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Being ECR in marine science: Results of a survey among early-career marine scientists and conservationists

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Ocean research and conservation are still largely exclusive fields, with ongoing issues of racial, gender, class, and geographic underrepresentation. To improve accessibility and retention within these fields, we need to create equitable, just, and welcoming study and work environments. It is therefore crucial to listen to the voices of students and early career ocean professionals (ECOP). We conducted an online survey on the study- and workplace experiences of ECOP, focusing on social obstacles, such as economic strain, unpaid work, and workplace discrimination and abuse. Strong economic barriers to education access were evident in certain geographic areas. Almost half of the reported work time in the field was uncompensated, yet unpaid work rarely translated into career advancement and was often associated with workplace abuse. Dissatisfaction and burn-out rates at the earliest career stages were alarming, and experienced hardship and mental health issues were particularly dire for women and non-binary persons. While most respondents were white and from the global north, meaning the results may not reflect experiences of ECOP in other regions, this study highlights some of the barriers to equity as well as work ethics issues that should be urgently addressed within the field.

KEYWORDS

Conservation ethics, diversity in STEM, equity, science and society, work abuse, gender, early career ocean professionals, early career researchers

Introduction

As the marine environment undergoes a drastic change, human rights and well-being are disproportionately challenged in already disadvantaged areas and communities (Österblum et al., 2020). Ensuring sustainable and fair access to ocean resources while conserving marine ecosystems for the future is both politically and environmentally complex, and must acknowledge the interests and perspectives of the oceans' diverse users in an equitable and balanced way (Barbier et al., 2018; Bax et al., 2021). Yet, access to both marine resources and different roles in marine science and conservation are still unevenly distributed (Österblum et al., 2020), with severe racial, geographic, and gender biases (e.g., Thompson et al., 2011; Srinivasan, 2018; Giakoumi et al., 2021). To remove these barriers, equitable, just, and welcoming study and work environments are needed, which improve representation and increase the diversity of voices (Green et al., 2015; Bailey et al., 2020; Alexander et al., 2021; Worm et al., 2021).

Previously identified barriers in ocean sciences include demanding workloads, stress, and limited support in sustaining work-life balance (Andrews et al., 2020). Inequity, however, is systemic and inherent to the current economic and political systems in all parts of the globe. Academia and conservation are not free from racism, sexism, or classism (e.g., O'Connell and Holmes, 2015; Fournier et al., 2019; Dutt, 2020). Talk about inclusion is empty if it does not address these factors. While increasing attention is paid to the situation of early-career ocean professionals (ECOP) (e.g., Andrews et al., 2020; Brasier et al., 2020), solutions are often suggested by successful senior professionals, whose experiences do not necessarily reflect diversity or current circumstances¹. With effective guidance, however, the scientific community can strengthen not only issues of conservation but also equity in future ocean scenarios through the improvement of various human dimensions (Visbeck, 2018; Alexander et al., 2021).

To create safe and accessible workplaces for new ocean professionals entering the field, we must understand the challenges they face rather than accept current assumptions and settings. Furthermore, advice from those already in senior roles can also fall short either because they are unaware of the persisting inequalities or due to different life experiences. To address this gap, we present the results of a survey looking at the personal experiences of a group of students and early career professionals in the field, with a particular focus on the economic strain, unpaid work, and stressful workplace issues (e.g., work safety, social exclusion, and physical abuse), which may be some of the most limiting factors at the first career stages. We hope

that increased recognition of these reported obstacles will help to make ocean sciences more inclusive.

