Advancing gender equity in deep-sea research activities: addressing the barriers to women's participation in at-sea missions

Gender guidelines to promote inclusive and equitable opportunities in deep-sea research expeditions

A publication of the

S.ee H.er E.xceed Mentoring Programme

October 2025

S.ee H.er E.xceed Mentoring Programme

The S.H.E. Global Mentorship Programme, launched in 2023 by the International Seabed Authority (ISA) under the Women in Deep-Sea Research (WIDSR) initiative, supports gender equity in ocean science by equipping women scientists from developing states with the mentorship, skills and professional networks needed to excel in deep-sea research and related fields.

Through a structured 12-month cycle, mentees receive personalised guidance on their scientific, professional and leadership goals, aligned with the ISA's Action Plan for Marine Scientific Research. The programme promotes skill-building, knowledge exchange and career visibility, while fostering a growing community of practice for women working in deep-sea exploration.

By strengthening technical capacity, leadership pathways and global networks, S.H.E. supports greater participation and representation of women at sea and contributes to a more inclusive and equitable deep-sea science workforce.

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ACKNOWLEDGEMENTS

This report was prepared by the Office of Stewardship, Environment and Resources under the framework of the International Seabed Authority's See Her Exceed Global Mentoring Programme - S.H.E., a flagship initiative of the Women in Deep-Sea Research project. The process was led by Dr. Noémie Wouters, Programme Coordinator (Marine Scientific Research) and Tanesha Dixon-Gayle, S.H.E. Project Support Consultant. The views expressed are those of the author(s) and do not necessarily reflect those of the International Seabed Authority.

The Office of Stewardship, Environment and Resources gratefully acknowledges the invaluable support and contributions provided by the S.H.E. mentees and collaborators. We wish to thank the mentees, Orji Ijeoma (Nigeria) and Mpho Sephalabo (South Africa), and the mentors, Dr. Annemiek Vink, a marine geobiologist (Germany), and François Charlet, an exploration manager (Germany).

Special thanks are due to all experts who participated in the key informant interviews, survey distribution and discussions. Your willingness to share your time, experiences and insights has been central to this research.

Finally, we wish to recognize Dr. Samantha Smith, a dedicated mentor and champion of the S.H.E., whose continued guidance and advocacy have shaped the vision and impact of this initiative.

ABBREVIATIONS

EU	European Union
ISA	International Seabed Authority
S.H.E.	See Her Exceed Global Mentoring Programme
STEM	science, technology, engineering and mathematics

FOREWORD

I am pleased to present the first knowledge output developed under the International Seabed Authority's (ISA) See Her Exceed Global Mentoring Programme - S.H.E., a flagship initiative of the Women in Deep-Sea Research project to advance gender equality in this important area of research.

This report marks a significant step forward in our shared commitment to ensuring that women, particularly those from developing States, are not only included in, but actively leading marine scientific research and exploration of the deep ocean. As the steward of the international seabed, the ISA has a responsibility to promote access, equity and safety for all those contributing to the knowledge and sustainable use of the Area.

Despite growing awareness of the importance of gender balance in science and technology, women's participation in offshore deep-sea expeditions remains disproportionately low. Through a rigorous mixed-methods approach, including global surveys and interviews, this study offers new insight into the barriers women face and the institutional actions required to dismantle them. The findings are timely, relevant and instructive. They point not only to persistent structural and cultural obstacles but then to tangible solutions, many of which are already being implemented across sectors.

Most importantly, this research sets the foundation for the development of the ISA Gender Equity Charter. This practical and actionable framework will help guide contractors, researchers and institutions in creating safer, more inclusive environments for women at sea; with an overarching goal of a more harmonious and productive at-sea working environment for both women and men. It builds on a global body of evidence, best practices and the lived experiences of scientists working in some of the most remote and challenging scientific environments.

I would like to commend the mentees and mentors of the S.H.E., as well as the ISA Secretariat staff and partners, whose vision and commitment made this work possible. Let this report serve not only as a milestone in our journey towards gender equity but as a call to action for all stakeholders to work together to transform deep-sea research into a truly inclusive field.

Leticia Reis de Carvalho
Madam Secretary-General
International Seabed Authority

EXECUTIVE SUMMARY

This research was conducted under the International Seabed Authority's (ISA) See Her Exceed Global Mentoring Programme - S.H.E. The purpose of this research was to explore gender-related barriers and enablers in offshore deep-sea exploration. Despite growing global commitments to gender equity in science, women remain underrepresented in at-sea missions, especially in leadership and technical roles. Recognizing the lack of targeted guidance in this area, the study aimed to generate evidence to inform the development of a Gender Equity Charter, focused on improving inclusion, safety and participation for women in deep-sea research.

A mixed-methods approach was used, combining qualitative and quantitative data-collection. The study involved 12 key informant interviews with scientists and professionals engaged in offshore research, representing diverse geographic and institutional backgrounds. In parallel, a global survey was disseminated through ISA networks and social media, yielding 149 complete responses. Data-collection was carried out by the S.H.E. mentees with guidance from ISA staff between April and June 2025.

Some of the key findings of this research include that women in deep-sea research face interconnected structural, cultural, social and environmental barriers that limit access to training, leadership and long-term at-sea participation. Mentorship, inclusive team dynamics, institutional flexibility and gender-sensitive vessel infrastructure are critical enablers of women's participation and career progression. Institutional gaps remain in safety protocols, reporting mechanisms and representation, often leaving inclusion practices dependent on individual leaders rather than policy.

Key recommendations informed by the research would be to institutionalize gender equity through clear policies, mandatory conduct briefings and vessel readiness standards that address safety, privacy and accessibility for women. It is also important to invest in structured mentorship and leadership development programmes to support women's advancement in scientific and technical roles at sea. Finally, adopt accountability mechanisms, such as tracking gender participation data and implementing formal harassment reporting procedures, to ensure lasting systemic change.

The study concludes that advancing gender equity in deep-sea offshore expeditions requires both systemic change and operational accountability. The development of a Gender Equity Charter, grounded in the findings of this study, offers a strategic and practical tool to promote inclusion, safety and equal opportunity for women at sea.

This research contributes to a growing body of global evidence on gender equity in STEM fields and provides specific, actionable insights tailored to the offshore research context. By embedding the recommendations of this report into institutional frameworks and field operations, the ISA and its partners can help transform marine science into a more inclusive domain for future generations.


