LINKING ECOLOGY AND MANAGEMENT: DEFINING THE ECOLOGICAL STATUS OF COASTAL BRACKISH AREAS.

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The EU Water Framework Directive focuses on ecological quality elements (macrozoobenthos, aquatic flora, phytoplankton and fish) when classifying environmental status in coastal areas. This is an improvement from the former physico-chemical approach of classification but requires robust methods to distinguish different levels of ecological quality when classifying surface water areas. A new way of classifying soft-bottom macrozoobenthos along the Finnish coasts is presented. Although multivariate methods in assessing the state of the marine environment have become widely used, few indices can operate over a wide salinity range. We thus propose a new index, BBI (Brackish water Benthic Index)(Fig 1), for the low-saline and species-poor Baltic coastal waters (Bonsdorff 2006). By combining multiple parameters (species sensitivity classification and their relative abundance, diversity and species richness) into a single multivariate index, a reliable tool is available for environmental classification in softbottom benthic environments under the demands of the EU WFD.
Finnish coastal waters have been divided into 11 different types comprising inner and outer archipelago/sea areas in different geographical marine basins (Kangas et al. 2003, Perus et al. 2004)(Fig 2.). The typology, based upon the B-system under the WFD (Vuori et al. 2006), has been tested for ecological relevance and takes into account the biological characteristics of Finnish coastal areas (Perus et al. 2004). A proposal for how to classify different surface waters in coastal areas have been developed and preliminary boundaries for different ecological classes (High, Good, Moderate, Poor and Bad) have been set for the individual types and the different depth intervals (0-10m; 10+m) belonging to them. Boundary values for the classification are further validated by checking species richness, abundance, diversity values, and community composition of tolerant/sensitive species (Fig 3) against the

$$BBI = \frac{\left[\left(\frac{BQI}{BQI\max}\right) + \left(\frac{H'}{H'\max}\right)\right]}{2} * \frac{\left[\left(1 - \frac{1}{ABtot}\right) + \left(1 - \frac{1}{S}\right)\right]}{2}$$

Figure 1. BBI-index formulae. (BQI-index sensu Rosenberg et al. 2004; H' –Shannon-Wiener (log2-base); AB-Abundance and S-Species Richness)

defined criteria for high, good and moderate status in coastal waters described in Annex V of the WFD.

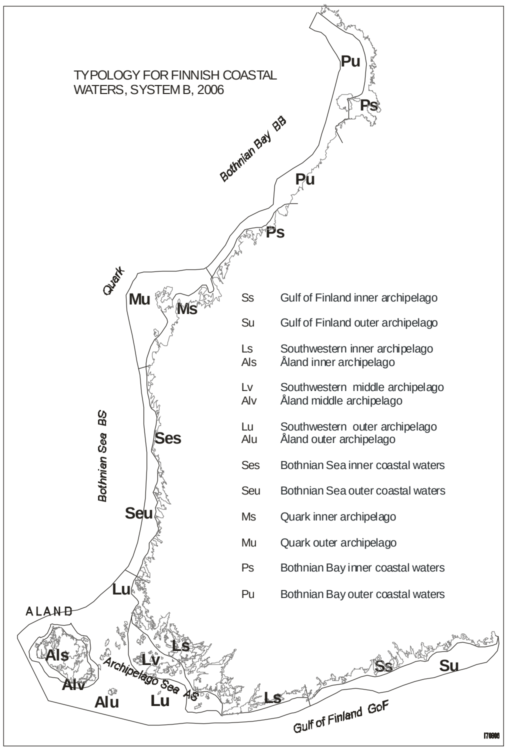

Figure 2. Map illustrating the Finnish coastal typology for the EU Water Framework Directive, containing 11 different types.

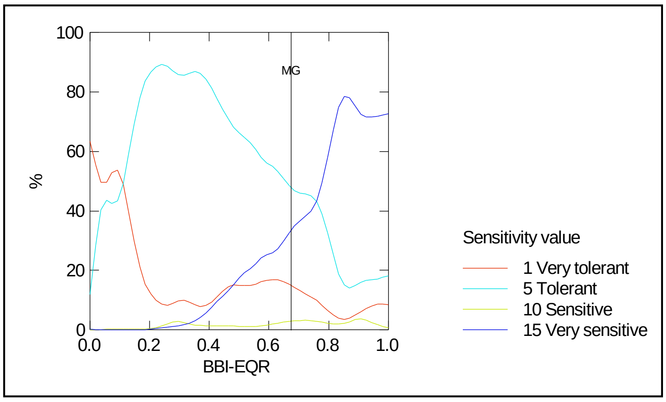

Figure 3.

