

## Understanding dimensions of ocean literacy in the European maritime industry for a sustainable blue economy

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The ocean plays a crucial role in sustaining life on Earth, offering a wide range of benefits and services. Through its diverse ecosystems, the ocean offers essential resources like food, energy, and minerals, while also regulating the climate and supporting human health and well-being. It significantly contributes to the global economy through industries like offshore renewables, fisheries, tourism and maritime transport, namely blue economy, creating millions of jobs worldwide. However, the rapid expansion of these economic activities poses an increasing risk for the marine environment, that is already facing a growing array of threats, including acidification, overfishing, pollution, habitat degradation and biodiversity loss. As interest in the ocean's economic potential grows, it becomes imperative to adopt sustainable practices and raise awareness among all members of society, particularly those whose livelihoods come directly from the sea, that is the maritime workforce. A thriving blue economy needs a workforce that understands the importance of the ocean, makes informed decisions to manage marine resources and ecosystems, and advocates for sustainable policies. Ocean literacy emerges as a tool to achieve this target, as a way not only to increase awareness, but as an approach to encourage maritime workers to have a more responsible behaviour towards the ocean and its resources. This research aims to expand the understanding on the status of ocean literacy with a focus on the European blue economy and to assess the levels of ocean literacy across maritime workers.

Drawing upon an extensive literature review, the first part of this study presents a comprehensive analysis of key concepts to introduce the reader to the field of ocean literacy. Chapter 1 provides an overview of the European blue economy sectors describing the features of the maritime workforce. This chapter brings forward the need of integrating ocean literacy research within the maritime sector.

Given the emergence of numerous ocean literacy initiatives, it became essential to obtain a comprehensive understanding of this topic to effectively involve the wider community. In chapter 2, we assessed the development of global research on ocean literacy applying bibliometric analysis and science mapping of the available scientific publications on ocean literacy (2005-2019). These techniques enabled us to represent the development of the ocean literacy field, to analyze the level of collaborations and to uncover its thematic areas. Our approach further identified the gaps in research related to the blue economy. Bibliometric analyses were used to describe the field's main features, including indicators of growth and research collaboration. We then used science mapping techniques to build collaboration networks among countries and institutions, and to identify research communities. The findings of this study suggest that ocean literacy is an emerging field of research with promising trends in research collaboration. Our results also suggest disparities in the scientific production and collaborations between the Global North and South. This study allowed us to verify the presence of a gap in the existing research, given that only a small proportion of the global ocean literacy research was focused on the blue economy (7.2%).

Having set the scene for the need of studies on the coupling of ocean literacy and the blue economy, we needed a tool to measure ocean literacy targeted to professionally active people. In chapter 3, we developed and tested the Blue Survey, an online instrument meant to measure ocean literacy in adult populations. Factor analysis was used to explore the validity and internal consistency of the Blue Survey in a purposive online sample of 251 adults. We found ocean literacy to consist of six dimensions captured by 34 survey items, viz. knowledge, personal interest, ocean stewardship, ocean as an economic resource, ocean-friendly behaviour, and willingness to act responsibly towards the ocean. The Blue Survey is proposed as a new instrument to measure ocean literacy in an adult population. This multilingual validated tool combines aspects such as knowledge, attitudes, and behaviours, in the same construct and provides a more integrated perspective on ocean literacy as a means of producing change, which has not been done before for this stakeholder group.

Based on the results from chapter 3, and in order to assess the validity of the Blue Survey across populations closely related to the sea, particularly maritime professionals, we designed the Blue Survey 2.0. In chapter 4, we conducted the Blue Survey 2.0 to assess the levels of ocean literacy of 536 maritime workers across Europe, using exploratory factor analysis, univariate and cluster analyses. Our findings suggest that the way maritime workers connect to the ocean is

complex, but it can be simplified by considering the integration of five pillars including knowledge, attitudes towards ocean sustainability, attitudes towards the use of the ocean, behaviour and personal interest. In addition, we found that factors related to the industry such as the blue economy sector, region and occupation; as well as sociodemographics like age and gender, influenced the levels of ocean literacy in European maritime workers. In the second part of chapter 4, we showcased the application of the Blue Survey 2.0 among maritime workers in Peru. These results constitute a benchmark for measuring ocean literacy in the blue economy sector.

Finally, a comprehensive discussion of the main findings presented in the previous chapters is showcased in chapter 5. This chapter highlights the implications of our findings for marine science and broaden goals of sustainability, such as the UN Sustainable Development Goals, the Ocean Decade and the European Strategy for a sustainable blue economy.

In conclusion, this study has deepened our understanding in the topic of ocean literacy in the context of the blue economy and has highlighted the importance of ocean literacy to ensure a sustainable future. Through an in- depth assessment of the current state of ocean literacy research, our findings support the inclusion of ocean literacy as one of the priority areas of research of the Ocean Decade. By conducting empirical research on the dimensions and levels of ocean literacy using the Blue Survey, this study provides two validated multilingual tools to measure the various dimensions of ocean literacy. The findings of this study underscore the need to integrate ocean literacy content into the trainings of maritime workers, especially for young workers, which seem to be the least engaged. Our results might help companies to understand that for certain groups of maritime workers enhancing knowledge on the ocean alone is not enough to achieve ocean- friendly behaviour and that other approaches for engagement with ocean sustainability seem appropriate. Moving forward, further research in this field should continue building on the foundations laid here to obtain an ocean literacy baseline in maritime communities over time and to assess the mechanisms through which ocean literacy initiatives effectively lead to an increase of knowledge, positive attitudes and behaviours towards the ocean.