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1. INTRODUCTION

Deep-sea research, including offshore expeditions, plays a crucial role in advancing scientific understanding of marine deep-sea ecosystems. Despite growing efforts to enhance gender equity in science, technology, engineering and mathematics (STEM) fields, women remain underrepresented in high-risk scientific settings, particularly those involving offshore expeditions. A range of structural and interpersonal barriers, including limited access to at-sea time, inadequate support systems, gendered safety concerns and social expectations around caregiving roles, often hinder participation in deep-sea research.

Cognizant of these challenges, the International Seabed Authority (ISA) has contributed to women's empowerment and leadership by enhancing their role and participation in deep-sea scientific research since 2017 (#OceanAction15467). This commitment is anchored in ISA's mandate to promote marine scientific research and its duty to encourage the design and implementation of appropriate programmes for the benefit of developing States. Women's empowerment initiatives are operationalized within the research priorities of the ISA Action Plan for Marine Scientific Research in support of the Ocean Decade for Sustainable Development and constitute a key domain of the ISA Capacity Development Strategy.

Research from adjacent sectors such as oil and gas, maritime operations and other offshore industries suggests that institutional policies, inclusive on-board protocols and gender-sensitive leadership can significantly improve women's participation and well-being. However, the specific needs and realities of women in deep-sea scientific research remain underexplored. There is an urgent need to document and respond to these realities through evidence-based practices and policies. In particular, little is known about how women navigate the intersection of professional expectations, physical challenges and social dynamics aboard research vessels, or how institutional practices can better support their inclusion. By systematically capturing women's lived experiences at sea, this study seeks to fill a critical gap in evidence and inform future policy and capacity development within the deep-sea research community.

This study was conducted as part of the ISA See Her Exceed Global Mentoring Programme - S.H.E., the first global initiative of its kind dedicated to women in deep-sea science. Led by S.H.E. mentees who have been deployed at sea more than a dozen times collectively, including the ISA contractor's training programme and supported by the mentors who have ample offshore expedition experience, this research seeks to better understand the lived experiences of women scientists participating in at-sea expeditions and to provide actionable insights for promoting a more inclusive and equitable marine science community.

The study aims to answer the following research questions:

- What are the key barriers (logistical, institutional, social) that women face when participating in deep-sea offshore expeditions?
- What facilitators (policies, institutional support, equipment, cultural factors) enable and encourage women's participation in at-sea activities?
- How can institutions and research vessels modify their practices to create a safer and more inclusive environment for women researchers at sea?
- What gender-specific best practices should be included in a Gender Equity Charter to support women's participation in deep-sea research?

2. METHODOLOGY & RESULTS

The methodology consisted of a literature review combined with a small-scale stakeholder consultation.

2.1. Literature review

2.1.1. Methodology

This review draws from institutional reports, scholarly research, European policy initiatives and internal programme documents from ISA to examine both the barriers that impede and the facilitators that promote women's meaningful engagement in at-sea scientific research. These sources are not simply descriptive but engage in critical dialogue with one another to reveal tensions, gaps and opportunities for systemic transformation.

2.1.2. Results

Despite significant strides in gender equity across STEM fields, women's participation in deep-sea research, particularly on offshore expeditions, remains disproportionately low (Nweje et al., 2025). The underrepresentation of women in deep-sea research is well documented (Grimett, 2024; Ojwala, 2023; Ojwala et al., 2022; Shellock, 2022; Giakoumi et al., 2021; Kitada, 2020). Kitada's analysis of women seafarers highlights how male-dominated occupational cultures limit entry and retention. She notes that "entrenched masculine norms on-board vessels not only influence hiring decisions but also social interactions, frequently sidelining women from both formal and informal networks" (Kitada, 2020). This is reinforced by the Global Maritime Forum's (2024) findings, which reported that 29 per cent of women seafarers identified gender discrimination as a primary barrier, compared to just 0.4 per cent of men.

Narayanan et al. (2023) add further nuance by exploring how technological changes, particularly digitalization and automation, are altering the criteria for participation. While these changes have the potential to reduce physical barriers, the authors caution that "without inclusive digital training and proactive gender integration, the technological transition risks reinforcing exclusion rather than remedying it."

The European Parliament Research Service (2024) also supports these findings, noting that women represent only 1.2 per cent of the global seafaring workforce. Combined with long deployments, the absence of family-friendly policies and a lack of visible role models, these figures reflect overlapping barriers that deter women from entering or remaining in the field.

To address these issues, various institutional responses have been introduced (Rehman, 2024; Wheeler and Wiese, 2024). The IMO-WISTA Women in Maritime Survey (2024) and the Norwegian Government's Gender Equality Strategy propose approaches focused on inclusive recruitment, workplace safety, role model promotion and gender-sensitive equipment.

The ISA S.H.E. reflects these trends by supporting women scientists from developing countries. It combines mentorship, leadership training and community building to address both individual and institutional deficits. The S.H.E. strategically matches mentors and mentees to promote advancement in personal, professional and scientific domains. This mirrors the Women in the Blue Economy initiative of the European Union (EU), which emphasizes integrated capacity-building linking gender policy with technical training and peer support.

Despite such efforts, the EU SHE4SEA project and the EU Maritime Women platform, Women in Transport – EU Platform for Change, observe that progress remains fragmented. The lack of universal standards for gender inclusion on research vessels and inconsistent enforcement of diversity policies limit the effectiveness of existing programmes.

Multiple sources identify key facilitators that support women's participation in at-sea research. These include mentorship, supportive peer networks and institutional flexibility. Flexible working arrangements and inclusive leadership training also emerged as essential factors. For example, the S.H.E. includes training in digital fluency and scientific communication, aiming to address the gendered digital divide described by Narayanan et al. (2023). Similarly, the EU's Diversity Ambassadors in Transport programme supports women's leadership in marine careers.

These findings affirm that individual empowerment must be supported by institutional reform. Mentorship alone, without structural accountability or policy mandates without meaningful implementation, will fall short.

A consistent message emerges across the literature and institutional landscape: addressing gender inequities in deep-sea research requires more than isolated programmes. It calls for coordinated, systemic change that integrates policy, technology, networks and a redefinition of leadership at sea.

