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Original Article

Past experiences can inform better practice for marine fieldwork

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Abstract

Field-based research is a common component of marine science and many researchers cite field opportunities as a reason for pursuing a career in the subject. As a result, fieldwork skills are a crucial attribute for marine scientists and opportunities to gain field experience are offered from an early career stage. Positive fieldwork experiences increase productivity, build collaborations, and strengthen a scientist's understanding and appreciation of the natural world. But the isolation and narrow hierarchies that can occur in fieldwork settings sometimes result in hostile working environments, causing significant psychological stress and disrupting career trajectories. In this study, we surveyed fieldwork experiences of marine scientists. We find that positive experiences are related to greater self-confidence, future career ambitions in the field, and further fieldwork opportunities. By contrast, negative experiences are related to poor psychological safety, reduced feelings of value and, in some cases, the decision to leave their career in marine science. Inappropriate behaviour is a common feature of both positive and negative experiences and appears unrelated to the presence of a code of conduct. We suggest that considerably more needs to be done to reduce the amount of inappropriate behaviour in marine science fieldwork settings and provide appropriate support for researchers, especially when early in their careers. Our results indicate that field scientists want fieldwork environments to be safe and stimulating learning environments. By drawing on guidelines developed in other disciplines, we signpost the tools that fieldwork leaders should use to make progress towards realising this aspiration and emphasize the value of positive field environments for both individual and scientific success.

Keywords marine science, fieldwork, safety, social science, guidelines

Background

Gaining fieldwork experience is important for students and early career researchers to build practical competencies, professional networks, and science-identities in field-based research within life sciences (Scott et al. 2012). Fieldwork experience and competence are expected, if not required, for many higher education courses, academic roles, and industry jobs (Scott et al. 2012). These experiences are also often formative in connecting scientists to nature, grounding their science in practical knowledge of study species and ecosystems, and driving their desire to continue in the field (Gerber 2000, Fleischner et al. 2017, Lewis 2017). Because of the important role of fieldwork in encouraging or discouraging scientific careers, the quality of work environments can shape the scientific workforce, including who feels that they belong and can succeed in science (Clancy et al. 2014).

Features of working environments

Across occupational settings, positive work environments are linked to feelings of psychological safety and personal value (Edmondson and Lei 2014). Psychological safety describes practices that create a safe learning environment, which includes comfort in voicing ideas, challenging authority, providing honest feedback, and experimenting with new methodologies (Edmondson 1999). High levels of psychological safety increase productivity, reduce mistakes, and enhance effective teamwork (Leroy et al. 2012, Bergmann and Schaeppi 2016). Psychologically safe environments limit the emergence of serious unsafe behaviours, such as bullying and harassment, by promoting a culture of respect and being safe spaces for individuals to raise concerns and prevent escalation (Siad and Rabi 2021). Personal value describes how a work environment makes an individual feel, including the extent to which they feel enthusiastic, energized, and optimistic about their work. It can be determined by how an individual identifies

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within their working environment; e.g. their sense of belonging and feeling valued (Bakker et al. 2008).

Fieldwork sites are unique among occupational settings. Researchers often spend extensive periods of time in remote areas within small research teams, creating intense social environments, which can be exacerbated by the competitive nature of academia and the power dynamics of narrow hierarchies (Moylan and Wood 2016, Amon et al. 2022). Further, fieldwork is encouraged very early in a researcher's career, typically through academic (i.e. undergraduate field courses) and private (i.e. volunteering or pay-to-participate opportunities at field sites) channels (Scott et al. 2012). Alongside scientific skills, conducting field-based research requires substantial social and administrative competency to work effectively in a small team, live remotely, work long or unsociable hours, and organise systems for logistical tasks such as cleaning, cooking, data entry, sample organization, and field gear preparation (Clancy et al. 2014). Researchers are rarely provided training in such skills and, as a result, it is common for researchers to normalize, and sometimes replicate, the social and scientific culture experienced in these intense early career stages (Posselt and Nuñez 2022). Thereafter, this can also result in fieldwork leaders taking up positions of seniority without formal training in people management or leadership (Nelson et al. 2017).

Impacts of fieldwork experience

Whether field experiences are positive or negative affects both personal and professional development (Clancy et al. 2014). Positive field experiences are linked to increased confidence, motivation, scientific identity formation, and an overall sense of professional satisfaction (Seymour et al. 2004). The ambitions formed during fieldwork in early career stages can improve academic performance and solidify career ambitions (Lopatto 2004, Beltran et al. 2020), while continued involvement with field research at advanced career stages is linked to greater funding and publication success (McGuire et al. 2012). Negative experiences can lead to a loss of research opportunities, reduced study completion rates, and limited future access to field sites, and can drive researchers to leave their career altogether (Stephens and Levine 2011). While surveys of fieldwork experiences often report high levels of participant positivity (Seymour et al. 2004), a single negative experience can be sufficient to deter an individual from continuing with their academic aspirations (Stephens and Levine 2011). Negative experiences can discourage persistence in Science Technology Engineering and Maths (STEM) disciplines, especially in marginalized groups who may be made to feel that science is 'not for people like them' and that they will not be given opportunities to succeed, inhibiting access to professionally important skills, networks, or opportunities (Ramirez-Castaneda et al. 2022).

Negative experiences of fieldwork, including extensive bullying and sexual harassment, are widely documented across disciplines in life sciences (Nelson et al. 2017, Nash et al. 2019, Moss and Mahmoudi 2021). The pressure on researchers to collect large volumes of high-quality data within narrow fieldwork time windows can lead to toxic working cultures with unreasonable expectations and unsafe practices, with which researchers feel obliged to comply or risk personal or professional repercussions (Clancy et al. 2014). Further, individuals from minority groups related to gender, sexuality, race, and religion are more likely to have negative fieldwork experiences (Clancy et al. 2014). Taken together, negative fieldwork environments lead to an uneven loss of young researchers within STEM, deny aspiring scientists the opportunity to pursue their chosen career path and reducing diversity of thought (Jensen et al. 2021, Hägele and Hornidge 2025). Creating safe and supportive field experiences, particularly for underrepresented or marginalized groups, is both a professional responsibility for scientists and benefits the quality of science (Ramirez-Castaneda et al. 2022).

Fieldwork environments are formed by a combination of organizational culture, behavioural standards (e.g. rules, codes of conduct), and procedures for dealing with issues that arise (Nelson et al. 2017). All three of these features can differ greatly between field sites due to variation in how they are managed (i.e. academic vs private), local cultures and a lack of standard practice (Clancy et al. 2014, Moylan and Wood 2016). Understanding the distinctions in the characteristics of positive and negative field experiences across working cultures, behaviours, and reporting procedures is therefore key to developing frameworks that can help more field sites replicate the successes of those creating inclusive learning environments characterized by high psychological safety. Excellent guidelines for ethical and safe practice in field science have already been developed (e.g. Ramírez-Castañeda et al. 2022), however, the distinctions between how different disciplines of life sciences conduct fieldwork require targeted investigation to inform their effective application (Clancy et al. 2014).

