disciplines in STEM⁶⁴. Past efforts to address diversity issues have focused primarily on gender or ethnicity⁶⁵, but excluded those living with disabilities. One barrier to people with physical disabilities is fieldwork. This component is often considered essential for participation in ocean sciences. While there have been discussions on how to mitigate the exclusion of people with disabilities, the solutions primarily focus on marine education and land-based geoscience disciplines^{65,66}, with few exceptions⁶⁷. While ocean science presents challenges when it comes to conducting fieldwork in remote locations and/or on a vessel for extended periods, not all research necessitates this type of data collection. Collaborators could sometimes help with fieldwork, so it does not represent a barrier. To be inclusive, it is important to recognise and acknowledge that, as individuals, we all have a different and unique combination of skills and things we may find challenging. Rather than assuming what these are for

others, collecting this information non-judgementally would open the way for building teams and opportunities that fit these varying abilities, skills, and experiences. It is also important to emphasise the many ways of engaging in ocean sciences which may require skill sets beyond the capacity to conduct fieldwork. However, lab techniques and equipment can also be exclusionary when, among other things, access, mobility, and dexterity are not considered. For those with mental disabilities, there are a range of different challenges. These are often magnified because of the stigma associated with many conditions. While we are not qualified to suggest ways to mitigate the exclusion of people living with disabilities, we feel it is an important issue that should be addressed immediately.

Passion exploitation

This is the legitimisation of the exploitation of people's passion for their work⁶⁸. This exploitation which manifests largely as pro bono requests, is commonly seen in jobs fuelled by passion, such as social work and conservation. It occurs because of the false assumption that passionate workers would have volunteered if provided the opportunity and the belief that, for passionate workers, the work is itself a reward. It fails to recognise that in some cultures, professionals are already volunteering their time to level the playing field in their countries due to limited resources, and the urgency of issues leads them to support the less fortunate in their countries. Passion exploitation also minimises the value given to areas where it occurs, as appropriate resources are not assigned.

Other instances of passion exploitation include the burden of service that academics and researchers of colour shoulder to achieve diversity and inclusion in their relevant institutions. Known as the 'cultural or minority tax'¹⁴, these services are often uncompensated, unacknowledged and unrewarded and include tasks such as sitting on DEI committees, translating documents or being ambassadors for their countries—tasks that their white counterparts are exempt from⁶⁹. This tax applies to other minority groups as well⁷⁰.

CONCLUSION

While the ocean community has taken steps over the last few years to discuss existing inequities and power imbalances publicly, many issues still need to be addressed, some of which have been identified here. While honest and transparent dialogue is the first necessary step for change, it is equally important to identify tangible actions that will enable such change. Many of these changes require a significant shift in institutional cultures and norms perpetuating discrimination, racism, and colonial approaches to ocean sciences. Such actions need to be co-identified and implemented by various stakeholders involved in ocean science, including researchers, professional societies, intergovernmental groups, institutions, funders, and publishers. It will take time and resources and, most importantly, a willingness from all parties to change the status quo. Achieving social equity will not be easy and will not happen overnight. To all, who at times despair after years of slow progress, we appreciate your allyship and we encourage you to continue to persevere in building a better and more equitable ocean research community for the benefit of our ocean, ourselves and future generations.

DATA AVAILABILITY

All data needed to evaluate the conclusions in the paper are present in the paper.

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P.V.S. conceived the idea of the review. All authors contributed to the study design and data collection. A.d.V. and P.V.S. led the original draft, including tables and figures, with comments, edits, and revisions from S.C.S., S.M., L.N., and L.C.W.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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