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Women are successful in marine science, but not in its narrative. A case study from Poland

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Abstract
Active participation of women in marine field work (research cruises) was almost nonexistent before the mid-1970s, and slowly increased to a present day 50:50 share in Poland. The detailed analysis is presented for the largest marine research institute in Poland with 200 employees and regular (over 240 days per year) in the sea presence onboard r/v *Oceania*. The overall share of women in the scientific activities (research papers) is almost 50%, with higher share in chemistry (60%) and lower in marine physics (40%). The share of women as leaders in external projects is equal to men and the scientific performance (measured as Hirsch index) is statistically the same as men researchers, however men researchers present both highest and lowest scores, contrary to more equal distribution of results among women. The striking difference is visible in the outreach activity – mainstream media releases, where men are responsible for nearly 90% of events for adult audience. The issue is presented in the context of international research on women presence in the science (STEM) and similar patterns around the globe.

Keywords
Women; Marine science; Gender equality; Media

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1. Introduction

The internationally recognized challenge of gender equality in science or in STEM (Science, Technology, Engineering, Mathematics) is an object of numerous sociological analyses and political initiatives as women formed 29.3% of the research personnel globally (UIS, 2024). The general conclusion is often that the mental capability of women is no different from men's, and factors other than competence determine the success of women in these fields.

Despite progress in this research, men continue to obtain a higher proportion of undergraduate and graduate degrees in the physical sciences, mathematics, computer science, and engineering than women do (UIS, 2024) and women remain underrepresented in science, technology, engineering, and mathematics (STEM) occupations (Hill et al., 2010).

The highest proportion of women in science was recorded in Central Asia, Latin America, and the Caribbean – over 40%. The lowest was in Southwestern Asia (19%) and Eastern Asia (21%). Women are better represented in fields such as social sciences, biology, or medicine. Drastic inequalities persist in engineering, computer science, and physics – in some countries, women account for less than 20% of the scientific workforce. UNESCO gives figure 33.9% of women in STEM jobs in Western Europe, compared to 38.7% in the Eastern Europe (UIS, 2024).

Marine science in this context is very specific, as it is associated with additional demand – namely physical work at sea and usually long separation from home during marine cruises.

Marine research in Poland, until the 2000s, was closely associated with fishery science cruises, often long-term and long-distance. Polish fishery-oriented Antarctic cruises in the 1970s usually required a researcher to be vessel-based for 3 to 9 months (Sea Fisheries Institute in Gdynia, personal comm.). This requirement, apart from the problem of equality in wages and restricted access to higher positions (Hub Ocean, 2023, Table 1), likely explains why women were significantly underrepresented in the marine field research in Poland prior to the 1990s. Major change occurred with the adoption of a new logistics model, i.e. airline transfer of the research crew to the port of embarkment nearest to the target research area, which resulted in shortening the time at sea for an individual researcher to present day 4–5 weeks.

Table 1. Initiatives promoting women participation in marine research.

Name	Web address
Women in Ocean Science	https://www.facebook.com/womeninoceanscience/
NOAA. Making waves: Notable Women in Ocean Science	https://oceanservice.noaa.gov/news/womens-history-month/
Society of women in marine science	https://swmsmarinescience.com/
Network of women in marine science	https://wims.wiomsa.org/
APEC Women in Ocean Science Report	https://www.apec.org/publications/2023/08/apec-women-in-ocean-science-report
Hub Ocean	https://www.hubocean.earth/press/news/closing-the-gender-gap-in-ocean-science

Our aim was to examine the recent 30-year history of gender balance in employment, field work and scientific performance and to follow the evolution of women's contribution to marine science in Poland in general. We also explored to what extent ecofeminist theory offers useful insights into the challenges women face in marine science. The case study is focused on the largest marine research institute in Poland, Institute of Oceanology, Polish Academy of Sciences (IO PAN), as a representative.

2. Material

We have examined the archives of the employment career data, IO PAN internal HR archives 1986–2024, the results of the grant projects and the scientific performance of researchers present in SCOPUS data base (H-index as of February 2024). Data about outreach were collected from the web page that keeps the register of mainstream media releases and the popular science movies produced by the Institute's employees. Statistics on marine educational books are taken from the web page advertisement of the main booksellers. IO PAN, from 1995, was the largest marine research institute in Poland with a highest and, over the years, growing employment of the research staff. Hence, to large extent, it may be representative in respect of gender issues for Poland. Anonymous data are available on request.

