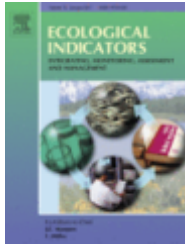


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The CARLIT method for the assessment of the ecological quality of European Mediterranean waters : relevance, robustness and possible improvements
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Abstract

The application of the European Union (EU) Water Framework Directive (WFD) requires the assessment of the ecological status (ES) of coastal waters in order to detect environmental changes and implement management plans to prevent their further deterioration. The ES of a water body (WB) has to be assessed on the basis of the status of several biological indicators, referred to as biological quality elements (BQE), such as phytoplankton, macroalgae, seagrasses, macroinvertebrates and fish. We present the most extensive assessment ever undertaken of the ES of Mediterranean waters, by means of the CARLIT index, the most widely used index for the Mediterranean Sea. This index is based on the Ecological Quality Ratio (EQR) between a measured value of Ecological Quality (EQ) and a value corresponding to a reference site. This assessment is based on an extensive field study, covering the whole of the Mediterranean French coasts (including Corsica), 40 WBs and 2 970 kilometres of shore (at a 1/2 500 scale). The original Ballesteros CARLIT method is compared to the Nikoli? modified method, and we have undertaken the challenge of developing an alternative new simplified CARLIT method. This simplified method, which requires less expert judgement, is easier to implement by local authorities, and provides results similar overall to those of the original method. Previous attempts, if any, to correlate EQRs with anthropogenic stressors (through pressure indices) were mainly based upon land uses or on comprehensive lists of stressors, some spatially very sporadic, temporally highly variable, non-representative of the WB and with the impact poorly established on species and communities. To date, the LUSI (Land Uses Simplified Index) and the MA-LUSI-WB have been the most widely used pressure indices. Here, we propose a new pressure index (HAPI) taking into consideration the possible shortcomings of previous indices. It takes into account the actual pressures at community levels considered by the CARLIT method. It accounts well for the EQR values of the study area, as evidenced by the high correlation coefficient between EQRs and HAPI, better than that of the other pressure indices. The present study provides a comprehensive view of the ES of the French Mediterranean coasts. Surprisingly, the picture is far less cause for concern than expected, although this could result from an artefact due to the focus on superficial waters and habitats inherent to the CARLIT method. Where two successive assessments were performed (23 WBs, 2007–2010 vs 2012–2015), the results were similar, which stresses the robustness of the method and/or the relative stability over time of the overall ES of the WBs, and suggests that the successive assessments could be carried out at low frequency.

Keywords

Biological indicator ; Macrophytes ; Mediterranean sea ; Pressure index ; Ecological status ; HAPI index