Change in species composition as environmental quality improves in depth stratum 10+m in the outer archipelago type Lu. The proportion of species classified as very tolerant to stress (1, red line) dominate at low BBI-EQR, while species sensitive to stress (15, dark blue line) dominate at stations classified as “Good” or “High” status. Distribution shown by least square smoothing lines (DWLS, stiffness 0.5).).

References:

Kangas, P., Bäck, S., Kauppila, P. (eds.) 2003: Suggestions for a Typology of coastal waters for the Finnish coast according to the European Union Water framework directive (2000/60/EC) (in Finnish). Mimeograph series of Finnish Environment Institute 284. 51 pp. (In Finnish with English abstract)

Perus, J., Bäck, S., Lax, H-G., Westberg, V., Kauppila, P., Bonsdorff, E. 2004. Coastal marine zoobenthos as an ecological quality element: a test of environmental typology and the European Water Framework Directive. Coastline Reports 4, 27-38.

Rosenberg, R., Blomqvist, M., Nilsson, H. C., Cederwall, H., Dimming, A. 2004. Marine quality assessment by use of benthic species-abundance distributions: a proposed new protocol within the European Water Framework Directive. Mar. Poll. Bull. 49, 728-739.

Vuori, K.-M., Bäck, S., Helssten, S., Karjalainen, S. M., Kauppila, P., Lax, H-G., Lepistö, L., Londesborough, S., Mitikka, S., Niemelä, P., Niemi, J., Perus, J., Pietiläinen, O.-P., Pilke, A., Riihimäki, J., Rissanen, J., Tammi, J., Tolonen, K., Vehanen, T., Vuoristo, H., Westberg, V. 2006. The basis for typology and ecological classification of water bodies in Finland. The Finnish Environment 807. 151 pp. (in Finnish with English summary).

IMAGINE - Relevant publications 2006 - 15 Feb. 2007:

Arroyo, N. L., K. Aarnio & E. Bonsdorff, 2006: Drifting algae as a means of re-colonizing defaunated sediments in the Baltic Sea. A short-term microcosm study. - Hydrobiol. 554: 83-95.

Boero, F. & E. Bonsdorff, 2007: A conceptual framework for marine biodiversity and ecosystem functioning. - Mar. Ecol. - in press.

Bonsdorff, E. 2006: Zoobenthic diversity-gradients in the Baltic Sea: Continuous post-glacial succession in a stressed ecosystem - J. Exp. Mar. Biol. Ecol. 330: 383-391.

Boström, C., M. Lastuniemi & E. Bonsdorff, 2006: Infaunal responses to seagrass habitat structure: A study of life-history traits and population dynamics of Corophium volutator (Pallas). - Mar. Biol. Res. 2: 398-410.

Hewitt, J. E., S. F. Thrush, P. K. Dayton & E. Bonsdorff, 2007: The effect of spatial and temporal heterogeneity on the design and analysis of empirical studies of scale-dependent systems. - Am. Nat. 169: 398-408.

Holmström, N., I. Haahtela & E. Bonsdorff, 2007: A new reality for coastal zoobenthos: long-term (1958-2005) in a shallow sheltered bay. - Memoranda Soc. Fauna Flora Fennica 82: - in press.

Joas, M. & E. Bonsdorff, 2006: Itämeren ympäristön muuttuva hallinta ja tieteellinen tieto. - Vesitalous 2/2006 (Vol. XLVII): 6-9 (in Finnish).

Johansson, S., F. Wulff & E. Bonsdorff, 2007: The MARE research program 1999-2006 - reflections on program management. - Ambio 36 (2/3) - in press.

Karlson, K., E. Bonsdorff & R. Rosenberg, 2007: The impact of benthic macrofauna for nutrient fluxes from Baltic Sea sediments. - Ambio 36 (2/3) - in press.

Kraufvelin, P., A. T. Ruuskanen, N. Nappu & M. Kiirikki, 2007: Winter colonisation and succession of filamentous macroalgae on artificial substrates and possible relationships to Fucus vesiculosus settlement in early summer. - Est. Coast. Shelf.. Sci. - in press.

Nordström, M., E. Bonsdorff & S. Salovius: The impact of infauna (Nereis diversicolor and Saduria entomon) on the redistribution and biomass of macroalgae on marine soft bottoms. - J. Exp. mar. Biol. Ecol. 333: 58-70.

Norling, K., R. Rosenberg, S. Hulth, A. Grémare & E. Bonsdorff, 2007: The importance of functional biodiversity and species specific traits of benthic fauna for ecosystem functions in marine sediments. - Mar. Ecol. Progr. Ser. - in press.

Perus, J. E. Bonsdorff, S. Bäck, H.-G. Lax, A. Villnäs & V. Westberg, 2007: Zoobenthos as indicators of ecological status in coastal brackish waters: a comparative study from the Baltic Sea, - Ambio 36 (2/3) - in press.

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