Fieldwork culture in marine science

Marine science is a popular field of study which commonly involves fieldwork. Due to the inaccessibility of many marine ecosystems, fieldwork is often isolated, with some researchers spending extensive periods of time at sea on research vessels or at small coastal field stations. These isolating conditions have been reported to contribute to harassment and bullying (Maia et al. 2024), with early career researchers reporting social obstacles, discrimination and bullying as barriers to pursuing a career in marine science (Osiecka et al. 2022). These concerning studies signpost important issues, but do not provide insight on the characteristics of fieldwork cultures that researchers consider most productive and safe. This is fundamental to our ability to determine appropriate goals for improving fieldwork culture, behaviour, and reporting. In the UN Ocean Decade, the opportunity to address challenges across marine science should include setting an example of creating safe, equitable environments for all researchers (Polejack 2021).

To characterize fieldwork culture in marine science, we used an online survey to recruit participants who had been involved in marine science fieldwork with the intention of pursuing a career in the field and provided them the opportunity to report positive and/or negative field experiences. Our survey was designed to answer three main questions:

1. What defines positive and negative fieldwork experiences?
2. Do reports of inappropriate behaviour vary between positive and negative experiences?
3. What are the impacts of positive and negative field experiences on researchers?

We use the results of our survey to compare the common characteristics of positive and negative field experiences. We also

make suggestions for how existing guidelines could be adapted to move the field towards positive and inclusive fieldwork experiences in marine research.

Methods

Ethics statement

Human research approval for the data collection in this project was granted by the University of Exeter Biosciences Research Ethics Committee (application ID: 529 579). All research participants were required to read a participation information sheet and provide informed consent before taking part in the study (Supplementary material: Informed consent statement). All data collection was anonymous.

Survey design

The survey was designed to identify the features of fieldwork that led to respondents considering it a positive or a negative experience. We asked respondents to answer questions across three areas: field site culture, experiences of inappropriate behaviour, and the impact of their field experiences. Questions on field site culture were designed to assess how it shaped respondents' feelings of psychological safety (Carmeli et al. 2010)) and personal value (Shao et al. 2011). We followed protocols from other published studies in the design of our questions and allowed participants to self-define inappropriate behaviour subjectively (Luthar and Pastille 2000), specifically avoiding using terms such as 'harassment', 'bullying', or 'assault' in questions to avoid misrepresenting respondent experiences. Questions regarding the effects of field experiences on opinions of self-worth, career goals and views of marine science as a profession were used to compare the outcomes of negative and positive field experiences and determine how individuals perceived their cumulative experience.

The final survey comprized 91 questions across four sections: (i) positive field experience ($n = 36$); (ii) negative field experience ($n = 36$); (iii) overall field experience ($n = 6$); and (iv) demographics ($n = 13$) (Supplementary material: Fieldwork survey). Sections (i) and (ii) asked identical questions, except for the first question which asked respondents to confirm if they had a positive or negative experience upon which they were willing to focus their answers. This allowed us to make direct comparisons between the characteristics of a reported 'positive' or 'negative' experience for fieldwork participants. If they selected 'yes', they were then directed to a new page and prompted to answer all questions in the section exclusively based on their identified experience type. If a participant selected 'no' to having an experience type, they were passed directly onto the next section without seeing any additional questions. Respondents were able to provide one positive and one negative response.

Questions were a mix of multiple choice, Likert scale, and free-text responses. Multiple choice and Likert scale questions were designed to make quantitative assessments of trends in fieldwork experience, while free-text answers were designed to add qualitative descriptions to our results. The survey was estimated to take 15–25 minutes to complete. There were no forced-choice questions within the survey and participants were provided with the option to select 'prefer not to answer' for every question. Participants were asked to provide information on their gender, race, sexuality, country of citizenship, and disability status at the end of the survey. While placing demographic questions last has been linked to lower response rates due to increased complete time and a fear of linking honest answers to potentially identifying information, we chose this placement to prevent respondents from answering questions immediately after being made self-aware of their identity (Teclaw et al. 2012). At the top of each page of the survey, participants were signposted to a link which contained online resources for support in relation to the topics that may have been brought up by answering the survey. Before the survey was finalized, we trialled it in a focus group to ensure that it was accessible and that questions were clear and interpreted as we intended.

We aimed to recruit a global sample of individuals who currently, or once planned to, have a career in marine science. By targeting participants who intended on having a career in marine science, but not making it a requirement to have remained in the field, we collected perspectives on the characteristics of fieldwork that contribute to retention and attempted to avoid survivor bias. To complete the survey, participants were asked to confirm that they met these criteria, had participated in fieldwork on at least one occasion related to their career, and were over 18 at the time of fieldwork. This was to ensure that fieldwork was related to the career ambitions of participants. To maximize accessibility, the survey was designed to be completed on a computer, mobile phone or tablet device. While we created the survey to collect answers from an international audience, the logistical constraints of translation meant that the final survey was published in English only.

Survey distribution

The survey was hosted online (Qualtrics, Provo, UT, USA) for 10 weeks between 9 January and 19 March 2024. The survey was distributed using chain-referral sampling (e.g. Clancy et al. 2014). This method entailed us distributing the survey to an identified group of contacts and organizations with the intention that they would complete the survey and circulate it further, leading to 'chains' of respondents from our initial points of contact (Heckathorn 2011). While chain-referral sampling can lead to a bias towards respondents that have similar characteristics to the researchers, as the field of marine science is relatively small and collaborative we considered that this would be an effective method to reach a large proportion of the target population. We contacted 24 societies, organizations, and higher education facilities, requesting that they circulate the survey on three occasions while the survey was online. In addition, we distributed the survey online through social media (X, Facebook, LinkedIn, and Instagram).

Data analysis

We completed all data exploration and analysis in R (R Core Team 2023) Chi-squared tests of independence were used to analyse the strength of association between categorical variables, and pairwise comparisons were included when we were interested in testing the differences in association strength between categories within a variable. To model the strength and direction of relationships between variables, we used logistic general linear models (GLM) using the 'glm' function from the base R 'stats' package (Thomas et al. 2013). We calculated the odds ratio (*OR*) from

the coefficients of logistic GLMs to determine the significance (P) of individual categorical variables, where OR represents the odds that each categorical outcome will occur (Hailpern and Visintainer 2003). The significance (P) and fit (X^2) of each full model were calculated as the difference in deviance against the null model using chi-square goodness of fit. We checked the assumptions for each model by checking residual deviance, variance, and leverage (Thomas et al. 2013). Plots were made in R using the packages 'likert' (Bryer and Speerschneider 2016, version 1.3.5) and 'ggplot2' (Wickham 2016, version 3.4.4)

For free-text answers, we used thematic analysis to group responses based on broad common themes (Castleberry and Nolen 2018). Descriptive codes were developed based on the most common words encountered in responses to each free-text question, and codes were then assigned to groups with similar descriptors. We then counted the number and proportion of responses that belonged to each group to describe the most common answers for each question.

Results

We recruited 221 participants to our survey, with respondents answering a median of 85 (±21) of 92 total questions over a median response time of 17 (±12) minutes. As respondents were able to skip questions they did not want to answer, the number of respondents reported for each question (n) is inconsistent across questions.

