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The use of benthic biodiversity indicators: pros and cons

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Summary

Biodiversity is an important aspect in environmental management. In this contribution, we discuss the consequences (pros and cons) of the use of various types of benthic diversity indicators. Diversity is not always considered in their algorithm or in various forms, and that lead to a lower comparability between indicators (cf. WFD intercalibration exercise). The experts excluding diversity in their indicator, justifying this by the fact that diversity does not show a monotonic trend along gradients of pollution (cf. Pearson Rosenberg model). And also when considering physical disturbances relationships between impact and diversity are not always linear, which was also the case in Belgian waters as a result of aggregate extraction and dredge disposal activities. This non-linear response, however, does not hamper a consistent environmental assessment by benthic indicators with a biodiversity component, due to an adequate definition of the GES boundaries. In the near future, genetic based biodiversity indicators will be used alongside the classic ones, based on taxonomic species identifications. Genetic tools such as meta-barcoding in environmental monitoring, however, are not yet fully applicable, and can lead to discrepancies with the regular taxonomical approaches.

Introduction

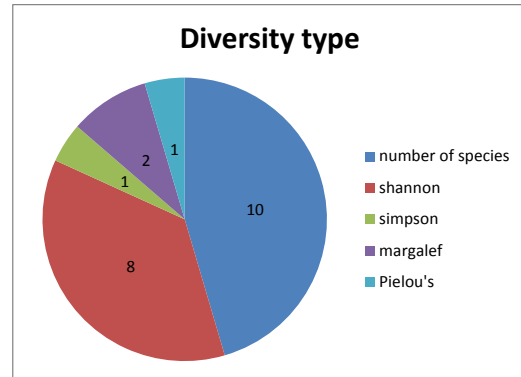
Indicators are the scientific translation of governmental needs for reliable information on the condition or so-called 'status' of an ecosystem. Biodiversity is an important component within status assessments and a high-level objective of marine policy (E.g. Marine Strategy Framework Directive [MSFD], Water Framework Directive [WFD]). Consequently, diversity is incorporated into most of the indicators for the assessment of benthic ecosystem status. However, diversity is not always considered in their algorithm or in various forms. On this aspect and what it means for environmental status assessment is investigated in this contribution.

Material and Method

A large set of indicators are defined for assessing certain aspects in the status of the benthic habitats, as derived from the Devotool, MARMONI and WISER database. For each of those indicators the manner of considering biodiversity is defined in following classes: (1) not; (2) as number of species (or expected number of species); (3) as diversity index (E.g. Shannon, Simpson). The results obtained from the application of the benthic indicators in relation to their comparability or relationship to a pressure were derived from own studies (Van Hoey et al., 2015; De Backer et al., 2014) or the literature (Pearson & Rosenberg, 1978; Josefson et al., 2009).

Results and Discussion

Forty six indicators are assessing a certain aspect of the status of benthic habitats (structural, functional), whereof 48% a biodiversity aspect. 62% are operational, whereas the other part is still under development or conceptual. Those indicators consist of different algorithm types (mainly direct measurements or single, multimetric and multivariate types). Seventeen of those are operational for assessing the benthic status in coastal waters for the



Water Framework Directive. Biodiversity in the WFD benthic indicators is mainly assessed by number of species and/or Shannon diversity (see Figure). Four of those indicators does not contain a diversity parameter, which was a criteria of the WFD guidance. The countries (Spain and France [their Mediterranean region's], Cyprus, Greece) justified this due to the unimodal or no relationship of biodiversity in relation to a pressure. This duality in including or not including a biodiversity indicator lead to comparability problems in the WFD intercalibration, whereas the non-biodiversity indicators shows no or very low comparability with the biodiversity indicators. Therefore, the question is, is diversity really a good indicator for evaluating status and detecting impacts of human pressures. It is clear that diversity shows a relationship with pressures on the system (Pearson & Rosenberg, 1978; Josefson et al., 2009), but this relationship is not always straight forward. In the study of the De Backer et al. (2014), the effects of three impacts, i.e. sand extraction, dredge disposal and offshore wind energy exploitation, on the soft-bottom macrobenthic assemblages was investigated. Similar diversity-disturbance responses, caused by sediment refinement lead to a shift towards a heterogenic, dynamic (transitional), more diverse soft-bottom macrobenthic assemblage in the impacted area. On the other hand, in severe impacted areas, the diversity declines strongly (Josefson et al., 2009; Van Hoey et al., 2015). These studies showed that it is not easy to use diversity as indicator. Classical diversity indices were widely used and form a core aspect in many benthic indicators. Currently, genetic tools such as meta-barcoding in environmental monitoring are upcoming. Diversity indicators generated from this, are not yet fully applicable, and can lead to discrepancies with the regular taxonomical approaches (genetic diversity higher than regular, cryptic species). The message is that a benthic biodiversity measure is necessary, but that this may not the only parameter in status assessments.

References

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