3. Results

Employment on research positions in the Institute over the last 15 years shows slight variations in balance around a generally equal number of men and women with an increased number of female researchers lately (Figure 1). The acquisition of external funds – success rate in 320 research grants was close to balanced (53% of men and 47% women) with strong interannual variation, where men's share in grants ranged from 20 to 80% (Figure 2).

Number of permanent positions and degrees hold by females and males (Figure 3) shows general balance, with slight prevalence of men on full professor positions.

Statistics of the heads of the organisational units (Figure 4) shows, that some positions were held by men only (general directors, elected in open competition by an external body), other positions like research units (department leaders) were elected by the employees of the department, here the gender balance was kept, some positions in administration were traditionally occupied by women (chief accountant, chief of project unit) other by men (chief engineer and IT head).

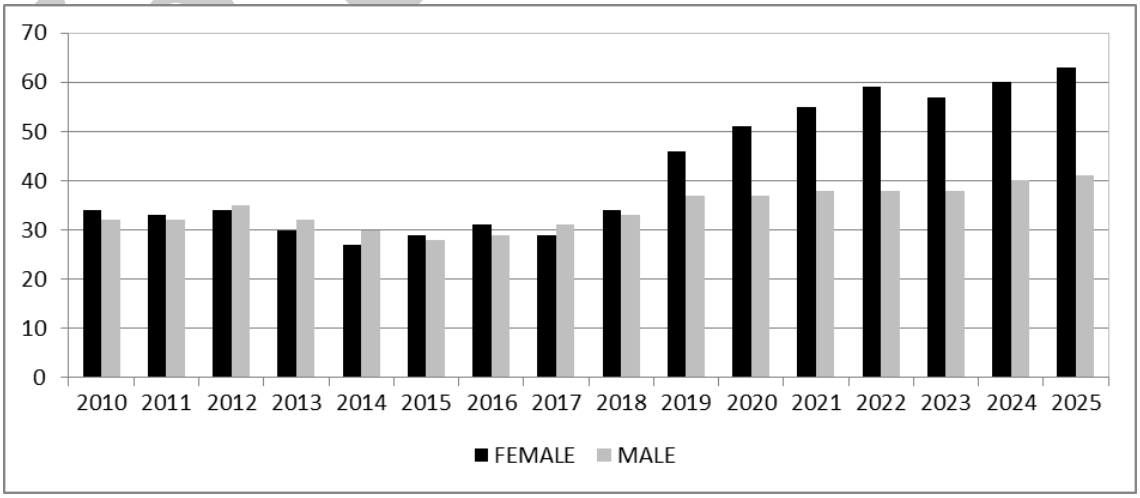

Figure 1. Number of employees on scientific positions at IO PAN (y-axis).

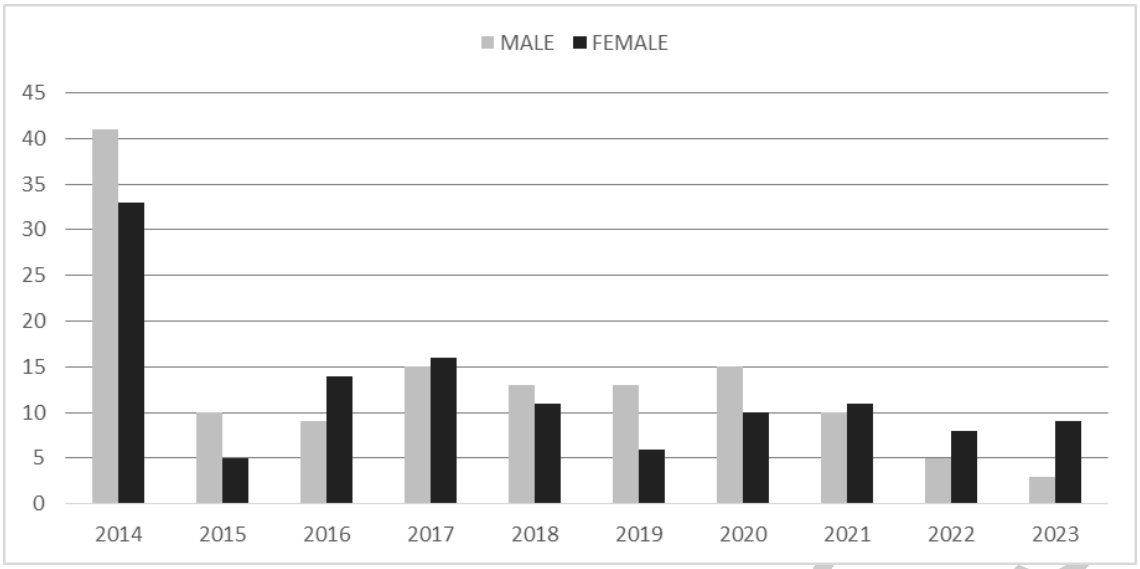

Figure 2. Number of employees – grant leaders at IO PAN (y-axis).