2.2. Stakeholder consultation

2.2.1. Methodology

A mixed-methods approach was used to provide a comprehensive understanding of both systemic and individual-level factors. The study combined qualitative interviews with women scientists, contractors and institutional stakeholders and a quantitative survey targeting marine professionals.

A semi-structured Key Informant Interview Guide was developed by the research team to gather qualitative insights from women who had participated in offshore research. The guide included open-ended questions on barriers, facilitators, gender dynamics, institutional support and recommendations.

An anonymous online survey was distributed via professional marine science networks, institutional partners and social media. The survey was designed to validate qualitative findings and gather broader quantitative data. It included closed- and open-ended questions about access to at-sea time, on-board conditions, mentorship and safety. All instruments are included in Appendix A.

A combination of convenience and snowball sampling strategies was employed to recruit participants (Biernacki & Waldorf, 1981). A convenience sampling strategy was used to disseminate an online survey via social media platforms such as LinkedIn and Twitter/X, targeting individuals actively involved in marine research. This method was chosen for its practicality and efficiency in reaching a broad audience within a limited time frame (Etikan, Musa and Alkassim, 2016).

For the qualitative component, purposive sampling was used to identify and select key informants with recognized expertise in ocean science, including researchers, policymakers and practitioners. To expand the pool of relevant experts, snowball sampling was also employed, allowing initial participants to recommend additional informants who met the study criteria (Biernacki & Waldorf, 1981). This approach ensured the inclusion of high-quality insights from knowledgeable stakeholders across the marine research sector.

The final sample included scientists and early-career researchers, engineers and technicians, research vessel coordinators and government and institutional representatives. This diverse group provided a valuable cross section of perspectives and experiences from both developed and developing States, contributing to a more comprehensive understanding of global deep-sea research engagement.

Data-collection was carried out by S.H.E. mentees under the guidance of ISA staff. The process involved both qualitative and quantitative methods.

A total of 12 key informant interviews were conducted between May and June 2025. Interviewees included both women and men scientists, engineers, offshore contractors and institutional representatives with direct experience in deep-sea research. Interviews were conducted virtually, primarily in English, using a video conferencing platform. Each session followed a semi-structured format guided by the ISA interview protocol.

The survey was open for 60 days, closing on 30 June 2025. It was distributed through ISA's internal network, shared directly with ISA contractors and trainees and publicly disseminated via email and social

media. Participants accessed the survey via a secure online link. The survey was available in English and included both multiple-choice and open-ended questions.

Data-collection efforts prioritized accessibility and confidentiality, ensuring that participants could contribute freely and securely from different geographic locations.

A preliminary literature review was conducted prior to data-collection to inform the development of the interview guide and survey questions. This initial review focused on gender equity in STEM, occupational safety in offshore environments and existing policies in maritime and deep-sea industries.

Thematic analysis was used to analyse data from the 12 key informant interviews. Full transcripts of interviews conducted via Microsoft Teams and automatically transcribed were reviewed and cleaned to correct transcription errors and fill in missing segments.

Transcripts were reviewed to ensure familiarity with the content. During this process, notes were taken to identify initial patterns and potential categories. Text segments were highlighted and coded to capture underlying meanings related to the research questions.

Recurring themes were identified and compared across interviews to identify similarities and differences in experiences and perceptions. This cross-case comparison supported the development of a thematic framework that captured recurring issues, unique perspectives and emerging insights.

All interview participants provided informed consent prior to participation and completed a brief online demographic questionnaire.

The mixed-methods design has several strengths and enabled the research team to explore the complex realities of women's participation in deep-sea research through both qualitative and quantitative lenses. The key informant interviews provided rich, detailed narratives of individual experiences, while the global online survey offered broader validation of those findings across diverse respondents.
First, although some insights are context-specific and may not be fully generalizable to all deep-sea research environments, generalizability is not the aim of qualitative research. Rather, the focus is on depth of understanding and the relevance of emerging themes to similar contexts.

Second, time and resource constraints limited the geographic spread and diversity of the sample, particularly for the interviews. As such, perspectives from underrepresented regions may be absent or underexplored. Nonetheless, the inclusion of participants from both developing and developed States adds valuable diversity to the data set.

Third, the survey tool strengthened the study by corroborating interview findings across a wider respondent group. While not exhaustive, the survey responses aligned closely with the thematic analysis, enhancing confidence in the relevance and resonance of the findings.

Finally, it was beyond the scope of this study to develop a comprehensive theoretical model that explains the interrelationships among all identified factors. Future research could deepen this work by applying gender-based or intersectional analytical frameworks, thereby contributing to theory-building on gender equity in high-risk, male-dominated scientific fields.

2.2.2. Results

This section presents findings from both phases of the research: qualitative interviews with key informants and a global online survey. Together, the data offer a view of the barriers, facilitators and structural dynamics shaping women's participation in deep-sea research.. The findings are organized by research questions, with supporting charts and tables used to highlight patterns and insights from the data.

Table 1. Key informant interviews and survey respondent demographic characteristics

Characteristic	Interview participants (n = 12)	Survey respondents (n = 149)
Gender	67% women (8) 33% men (4)	58% women (90) 39% men (62) 3% not specified
Age range	Predominantly 30-50 years	18-24: 6.5% 25-34: 37% 35-44: 38% 45-54: 11.6% 55-64: 3.9% 65+: 0.6%
Geographic origin	Diverse (Africa, Asia, Europe, Latin America)	Broadly distributed, the top 4 countries: Nigeria, Kenya, Thailand and Germany
Education	All postgraduate or higher	Masters (40%) PhD (28%) Bachelors (27%)
Professional background	Marine biologists, geologists, engineers, consultants	Researchers (42%) government (20%) students (20%) contractors and technicians: 7% combined
At-sea experience	Ranging from first-time participants to >10 years offshore	Varied, corresponding to career stage and professional role

The qualitative component included 12 key informant interviews conducted with both women and men senior professionals engaged in offshore expeditions. Participants were drawn from across Brazil, Canada, China, the Cook Islands, France, Germany, India, Italy and Portugal. The interviewees included deep-sea geologists, oceanographers and biologists, submersible engineers and expedition leads and consultants

with experience in data coordination and project implementation.