Methods

Survey

Between 1 April and 5 May 2020, we conducted an online survey (see Data Statement) on the experiences of marine scientists and conservationists in the first stages of their careers (i.e., undergraduate to postgraduate students and professionals with up to seven years of post-doctoral experience). The survey was developed at the University of Business and Administration in Gdynia, Poland, and was approved by its ethics committee. Since it is hard to estimate the total number of ECOP worldwide, the study was designed in an open format to reach as many people as possible instead of aiming at sampling a defined percentage of early-career professionals. The questionnaire was made available publicly and shared widely on professional mailing lists and through social media relating to marine science and conservation (e.g. MARMAM mailing list, Ocean Oculus newsletter, Twitter, and various professional Facebook groups). To identify potential social barriers to entry and retention in the field, this exploratory survey focused specifically on the financial investment in work and study, time spent on and gains from uncompensated work, received support, motivation, satisfaction, and experiences of exclusion, discrimination, and abuse (see Data Statement), compiling what has been identified as common issues in academia and conservation work environments (e.g. Oreskes, 1996; Leta and Lewison, 2003; Killoren, 2014; Hooker et al., 2017; Coin, 2018; Lindquist and McKay, 2018; Srinivasan, 2018; Fournier et al., 2019; Woolston, 2020). As most of the questions were open-ended or multiple choice, the sample sizes for the different questions varied slightly.

Data analysis

Responses from people representing other fields (e.g., land conservation) and those with more than seven years of post-doctoral experience were filtered out. As most respondents identified as white/European descent (see Results), respondents' race was divided into two categories to allow for significant statistical analysis: 'white' and 'people of colour' (POC). All monetary values were recalculated to USD². Data analysis was conducted in R v.4.0.2 using

¹ Society for Marine Mammalogy Discussion Panel: Unpaid Positions in Science. Recording accessible at: <https://www.youtube.com/watch?v=IhdXvE0nR0c> - last accessed 3 November 2021.

² According to the Xe Currency Converter, available at: www.xe.com/currencyconverter - rates as of 4 June 2020

glmmTMB (Bates et al., 2015; Brooks et al., 2017), with generalized models fitted by maximum likelihood using a Laplace approximation. We analysed whether gender, race, or current employment status were related to (i) access to free education, (ii) the number of months spent on unpaid work, (iii) the amount of money spent on extra qualifications, (iv) the amount of money spent on education, (v) whether the respondent felt they gained from these experiences, (vi) whether the respondent suffered from any mental health issues, (vii) whether the respondent had experienced any kind of discrimination, abuse, or mockery in their place of work or study, and (viii) whether their work within marine science professional environment contributed to or worsened respondents' mental health issues. We also analysed whether respondents' region was related to (ix) the number of months spent on unpaid work, and (x) the amount of money spent on education. Analyses (i) and (v)-(viii) used binomial error distribution (logit-link). Analyses (ii)-(iv) and (ix)-(x) used Gaussian error distribution (identity link) with values log-transformed where needed. Testing for statistical significance was conducted with Wald chi-square tests (package 'car': Fox et al., 2012), with Wald z-tests used as *post-hoc* tests to evaluate differences among various levels.

Model results and figures are provided in the Supplementary Material, and the main findings are summarized in the Graphical Abstract. Anonymized open field comments are available as supplementary data (see Data Statement).

Results

After applying the above-mentioned filters, we received 492 answers from people who had achieved their latest degree no longer than seven years ago. Respondents were between 18 and 44 years old, with the vast majority (85.00%) aged 22-35; 81.91% identified as female, with 0.20% being trans-women, 17.28% identified as male, and 0.81% as non-binary. Most respondents were based in the Global North (i.e., USA 32.60%, UK 23.60%, and the rest of Europe including Russia 26.30%; Appendix 1).

The racial make-up was even more unevenly spread, with 86.38% of respondents being of white/European descent (Appendix 2). Three respondents identified with their ethnic group (i.e., Galego, Luhya, Malaysian Chinese), and one person with their religion (i.e., Muslim).

Education and employment

Less than half (43.90%) of respondents were employed in a paid job relevant to the field of ocean science and/or conservation at the time of the survey. Most held a graduate (49.19%) or undergraduate (36.38%) degree (Appendix 3).