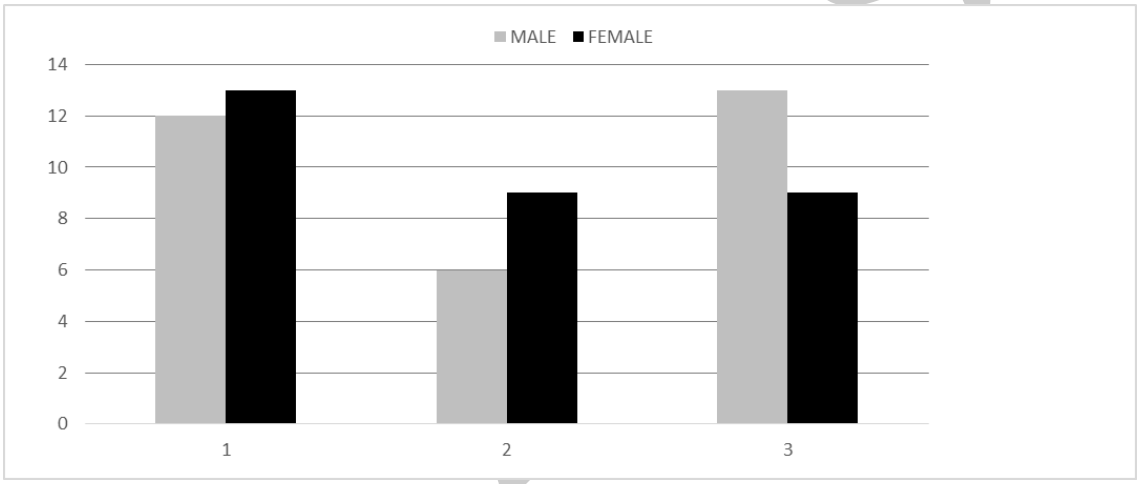

Figure 3. Number of employees with academic degree at IO PAN (1 – PhD, 2 – habilitation, 3 – professorship) (y-axis).

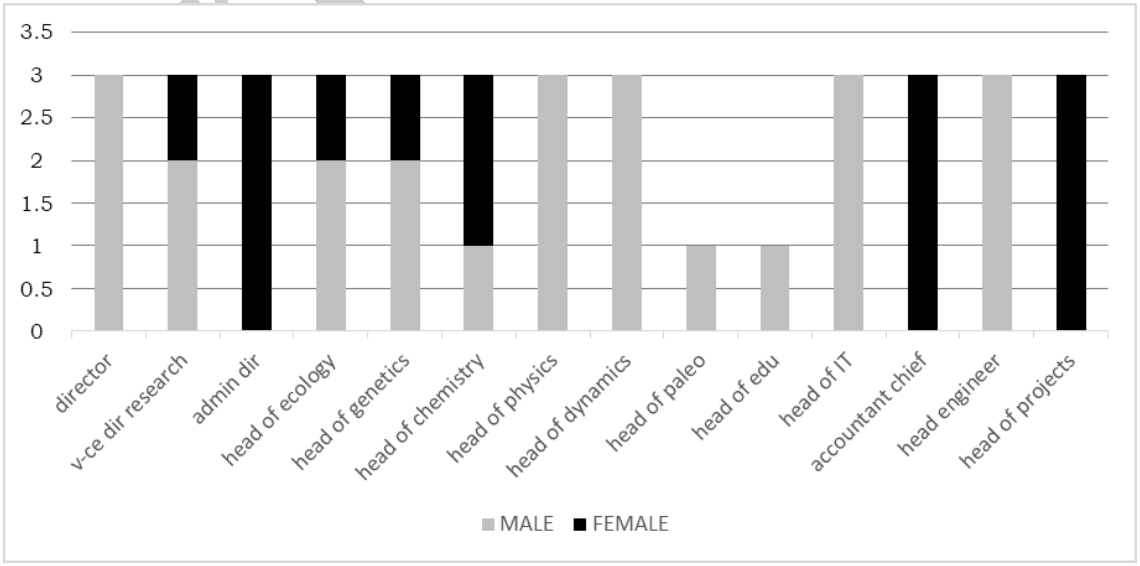

Figure 4. The last 24 years at IO PAN, 4-year terms, heads of organizational units (y-axis).