Respondent demographics

Precise categorical responses to demographic questions are not reported to reduce the chance of individual identification (Clancy et al. 2014). Instead, we report broad trends to provide a demographic overview of our sample population.

Most survey respondents identified as female (77%, $n = 169/219$) or male (19%, $n = 41/219$). Respondents were from 39 countries across six continents, with the majority from the Western Europe (47%, $n = 100/215$) and North America (35%, $n = 75/215$). Respondents spanned all age categories from 18–25 to > 60, with the majority aged 18–30 (56.9%, $n = 125/220$). Collectively, respondents self-reported 13 categories for race, with most reporting as white (74%, $n = 149/202$). Most respondents did not consider themselves to belong to the LGBTQIA + community (70%, $n = 153/220$) or to have a disability (85%, $n = 185/219$). Due to the limited variation in demographic categories for race, age, sexuality, and disability, we were unable to compare survey responses quantitatively between these categories. We did have a sufficient sample size to compare female and male experiences, however, we were not able to include gender minorities in statistical analyses.

Most respondents had completed fieldwork at more than one field site (91.4%, $n = 201/220$), with nearly half of those respondents working at ≥ 5 field sites (52%, $n = 104/201$). The highest level of education completed by most respondents was a postgraduate degree (67%, $n = 144/216$), with the majority currently occupied in an academic role (70%, 151/216). Of respondents not working in an academic role, the most common occupations included employment as a research scientist in government or industry, teaching and outreach positions, non-profit and non-governmental organization roles, and recent graduates.

Field site culture

97% of respondents ($n = 214/221$) reported a positive experience that they had working at a field site and 65% ($n = 144/221$) reported a negative experience, with 63% ($n = 139/221$) reporting both. Most respondents reported an experience that occurred between 2010 and 2024 (positive: 91%, $n = 181/200$; negative: 96.3%, $n = 130/135$). There was no significant association between the type of experience a respondent had (positive or negative) and the decade in which fieldwork took place (Chi-squared test: $X^2 = 5.92$, $df = 3$, $P = .12$), the number of people at the field site ($X^2 = 4.45$, $df = 6$, $P = .62$), the role of the respondent ($X^2 = 1.80$, $df = 3$, $P = .61$), whether the respondent lived on-site ($X^2 = 0.62$, $df = 2$, $P = .73$) or the amount of engagement they had with the local community ($X^2 = 5.00$, $df = 3$, $P = .17$). There were similar rates of reporting for positive experiences between male (95%, $n = 39/41$) and female (98%, $n = 166/169$) participants. More female participants (70%, $n = 118/169$) reported a negative experience than male participants (51%, $n = 21/41$); however, there was no significant association between gender and reporting rate ($X^2 = 1.03$, $df = 1$, $P = .31$) (Supplementary Table S1).

Respondents were significantly less likely to feel comfortable across all measures of psychological safety during negative experiences compared with positive experiences (Logistic GLM: 'asking for help', odds ratio (OR) = 7.66, $X^2 = 14.04$, $P < .01$; 'admitting to mistakes', $OR = 5.64$, $X^2 = 20.16$, $P < .0001$; 'raising concerns', $OR = 5.94$, $X^2 = 21.85$, $P < .0001$; 'sharing ideas' $OR = 7.07$, $X^2 = 15.55$ $P < .01$; 'challenging those in authority', $OR = 6.74$, $X^2 = 62.46$, $P < .0001$) (Fig. 1). Male respondents reported feeling more comfortable challenging those in authority than female respondents ($Estimate\ (Est) = 1.73 \pm 0.59$, $P < .01$), but there were no significant differences between genders across any another measure of psychological safety ('asking for help', $Est = 0.34 \pm 0.80$, $P = .67$; 'admitting to mistakes', $Est = 1.66 \pm 1.05$, $P = .12$; 'raising concerns', $Est = 1.71 \pm 1.05$, $P = .10$). There were no significant interactions between gender and experience type across any measure of psychological safety, indicating that there were similar reductions in comfort during negative experiences across gender ('challenging those in authority', $OR = 0.41$, $X^2 = 1.02$, $P = .31$; 'asking for help', $OR = 0.25$, $X^2 = 1.29$, $P = .26$; 'admitting to mistakes', $OR = 0.16$, $X^2 = 2.03$, $P = .15$; 'raising concerns', $OR = 0.15$, $X^2 = 2.15$, $P = .14$; 'sharing ideas', $OR = 4.28$, $X^2 = 2.95$, $P = .09$) (Supplementary Table S2).

Respondents were less likely to have positive experiences with site leadership when reporting negative experiences compared to positive experiences. Specifically, they were less likely to agree that they received regular and constructive feedback (Logistic GLM: $OR = 0.19$, $X^2 = 27.82$, $P < .0001$), had regular and positive interactions with leadership ($OR = 0.12$, $X^2 = 52.85$, $P < .0001$), knew what was expected of them ($OR = 0.35$, $X^2 = 19.05$, $P < .0001$), were treated fairly ($OR = 0.19$, $X^2 = 36.41$, $P < .0001$) and felt a sense of teamwork across the field site hierarchy ($OR = 0.07$, $X^2 = 67.75$ $P < .0001$) (Fig. 2). There was no significant difference in how likely respondents were to agree with statements on leadership based on gender ('feedback', $Est = 0.63 \pm 1.08$, $P = .56$; 'interactions with leadership', $Est = -0.51 \pm 0.63$, $P = .42$; 'expectations', $Est = 0.29 \pm 0.60$, $P = .63$; 'fair treatment', $Est = 1.60 \pm 1.06$,

