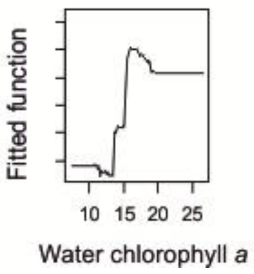
Name of indicator	2.14 Macrozoobenthos community index (ZKI)
Type of Indicator	State indicator
Author(s)	Jonne Kotta
Description of the indicator	The structure of benthic assemblages responds diversely to many kinds of stresses because these assemblages typically include organisms with a wide range of physiological tolerances, feeding modes, and trophic interactions. In order to make this information usable for water quality assessment, the ZKI index divides the macrofauna into three distinct groups according to their sensitivity to an increasing stress (including eutrophication). Species belonging to class 1 are those that can be found at heavily eutrophicated conditions, species belonging to class 2 are those that gain biomass under moderate eutrophication conditions, and class 3 species are those typical to pristine conditions. The index also takes into account species number at station and compensates this diversity term for salinity gradients. The compensation term is based on waterbody-specific maximum values for species number calculated from the entire content of national database. The index is currently used when assessing the water quality in Estonia in the frame of the EU Water Framework Directive.
Relationship of the indicator to marine biodiversity	The index takes into account species number at survey station and compensates this diversity term for salinity gradients. Thus, the index has a potential to reflect spatial and temporal variability of diversity of benthic invertebrate communities related to changes in the intensity of various pressures.
Relevance of the indicator to different policy instruments	The index is currently used in the frame of the Water Framework Directive, there is a potential to use the indicator for assessment of MSFD descriptors 1, 2, 4, 5, 6 and in the frame of the Habitats Directive.
Relevance to commission decision criteria and indicator	1.6. Habitat condition 1.6.1. Condition of the typical species and communities 1.6.2. Relative abundance and/or biomass, as appropriate 1.7. Ecosystem structure 1.7.1. Composition and relative proportions of ecosystem components (habitats and species)
Method(s) for obtaining indicator values	The equation of the ZKI index is as follows: $\mathrm{ZKI} = [0.5 \times (\mathrm{Class}\ 1 + 2 \times \mathrm{Class}\ 2 + 3 \times \mathrm{Class}\ 3) - 0.5] \times \left[\frac{S}{S_{\max}}\right]$ where: Class i is a ratio of sum of dry weight of the species belonging to class i to total invertebrate biomass at station; S is number of species/taxa at station; S_{max} is a waterbody-specific value of maximum species number at station. The values of ZKI index vary locally between 0 and 1 i.e. 1 representing the healthy communities and 0 representing the most deteriorated communities (Kotta *et al*., 2012). There are certain criteria that need to be fulfilled: (1) The index can be used for soft bottom communities including mixed sand sediments. (2) Sampling device is either a van Veen or Ekman type benthic grab. (3) Depth should be ≥ 5 m and ≤ 30 m.
Documentation of relationship between indicator and pressure	The index responded differentially to the studied environmental variables. The links between environmental variables and index were always the strongest at 5 km spatial scale. At smaller spatial scales the index reflected changes to local ice conditions and/or coastal topography. At 5 km spatial scale, however, the index followed the variability in coastal eutrophication. Thus, this is the scale where eutrophication processes are likely to have the largest effects on coastal environment and at which the impacts of eutrophication on coastal biota should be assessed. The ZKI index increased with elevating eutrophication i.e. chl a values. This can be explained as follows. Locally, the biomass of macrophyte species is a function of nutrient availability and that of benthic invertebrates by macrophytes. Thus, an increasing eutrophication of the Baltic Sea ecosystem relaxes competitive interactions for food and

	increases a chance of any benthic species to be observed. Consequently, local species diversity increases with eutrophication. Too high a nutrient loading, however, is known to cause hypoxia and irreversible changes in communities. Nevertheless, such conditions are not met in the study area (Kotta *et al*. 2012).
Geographical relevance of indicator	2. Regional
How Reference Conditions (target values/thresholds) for the indicator were obtained?	Due to the lack of historical data of required spatial resolution and extent, the reference condition was set at the lower tail (5th percentile) of the natural variability of the index value in the MARMONI pilot area. This expert judgement is based on the current status of the marine coastal ecosystems and on the established probability distribution of the index value. According to these criteria the reference condition of ZKI index was set at 0.
Method for determining GES	GES was determined using the European *Union* Water Framework Directive classification scheme for water quality in the Estonian coastal areas. Specifically, among the eutrophication related variables water chlorophyll a was best related to the ZKI index. Thus, in order to set GES value, a functional relationship between pressure levels (e.g. chl a values) and index values was established (the BRT modelling). Then, the existing boundary of chl a between moderate and good water quality class was used to define the GES boundary of ZKI index. According to the established criteria the GES value of NFT index was 0.03.
References	Kotta, J., Lauringson, V., Kaasik, A., Kotta, I. 2012. Defining the coastal water quality in Estonia based on benthic invertebrate communities. Estonian Journal of Ecology, 61, 86–105. Lauringson, V., Kotta, J., Kersen, P., Leisk, Ü., Orav-Kotta, H., Kotta, I. 2012. Use case of biomass-based benthic invertebrate index for brackish waters in connection to climate and eutrophication. Ecological Indicators. 12, 123–132.
Illustrative material for indicator documentation	**Macrozoobenthos community index**  **Supplementary figure**. The Boosted Regression Tree model on the functional relationship between eutrophication variable and the index calculated at 5 km spatial scale. As a proxy of eutrophication we used the MODIS satellite derived water chlorophyll a values. The frequency of satellite observations was generally weekly over the whole ice-free period, however, several observations were discarded due to cloudiness. The spatial resolution of satellite data was 1 km. In general, increasing eutrophication is associated with elevated Chl a and Kd values in our study area.