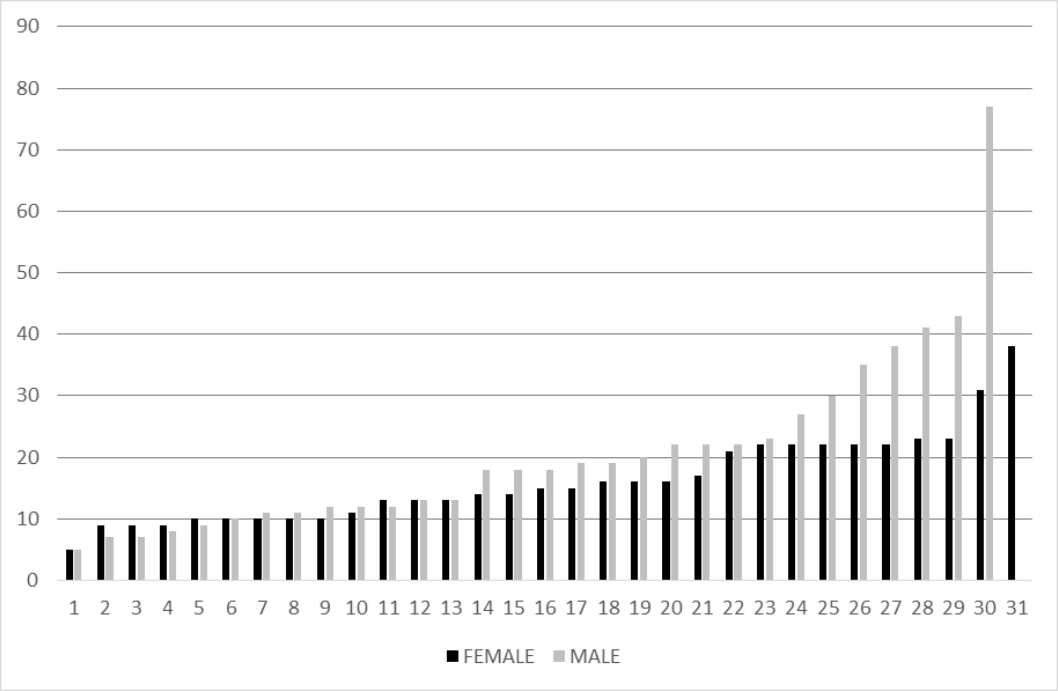

Figure 5. Scientific performance (H-index) of 31 female and 28 male marine researchers (phD plus) at IO PAN as of year 2023.

Scientific performance (H-index) of 28 male and 31 female researchers (Figure 5), shows balanced results; the median is similar, 17 to 20, while the standard deviation differs significantly, 7 for females versus 16 for males.

The relation between family status (no children, 1, 2, 3 kids) and scientific performance of female researchers is apparently not correlated (Figure 6). Using the number of children as a predictor of the Hirsch index (H-index) value yielded an R-squared of 0.0507, indicating that only approximately 5% of the variance in the H-index can be explained by this variable. Furthermore, the obtained p-value ($p = 0.232$) exceeds conventional significance thresholds, providing insufficient evidence to reject the null hypothesis. Thus, we conclude that there is no statistically significant effect of the number of children on the H-index magnitude.

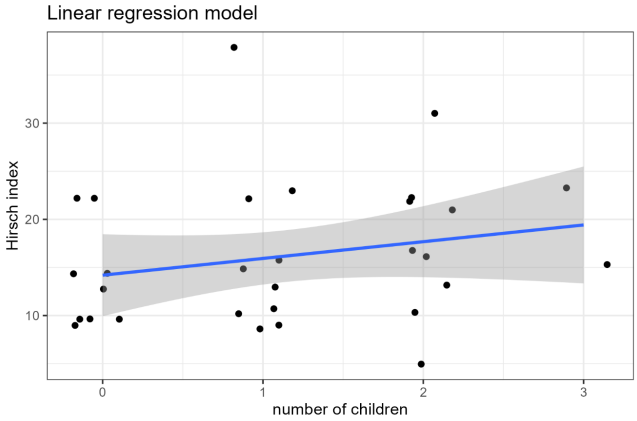

Figure 6. Family status and performance (H-index) in PhD-holding female marine researchers (28 persons from IO PAN).

Participation of female and male researchers in 264 scientific cruises onboard r/v *Oceania*, shows 1884 berths for men and 1433 berths for women, with female ranging between 39 to 52% of cruise team (Figure 7).

Although most of the presented above parameters show very balanced performance of male and female researchers, the striking difference is the frequency of mainstream media releases by male and female scientists. This is the situation, when TV or radio journalist ask Institute for ad hoc statement on the current problem – like a rapid algal bloom or a dead whale on the shore (Figure 8).

