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Are the Eastern and Western Basins of the English Channel two separate ecosystems? Get back in line with some cautionary comments

The European Marine Strategy Framework Directive (MSFD 2008/56/EC-17/06/2008) will be implemented in regions/subregions determined by their hydrology, oceanographic and biogeographic features. In this framework, Dauvin (2012) claimed that the English Channel (EC) is characterized by hydrologic, oceanographic and biogeographic features that support its division in two main ecosystems: the Western Basin (WBEC) and the Eastern Basin (EBEC). We think that this statement is controversial and that the conclusions drawn by Dauvin (2012) were not supported by the data presented, especially regarding the use of the term 'ecosystem'. We therefore re-evaluated this viewpoint with regard to the data and terminology used.

To reach his conclusion, Dauvin '*examined the similarities and differences between the basins*' based on a large table providing general characteristics of each 'basin' without any analysis. After this intuitive examination, the table '*indicates that the natural and human characteristics are very different for both of the basins of the EC, clearly distinguishing two different systems*'. We extracted data from Table 1 of Dauvin (2012) and computed the Gower dissimilarity (D_{gower}) for EBEC and WBEC. This coefficient was chosen because it allows the use of mixed variable types (quantitative, qualitative, categorical, binary) and missing values (Legendre and Legendre, 1998; Podani and Schmera, 2006). Significance was tested by permutation (999 distances calculated after randomly shuffling the data in the table; Manly, 1991). Three cases were considered, being (i) the entire data set, (ii) the 'ecosystem' based data i.e. oceanographic characteristics, superficial sediment type, biological components and most significant alien species, and (iii) human activities. In the first and second cases, $\underline{D}_{gower}$ was respectively, 0.66 and 0.50, non significant at the 0.05 level in both cases. A significant difference, however, was observed for human activities between EBEC and WBEC, with $D_{gower} = 0.85$ ($p < 0.05$). Therefore, with the data provided and used by Dauvin (2012) in his viewpoint, these two areas cannot be separated neither from on an ecological nor a biogeographical base. However, human activities appeared to be different between the two zones considered.

Following Dauvin (2012), '*the functional observations show that the two basins of the EC correspond to two different ecosystems*'. This is a speculation that is not supported by the data provided by the author. Trying to discriminate between two ecosystems with so little accurate data does not even fulfil the information required for the basic definition of an ecosystem, i.e. 'a community or a series of communities and the surrounding physical and chemical environment' following Nybakken (1997) or 'a community and the nonliving environment function together as an ecological system or ecosystem' *sensu* Odum (1971). As widely now recognized (Levin, 1999, 2003; Frontier et al., 2008), ecosystems are complex adaptive systems in which macroscopic dynamics emerge from numerous nonlinear interactions at both the smaller and larger hierarchical (spatio-temporal) scales. Analysing the English Channel in this context would be the only one that could lead to a functional conclusion, if any.

Most of the biogeographical analysis presented by Dauvin (2012) were essentially based on Cabioch et al. (1977), interpreting a survey from the 1972–1976 period (concerning only macrobenthic sessile epifauna). However, more recent results are currently available (only one of them was used by Dauvin (2012) for an area of the central Channel) and should have been discussed to take into account the spatio-temporal evolution of the fauna (potential 'biogeographical shifts') linked, for instance, to climate change (e.g. Lindley et al., 2010). These changes (not only '*challenges for the future*') may cause trophic amplification in ecosystems on short time scales (e.g. pelagic birds: Luczak et al., 2011) and thus lead to the establishment of a new ecosystem dynamic regime through internal reorganisation.

As there is a huge amount of literature focusing on marine biogeography/bioregionalization including the EC (e.g. Arvanitidis et al., 2009; Longhurst, 2007; Spalding et al., 2007; Beaugrand et al., 2000), even a viewpoint should present the most complete literature synthesis on the topic. For instance, in the English Channel, Beaugrand et al. (2000) defined three zones characterized after their similar biological composition and their seasonal and interannual evolution (1979–1995) in plankton communities: the first zone corresponds to EBEC, the next to WBEC and the third is the Ushant front. Arvanitidis et al. (2009) examined whether biogeographical/managerial division across the European seas – i.e. OSPAR, IHO, Longhurst (2007), ICES, LME – could be validated using soft-bottom macrobenthic data. They found that the only marine biogeographic system supported by the analysis was the one proposed by Longhurst (2007), even if this partition was developed to interpret plankton multi-species distribution patterns as a function of regional oceanographic characteristics. These results suggested a strong bentho-pelagic coupling. Following Longhurst (2007), the EC is the area from the Strait of Dover west to Ushant and belongs to the Atlantic coastal biome and the Northeast Atlantic shelves province (NECS). This province runs from Cape Finisterre to Southern Norway. Spalding et al. (2007) proposed a global nested system for coastal and shelf areas: the Marine Ecoregions of the World (MEOW). In this classification, EBEC belongs to the North Sea ecoregion, WBEC to the Celtic seas ecoregion, with a boundary between EBEC and WBEC close to the one proposed by Dauvin (2012): Cotentin peninsula – Dorset. This brief overview of some of the published items highlighted some discrepancies but also some convergence with Dauvin's proposal but are overall in contradiction with Dauvin's statement that apart from macrobenthos, '*biological component are more homogeneous on the scale of EC*' (note that this statement itself *de facto* eliminates the potential existence of two ecosystems). As the author wrote that

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'*the Channel can be defined as a biogeographical transition zone because located between the lusitanian and boreal provinces*', the fundamental ecological and biogeographical statement that should be investigated is thus 'is the EC an ecotone?'.

In conclusion, EBEC and WBEC are far from being clearly distinguished with Dauvin's viewpoint. Classifying ecologically relevant marine zones, even considering only the seafloor, needs a statistical approach (e.g. Verfaillie et al., 2009). An in depth analysis of these complex systems with more complete and robust data is thus needed to rigorously answer the question from an ecological and biogeographical perspective. In this context results will enable appropriate subdivision and ecosystem-based management to be set in place. From Dauvin's paper and our subsequent analysis of his Table 1, it is however clear that WBEC and EBEC are exposed to different anthropogenic pressures and should thus probably be considered as two different 'regions' for their management (including in the MSFD). However, even for management, the terminology is important and these regions should not be named 'ecosystems'.

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