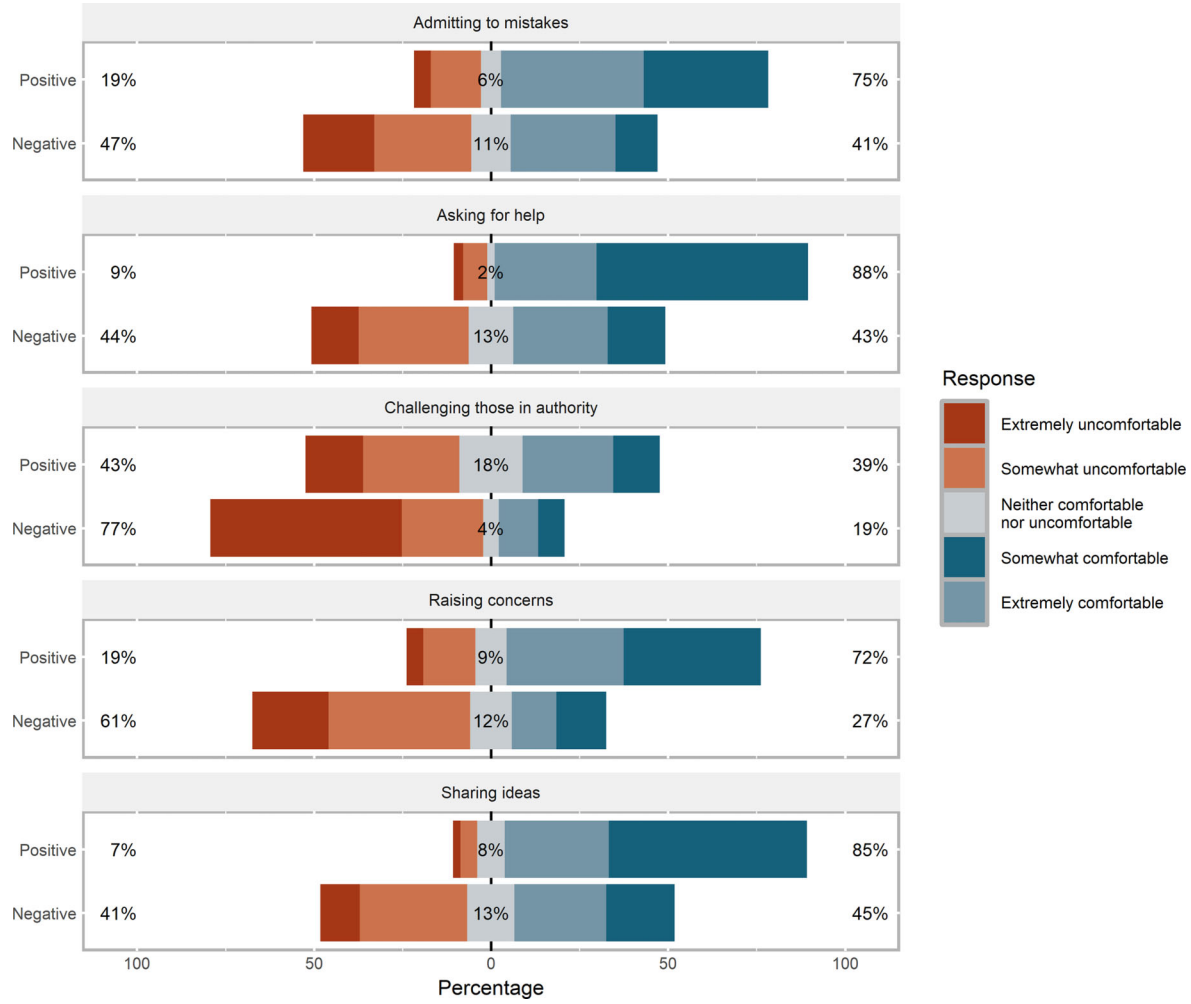

Figure 1 Agreement of field scientists with statements related to their psychological safety while describing positive or negative fieldwork experiences in an online survey.

$P = .53$; 'teamwork', $Est = -0.85 \pm 0.74$, $P = .25$). Nor was there a significant interaction between gender and experience ('feedback', $OR = 1.12$, $X^2 = 0.01$, $P = .92$; 'interactions with leadership', $OR = 4.12$, $X^2 = 3.29$, $P = .07$; 'expectations', $OR = 0.76$, $X^2 = 0.11$, $P = .75$; 'fair treatment', $OR = 2.16$, $X^2 = 0.88$, $P = .35$; 'teamwork', $OR = 4.60$, $X^2 = 2.98$, $P = .08$).

Respondents reported significantly lower perceptions of their personal value during negative experiences when compared to positive experiences (Logistic GLM: 'sense of belonging', $OR = 25.66$, $X^2 = 55.58$, $P < .0001$; 'treated equally', $OR = 11.14$, $X^2 = 53.12$, $P < .0001$; 'feeling valued', $OR = 9.47$, $X^2 = 41.53$, $P < .0001$; 'contributions recognised', $OR = 6.10$, $X^2 = 29.80$, $P < .0001$) (Fig. 3). There was no significant difference in perceptions of personal value between genders ('sense of belonging', $Est = 1.60 \pm 1.06$, $P = .53$; 'treated equally', $Est = 0.96 \pm 0.59$, $P = .10$; 'feeling valued', $Est = 0.38 \pm 0.55$, $P = .49$; 'contributions recognised', $Est = 0.66 \pm 0.60$, $P = .26$). Nor was there a significant interaction between gender and perceptions of value for any category ('sense of belonging', $OR = 2.41$, $X^2 = 1.65$, $P = .36$; 'treated equally', $OR = 2.63$, $X^2 = 0.05$, $P = .82$; 'feeling valued', $OR = 1.46$, $X^2 = 0.02$, $P = .89$; 'contributions recognised', $OR = 5.10$, $X^2 = 2.48$, $P = .12$).

Thematic analysis identified good communication skills, inclusivity, involvement with the research, direct engagement within the field site, and enthusiasm as the most desirable qualities of a 'good' field director (Table 1). The most commonly described qualities of a 'bad' field director were poor people management skills, entitlement, poor organizational skills, being abusive of power, and having a condescending attitude (Table 1). When given the opportunity to describe how the field site culture made them feel, respondents most often said that positive experiences made them feel 'excited', 'included', 'valued', 'inspired', 'accomplished', and 'appreciated'. When reporting negative experiences, respondents described that the field site culture made them feel 'anxious', 'isolated', 'worthless', 'unsafe', 'tired', 'undervalued', and 'frustrated'. While less common, respondents also occasionally described feeling 'anxious', 'tired', or 'nervous' during positive experiences, and 'determined to make change', and 'resilient' during negative experiences.

When given the opportunity to describe what made their field experience either positive or negative, thematic analysis identified three themes amongst responses. The impact of positive field experiences on respondents were (i) feeling part of something 'bigger' and impactful; (ii) greater career opportunities; and (iii) satisfaction that negative situations were appropriately dealt with.