Most (77.85%) of the respondents had undertaken additional training, such as professional certifications and permits (e.g., Marine Mammal/Protected Species Observer, diving certification, drone and boat licenses, or other education), with a median of 8.5 additional qualifications (Appendix 4).

Access to social and academic support (e.g., mentoring, housing support, library access, etc.) was not correlated to gender, race, or current employment status (Table 1 and Appendix 5).

Educational expenses

Most (75.6%) respondents had not had access to free education, with no correlation to gender, race, or current employment status (Table 1). Access to free education was reported predominantly by Europeans. Student debt reached as high as \$350,000 (mean \$55,068, dominant \$120,000), with a significant difference between geographical regions (highest in the USA, UK, and Africa; Table 1). The amount spent on education was lower for white respondents ($p=0.013$, $\chi^2 = 6.169$, $df=1$), but was not correlated to gender or current employment status (Table 1). Education costs were covered mostly by financial aid from family or friends (64.02%) and by employment outside of the university (56.50%; Appendix 6).

Extra qualifications cost respondents an average of \$3021.29 (SD = \$6649.10, dominant \$2000), with a maximum reported amount of \$100,000. This had no correlation with gender, race, or current employment status (Table 1). Over 70% of respondents did not have a clear expectation of being able to repay their student debts: 63.41% were unable to give an estimate of whether they would ever be able to pay them off, and 7.92% claimed that they would never be able to do so. Only 15.65% of respondents expected to be able to pay off their student debts within the next decade.

Work experience and unpaid labour

The majority of respondents had 2-5 years of work experience (Appendix 7). Only 57.11% of all reported work time was paid, 28.41% unwaged with no support, 8.91% spent working for food and board, and 5.57% of the total reported work time required a fee for the possibility to work (i.e., volunteer work with an 'entry fee'). Time spent on unwaged labour had no correlation with gender, race, region, or current employment status (Table 1). Respondents spent on average \$6,176.91 (max = \$100,160, SD=\$9,286.25) on unpaid work (e.g., covering costs of travel, visas, insurance, etc.).

Gains from unpaid labour

Roughly half (54.30%) of the respondents received professional references for their unwaged work. One-fifth (20.10%) were able to publish or present the results of their unpaid work, while 51.20% were afforded no opportunity to do anything further with their unwaged work (Appendix 8 also Appendix 9 for other gains from unpaid work).

Mental health

Most respondents reported experiencing anxiety (66.67%), burn-out (50.81%), depression (47.97%), panic attacks (37.60%), and other mental health issues (Appendix 10). Mental health issues were strongly correlated to gender: men suffered from significantly fewer issues than women and non-binary persons ($p < 0.001$, $\chi^2 = 19.058$, $df=3$). There was no correlation with race or current employment status (Table 1).

While 60.8% reported that work in marine sciences contributed to or worsened their condition, this was not correlated to gender, race, or current employment status (Table 1).

Discrimination and abuse

Most (72.15%) respondents reported experiencing mockery, discrimination, and/or abuse in their place of work or education, predominantly based on respondents' gender (47.56%) and age (30.49%; Appendix 11).

Regarding workplace issues, respondents reported being expected to cancel or postpone private life events or choices (44.11%), exclusion from decision-making of direct relevance to them (34.76%), exclusion from publication credits even though they had contributed significantly (26.42%), and not being paid for work as agreed (18.50%), among other issues (Appendix 12).

Regarding health and safety, respondents reported having to work when they were compromised either physically (19.92%) or mentally (23.58%), and having to work under conditions that their put health or safety at risk (32.11%), among other issues (Appendix 13).

Other forms of abuse in work and study environments included verbal (39.23%) and sexual abuse (17.89%; Appendix 14). Most (63.41%) respondents knew at least one person who had experienced discrimination in the field. Men reported experiencing significantly less abuse and/or discrimination in any form than women or non-binary persons ($p=0.003$, $\chi^2 = 13.733$, $df=3$).