Experience levels varied from first-time at-sea participants to individuals with over 10 years of at-sea experience. Some interviewees were mentors themselves or held senior technical positions, while others were early-career researchers navigating the structural challenges of accessing offshore opportunities.

2.3. Research question 1.
What are the key barriers (logistical, institutional, social) that women face when participating in deep-sea offshore expeditions?

Survey respondents were asked to identify factors that influenced their participation in deep-sea research. Analysis of the data revealed several recurring themes that constitute both structural and cultural impediments to women's participation at sea. These barriers, ranging from inadequate infrastructure and limited leadership opportunities to safety concerns, funding inequities and entrenched gender stereotypes, reflect systemic constraints within organizational and expedition frameworks.

The constraints most frequently cited by respondents included limited access to offshore training and cruise opportunities (39 per cent of respondents), institutional barriers, including rigid policies and insufficient funding support (31 per cent), gendered expectations in role assignments, particularly in technical or leadership tasks (28 per cent), safety concerns, including lack of clear protocols or inadequate infrastructure for women (23 per cent) and work-life balance issues and caregiving responsibilities, especially during multi-week expeditions (21 per cent).

These challenges encompass both direct barriers (lack of infrastructure and access to training) and indirect barriers (role stereotyping and cultural expectations), as illustrated in Figure 1.

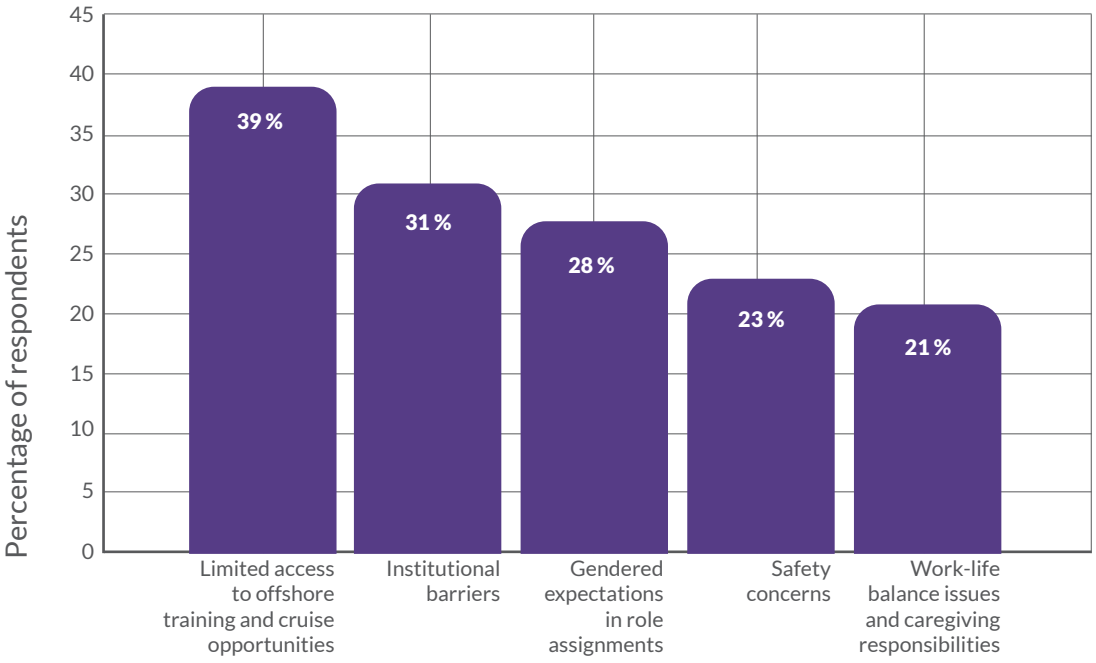

Figure 1. Reported barriers and influencing factors in deep-sea research participation

In-depth interviews with the key informants offered further insight into these dynamics. Across these interviews, four primary categories of barriers were identified:

- **Structural barriers**

Participants described persistent inequalities in access to technical roles, leadership positions and mission-planning responsibilities. One participant noted that women were frequently assigned to data analysis and laboratory roles, while men performed deck operations, despite equivalent training. These practices were often reinforced informally, rather than by written policy.

- **Cultural norms and gender role expectations**

Interviewees commonly referred to the internalized and external pressure placed on women regarding caregiving. Several described declining extended offshore assignments due to family responsibilities. One respondent reported that such decisions were not perceived as career-limiting for men, highlighting a gendered double standard.

> *"It is the guilt, honestly. Being away for five weeks is seen differently for women than for men."*
>
> — Participant, academic institution

- **Environmental and safety-related concerns**

Respondents raised concerns about vessel conditions, including the lack of private spaces and adequate sanitary facilities. One participant attributed the lack of women in extended deployments to inadequate emotional safety and the absence of clear reporting channels for misconduct.

- **Social and professional isolation**

Participants emphasized the psychological and professional impact of being one of the very few, or the only, woman aboard a vessel. This underrepresentation in scientific leadership and on-board decision-making was described as both limiting and discouraging. Several interviewees cited a lack of visible female mentors or role models at sea.

2.4. Research question 2. What facilitators (policies, institutional support, equipment, cultural factors) enable and encourage women's participation in at-sea activities?

Research question 2 examined the enabling factors that support women's involvement in deep-sea research, particularly through access to offshore scientific expeditions. Both survey responses and qualitative interviews indicate that institutional, cultural and interpersonal supports play a substantial role in fostering women's participation at sea.

Survey respondents were asked to identify factors they believed encouraged greater participation by women in at-sea research (Table 2).

Table 2. Top reported facilitators for women's participation in at-sea research

Facilitator	Mentions
Supportive institutional policies	80%
Access to mentorship and training programmes	76%
Organizational culture that promotes inclusion	69%
Gender-sensitive equipment and accommodations	57%
Visibility of female role models	30%
Transparent recruitment/promotion processes	24%
Targeted funding/grants	20%
Shorter campaigns for caregivers	8%
Family support structures	6%

These findings indicate that institutional culture and formal support mechanisms, such as mentorship, inclusive policy frameworks and infrastructure, are perceived as the most critical enablers of women's participation at sea.

Interviews with the participants provided further insight into how these facilitators operate in practice. These interviews identified the following four primary categories of enablers.