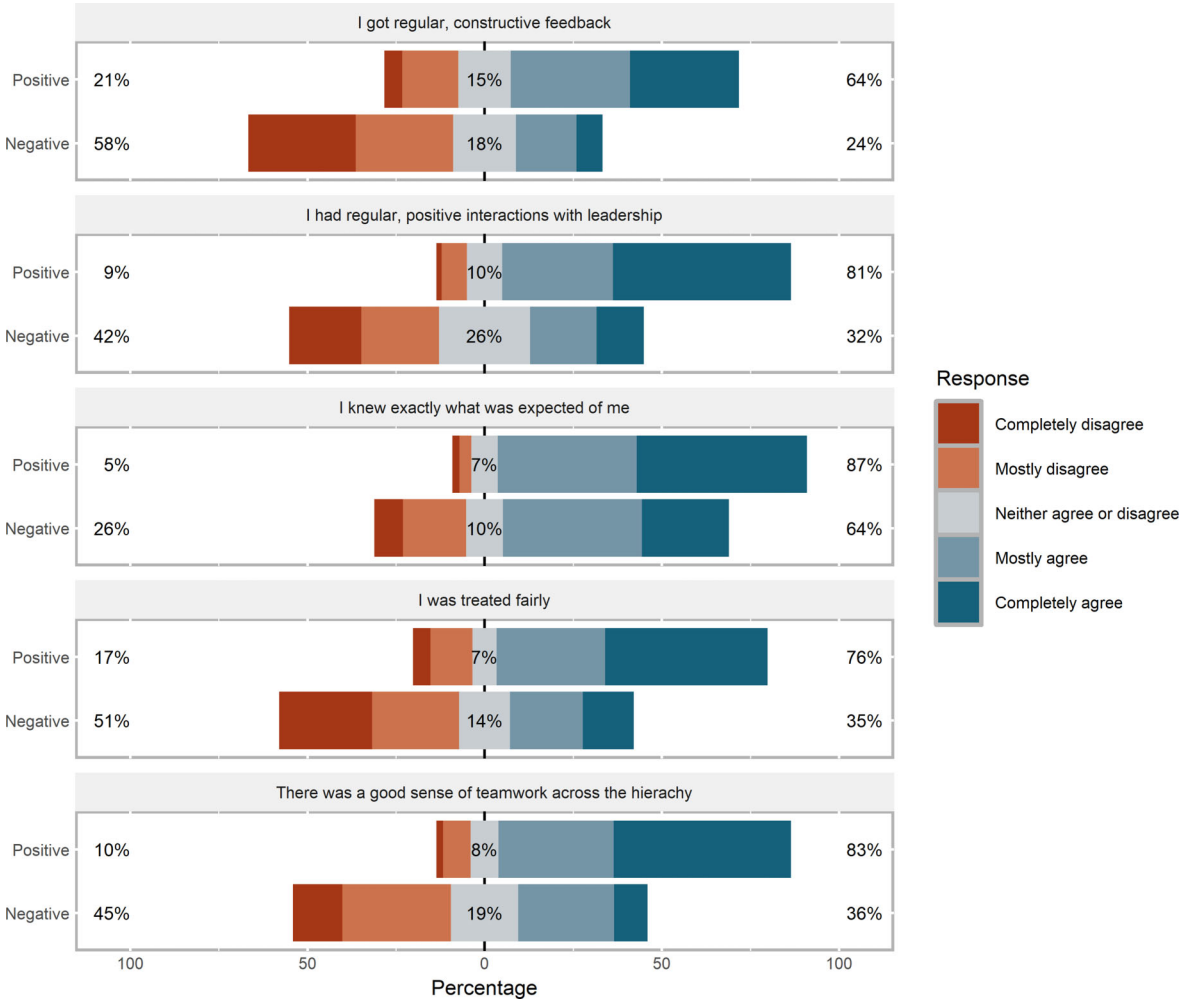

Figure 2 Agreement of field scientists with statements on leadership while describing positive or negative fieldwork experiences in an online survey.

The impact of negative experiences on respondents were: (i) a lack of knowledge or trust in reporting structures/senior management; (ii) feeling as though they had to 'put up' with inappropriate behaviour to complete their research; (iii) leaving (or feeling forced to leave) the field they planned to pursue a career in; and (iv) a significant negative impact on their personal life and well-being.

Experiences of inappropriate behaviour

Across all experiences, 39% of respondents reported that they had experienced inappropriate behaviour ($n = 131/335$), with female respondents significantly more likely than males to report experiencing inappropriate behaviour (Logistic GLM: $Est. = -1.11 \pm 0.51$, $P = .03$) (Fig. 4). Both male and female respondents were more likely to report inappropriate behaviour during a negative field experience than a positive field experience ($Est. = -1.35 \pm 0.26$, $P < .0001$), with the majority of female respondents reporting that they personally experienced inappropriate behaviour during a negative field experience (62%, $n = 71/114$), more than double that during positive experiences (30%, $n = 49/165$). Perpetrators of inappropriate behaviour were significantly more likely to be senior to the victim (50%, $n = 67/134$; *Chi-squared pairwise:* $X^2 = 47.05$, $df = 3$, $P < .001$) than a peer or someone junior to them.

Two-thirds of respondents reported that there was a code of conduct at their field site (64%, $n = 162/253$), with 74% of respondents reporting that it was easy to access ($n = 120/162$) and 67% reporting that it was upheld ($n = 109/162$). There was a trend but no significant difference between experience type and whether or not a respondent reported that there was a code of conduct (logistic GLM: $OR = 1.69$, $X^2 = 3.57$, $P = .06$), but they were less likely to say that the code of conduct was easy to access ($OR = 13.34$, $X^2 = 31.34$, $P < .0001$) or upheld ($OR = 5.62$, $X^2 = 11.02$, $P < .0001$) during negative experiences than during positive experiences. Less than half of participants said that they would have felt comfortable reporting inappropriate behaviour at their field site (45%, $n = 155/347$), and there was a strong trend but no significant difference between how comfortable respondents felt about reporting inappropriate behaviour and experience type ($Est. = -0.70 \pm 0.38$, $P = .06$), and no significant difference between male and female respondents ($Est. = -1.02 \pm 0.60$, $P = .09$).

Across all positive and negative responses that reported experiencing inappropriate behaviour ($n = 131/335$), nearly half of those who responded to further questions said that there

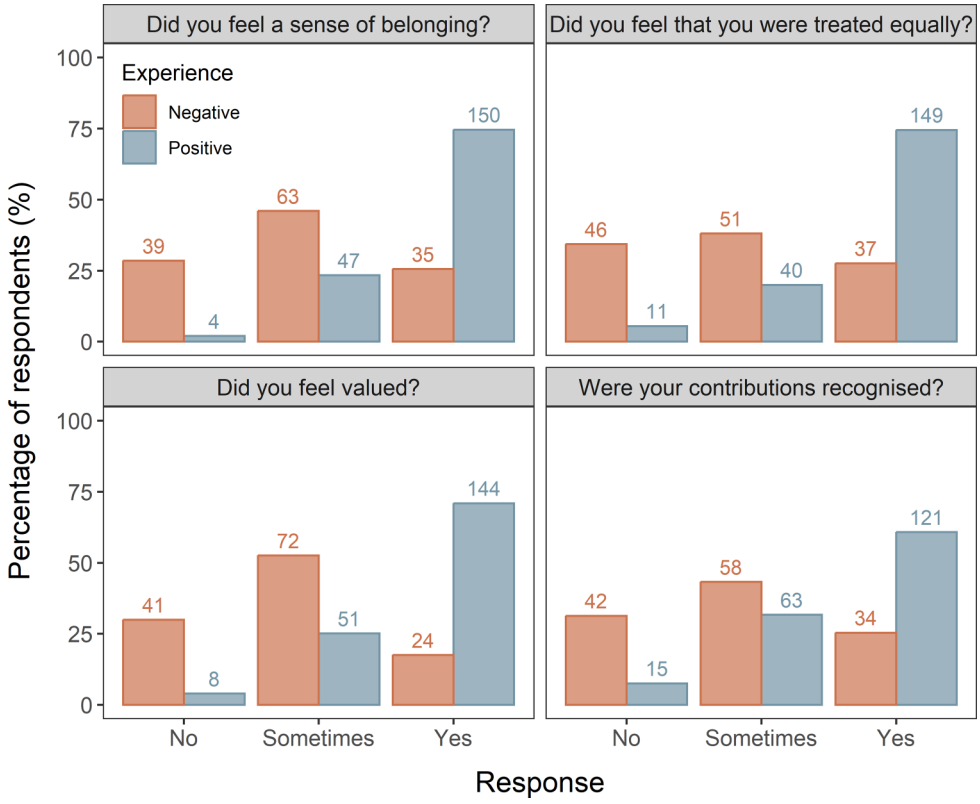

Figure 3 Perceptions of personal value of field scientists when responding to questions about a negative and positive field experiences in an online survey.

