The effects of anthropogenic stressors on the food quality in estuarine systems

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During the last decades discharge of contaminants is one of the high concerns to the marine scientific community of the threat and adverse effects it may cause in aquatic ecosystems (McKnight *et al.*, 2012). Little is known about how natural ecosystems respond to chronic exposure to pollutants, many of which, especially metals, are non-degradable and therefore accumulate in nature. Anthropogenic pressures often decrease the health and stability of ecosystems, although the precise effects of these stressors on the biochemical components of living organisms and their interactions remain largely unknown (Gonçalves *et al.*, 2012 a; Holliday *et al.*, 2009). Despite the extensive literature on anthropogenic pressures, a more functional approach to trace changes in food webs due to the modified biochemical composition of interacting species is lacking so far.
Nutrients, mainly lipids and proteins, are involved in many vital functions of aquatic individuals (Arts *et al.*, 2001; Hibbeln *et al.*, 2006; SanGiovanni and Chew 2005; Teilum *et al.*, 2011). Since some of them can only be obtained from food and therefore referred to as 'essential nutrients', they proved to be useful trophic markers (De Troch *et al.*, 2012, Kelly and Scheibling, 2012) in order to detect changes in the efficience of energy transfer between trophic levels. Trophic biomarkers as fatty acid (FA) profiles, protein quantification and enzymatic activity will be used to test for potential effects of pollutants as stressors on the energy flow between two trophic levels i.e. primary producers and primary consumers. Integrating multiple specific biomarkers to assess biochemical responses of estuarine species provides a powerful tool to quantify the health status of an individual in response to anthropogenic stressors (Masclaux *et al.*, 2012).
This Mares PhD study (2014-2016) aims to address the influence of human-induced environmental changes on functional (biochemical, in relation to food web interactions) composition of two main estuarine planktonic groups in a southern European estuary (e.g. Mondego Estuary, Portugal) by means of (trophic) biomarkers.
We will focus on phytoplankton and zooplankton as they are widely used in the determination of environmental impacts due to their key position in the grazing food chain (Gonçalves *et al.*, 2012 a, b, c). Two main representatives of both trophic levels (key species as e.g. the diatom *Thalassiosira weissflogii* and the copepod *Acartia tonsa*) will be used to constitute a simple trophic food chain under lab conditions.
Copper and herbicide Primextra® Gold TZ will be used as contaminants. The assessment will include individual exposure of toxicants and their bifactorial combinations as well. This will allow to conduct controlled lab experiments in order to determine and quantify the individual and combined effects of anthropogenic stressors.
According to experimental data about toxicity acquired in this project, along with other data from literature, an ecotoxicological model based on biochemical composition of estuarine species will be built in collaboration with Prof. Dr. Frederik De Laender (University of Namur, Belgium). This model aims to predict potential changes in aquatic food web, and thus in food quality, caused by anthropogenic activities, and to determine the level and type of pollution in estuarine systems susceptible of causing changes in species' biochemical composition.

References

Arts M.T., R.G. Ackman and B.J. Holub. 2001. 'Essential fatty acids' in aquatic ecosystems: a crucial link between diet and human health and evolution. Canadian Journal of Fisheries and Aquatic Sciences 58:122 – 137.

De Troch M., P. Boeckx, C. Cnudde, D. Van Gansbeke, A. Vanreusel, M. Vincx and M.J. Caramujo. 2012. Bioconversion of fatty acids at the basis of marine food webs: insights from a compound-specific stable isotope analysis. Marine Ecology Progress Series 465:53-67.

Gonçalves A.M.M., U.M. Azeiteiro, M.A. Pardal and M. De Troch. 2012a. Fatty acid profiling reveals seasonal and spatial shifts in zooplankton diet in a temperate estuary. Estuarine, Coastal and Shelf Science 109:70-80.

Gonçalves A.M.M., M.A. Pardal, S.C. Marques., S. Mendes, M.J. Fernández- Gómez, M.P. Galindo-Villardón, U.M. Azeiteiro. 2012b. Diel vertical behavior of Copepoda community (naupliar, copepodites and adults) at the boundary of a temperate estuary and coastal waters. Estuarine, Coastal and Shelf Science 98:16–30.

Gonçalves A.M.M., M.A. Pardal, S.C. Marques, S. Mendes, .M.J. Fernández- Gómez, M.P. Galindo-Villardón, U.M. Azeiteiro. 2012c. Responses of Copepoda life-history stages to climatic variability in a southern-European temperate estuary. Zoological Studies 51(3):321-335.

Hibbeln J.R., T.A. Ferguson and T.L. Blasbalg. 2006. Omega-3 fatty acid deficiencies in neurodevelopment, aggression and autonomic dysregulation: opportunities for intervention. International Review of Psychiatry 18:107–118.

Holliday D.K., A.A. Elskus and W.M. Roosenburg. 2009. Impacts of multiple stressors on growth and metabolic rate of Malaclemys terrapin. Environmental Toxicology and Chemistry 28:338-345.

Kelly J.R. and R.E. Scheibling. 2012. Fatty acids as dietary tracers in benthic food webs. Marine Ecology Progress Series 446:1-22.

Masclaux H., A. Bec, M.J. Kainz, F. Perrière, C. Desvilettes and G. Bourdier. 2012. Accumulation of polyunsaturated fatty acids by cladocerans: effects of taxonomy, temperature and food. Freshwater Biology 57: 696-703.

McKnight U.S., J.J. Rasmussen, B. Kronvang, P.L. Bjerg and P.J. Binning. 2012. Integrated assessment of the impact of chemical stressors on surface water ecosystems. Science of the Total Environment 427-428:319-331.

SanGiovanni J.P. and E.Y. Chew. 2005. The role of omega-3 long-chain polyunsaturated fatty acids in health and disease of the retina. Progress in Retinal and Eye Research 24:87–138.

Teilum K., J.G. Olsen and B.B. Kragehund. 2011. Protein stability, flexibility and function. Biochimica et Biophysica Acta 1814:969 – 976.