Only 2.85% of respondents said that they had reported all the abuse they experienced, while 24.19% said they reported only some of it. The most common reason given not to report abuse

TABLE 1 Summary of main models testing effects of gender, race, employment status or region on selected aspects.

Variable	df	χ^2	P-value
<i>Offered support</i>			
Gender	3	1.206	0.751
Race	1	0.166	0.684
Employment	1	1.813	0.178
<i>Access to free education</i>			
Gender	3	0.494	0.482
Race	1	0.071	0.790
Employment	1	3.050	0.081
<i>Amount spent on education</i>			
Gender	3	3.454	0.327
Race	1	6.169	0.013
Employment	1	0.590	0.442
Region	8	154.29	<0.001
<i>Amount spent on extra qualifications</i>			
Gender	3	0.992	0.803
Race	1	1.855	0.173
Employment	1	0.556	0.456
<i>Time spent on unwaged labour</i>			
Gender	3	1.963	0.580
Race	1	0.056	0.813
Employment	1	0.279	0.597
Region	8	10.838	0.211
<i>Mental health issues</i>			
Gender	3	19.058	>0.001
Race	1	0.958	0.328
Employment	1	1.394	0.238
<i>Contribution to or worsened conditions</i>			
Gender	3	2.628	0.453
Race	1	0.986	0.321
Employment	1	2.362	0.124
<i>Experienced any kind of discrimination, abuse or mockery</i>			
Gender	3	13.733	0.003
Race	1	2.982	0.084
Employment	1	0.971	0.324

Bold font indicates statistical significance. df, degrees of freedom.

was fear of losing future career or work opportunities (37.80%; Appendix 15).

Motivation and satisfaction

Respondents' main reasons for having chosen ocean science and conservation as a career were their love of the ocean (89.02%) and a personal interest in particular conservation issues (76.42%; Appendix 16). When choosing their career, the majority of the respondents reported that they had expected to face multiple issues in the job market, such as high competition (79.47%) or the need to relocate for work (59.76%). Only 3.46%

of respondents thought that there were no issues regarding their work or study environment in their field (Appendix 17).

Meanwhile, only 15.65% of respondents reported feeling very satisfied with having chosen ocean science and conservation as a career (Appendix 18), while 29.67% felt that following this career path had been worth the financial costs (Appendix 19).

Discussion

The results of our survey present some of the issues faced by the ocean scientists and conservationists entering the job market now and in the coming years. Before addressing these obstacles, we would like to stress that the inequalities in geographic and racial representation in our results are striking, and may be an artefact of a biased reach of the online survey. While the general racial and ethnic makeup of the field is indeed heavily biased toward white Westerners (Cook et al., 2016; Srinivasan, 2018), the unequal distribution of our respondents prevents us from discussing some of the issues with absolute confidence.

Due to this uneven representation in our survey, our results should be taken with some caution, and understood as more of an indicator of issues than a comprehensive report. For example, while we did not show a correlation between race and experienced discrimination, this is likely a result of the very small sample size of interviewed POC, as well as of prevalent gender-based discrimination. Racism is as widespread in science as it is in general society (e.g., Bailey et al., 2020; Dutt, 2020), and we hope that the lack of direct correlation shown in this study will not be used to lessen the importance and seriousness of the issue. Similarly, it is unclear whether the uneven gender representation reflects the composition of the field (i.e., female-dominated at the entry-level) or a biased reach of this survey, and thus analyses taking gender into account should be approached with caution.

Due to the extremely uneven racial representation in our survey results, we have also excluded analyses that took both race and gender into account simultaneously. We recognise that this omission of intersectionality is a major blind spot of this survey. Finally, the severe geographical bias has made in-depth analysis by region impossible, and the costs are analysed from a global perspective only without taking local costs of living into account. More targeted studies are needed to better understand the needs of different groups within the field, as well as the obstacles they each face due to factors not covered by this survey.