The analysis of popular science books on marine science offered in Polish bookshops, shows the prevalence of male authors 52:5, while the offer for kids shows the predominance of females (Figure 9).

The initiative on ocean literacy, "Ocean non-handbook" targeted at junior schools and the younger generation of the general public, conducted by IO PAN in cooperation with The Sea Aquarium in Gdynia (Sea Fisheries Institute) https://www.youtube.com/playlist?list=PLkobaySTd7ilznqJ01wRLJZaJaaihyTg0 and presented on YouTube and Facebook, has been prepared by early-career researchers from the both institutes, and here the gender balance is

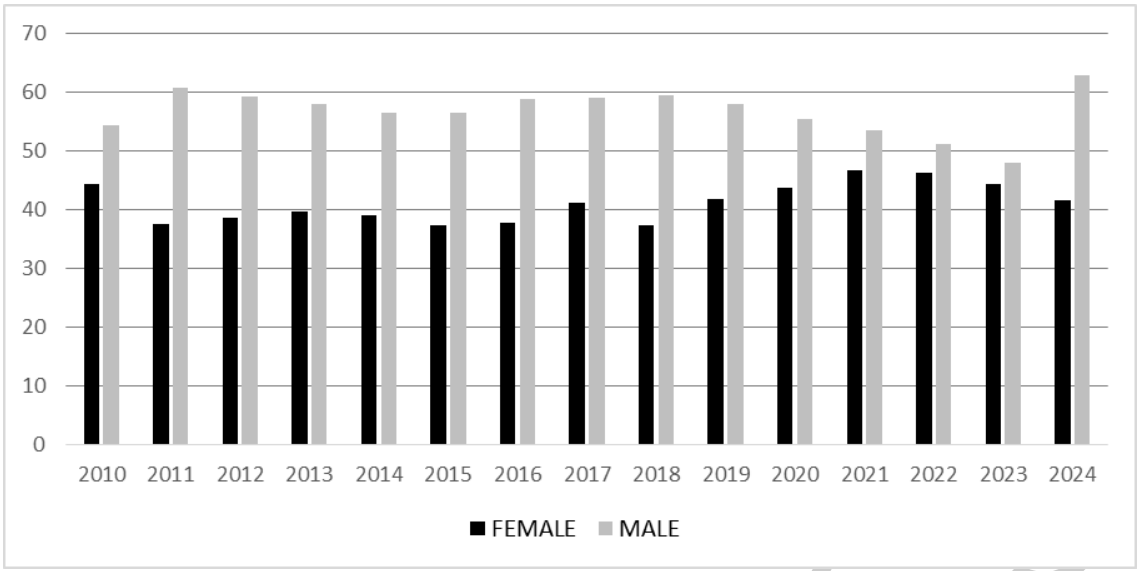

Figure 7. Number of research staff onboard r/v *Oceania* cruises (*y*-axis).