- **Institutional support**

Several participants reported receiving tangible support from their home institutions or contractors, including flexible leave arrangements, assistance with childcare and administrative accommodations for long-term cruises.

Such organizational measures were seen as particularly important for early-career women balancing caregiving roles.

> *"My institution offered to support childcare expenses for offshore work. I did not need it, but just knowing that was available made a difference."*
>
> — Mid-career marine scientist

- **Mentorship and female leadership**

Interviewees consistently highlighted mentorship, especially by senior female scientists, as a key contributor to their confidence, preparedness and continued engagement in offshore research.

> *"I had a female supervisor who had done this work for decades. Seeing her lead gave me confidence that I could do it too."*
>
> — Participant, European institution

> *"Being mentored by someone who had lived through the challenges helped me prepare for life at sea in ways formal training never could."*
>
> — Early-career respondent

This finding aligns with the survey, which found that over 50 per cent of respondents selected mentorship as a critical enabling factor.

- **Cultural and team-level support**

Participants noted the importance of working in environments where inclusivity was modelled by leadership and reinforced through team behaviour.

This form of cultural facilitation was described as creating a safer and more welcoming on-board environment, which contributed to higher retention among women team members.

- **Enabling logistics and infrastructure**

Though less frequently cited, some interviewees described accommodations such as gender-segregated cabins, adjustable safety equipment and protocols to manage menstrual hygiene needs as "small but significant" contributions to on-board comfort.

> *"They added simple things, like curtain partitions and supply kits, that made us feel like our needs were not an afterthought."*
>
> — Environmental researcher

2.5. Research question 3. How can institutions and research vessels modify their practices to create a safer and more inclusive environment for women researchers at sea?

This section presents qualitative findings and comparative insights regarding institutional strategies to enhance safety and inclusion for women in offshore research settings. The analysis focuses on logistical conditions, reporting protocols, cultural norms and leadership practices that shape on-board environments.

Interviews with participants revealed consistent themes regarding institutional and operational gaps in gender inclusion at sea. While most respondents acknowledged recent improvements, a range of unresolved safety and equity concerns were reported.

- **Emotional safety and reporting mechanisms**

Six participants expressed concern about the lack of confidential or effective processes for reporting harassment or misconduct on the board. Some had directly experienced inappropriate behaviour or witnessed it being poorly handled by leadership.

> *"There is no real structure for filing a complaint or having it taken seriously. You just have to put up with it or avoid trouble."*
>
> — Mid-career field researcher

> *"Teams are tight-knit. If something happens, women often do not want to disrupt the mission or draw attention."*
>
> — Senior scientific coordinator

This contributes to emotional insecurity and self-censorship, which undermines both psychological well-being and professional performance.

- **Inadequate physical infrastructures**

Eight interviewees cited vessel designs that do not adequately account for gender-specific privacy or hygiene needs. Key issues included shared sleeping quarters without adequate partitions, lack of gender-designated sanitary facilities and limited provisions for managing menstruation at sea.

Some organizations had addressed these concerns by introducing curtain partitions or supply kits, though such efforts were often ad hoc rather than standardized across missions.

> *"There is rarely privacy. Men and women share everything, including cabins and toilets. Some women stop participating because of that."*
>
> — Participant, independent consultant

- **Role of leadership and pre-departure briefings**

Half of the interviewees emphasized the importance of on-board leadership in establishing a culture of respect and accountability. Where cruise leaders modelled inclusive behaviour and implemented formal pre-departure briefings on conduct expectations, women reported a more supportive atmosphere.

> *"On our last expedition, the chief scientist laid out ground rules for respectful behaviour. That made a difference."*
>
> — Environmental scientist

However, such practices are not universal and are typically left to individual leaders' discretion rather than institutional policy.

• Gender-sensitive policies and career development

Respondents recommended that institutions adopt gender-responsive policies covering inclusive crew selection protocols, sexual harassment prevention training, leadership development opportunities for women scientists, and scheduling flexibility to accommodate caregiving obligations.

These policies were seen as critical not only for safety but also for women's long-term retention in deep-sea research.

Table 3. Institutional practices to enhance safety and inclusion for women in offshore research

Theme	Key issues identified	Illustrative quotes	No. of mentions (n=12)	Gender of respondents
Emotional safety and reporting mechanisms	Absence of confidential and effective procedures for reporting harassment or misconduct on board. Respondents described a culture of silence and self-censorship to avoid conflict or mission disruption.	"There is no real structure for filing a complaint or having it taken seriously." — Mid-career field researcher "Teams are tight-knit. If something happens, women often do not want to disrupt the mission." — Senior scientific coordinator	6	Female (5), Male (1)
Inadequate physical infrastructures	Vessel design fails to account for privacy and gender-specific hygiene needs. Common concerns include shared sleeping quarters, unsegregated sanitary facilities and limited menstrual supplies.	"There is rarely privacy. Men and women share everything, including cabins and toilets." — Independent consultant	8	Female (7), Male (1)
Role of leadership and pre-departure briefings	The presence of inclusive, accountable leadership and formal pre-departure briefings on conduct expectations fosters safer on-board environments. However, such practices depend on individual leaders, not policy.	"On our last expedition, the chief scientist laid out ground rules for respectful behaviour. That made a difference." — Environmental scientist	6	Female (4), Male (2)
Gender-sensitive policies and career development	Need for institutional policies addressing inclusive recruitment, sexual harassment prevention training, leadership development for women and flexible scheduling for caregiving roles. Seen as vital for safety, retention and advancement.	"Institutions should have clear, gender-responsive policies — not rely on goodwill or luck of leadership." — Marine policy advisor	7	Female (6), Male (1)

2.6. Research question 4.
What gender-specific best practices should be included in a Gender Equity Charter to support women's participation in deep-sea research?

This section presents findings on the gender-specific recommendations that stakeholders believe should be included in a Gender Equity Charter to support women's participation in deep-sea research. These practices are intended to guide institutional policy, mission planning and on-board operations to enhance women's participation and well-being in offshore settings.

Participants were asked to identify the best practices to prioritize in a Gender Equity Charter. Responses reflect both operational improvements and institutional culture change.

