



Editorial

Ocean literacy: a 'new' socio-ecological concept for a sustainable use of the seas



New socio-ecological concepts are continuously being incorporated into the scientific language. Blue-growth, eco-intensification, sustainable exploitation, eco-labelling, climate change mitigation, citizen science, and ecosystem approach are some of these concepts, all of which are following different patterns of integration into the language. New concepts can become quickly fashionable and trending topics, others can be misused and/or overused (often being “good selling” terms), and others may be abandoned. The evolution and meaning of the concepts ‘environmental literacy’ and ‘ocean literacy’ are a matter of interest, for the implication that they can have in the future of our environment and oceans.

The ‘environmental literacy’ concept was incorporated by a New Jersey group (Anonymous, 1971) to face the important problem of pollution in this state, aiming for environmental education of the general public and of students from kindergarten to college. Based on this paper, environmental literacy seeks to change human behaviour, to preserve the natural environment and increase the quality of life. Up until 1991, only two more papers were published under this topic (after a SCOPUS consultation of this term, on 30th December 2015); however, after 2001 this topic started to increase, numbering 20–30 papers per year since 2010 (Fig. 1). In parallel, there was an increasing number of citations, which reached more than 200 in 2015 (Fig. 1), totalling nearly 1200 during the period 1971–2015.

The first and only article on ‘marine literacy’ was published in 1980 (Spector, 1980). Then, in 2004, this concept was replaced by ‘Ocean literacy’ (West, 2004), which is currently defined as “an understanding of the ocean’s influence on you—and your influence on the ocean”. Hence, “an ocean-literate person: (i) understands the essential principles and fundamental concepts about the ocean; (ii) can communicate about the ocean in a meaningful way; and (iii) is able to make informed and responsible decisions regarding the ocean and its resources” (Anonymous, 2013). This means that ‘ocean literacy’ is not only an educational matter, but an attitude in which understanding of the ocean’s influence on people and people’s influence on the ocean will result in a positive human behavioural change.

Publishing on ocean literacy has not been as successful as publishing on environmental literacy,¹ with only 46 papers published after 2004 (Fig. 1). Also, the number of citations received by these papers is very limited, at 86 (Fig. 1). The most cited paper is that of Steel et al. (2005), on public ocean literacy in the United States, with 44 citations.

¹ Other concepts have been more successful, e.g., since the first publication on the ‘Citizen science’ concept in 1997, 1155 papers have been published, with more than 150 papers per year after 2012, and receiving a total of 10,318 citations (source: SCOPUS, consulted on 30th December 2015).

But, why is it so important to promote research and publications on ocean literacy? In our opinion, most people, including societal groups of special relevance such as policy makers, decision makers, managers and the society at large, are not sufficiently ocean literate, which can have a potential negative cascading effect on the health of our oceans.

Some specific ocean problems (e.g. the stranding of whales on the beach, the floating plastics at sea, or even the sea-level rise because of climate change) have transcended to society, and resulted into behavioural changes. Examples of effective ocean literacy have been reported in the USA (Steel et al., 2005), Ireland (Hynes et al., 2014) and China (Umuhire and Fang, 2015). However, it is more difficult for scientists to explain about - and broader society to understand - the complexity of ocean ecosystems, or an example where tiny organisms (e.g. microbes, plankton) are of paramount importance in maintaining the functionality of the whole ecosystem and the services it provides (e.g. food and carbon sequestration). Indeed, the current trend for a political push towards a continuous economic (blue, in the marine case) growth, is a consequence of insufficient ocean literacy, as this is not possible in a finite world. Ocean productivity is based upon natural capital, and even if most of it is renewable, its carrying capacity is limited and, so is blue-growth.

To make decision-makers and the society at large ocean literate, we, scientists, need to first understand both how people influence the oceans (i.e. impact, for which much scientific basis already exists) and how the oceans influence people (e.g. ecosystem services, a rather new topic), as well as how a better understanding of the human-ocean relationship translates into a behavioural change that positively affects the oceans. In addition, aiming for behavioural changes requires us to further understand what the most effective means and media are to increase society’s literacy. Only by completing the whole process, will we be able to effectively have people who are ocean literate.

Scientists have often been blamed for our limited capacity to engage with the society. While this may be true, by increasing knowledge about the functioning of ocean literacy, different professional disciplines (e.g. journalists), organisations (e.g. NGOs, governments) and actions (e.g. media production, campaign) may gain higher relevance and a more defined role in the field of ocean literacy.² This task should start with primary and secondary school educators, trying to increase students’ awareness about the ocean, since low levels of ocean literacy have been identified in many countries as a barrier for citizens to engage in

² Note that there is a clear distinction between ocean literacy and dissemination activity. Dissemination activities may be used as means to ocean literacy, but may only be effective if adequately used.