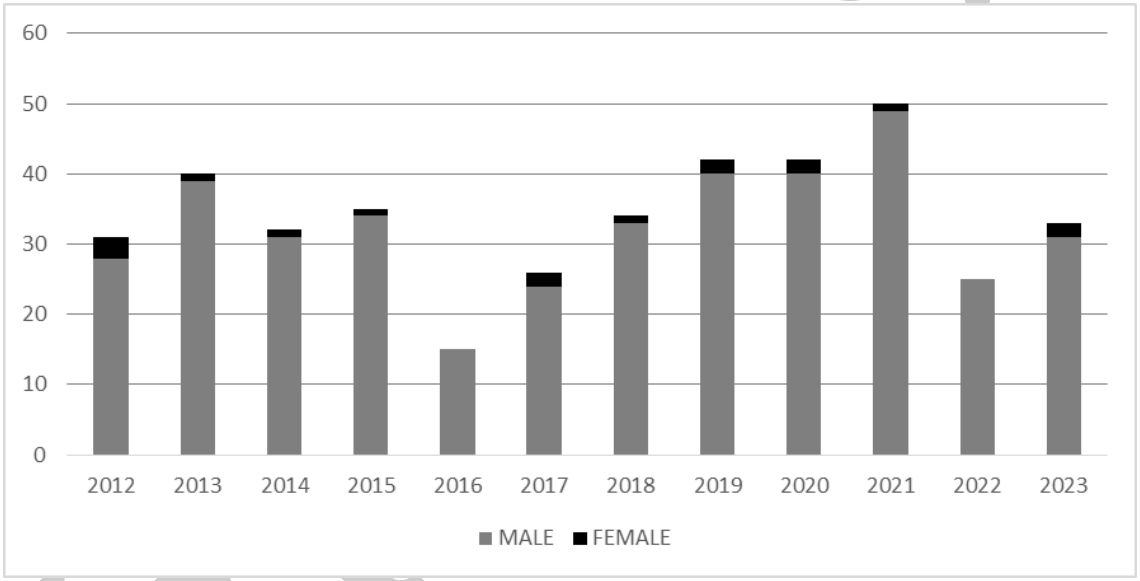

Figure 8. Number of science news in the mainstream media (TV, radio, newspapers) from IO PAN, between 2012 and 2023 (*y*-axis).

again skewed towards female researchers as presenters. From 183 short movies, 69% were presented by female researchers while 31% by males.

4. Discussion

Since 1974 the University of Gdansk has offered oceanography as a separate course, a five-year degree program, leading to the Master of Science degree in biological or physical oceanography. The first group of graduates from 1979 consisted of 5 men and 15 women. To this day (2025) all five men from this first course achieved the position of full professor or equivalent, and none of the fifteen women achieved the position in science, save for one as lab technician. In 2000's number of graduates rose to roughly 30 per year, with more women than men continuing the education in PhD schools. However, while achieving professorship, most of them are in marine chemistry and marine biology. That gender difference might be partially attributed to increased offer of specialisations in oceanography studies considered "soft", such as marine biology and marine ecology, and to reduced recruitment to physical oceanography. Early strands of ecofeminism posited that women are "naturally" closer to nature and thus inherently better predisposed to environmental protection (Mamzer, 2025). In effect, the offer of education paths might be a controlling

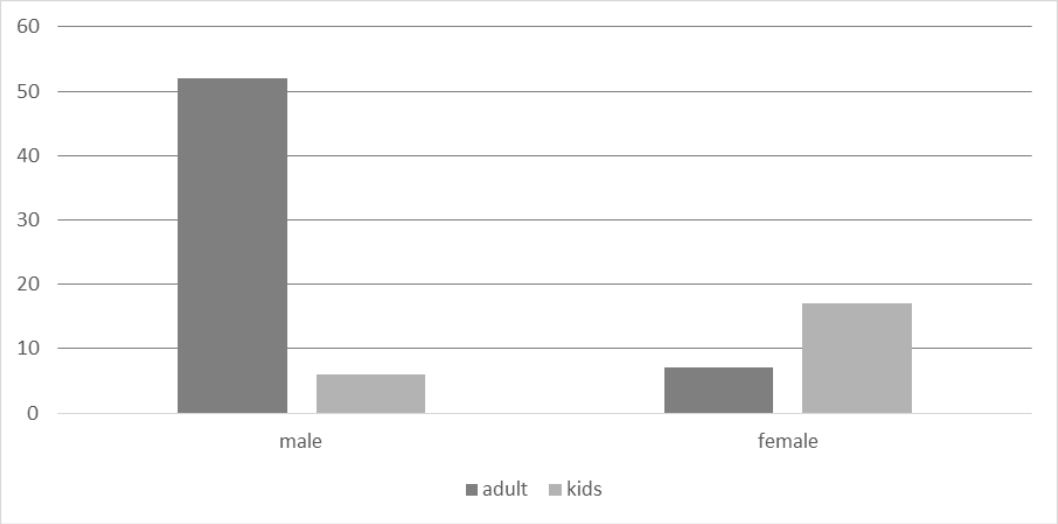

Figure 9. Number of authors of popular science marine books for adults (52) and for kids (23) available in Polish language (2010–2025) (*y*-axis).

factor that would select one gender over another in the field of marine research.

The most common concern in gender inequality is the pay gap between men and women and limited access to the key positions. Empirical research data demonstrate that men disproportionately occupy leadership positions in the natural sciences, while women face systemic devaluation – creating a stark contrast with essentialist assumptions (Perrin and Siriwardane-De Zoysa, 2017). However, this seems not to be the case of the analyzed IO PAN, in which, as a governmental institution, salary depends on the held position and the length of employment, with no consideration of gender. Also the history and timeline of leadership positions show no significant gender difference there.

On the level of the European Union research agenda, all institutes eligible for Horizon framework programs (main source of funding for the marine research in the EU) need to publish "gender equality plans", following the decision introduced with document "Horizon Europe: Regulation (EU) 2021/695 of the European Parliament and of the Council". Appropriate internal regulations were then introduced and applied in participating institutions in Poland, including IO PAN. On the global level, the Intergovernmental Ocean Commission at UNESCO claims a similar policy to UNESCO programs and actions (UNESCO, 2023).