The 10 most frequently cited best practices included: clear reporting mechanisms for harassment and safety incidents (78%), mentorship and leadership development programmes tailored for women (74 per cent), availability of gender-sensitive facilities such as private cabins and appropriately fitted PPE (69 per cent), training on gender equity and inclusion for all crew members (66 per cent), equal opportunities in cruise selection and leadership appointments (64 per cent), work-life balance accommodations including flexibility for caregivers (58 per cent), representation of women on decision-making committees (55 per cent), regular assessments of vessel infrastructure for gender inclusion (52 per cent), public accountability metrics on gender participation and promotion (49 per cent), and gender-sensitive mental-health support before and after cruises (46 per cent).

Figure 2. Top recommended gender-specific practices for the Gender Equity Charter

When asked which gender-specific best practices should be included in a Gender Equity Charter to support women's participation in deep-sea research, respondents most frequently emphasized the need for structured mentorship and leadership pathways (72 per cent). Many also recommended implementing standardized reporting and grievance systems (68 per cent). A further priority emphasized the need for physical and emotional safety infrastructure on-board (and 63 per cent).

Interview participants emphasized similar priorities. All interviewees mentioned mentorship as a critical enabler of retention and advancement. Female role models were cited as particularly impactful in encouraging confidence and long-term career planning. Seven respondents emphasized the need for gender-sensitive accommodations (sanitary facilities, sleeping quarters). These are often improvised rather than institutionalized. Respondents supported the formal adoption of gender-responsive policies, including pre-departure orientation on respectful conduct and the presence of a designated ombudsperson on-board.

> ***"Without written policies, you depend on the goodwill of whoever is in charge. That is not enough."***
>
> — Participant, government-affiliated institution

3. DISCUSSION

This study set out to examine the barriers and facilitators that influence women's participation in deep-sea offshore expeditions, to inform a Gender Equity Charter for offshore deep-sea research scientific missions. Drawing on existing literature, survey data and key informant interviews, the findings provide a comprehensive account of the multi-layered challenges women face at sea, as well as the institutional practices that can support safer, more inclusive participation. The discussion below interprets these findings in relation to the research questions and situates them within the existing literature.

The research revealed four central themes aligned with the study's research questions

1. Women's participation is constrained by structural, cultural, social and environmental barriers
2. Participation is supported by a combination of institutional policy, mentorship, inclusive team dynamics and gender-sensitive logistics
3. Institutional safety and inclusivity are undermined by gaps in infrastructure, reporting mechanisms, leadership engagement and policy enforcement
4. Stakeholders consistently endorse formalized gender-specific best practices, such as mentorship programmes, infrastructure standards and accountability frameworks, for inclusion in a Gender Equity Charter

These findings are significant because they highlight the persistent institutional and cultural barriers that reinforce gender disparities at sea, while also offering clear, actionable pathways for reform.

The findings corroborate prior research on gender dynamics in high-risk, male-dominated fields such as maritime operations, offshore energy and polar science. Studies have consistently shown that women remain underrepresented not only numerically but also in leadership roles and decision-making positions (UNESCO, 2017; Clancy et al., 2014). The current study affirms that gender-based exclusion in deep-sea research is not limited to overt discrimination but is often embedded in organizational norms, infrastructural design and informal practices.

The emphasis respondents place on mentorship aligns with earlier studies suggesting that the presence of female role models is critical to increasing both participation and retention (Huyer, 2015). Similarly, the reported need for standardized safety protocols and confidential reporting mechanisms echoes long-standing calls in the literature for trauma-informed and gender-sensitive safety cultures aboard research vessels (Johnson et al., 2020).

Unexpectedly, the study also found that some institutions had implemented informal or case-by-case support measures, such as financial assistance for childcare or team briefings on respectful behaviour, which, although not codified, were reported to have a positive effect on women's experiences. This highlights an opportunity for institutions to build on existing practices and institutionalize practices that currently depend on individual leadership discretion.

Several limitations of this study should be acknowledged. First, the interview sample was relatively small (n=12) and may not capture the full range of experiences across different institutions and regions. While the diversity of participants added depth, the findings may not be fully generalizable. Second, while survey responses provided useful quantitative insights, they relied on self-selection and may reflect the perspectives of those already sensitized to gender equity issues.

Furthermore, the absence of longitudinal data prevents us from assessing whether reported facilitators or barriers have long-term career impacts. Finally, the available literature reviewed was limited to publicly available documents and may not reflect internal practices within sector organizations or research institutions.

The results have important implications for institutions conducting deep-sea research expeditions offshore. First, they demonstrate the necessity of embedding gender equity into the design and execution of offshore missions, not as an ancillary concern but as a central operational standard. This includes investing in gender-sensitive infrastructure, establishing formal codes of conduct and reporting systems actively supporting mentorship and leadership development for women scientists.

Second, the findings support the adoption of accountability measures such as gender audits, crew composition tracking and the public reporting of inclusion metrics. These practices, already implemented in parts of the maritime and energy sectors, provide a model for systematic reform in ocean science.

Finally, the findings reinforce the need to approach gender equity holistically, integrating structural, interpersonal and cultural interventions to shift the paradigm from informal accommodation to institutionalized inclusion.

4. CONCLUSION AND RECOMMENDATIONS

As the first investigation into the gendered experiences of women in offshore deep-sea research expeditions, this study has identified key barriers and enablers to women's participation at sea. Findings show that institutional policies, mentorship and inclusive infrastructure play a critical role in shaping access and retention.

This study contributes to the growing body of evidence that gender disparities in offshore deep-sea research expeditions are not only persistent but systemic. By identifying both the barriers to women's participation and the institutional practices that can support equity and inclusion, this research provides a strong empirical foundation for developing a Gender Equity Charter. Such a charter, if widely adopted and enforced, has the potential to transform offshore science into a safer, more inclusive and more equitable domain for all researchers.

A summary of key recommendations to guide the development of a Gender Equity Charter to enable the safe participation of more women in offshore expeditions is given below. These recommendations are intended to inform the development and institutionalization of a Gender Equity Charter and to support organizational change among research institutions and contractors working offshore.

At the outset, institutions and companies commissioning or organizing offshore expeditions are encouraged to explicitly integrate gender equity considerations into their operational mandates and planning documents. This includes considering expectations for inclusive team composition, equitable role assignment and the integration of gender-sensitive protocols as an essential part of routine practice.