In some regions, there is a strong economic barrier to accessing marine sciences and higher education in general. Few respondents had access to free education and strong support systems. Among those who paid to study, it was clear that having strong financial support from family or friends and the

ability to take on a second job was crucial. Even though the reported spending on education was very high, and few respondents predicted ever being able to pay off their student debts, many took on additional qualifications. The expectation that one should be 'specialised in everything' can be detrimental to both science and conservation (Cosentino and Souviron-Priego, 2021), as well as being not financially viable. Ethical statements must be supported by action, and generally, the most urgent and prominent assistance needed is funding. While small grants dedicated to marginalised groups or economically less privileged countries are offered through many professional organisations, these grants rarely secure project longevity, and more sustainable funding options are needed (Srinivasan, 2018).

Despite their formal education and additional training, less than half of the respondents were employed in a paid job within the fields of ocean sciences and marine conservation. Even so, nearly half of the reported work time for these positions was not paid for, also in breach of existing contracts (i.e., paid less than agreed or not paid at all despite the existing contract). Indeed, most of the early-career work in ocean science and conservation was reported in another study as uncompensated or involving additional fees from the worker (Osiecka et al., 2021). While volunteering may provide initial experiences in a highly competitive field, only about half of the respondents felt as though they gained valuable skills and expertise through volunteering, and few of them were able to publish the results of their work, and almost a half did not even receive a letter of recommendation. This may be in part due to the misuse of these volunteers, for example, some respondents reported having to clean houses or babysit for their supervisors during unpaid or pay-to-play work advertised as scientific or conservation projects (see Data Statement). At the same time, unpaid work rarely offers significant career advances (Fournier et al., 2019; Osiecka et al., 2021), and its pitfalls are often bigger than the benefits (see also Siebert and Wilson, 2013). Time spent working unpaid did not predict the employment status of the respondents, and volunteer workers reported experiencing various forms of exclusion and abuse, including criminal actions from data theft to physical abuse (see Data Statement for case stories). Also concerning is the fact that the option of working for free excludes people from less privileged social backgrounds or who are unable to take up a second paid job for whatever reason (Fournier et al., 2019; Favaro and Hind-Ozan, 2020).

With regards to gender representation in ocean sciences, women have largely achieved education parity (O'Connell and Holmes, 2015; Brooks and Déniz-González, 2021), and are even a majority group in some fields (e.g., marine mammalogy)³.

³ 22nd Biennial Conference of the Biology of Marine Mammals Workshop report: Women in marine mammal science: Breaking down barriers to success, 2017. Accessible at: <http://wimms.weebly.com/>

Women were also the predominant respondent group in our study – which can reflect either a changing composition of the field (i.e., female-dominated in the first career stages) or a biased reach of the survey (e.g., women being more motivated to report the issues they experience). Even so, women continue to be less likely to be retained in a tenure track or other permanent positions (Thompson et al., 2011; O’Connell and Holmes, 2015; Cook et al., 2016; Potvin et al., 2018; Gillanders and Heupel, 2019; Giakoumi et al., 2021), or have their work represented and funded equally compared to their male colleagues (e.g., Oreskes, 1996; Leta and Lewison, 2003; Wittenman et al., 2019; Bellotti et al., 2022.). Gender minorities are still virtually excluded from any such comparisons and were also severely underrepresented in our study.

Our results showed that the reported mental health and abuse issues were gendered. Most respondents had experienced abuse or knew someone who had. Men report fewer forms of abuse than women and non-binary people and generally tend to notice fewer instances of abuse in the field (this study; Hooker et al., 2017). Gender minorities are extremely underrepresented in ocean sciences and are commonly excluded from equity actions, which are most often dedicated to cis-women. Experienced harassment directly affects not only health but also scientific productivity (Lindquist and McKay, 2018; Wilkins and Marín, 2021). Having to spend extra time coping with the abuse and time investment in equality activism adds yet more pressure on already disadvantaged groups (e.g., Killoren, 2014; Gewin, 2020). Allowing abusers to exist within their professional environment is thus not only unethical but a waste of human and financial resources (McKay et al., 2008).