Despite the efforts and regulations, the position of women in marine sciences is not fully balanced, as according to statistics, while 38% of marine researchers are women, only 28% hold senior researcher position. However, it is still almost 10% higher than in comparison to other STEM disciplines (UNESCO, 2021).

4.1 Access to infrastructure

Success in marine research is commonly linked to access to large, expensive infrastructure, such as research vessel or field stations. Nowadays Poland offers workplace on two polar stations (Arctic and Antarctic) and three regional class research vessels (*Oceania*, *Baltica*, *Oceanograf*) while in 1970–2000, large oceanic vessels were exploited for fisheries research (*Siedlecki*, *Bogucki*, *Wieczno*). Important opportunities are being offered through the international cooperation in research projects, and in effect, Polish marine researchers were active in German (*Polarstern*, *Sonne*), Norwegian (KV *Svalbard*, *Lance*, *Hellmer Hansen*, *G.O. Sars*), US (*Helly*, *Polar Star*), Canadian (*St. Laurent*, *Amundsen*). Women researchers were present on all those platforms, very likely in equal proportion to men, however precise statistics are not available (for the IO PAN researchers it was 50:50 proportion on international research vessels participation after the year 2000).

Although globally women's representation in leadership roles is increasing, they remain significantly underrepresented in scientific publications. Women are less frequently listed as first authors, indicating limited presence in research team leadership positions despite their growing participation in high-impact journals. Similar trends are observed at conferences – while women constitute a substantial proportion of attendees, they are underrepresented as invited speakers, particularly those from ethnic minority groups (Legg et al., 2023).

Regarding awards, women are increasingly recognized in early-career categories, yet men continue to dominate senior-level distinctions. In governance bodies and committees, female representation fluctuates around 30%, though some organizations – such as CLIVAR – are actively implementing diversity initiatives. Overall, progress is evident but uneven, with persistent barriers, especially for women from minority backgrounds (Legg et al., 2023).

Women contribute indispensably to ocean manage-

ment. Their inclusion in sectors like fisheries is essential for understanding socio-ecological linkages in marine ecosystems. Often regarded as key drivers of sustainability due to their collaborative and inclusive approaches, women also lead initiatives for marine conservation and the global ocean commons, addressing frequently overlooked issues. Historically and contemporarily, women have played a pivotal role in shaping modern ocean governance, particularly in fisheries, marine conservation, and the blue economy. Their contributions are rooted in inclusivity and cooperation – qualities central to sustainable development (Gissi et al., 2018).

Carli et al. (2016) identify two primary factors contributing to gender disparities in science. First, social roles play a significant role: stereotypical traits ascribed to women – such as nurturing behaviour and emotionality – are often perceived as incompatible with qualities associated with scientific excellence, including objectivity, competitiveness, and independence. Second, women in STEM fields frequently encounter bias and discrimination, which undermines their job satisfaction and restricts career advancement opportunities (Vagni et al., 2025).

Comparative studies on gender representation in marine sciences/oceanography reveal persistent inequities. In-depth interviews with female scientists of diverse nationalities and career stages collaborating with German research institutes highlighted a pronounced overrepresentation of men among professors and senior faculty, despite women constituting the majority of students and PhD candidates (Perrin and Siriwardane-De Zoysa, 2017). Their key findings are generational difference (younger researchers report less overt discrimination), yet nearly all interviewees experienced gender based discrimination or sexual harassment during their careers (Perrin and Siriwardane-De Zoysa, 2017). Women in marine science continue to face bullying and verbal abuse (Legg et al., 2023), with harassment remaining a critical issue, particularly for students during field work (Clark et al., 2008).

Media representation plays a significant role by perpetuating gender stereotypes, predominantly portraying scientists as male while marginalizing or omitting women's achievements in the field.

In ocean sciences, women are more likely than men to engage in interdisciplinary research with social significance and participate in science communication and educational outreach (Clark et al., 2008). However, Corsbie-Massay and Wheatly (2022) emphasize that media stereotypes have tangible consequences for reinforcing gender inequalities in STEM fields. Women are not only underrepresented in media coverage but are also frequently depicted in less professional terms compared to their male counterparts. The authors advocate for systemic changes, including journalist education programs, editorial policy reforms, and broader transformation of media culture. They particularly stress that science and media should not operate in isolation – building bridges between these domains through mentoring programs, media communication training, and active representation of women in public discourse is crucial. Our case study clearly confirms that situation, showing almost 90% of media coverage by men (Figure 8) and women's prevalence in the kids, products category only.