Gender-sensitive infrastructure requirements, such as the provision of private sleeping quarters, appropriate sanitation and personal protective equipment designed for a range of body types, should be clearly outlined in vessel readiness protocols. These standards could be reviewed periodically and reflected in vessel audits or mission debriefs.

Pre-departure briefing protocols may benefit from dedicated components on respectful conduct, gender equity and inclusive team behaviour. These briefings are best included as part of the formal orientation process for all offshore personnel, rather than optional content.

Institutions may wish to implement mentorship programmes that pair early-career women with experienced offshore researchers. These initiatives could be enhanced by being adequately resourced, monitored and aligned with broader institutional development strategies.

Leadership development pathways should be designed with attention to gender parity, with targets for the nomination and promotion of women into roles such as chief scientists, principal investigators and mission planners. Gender representation might also be tracked in technical roles traditionally dominated by men.

Confidential, accessible and enforceable mechanisms for reporting harassment, discrimination, or misconduct are vital and can be strengthened by clear communication to all cruise participants prior to departure. These mechanisms should ideally be supported by trained personnel and structured to allow follow-up action without risking professional retaliation.

Policies that acknowledge and support caregiving responsibilities can play a meaningful role in creating inclusive work environments. This includes flexible rotation scheduling and, where feasible, the provision of childcare subsidies or family support allowances for researchers with dependents.

Institutions are encouraged to uphold both physical and emotional safety at sea by adopting gender-responsive safety standards. Creating vessel environments that are structurally secure and psychologically inclusive will likely increase women's participation in offshore roles.

Recognizing and addressing the psychological burden experienced by women who are often the only or one of very few female participants on-board can help mitigate feelings of isolation and visibility pressure. Institutions might consider developing support measures to reduce such impacts.

Access to gender-sensitive mental health services could be included as a standard element of offshore research planning. Pre- and post-expedition counselling and support mechanisms can help address the unique emotional, social and occupational challenges faced by women at sea.

Institutions should track and publicly report gender-disaggregated data on expedition participation, leadership roles and scientific outputs. This transparency is crucial for accountability and allows stakeholders to monitor progress towards equity goals. Furthermore, institutional accountability can be strengthened by integrating gender equity performance indicators into mission evaluations and organizational audits. By reporting equity considerations alongside scientific deliverables, inclusion is reinforced as a core outcome.

Opportunities for cross-sectoral learning should be explored. Lessons from adjacent fields, such as offshore oil and gas, maritime law and global public health, may offer valuable insights for improving operational equity in marine science. Institutions could benefit from commissioning dedicated reviews, pilot projects or knowledge exchanges focused on interdisciplinary approaches to intersectional equity.

Finally, the deep-sea literacy programme targeting schoolchildren should be sustained and, if possible, expanded to raise awareness from an early age of the wonders of the deep sea and the opportunities for marine scientific careers, especially for young girls.

To conclude, this study shows that with deliberate planning, institutional commitment and inclusive design, it is possible to transform offshore research into a more equitable and supportive environment for women scientists and technicians. The adoption of a Gender Equity Charter grounded in these recommendations offers a practical step towards realizing that goal.

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RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies should aim to capture longitudinal data to assess the career trajectories of women participating in offshore missions. Comparative studies between institutions with formal gender equity policies and those without could provide deeper insight into the effectiveness of specific interventions. Additionally, further research is needed to explore the intersectional dimensions of offshore research experiences, including how race, nationality and socioeconomic status intersect with gender in shaping access and opportunity.

APPENDIX 1.
KEY INFORMANT INTERVIEW GUIDE

Research title:

Promoting gender equity in deep-sea research: barriers and facilitators to women's participation in offshore activities

Purpose:

This interview is part of the International Seabed Authority's See Her Exceed Global Mentoring Programme - S.H.E. knowledge output. It aims to gather insights into the experiences of professionals in deep-sea research, especially regarding gender dynamics, institutional support and potential actions to promote women's participation in offshore expeditions.

Confidentiality statement:

All responses will be treated as confidential. No individual will be identified by name in any report. Participation is voluntary the respondent may decline to answer any question or withdraw at any time.

Section A:
Respondent information (for contextual use only; not for publication)

1. Name of respondent: (will not be linked with responses)

2. Organization:

3. Role/title in organization:

4. Years of experience in deep-sea research:

5. Have you participated in offshore cruises?

No Yes

If yes, please estimate how frequently:

• Occasionally (1-2 times per year) • Frequently (3+ times per year)

Section B:
Interview questions

1. Background and experience
• Can you briefly describe your experience or role in deep-sea research and offshore expeditions?

2. Barriers to participation
• What are the most significant barriers that women face when participating in offshore expeditions?
• Could you share any specific examples or incidents that highlight these challenges?

3. Gender dynamics at Sea
• How do gender dynamics manifest during offshore cruises or research projects?
• Are there roles or responsibilities typically assigned based on gender?

4. Institutional support
• What kind of support, formal or informal, does your organization provide to encourage women's participation in offshore research?
• Are mentorship programmes or leadership development initiatives effective?

5. Safety and logistics
• What safety or logistical concerns are commonly raised by women during offshore expeditions?

6. Opportunities for improvement
• In your view, how can research institutions improve women's access to and leadership in deep-sea research projects?

7. Policy and programme recommendations
• What specific policies, programmes or initiatives would have the greatest impact in promoting gender equality in offshore research?

8. Sustained participation
• From your perspective, what are the top recommendations to increase and sustain women's participation in deep-sea research?

9. Mentorship and leadership (optional probe)
• How has mentorship or peer support influenced career progression for women in this field?

10. Referral for additional input
• Is there another individual or colleague you recommend we speak to about this topic?

Section C:
Conclusion

- Is there anything else you would like to share that has not been covered in this discussion?

Interviewer notes
(to be filled post-interview)

- Interview date & time:
- Duration:
- Mode: MS Teams Zoom Phone In-person
- Consent obtained: Yes No
- Recording enabled: Yes No

APPENDIX 2.
SURVEY INSTRUMENT AND KEY INFORMANT INTERVIEW GUIDE

A. Survey: "ISA – Promoting Gender Equity in Deep-Sea Research: Barriers and Facilitators to Women's Participation in Offshore Expeditions"

Section A:
About the Survey

The See Her Exceed (S.H.E.) Mentorship Programme is a global initiative of the International Seabed Authority (ISA), launched under the Women in Deep-Sea Research (WIDSR) project. It is the first mentoring programme of its kind, designed to support high-potential women scientists from developing States in advancing their personal, professional and scientific goals in deep sea research.