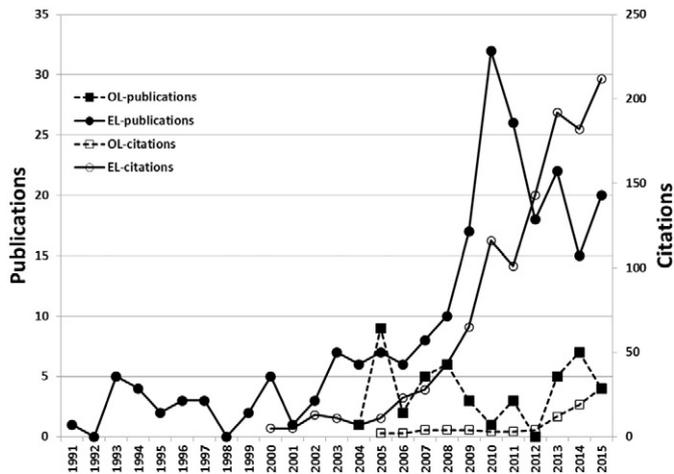


Fig. 1. Environmental Literacy (EL) and Ocean Literacy (OL) publications and citations, since 1991 (after SCOPUS, consulted on 30th December 2015).

environmentally responsible behaviour (see the study of Guest et al. 2015). In addition, universities should train future scientists in communicating research, translating science into stories (Wood-Charlson et al., 2015). However, probably this is not enough and scientists need to engage with other professionals in which society can mirror.

To assist this process, there are now two European projects, funded under the H2020 research framework, trying to promote and increase knowledge on ocean literacy: (i) ResponSEable (Sustainable oceans: our collective responsibility, our common interest. Building on real-life knowledge systems for developing interactive and mutual learning media; www.responseable.eu); and (ii) SeaChange (Sea Change: our ocean, our health; <http://seachangeproject.eu/>). These two projects integrate scientists and many other professionals (i.e. journalists, media producers, writers, artists, and economists,) with the aim of bridging the gap between science and society. Such a “multi-professional” approach should serve as an example and become a common practice in funded projects for achieving an ocean literate society.

With a tight agenda ahead, including the achievement of the Aichi biodiversity targets (SCBD, 2010) and the good environmental status of European marine waters (within the Marine Strategy Framework Directive (European Commission, 2008)), all by 2020, the inclusion of ocean literacy and multi-professional approaches in the agenda of research frameworks is needed more than ever. This means increasing our understanding of the functioning of ocean literacy and the translation of these findings through specific actions, by different professionals (including policy makers, managers, educators, etc.), to the society. We should ensure that the ‘ocean literacy’ concept goes beyond 2020 political targets and will remain in its essence (as defined by Anonymous,

2013), without falling into its misuse, overuse or abandonment. Only by improving and increasing public understanding of the human-ocean relationship will behaviours change, which will potentially result in healthier and sustainable oceans.

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References

- Anonymous, 1971. State council promotes environmental literacy. *Chem. Eng. News* 49 (41), 42–43.
- Anonymous, 2013. *Ocean Literacy. The Essential Principles and Fundamental Concepts of Ocean Sciences for Learners of All Ages*. NOAA (13 pp.).
- European Commission, 2008. Directive 2008/56/EC of the European Parliament and of the Council establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). *Off. J. Eur. Union* L164, 19–40.
- Guest, H., Lotze, H.K., Wallace, D., 2015. Youth and the sea: Ocean literacy in Nova Scotia, Canada. *Mar. Policy* 58, 98–107.
- Hynes, S., Norton, D., Corless, R., 2014. Investigating societal attitudes towards the marine environment of Ireland. *Mar. Policy* 47, 57–65.
- SCBD (Secretariat of the Convention on Biological Diversity), 2010. COP-10 Decision X/2: Strategic plan for biodiversity 2011–2020. <https://www.cbd.int/decision/cop/?id=12268>.
- Spector, B.S., 1980. Marine Literacy: an attainable goal. *Mar. Technol. Soc. J.* 14 (3), 31–35.
- Steel, B.S., Smith, C., Opsommer, L., Curiel, S., Warner-Steel, R., 2005. Public ocean literacy in the United States. *Ocean Coast. Manag.* 48, 97–114.
- Umuhire, M.L., Fang, Q., 2015. Method and application of ocean environmental awareness measurement: Lessons learnt from university students of China. *Mar. Pollut. Bull.* <http://dx.doi.org/10.1016/j.marpolbul.2015.07.067>.
- West, R.D., 2004. Ocean literacy is key to preserving our oceans and coasts. *Mar. Technol. Soc. J.* 38 (4), 68–69.
- Wood-Charlson, E.M., Bender, S.J., Bruno, B.C., Diaz, J.M., Gradoville, M.R., Loury, E., Viviani, D.A., 2015. Translating Science into Stories. *Limnol. Oceanogr. Bull.* 24, 73–76.

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