Research suggests that greater gender balance would positively impact marine conservation outcomes. Gender diversity enhances problem-solving effectiveness, with women demonstrating higher social sensitivity. Female researchers frequently raise important yet underrepresented issues in marine environmental protection. Increasing women's participation in marine science and conservation would lead to more innovative solutions for environmental challenges (Giakoumi et al., 2021).

The portrayal of scientists in mass media is widely recognized as a key factor contributing to the underrepresentation of women in engineering and technology (Chimba and Kitzinger, 2010). Research indicates that public perceptions and expectations of STEM professionals are more likely to be shaped by media depictions of female scientists than by direct interactions with them (Chambers and Thompson, 2020; Murphy et al., 2023; Robertson et al., 2018).

Few studies have addressed the core issue: the persistent, narrow framing of women in STEM by media professionals. While various initiatives aim to encourage girls to pursue science, the problem also lies in media representation (Corsbie-Massay and Wheatly, 2022). Current portrayals may exacerbate the *leaky pipeline* phenomenon, discouraging women from public engagement and influencing attitudes within STEM fields (Thébaud and Charles, 2018).

An analysis of UK media representations reveals stark disparities in how male and female STEM professionals are depicted (Chimba and Kitzinger, 2010). Historically, women scientists were rarely featured, and when they were, their roles were often reduced to being wives or mothers (LaFollette, 1988). Chimba and Kitzinger's (2010) study of the British press found that 84% of scientist profiles focused on men, compared to only 16% on women. Notably, 50% of profiles about female scientists referenced their clothing, appearance, or hairstyle, versus just 21% for men.

Contemporary media still exhibit *tokenism* – while outlets like *The New York Times* now feature near-equal representation of male and female scientists, women are disproportionately asked about work-life balance (Mitchell and McKinnon, 2019).

Female scientists are often invited to comment on others' research rather than their own, and their contributions are more likely to appear in "women's interest" sections or blogs (Chimba and Kitzinger, 2010; Mendick and Moreau, 2013; Nelkin, 1995). Journalists frequently emphasize

their appearance, sexuality, or other gendered traits, undermining their professionalism (Chimba and Kitzinger, 2010).

This focus on superficial attributes risks delegitimizing women's expertise discouraging their media participation. Those who actively communicate science face additional challenges, including image depreciation and accusations of self-promotion, alongside sexist portrayals (Chimba and Kitzinger, 2010).

While the visibility of female scientists in media has increased in recent years (Benson-Greenwald et al., 2021), and children's media now makes conscious efforts to portray women as scientists (Previs, 2016), the stereotypical image of a scientist remains predominantly male. This archetype embodies characteristics not automatically ascribed to women in societal perceptions.

Although initiatives supporting women in marine sciences exist (e.g., the IOC-UNESCO *Initiative for Women Marine Scientists*), systemic barriers continue to limit their participation in decision-making processes. To effectively manage ocean resources and achieve sustainable development goals – particularly SDG 14 – it is crucial to recognize the role of women and eliminate cultural and institutional obstacles that hinder their access to positions of power and influence (Gissi et al., 2018).

Burdett et al. (2022) propose moving beyond superficial measures, such as quotas, toward structural reforms that support work-life balance, transforming organizational culture (including evaluation and promotion criteria), providing leadership training on gender equality and unconscious bias, recognizing diverse forms of success beyond traditional "hard" metrics and engaging men as active allies in equity efforts.

Many respondents highlighted the unequal distribution of childcare responsibilities and its detrimental impact on women's research careers. Institutional and policy-level support is needed to empower women balancing caregiving duties (Giakoumi et al., 2021). However this effect was not observed in our case study – childbearing and childcare not reflected by women's scientific career indicators.

Increasing the visibility of women scientists in media – including social media – is a critical step toward dismantling stereotypes. While science communication is often relegated to women as a "softer" task (Johnson et al., 2014), their underrepresentation in media perpetuates harmful norms. Challenging the perception of women in STEM as a monolithic group – by showcasing their diverse roles as advocates, educators, and science communicators – could help reduce bias (AbiGhannam, 2016).

One of the novel ways in promoting women visibility in narratives about marine realm is the combination of Art and Science – Women View of the Sea (2025), where women researchers presents their favourite topic commented by piece of art by women artists. This initiative promoted by Institute of Oceanology in 2022–2025 attracted thanks to the art involved a broad audience of citizens, never interested in the marine science before (see on the project web page (https://old.iopan.pl/projects/Kobiety2/index-eng.html).

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Conflict of interest

None declared.

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