As part of the programme's outcomes and knowledge-building component, the mentees are conducting a research project to better understand the barriers and enabling factors that influence women's participation in deep sea exploration campaigns. Your input will be instrumental in shaping evidence-based recommendations to improve institutional practices and support systems for women at sea.

The findings from this study will inform the development of a Gender Equity Charter — a practical tool featuring best practices, safety protocols, and institutional guidelines to foster a more inclusive and equitable environment in marine science.

Demographic Data

1. What is your age group?
   18–24
   25–34
   35–44
   45–54
   55–64
   65 and above

2. What is your gender?
   Male
   Female
   Non-Binary/Other
   Prefer not to say

3. Highest Level of Education
   Bachelors
   Masters
   PhD or Higher
   Prefer not to say

4. In which country are you based?

5. What is your current role in marine science or related fields?
   Researcher/Scientist
   Student/Trainee
   Policy Maker
   Government Official
   Filed Technician
   Contractor
   Administrative Support Staff
   Other

6. If other, please state here.

Section B:
Experience in Deep-Sea Research

7. Do you currently work, or have you ever worked, in the marine scientific research (MSR) field or in a related field (e.g., oceanography, marine policy, offshore engineering, environmental monitoring)?
   Yes, currently work in the field
   Yes, previously worked in the field
   No, I have never worked in the field

8. What is your current role in marine science or a related field?

9. How many years have you been involved in deep-sea research?
   Less than 1 year
   1–3 years
   4–7 years
   Over 7 years

10. Have you ever participated in a deep-sea exploration cruise/campaign?
   Yes
   No

11. If yes, what was the duration of the most recent cruise/campaign?
   Less than a week
   1–4 weeks
   More than 4 weeks

12. How frequently do you participate in deep-sea exploration cruises?
   Rarely (once every 2–3 years)
   Occasionally (1–2 times per year)
   Frequently (3+ times per year)

13. Have you ever served as chief scientist on a research cruise?
   Yes
   No

14. Please estimate the percentage of men, women, and non-binary individuals on your first research cruise.
(Percentages must total 100)

15. Please estimate the percentages on your most recent research cruise.

16. How many nationalities were represented in the entire crew?
   1–4
   5–10
   More than 10

17. Please specify your role during the cruise(s) (select all that apply):
   Chief Scientist/Principal Investigator
   Research Scientist
   Research Assistant/Graduate Student/Trainee
   Laboratory Technician
   ISA Trainee
   Marine Technician/Technical Support
   ROV/AUV Operator
   Vessel crew
   HSE Officer
   Contractor/Industry representative
   Government/Regulatory Observer
   Media/Communications
   ISA Mentee
   ISA Mentor
   Junior Scientist
   Senior Scientist
   Other

18. If other, specify.

Section C:
Challenges and Barriers

19. Do you feel that women are underrepresented in deep-sea research?
    Strongly agree
    Agree
    Neutral
    Disagree
    Strongly disagree

20. What challenges have you or colleagues faced in participating in at-sea research? (Select all that apply)
    Limited funding opportunities
    Lack of mentorship/support
    Work-life balance difficulties
    Safety/security concerns at sea
    Limited access to leadership roles
    Institutional barriers
    Social barriers
    Physical barriers
    Cultural barriers
    Other

21. If other, specify.

22. Are you aware of any gender-specific barriers during deep-sea exploration cruises/campaigns?
    Yes
    No

23. If yes, please describe briefly.

24. How often do you think women experience barriers compared to male counterparts?
    Never
    Rarely
    Sometimes
    Often
    Always

25. Examples of barriers experienced or observed:

26. Is there a gender-based pay gap in ocean science?
    Yes
    No
    Not sure

27. Is there a gender-based pay gap in deep-sea research, particularly offshore?
    Yes
    No
    Not sure

Section D:
Support and Opportunities

28. What factors encourage women's participation at sea?
    Supportive institutional policies
    Mentorship/training programmes
    Gender-sensitive equipment/accommodations
    Organizational support
    Other

29. If other, specify.

30. What support would enhance women's participation?
    Mentorship programmes
    Leadership training
    Financial support
    Flexible work schedules
    Networking opportunities

31. What training would be most beneficial?

32. Programmes or initiatives that have positively influenced participation:

33. Existing guidelines or safety instructions addressing gender-specific topics:

34. Importance ratings (1–5):
    Access to funding
    Mentorship/leadership development
    Gender-sensitive facilities/equipment
    Training on gender inclusion
    Clear reporting mechanisms

Section E:
Career Goals & Recommendations

35. What inspired your career?
    Passion for marine science
    Technological innovation
    Environmental challenges
    Academic curiosity
    Other

36. If other, specify.

37. Aspects of deep-sea research most involved in:
   Fieldwork
   Laboratory analysis
   Data processing
   Policy/management
   Technology development
   Other

38. If other, specify.

39. Factors influencing your participation:
   Funding
   Mentorship
   Advanced technologies
   Organizational policies
   Other

40. If other, specify.

41. Primary career goals:
   Conduct innovative research
   Publish in high-impact journals
   Secure funding/lead projects
   Mentor others
   Transition into policy
   Other

42. If other, specify.

43. Recommendations to improve inclusivity and safety:

44. Gender-specific best practices for the gender equity charter:

45. Additional comments:

B. Key Informant Interview Guide

1. Can you briefly describe your experience or role in deep-sea research and offshore expeditions?
2. What are the most significant barriers that women face when participating in offshore expeditions? Please share examples.
3. How do gender dynamics play out during offshore cruises or research projects? Are roles typically assigned based on gender?
4. What institutional or organizational support exists to encourage women's participation? Are mentorship or leadership programmes effective?
5. What safety or logistical concerns do women encounter during offshore expeditions?

6. How can institutions improve opportunities for women to participate in and lead deep-sea research?
7. What policies, programmes, or initiatives would most effectively promote gender equality in offshore research?
8. What key recommendations would help increase and sustain women's participation in deep-sea research?
9. Do you have suggestions for additional individuals we should interview?

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