Table 1. Descriptions of the qualities that respondents considered made a 'good' or 'bad' field director.

	Response	Level of response (*n*, %)
In your opinion, what qualities make a good field director? ($n = 184$)	Good communication	70 (38%)
	Inclusivity	58 (32%)
	Involvement in research	43 (23%)
	Engagement with field site	33 (18%)
	Enthusiasm	29 (16%)
In your opinion, what qualities make a bad field director? ($n = 125$)	Poor people management	42 (34%)
	Entitlement	32 (26%)
	Poor organization	27 (22%)
	Abusive of power	24 (19%)
	Condescending attitude	16 (13%)

Response groups were determined through thematic analysis.

was no mechanism in place at their field site for them to report their experience (47%, $n = 45/95$), with no difference between positive and negative experiences (Logistic GLM: $OR = 2.09$, $X^2 = 2.78$, $P = .10$). If there was a reporting mechanism in place, more than half of respondents chose to report the incident (56%, $n = 27/50$). There was no significant difference in the likelihood of reporting between experience types ($OR = 1.75$, $X^2 = 2.06$, $P = .40$).

Thematic analysis grouped the reasons respondents cited for choosing whether to report inappropriate behaviour into three categories: (i) trust in the reporting process; (ii) seriousness of the behaviour they experienced; and (iii) their predicted outcome of reporting (Table 2). Of participants that reported experiencing inappropriate behaviour, 11% reported that they had the ability to complete their work at an alternative field site if they requested ($n = 13/118$).

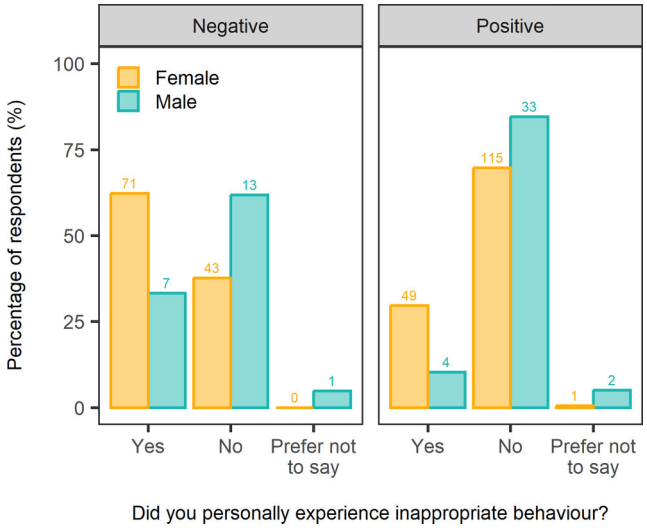

Figure 4 Proportion of respondents that described experiencing inappropriate behaviour when responding to an online survey about negative and positive fieldwork experiences. Female respondents experience more inappropriate behaviour regardless of experience type.

Impact of field experiences

When asked to consider all their fieldwork experiences, respondents generally reported that they perceived them as more positive than negative (83%, $n = 176/225$). While the majority of respondents reported that fieldwork had a positive impact on their self-confidence (76%, $n = 161/218$), sense of belonging in the field (69%, $n = 145/218$) and desire to pursue a career in marine science (51%, $n = 107/212$), there were significantly more negative responses across all measures for respondents who reported a negative experience (Logistic GLM: 'self-confidence', $Est. = -1.86 \pm 0.76$, $P = .01$; 'sense of belonging', $Est. = -2.94 \pm 1.03$, $P = .005$; 'career goals', $Est. = -1.36 \pm 0.66$, $P = .04$). There was no significant difference based on gender ('self-confidence', $Est. = -0.36 \pm 1.25$, $P = .77$; 'sense of belonging', $Est. = -0.95 \pm 1.44$, $P = .51$; 'career goals', $Est. = -0.36 \pm 0.97$, $P = .71$). Nor was there a significant interaction between gender and negative experiences ('self-confidence', $OR = 5.63$, $X^2 = 18.78$, $P = .30$; 'sense of belonging', $OR = 4.46$, $X^2 = 21.64$, $P = .36$; 'career goals', $OR = 0.78$, $X^2 = 8.47$, $P = .83$).

Finally, when asked to use three words to describe the most important factors that would make for a positive fieldwork experience, thematic analysis grouped responses ($n = 171/219$) into three categories: (i) a positive, supportive learning environment; (ii) being part of a team making a real-world difference; and (iii) a culture of respect and being treated as an individual.

Discussion

In this study, we described the characteristics that determined whether fieldwork experiences were assessed as negative or positive by participants in marine science. We found that participants reporting negative experiences had significantly reduced feelings of psychological safety and personal value and had more negative perceptions of their relationship with field site leadership. While inappropriate behaviour was more common during negative experiences, it was still described in one-third of positive experiences, with female participants significantly more likely to experience inappropriate behaviour. Codes of conduct and reporting structures for inappropriate behaviour were equally available between negative and positive experiences, but codes of conduct were less likely to be upheld and easy to access during negative experiences. Only half of respondents said that they would have felt comfortable reporting inappropriate behaviour regardless of the experience type. While the majority of respondents had a positive overall opinion of their field experience, and reported it had a positive effect on their confidence and career ambitions, this was significantly lower for participants who opted to report a negative experience.

Psychological safety and personal value

Respondents describing positive field experiences reported more psychological safety at their field sites than those reporting negative experiences. Psychological safety is central to creating positive learning environments and is related to higher productivity and more effective teamwork (Edmondson 1999, Patil et al. 2023). The characteristics of working environments with high psychological safety include feeling comfortable asking for help, sharing new ideas, challenging those in authority, raising concerns, and admitting to mistakes. As many of these behaviours include speaking up amongst peers and those in positions of authority,

Table 2. Reasons for choosing to report, or not, inappropriate behaviour during fieldwork.

	Reported	Not reported
Trust	- Trust in the person reporting to	- Lack of trust in the person reporting to
Seriousness	- Behaviour was perceived as too serious to go unreported	- Behaviour was common and usually went unreported
		- Behaviour was perceived by the respondent as not serious enough to report
Outcome	- Wanted to prevent others having the same experience	- Fear of personal repercussions as a result of reporting
	- Wanted to obtain proof of the behaviour occurring	

Reasons are grouped into three themes as identified through thematic analysis: 'trust', 'seriousness', and 'outcome'.

across occupational settings psychological safety is closely linked to positive and effective leadership (Nembhard and Edmondson 2006, Newman et al. 2017). Evidence of poor leadership contributing to lower levels of psychological safety was reflected in survey responses to statements that pertained to effective leadership, with those reporting negative experiences being less likely to feel that they were treated fairly, knew what was expected of them, received constructive feedback and had positive interactions with leadership. In addition, a reduced sense of teamwork reported by respondents for negative experiences is an indicator of poor psychological safety (Carmeli and Gittell 2008)). Field sites often have narrow hierarchies, with field leaders assuming positions of responsibility with little or no training in people management or leadership (Nelson et al. 2017). Therefore, although the culture of a field site is largely related to the behaviour and ethics of leaders setting an example (Small 2006), the variation in how sites are managed and lack of standardised training for leaders facilitates poor psychological safety. The effects of this are reflected in the personal values of participants, where positive personal values contribute to greater productivity, optimism and motivation to be involved with fieldwork (Bakker et al. 2008). In our survey, respondents reporting negative experiences agreed less with statements related to feelings around personal value, including being less likely to feel a sense of belonging, that they were treated equally, were valued and that their contributions were recognized than during positive experiences. Improving field site culture therefore relies on improving the quality of leadership. Free-text responses indicated that participants value field leaders who are honest and effective in their communication styles, actively engage in fieldwork, are willing to share their expertise, are inclusive, show enthusiasm for the research and do not abuse their position of power. Undoubtedly, work must be done towards establishing and standardising these values across positions of leadership at field sites to move towards more ubiquitous positive experiences.