There is a global mental health crisis among graduate students and postdocs (Evans et al., 2018; Woolston, 2020). The mental health issues reported in our survey were particularly concerning: most respondents suffered from anxiety, depression, and burn-out already in their very first steps in their careers. This was particularly true for women and nonbinary people. Few respondents reported being happy with their career choice, and over 60% of respondents across gender and race felt that their health had worsened because of their work. These are not issues that simply disappear when one changes jobs – rather, we are witnessing what may for many be the beginning of a life-long crisis. Almost half of our respondents had been asked to cancel or postpone private life events due to work plans. Such an expectation hits particularly hard on caretakers and reflects severely on the retention of women in the field (Hooker et al., 2017). At the same time, over one-third of respondents reported having to work in situations that risked their life or health in unpaid positions (e.g., working with malfunctioning diving equipment, unsanitary equipment, insufficient protection from chemicals, etc.), without

necessary training or equipment, or when unwell. While dedication to academia often pulls vulnerable workers into abusive situations (Coin, 2018), the impositions of unnecessary risk and expected negligence towards one’s health should serve as alarm bells.

Recommendations

Mentoring people from marginalised groups in ocean sciences has been shown to improve their retention (Johnson et al., 2016; Mouw et al., 2018), but more solutions are needed. The alarming reported state of mental health calls for improving access to free or affordable professional help and organising a network of support within the field with safe, anonymous ways to share stories and report abusers. Ensuring safety in professional spaces and situations should include specifying a code of conduct and removing harassers from workplaces and professional meetings (Favaro et al., 2016). At the same time, efforts should be taken to ensure the physical safety of the workers, such as providing them with adequate safety equipment, health insurance, and sick leave.

Furthermore, there is a need to address underrepresented groups and recognise the intersectional impacts of different backgrounds and identities in ocean careers. We must be careful not to fight discrimination with punishment or to tokenize people to build a more positive image of the field, rather, we should construct a better, more inclusive value system. Fostering true diversity in science and conservation must include and reward various roles (e.g., local guides, technicians, diverse specialists) and viewpoints (such as non-western or niche ways of thinking; e.g., Matulis and Moyer, 2017; Davies et al., 2020; Chaudhury and Colla, 2021; Davis et al., 2021). Perhaps the most needed and straightforward tool to do this is by providing adequate funding. This should take various forms, from academic scholarships, free or subsidised training, and financial support dedicated to underprivileged groups, to ensuring compliance with local labour laws and fair pay to all workers in the field.

The stories we live by are still dictated by only a few. As long as the racist and classist roots of the sciences and the environmental movement are left largely unaddressed, they remain hurtful and excluding (Schelhas, 2002; Nocco et al., 2021), and can further discourage people from entering these academic fields. At the same time, homogenous groups failing to grasp different cultural values and contexts are unlikely to develop appropriate conservation solutions (Green et al., 2015). Including diverse actors will lead to great results for ocean sustainability (Lubchenco et al., 2016) both in conservation science and human wellbeing dimensions (Davies et al., 2020; Nash et al., 2021). It is extremely important to hear,

normalise, and respect stories of hardship in the field and marginalised perspectives, and use these to determine how to create safe and fair work environments. We depend on the marine areas, and on the people who take care of them. If we want to conserve the ocean, it is imperative that we also support those who study and protect it.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: <https://osf.io/2q54b/>.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of the University of Business and Administration. The participants provided their informed consent to participate in this study.

Author contributions

AO and KO-B: idea and design of the study. AO: data collection. AW, I-WH, and KO-B: data analysis. AO: first manuscript and review process. KO-B and AO: graphical abstract. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2022.835692/full#supplementary-material>

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