

Name of indicator	2.4 Indicator of macroalgal community structure (MCS)
Type of Indicator	State indicator
Author(s)	Tiia Möller, Georg Martin
Description of the indicator	The indicator focuses on the phytobenthic community and its structural features. The macrophytes function both as a habitat and a food source for macrofauna and it is known that macrofaunal composition depends mainly on habitat architecture at a spatial micro-scale. Also that most faunal species show high mobility and dispersal rates and they colonize available habitats rapidly. Thus, though focusing only on plants, the indicator illustrates the macrofaunal community as well both in soft and hard substrates. During last years the focus on studying macroalgal communities has moved towards biological traits including structure and structural complexity (e.g. Christie <i>et al.</i> 2009), but only few indicators are based on macroalgal community structure so far (Blomqvist <i>et al.</i> 2012 and references therein). To our knowledge, this specific indicator has not been described before at least in such formula.
Relationship of the indicator to marine biodiversity	The indicator reflects the structural diversity of macroalgal community and through that composition of accompanying fauna.
Relevance of the indicator to different policy instruments	MSFD - indicator can be used under qualitative descriptors 1 (Biological diversity) as it reflects the structural diversity of macroalgal community and illustrates the possible suitable habitats for benthic fauna. Habitats Directive - indicator can be used to illustrate the variability within valuable habitat types and evaluate the temporal and spatial changes within habitat. Birds Directive – not applicable. HELCOM BSAP – indicator can be used to illustrate the variability within habitats that belong to the HELCOM Red list of Baltic habitats. Indicator can also be used in detailed landscape/habitat maps as a descriptive unit of biodiversity.
Relevance to commission decision criteria and indicator	1.7. Ecosystem structure 1.7.1. Composition and relative proportions of ecosystem components (habitats and species)
Method(s) for obtaining indicator values	The indicator values are based on coverage data of different functional and structural groups of macroalgae. Sampling is performed and coverage estimations of all distinguishable species are gained via diving or remote underwater video analysis. In the Baltic Sea area, sampling should be conducted in late summer, when all the communities have evolved. The indicator values are based on coverage data of different functional and structural groups of macroalgae, for that 3 different macroalgal groups are defined based on literature (Kotta and Orav, 2001; Salovius and Kraufvelin 2004; Råberg and Kautsky 2007; Kersen <i>et al.</i> 2007; Christie <i>et al.</i> 2009; Hansen <i>et al.</i> 2010) and available datasets: Group 1) all filamentous algae, <i>Chorda sp.</i>, <i>Potamogeton perfoliatus</i>, Group 2) higher plants (excl. <i>Zostera marina</i> and <i>P. perfoliatus</i>, incl. <i>Potamogeton sp.</i>, <i>Ruppia sp.</i>, <i>Zannichellia sp.</i>, <i>Myriophyllum sp.</i>, <i>Ceratophyllum sp.</i>, <i>Myriophyllum sp.</i>, <i>Chara sp.</i>, <i>Tolypella nidifica</i>, <i>Furcellaria sp.</i>, <i>Phyllophora sp.</i>, <i>Fucus radicans</i> 3) <i>Zostera marina</i>, <i>Fucus vesiculosus</i>, <i>Furcellaria lumbricalis</i> (loose). The coverage of species within different structural groups is summarized and the exact formula for calculations is given in illustrative materials.
Documentation of relationship between indicator and pressure	The indicator varies between 0-1. Low indicator values indicate on dominance of filamentous algae and higher values reflect the dominance of structurally more diverse community. Due to eutrophication the general tendency of the macroalgal community is the replacement of structurally more diverse perennials (key-species) with ephemeral fast-growing filamentous algae (e.g. Valiela <i>et al.</i> 1997, Kraufvelin 2006; Burkholder <i>et al.</i> 2007). The indicator is expected to mirror the change in environmental conditions also when minor changes occur.
Geographical relevance of indicator	3. Baltic sea wide
How Reference Conditions (target values/thresholds) for the indicator	Reference conditions are not available and need to be developed.

were obtained?	
Method for determining GES	Methods for determining GES are not available and need to be developed.
References	Blomqvist, M., Krause-Jensen, D., Olsson, P., Susanne Qvarfordt, Wikström, S.A. (2012) Potential eutrophication indicators based on Swedish coastal macrophytes. WATERS Report no. 2012:2. 72 pp. Burkholder, J.A., Tomasko, D.A. and Touchette, B.W. (2007) Seagrasses and eutrophication. Journal of Experimental Marine Biology and Ecology 350:46-72 Christie, H., Norderhaug, K.M. and Fredriksen, S. (2009) Macrophytes as habitat for fauna. Marine Ecology Progress Series, 396:221-233 Hansen, J.P., Sagerman, J. and Wikström, S. (2010) Effects of plant morphology on small-scale distribution of invertebrates. Marine Biology 157:2143-2155 Kersen, P., Kotta, J., Bučas, M., Kolesova, N. and Dekere, Z. (2011) Epiphytes and associated fauna on the brown alga <i>Fucus vesiculosus</i> in the Baltic and the North Seas in relation to different abiotic and biotic variables. Marine Ecology 32:87-95 Kotta, J. and Orav, H. (2001) Role of benthic macroalgae in regulating macrozoobenthic assemblages in the Väinameri (north-eastern Baltic Sea). Annales Zoologici Fennici 38: 163-171 Kraufvelin, P., Moy, F.E., Christie, H. and Bokn, T.L. (2006) Nutrient addition to experimental rocky shore communities revisited: delayed responses, rapid recovery. Ecosystems 9:1076-7093 Råberg, S. and Kautsky, L. (2007) A comparative biodiversity study of the associated fauna of perennial fucoids and filamentous algae. Estuarine, Coastal and Shelf Science 73:249-258 Salovius, S. and Kraufvelin, P. (2004) The filamentous green alga <i>Cladophora glomerata</i> as a habitat for littoral macro-fauna in the Northern Baltic Sea. Ophelia 58: 65-78 Valiela I., McClelland J., Hauxwell J., Behr P.J. and Hersh D. (1997) Macroalgal blooms in shallow estuaries: Controls and ecophysiological and ecosystem consequences. Limnology and Oceanography, 42:1105-1118
Illustrative material for indicator documentation	A – total summarized coverage of taxa belonging to the group 1. (can be over 100) B – total summarized coverage of taxa belonging to the group 2. (can be over 100) C – total summarized coverage of taxa belonging to the group 3. (can be over 100) D – total summarized coverage (can be over 100) E – total summarized cover with maximum value 100 (in case of exceeding 100, value 100 is used in the formula) $MCS = \left(\frac{(1 \times A + 2 \times B + 3 \times C)}{D} / 300 \right) \times E$