



Estimation of Effect Factors for application to marine eutrophication in LCIA

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274 Estimation of Effect Factors for application to marine

eutrophication in LCIA N. Cosme, Technical University of Denmark DTU / DTUMAN QSA; M.Z. Hauschild, Technical University of Denmark / Department of Management Engineering. Marine eutrophication is defined as the set of ecosystem responses to nutrient loadings in the photic zone of marine waters. The nutrients enrichment boosts primary production and subsequent degradation of this organic matter by heterotrophic bacteria in bottom waters results in the consumption of dissolved oxygen (DO). Impacts to ecosystems health and local economy may rise from changed communities' composition, species interaction, decrease of water quality and depleted DO in bottom waters down to hypoxic or anoxic levels that may affect the survival of benthic species. The impacts of hypoxia on biota depend on the severity, frequency and duration of the exposure to low DO, and both acute and chronic effects can be expected. Exposure to extreme or prolonged hypoxia leads to mass mortalities, but hypoxia also induces many different sub-lethal responses in organisms at the behavioural, physiological and ecological levels. The geographical distribution of relevant benthic, demersal, or benthopelagic species (n=58), available from a dataset of sensitivities of individual species to hypoxia, was found. These were grouped into 5 climate zones - polar, subpolar, temperate, subtropical, and tropical. Species Sensitivity Distribution (SSD) curves were produced to estimate the Potentially Affected Fraction of species (PAF) at different levels of DO. For the application in Life Cycle Impact Assessment (LCIA), the distribution of the sensitivities of individual species to hypoxia is used to estimate the sensitivity to low DO levels of the communities found in each climate zone. The distribution is used to estimate the HC50, i.e. the concentration of DO (intensity of the stressor) affecting 50% of the species above their EC50 level. Characterisation Factors (CF) are used in LCIA to convert emissions and resources consumed into impact potentials for specific impact categories. The CF integrates the Fate Factor (FF), the habitat Exposure Factor (XF), and the Effect Factor (EF). The EF expresses the change of effect due to a variation of the stressor intensity and it is calculated by $EF = \frac{PAF}{([O_2] - 0.5)/HC50}$, in accordance to the average gradient method. Preliminary EF results were produced for the 5 climate zones together with a global default. The spatial differentiation obtained for the EF results was found essential to increase the discriminatory power of the model. This approach will be combined with a suitable methodology for the FF and XF.