Experiences of inappropriate behaviour

High levels of inappropriate behaviour were reported at marine science field sites. While more respondents reported inappropriate behaviour during negative experiences, we found that close to a third of respondents reported inappropriate behaviour during an overall positive field experience. As we allowed participants to define 'inappropriate behaviour' subjectively, this could span a range of commonly reported behaviours including, but not limited to, mismanagement of scientific data, poor ethical scientific practice, inappropriate comments and microaggressions, incidents of physical harassment, sexual assault or persistent bullying (Clancy et al. 2014, Nelson et al. 2017). Female respondents were significantly more likely to experience inappropriate behaviour than males. Disappointingly, reports of inappropriate behaviour are not uncommon in marine science (Amon et al. 2022, Osiecka et al. 2022), and our results show similar gender-based differences to those reported across other scientific fieldwork settings by Clancy et al. (2014). Perpetrators of inappropriate behaviour were more likely to be senior in rank to the victim than a peer or someone junior, a common feature of academic bullying and hierarchical leadership structures (Moss and Mahmoudi 2021). Experiences of inappropriate behaviour during fieldwork have been explicitly linked to serious personal and professional consequences, including poor mental health, isolation, reduced further research and career opportunities and leaving the field (Stephens and Levine 2011, Clancy et al. 2014). In free-text answers, respondents reported feeling scared, anxious, depressed and helpless in response to experiences of inappropriate behaviour, and reported that the effects of their experience reduced their academic output with consequences to their career advancement. The concerning prevalence of inappropriate behaviour across field experience types indicates that it is not exclusively a feature of negative experiences, but clearly significant action must be taken to reduce the amount of inappropriate behaviour at marine science field sites.

We found that experiences of inappropriate behaviour were more common for female respondents than male respondents, and this was consistent across both positive and negative fieldwork experiences. These results are in line with studies of bullying and sexual harassment in marine science (Maia et al. 2024), maritime industry (Östermen and Böstrom 2022), and other field-based academic disciplines (Clancy et al. 2014), which also found that women are more likely to be victims of harassment than their male counterparts. In addition to prevalent inappropriate behaviour, McGuire et al. (2012) found that female researchers in field-based careers were paid less than their male colleagues and felt that their family commitments were unsupported. As a result, they were twice as likely to abandon their career than male fieldworkers. Fieldwork environments with clear behavioural standards, diverse field teams, decentralized hierarchies and reliable reporting structures are linked to both lower levels of harassment and better handling of inappropriate behaviour (Maia et al. 2024). Developing these features, along with granting provisions to address structural challenges around pay, childcare and physical safety, are critical to developing safe field cultures for women to succeed in marine science (McGuire et al. 2012).

Support structures

Most respondents said that their field site had a code of conduct, with no significant difference between positive and negative experiences. However, when describing a negative experience, respondents were less likely to consider the code of conduct easy to access or report it was upheld. While this may likely reflect bias based on how much the respondent's experience required interaction with the code of conduct, the presence of a code of conduct without monitoring of its implementation has been reported in other scientific disciplines (Schuurbiers et al. 2009). In occupational settings, effective implementation of codes of conduct has been linked to example-setting by leadership and the development of 'social norms' that support the principles of the code of conduct (Adam and Rachman-Moore 2004). Nelson et al. (2017) demonstrated that having clear consequences for inappropriate behaviour produces more positive fieldwork experiences. Therefore, the presence of a code of conduct alone is not sufficient to secure positive field experiences.

Instead, a code of conduct should form part of a wider system of support structures and cultural principles upheld by field site leadership, as described by Ramírez-Castañeda et al. (2022). Central to this should be anonymous (to the extent possible), accessible, and clear guidelines for reporting inappropriate behaviour. Less than half of respondents (45%) across experience types would have felt comfortable reporting inappropriate behaviour at their field site, and of those who experienced inappropriate behaviour,

only 47% said that there was a reporting mechanism available. Further, the small number of people at many field sites, coupled with their narrow hierarchies, often makes anonymous reporting difficult as the number of potential victims and perpetrators is limited. As the direction of inappropriate behaviour is often top-down, it is not unusual for the person designated to receive reports of inappropriate behaviour to be the individual engaged in inappropriate behaviour (Clancy et al. 2014). Strategies that avoid these common issues include creating dedicated reporting systems within academic institutions that are independent of field sites and leaders, such as the guidelines published by the University of Washington's School of Aquatic and Fishery Sciences (https://fish.uw.edu/wp-content/uploads/sites/29/2023/08/Guidelines-for-Safe-and-Equitable-Fieldwork-2023-FINAL.pdf; Woodgate et al. 2018). Currently, these systems are lacking across institutions and field contexts, with no independent equivalent for private field sites. Given that University reporting infrastructure is publicly available and clear, evidence-based guidelines have been published in peer-reviewed journals (e.g. Ramírez-Castañeda et al. 2022), it should be an urgent priority of all field sites to adopt reporting procedures and provide resources to comprehensively support researchers (e.g. online support platform such as Safer Waves https://www.saferwaves.org/). As the adoption of fieldworker support systems relies on either proactive uptake or requirement, the development of an independent regulatory body for private field sites could be considered to provide support for independent field scientists. This could provide third-party advice, host resources, and collate information on field sites and their regulations. Only 11% of respondents had an alternative field site option, and free-text answers indicated that some participants felt obliged to stay at a field site despite their negative experiences due to their data collection needs. A knowledge-sharing platform that brings together fieldworkers could help match a researcher's data needs with an appropriate field site that matches their personal needs. Funding bodies can also take responsibility for ensuring fieldwork safety is embedded in the research they fund by mandating fieldwork codes of ethics in their contracts.

In addition to providing an avenue for reporting, institutions should provide clear guidance on expected outcomes of reporting procedures, including details about the support available for data collection and scientific outputs following an incident. Based on the themes identified in our survey, dealing with inappropriate behaviour by reliably using these reporting procedures, developing behavioural norms that encourage their use, and providing clear information on the expected outcomes of going through the reporting process could contribute considerably to reducing the negative experiences of participants. In free-text answers, respondents who experienced inappropriate behaviour but still considered their experience to be positive attributed it to appropriate handling of the situation, suggesting the importance not only of prevention but effective and compassionate responses to inappropriate behaviour. This should be a priority for field site leadership.

Impact of overall field experience

The majority of respondents reported that they considered their collective experience of fieldwork positive. Further, their fieldwork experiences positively influenced their confidence, sense of belonging, and motivation to stay in the field of marine science, similar to trends reported for undergraduate students taking field courses (Lopatto 2004) and scientists in the adjacent field of evolutionary ecology (Beltran et al. 2020). This reflects the importance of fieldwork experience on both personal and professional development. In free-text answers, respondents often reported that fieldwork built important professional relationships, and that the experiences that they had interacting with the natural world were worth more to them than the drawbacks of fieldwork, such as isolated living, long working hours, and limited access to resources. However, if a respondent had reported a negative experience, their self-confidence, sense of belonging and desire to pursue a career in marine science were all significantly reduced. The 'leaky pipeline', particularly of women and minority groups leaving academic fields as their careers progress is linked to negative experiences (Wickware 1997, Stephens and Levine 2011). This was reported by some respondents in the free-text answers, who identified themselves as having left field-based careers as a result of their negative fieldwork experiences. For example, one participant stated:

> 'I don't think I could physically go through the experiences I have had again. I want to live a happy and healthy life, and endlessly pursuing a career in a field that doesn't support people isn't a way to do that.'

Taken together, this indicates that reducing negative field experiences by addressing planning gaps for both effective prevention and responses could increase retention (Beltran et al. 2020).

Upholding ethical conduct and creating positive working cultures are fundamental to creating safe and equitable occupational environments. Across small organizations, ethical culture is upheld through formalized training, good leadership, and explicit expressions of values, such as clear Codes of Ethics (Small 2006). Respondents to our survey reported that the features they associated with a positive field experience included a supportive learning environment, sense of purpose and belonging, and a culture of inclusivity and respect. With these core values in mind, we suggest that standardised Codes of Ethics should be developed for implementation across marine science. Crucially, effective implementation of these codes will rely on having engaged leadership who uphold these values, and opportunities for all to participate in creating working expectations (e.g. through practices like community guideline and agreement development) (Barzi et al. 2022). Therefore, all academic and private organizations involved with marine science fieldwork should ensure participants have specialized training to know both what to expect and what is expected of them during fieldwork to contribute to a positive working environment, similar to initiatives that have successfully increased physical safety in fieldwork (Daniels and Lavallee 2014). This can be achieved subjectively by engaging with initiatives which specifically focus on training participants for ecological fieldwork (e.g. University of California Santa Cruz 'Better Fieldwork Futures' program, www.fieldfutures.org) and are effective in increasing participant knowledge on the risks of fieldwork and likelihood of reporting inappropriate behaviour (Cronin et al. 2024).

Limitations

While we have identified multiple areas for improvement to move towards more positive working environments in marine science,

we acknowledge that there are limits to our ability to draw conclusions based on our sample population. Most respondents were in the early stages of their career, under 35 years of age, and reporting on experiences within the past 15 years. While this gives us a good assessment of the current issues facing early career researchers in marine sciences, there will be many unique fieldwork experiences that our results are not able to capture. Further, 82% of respondents were from Western Europe or North America. While our recommendations are applicable in these areas, other global regions will vary greatly in their culture and the barriers facing those wanting to pursue a career in marine science. While we did capture responses from participants that indicated they had left their career or ambitions in marine science, our sampling method primarily targeted academic or marine science organizations where it is probable that most people are currently engaged with the field. Therefore, our results likely include survivor bias. Regrettably, we were unable to recruit a sample allowing us to report the experiences of underrepresented groups separately, with the exception of women. Sexual and gender minorities, people with disabilities, and racial and ethnic minority groups are reported to be frequent targets of inappropriate behaviour and are more likely to face significant barriers when pursuing a career in STEM (Clancy et al. 2014). Guidance can be found on how to support gender diverse fieldworkers when developing fieldwork environments (McMonigal et al. 2023), however, targeted reporting of the experiences of a wider demographic of age, hierarchy, geographic location, and minority groups in marine science should be a priority of future research. This is crucial to ensure that the development of safe working practices is designed to support the broadest range of participants and early career scientists.

Crucially, while we identified statistical trends to suggest areas for interventions benefiting working cultures for those in our survey demographic, we cannot overlook the danger of using generalizations to describe the effects of personal experiences. Trends that indicate that a demographic group are not having negative experiences, or not experiencing them 'as badly', can be used to invalidate or dismiss individual experiences. For example, free-text answers indicated that some participants had experienced bullying from peers and people in positions junior to them, and some male participants reported that inappropriate behaviour from women had significantly affected their career ambitions and self-confidence. Often, those having negative experiences that oppose the stereotypical narrative may have a hard time being believed, feel shame or embarrassment, fear that their concerns will be dismissed or minimized, and have greater hesitancy using reporting structures as they are not designed in their interest (Swim, Hyers and Cohen 2001) ; Walker et al. 2020). Therefore, we stress the importance of open communication and the active development of diverse research teams, as recommended by Ramírez-Castañeda et al. (2022), to create an environment where all negative experiences are taken seriously and given space to be addressed.

Conclusions and recommendations

This survey investigated characteristics of positive and negative fieldwork experiences in marine science, and we provide the following recommendations based on published guidelines for best practice to suggest how to develop safe, positive field site cultures:

1. Leadership-led standards of behaviour and conduct: Standards of behaviour and conduct should be explicit and unambiguous. It is critical that field leaders exemplify these standards to set the cultural expectation for all other field participants to follow.
2. Accessible reporting structures: A system for reporting issues that arise during fieldwork should be in place for every field site. It should be signposted to participants before fieldwork and easily accessible to them throughout. Where available, it should align with third-party structures (e.g. university processes or funder requirements) or people to prevent reports being exclusively handled within the field team.
3. Clear reporting outcomes: Repercussions for breaching standards of behaviour or conduct should be clearly stated in field site expectations. They should be reliably and fairly applied to establish a sense of trust in leadership and reporting structures.
4. Training: Field leaders should undertake leadership and management training. Field stations and universities should provide all fieldwork participants with opportunities to undertake training to develop realistic expectations and learn their responsibilities for upholding positive culture (e.g. Field Futures).
5. Specific support for marginalized groups: Particular attention should be given to minority groups that are at greater risk during fieldwork. Field leaders should incorporate existing guidance and support for women and gender minorities. Future research should focus on developing support mechanisms for racial and ethnic minorities, as well as those with disabilities.

As our recommendations are based on experiences reported by a predominantly white, female, English-speaking sample, we also suggest that future research should focus on elevating the perspectives of minority groups to ensure that the significant and unique barriers they may face are clearly reported and appropriately considered in guideline development. Fieldwork is an important part of a marine scientist's career, leading to the acquisition of relevant skills, collaboration opportunities, connection with study systems and career advancement opportunities (Osiecka et al. 2022). We believe that fieldwork should be accessible to all, and that everyone who engages with fieldwork has the right to experience a safe, equitable working culture designed to support their learning and career ambitions. This would support progress towards the ultimate goal of making marine science a positive example of working fieldwork cultures in life sciences.

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Supplementary material

Supplementary material is available at *ICES Journal of Marine Science* online.

Conflicts of interest

The authors have no competing interests to declare.

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Data availability

The data underlying this article cannot be shared publicly due to the privacy and confidentiality requirements for study participants.

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