Living in multi-stressed sediments: behavioral consequences for the functioning and diversity in coastal habitats

Ong Ee Zin[1], Tom Moens[1], Mark Briffa[2], and Carl Van Colen[1]

[1] Department of Biology, Marine Biology Section, Ghent University, Ghent, Belgium
E-mail: EeZin.Ong@UGent.be

[2] Marine Biology & Ecology Research Centre, School of Marine Science & Engineering, Plymouth University, Plymouth, UK

Shallow coastal habitats and estuaries provide a number of important ecosystem services and functions and are therefore considered to be of high ecological and socio-economic value. However, these crucial habitats are worldwide impacted by multiple stressors that alter the delivered critical ecosystem benefits or services. In the interest to assess how shallow coastal ecosystems respond to climatic and non-climatic stressors, it is essential to understand the dynamics and functioning of species populations within the ecosystem; specifically, how these processes and patterns are affected by various degrees of interactive stressors. Marine organisms carry out crucial behavioural activities, for example, foraging, avoiding predation and competing with others. Any stressor or environmental change that is able to induce disruption of behavioural processes has the potential to influence individual fitness and ultimately will affect community dynamics and coupled ecosystem functioning (Thrush *et al*., 2009). This project experimentally investigates the behavioural response of benthic key species to different degrees of multiple interactive stressors: hypoxia, warming and acidification of seawater; and how these responses affect the functioning and diversity of coastal ecosystems. Behaviour of benthic key species such as sediment reworking, siphon activity, sediment plume production and manoeuvring (Townsend *et al.,* 2014) as well as predator avoidance (Maire *et al*., 2010) will be documented by using time lapse cameras and non-destructive pressure sensors to capture the hydraulic activities of the benthic organisms in pressure wave-forms within the sediment pore water (Woodin *et al.,* 2010). Images and hydraulic pressure signals collected from both methods will be synchronised and analysed in order to identify activities carried out by the benthic species in surface and subsurface of sediment. Furthermore, the physiological responses of benthic macrofauna will be recorded. For example, respiration rate will be measured using Pyroscience sensor technology, feeding rate will be measured using a Coulter Multisizer to obtain the cell concentrations and the feeding rate will be derived from these cell concentrations using mathematical formula (Iglesias *et al*., 1996). Moreover, biodeposition rate, clearance rate and absorption efficiency will be calculated using mathematical formula (Iglesias *et al*., 1996; Norkko *et al*., 2005) and calcification rate will be measured with the alkalinity anomaly technique (Gazeau *et al*., 2007). In addition, ecosystem processes and properties mediated by of these benthic study species will be measured; for example fluxes of oxygen and nutrient across the sediment-water interface using closed corer incubations and benthic community composition using corers for sediment extraction (Thrush *et al*., 2006).

References

Gazeau Frederic, Christophe Quiblier, Jeroen M. Jansen, Jean Pierre Gattuso, Jack J. Middelburg, and Carlo H.R. Heip. 2007. Impact of elevated CO2 on shellfish calcification. Geophysical Research Letters 34(7).

Iglesias J.I.P., M.B. Urrutia, E. Navarro, P. Alvarez-Jorna, X. Larretxea, S. Bougrier, and M. Héral. 1996. Variability of feeding processes in the cockle *Cerastoderma edule* (L.) in response to changes in seston concentration and composition. Journal of Experimental Marine Biology and Ecology 197(1):121-143.

Maire O., J.N. Merchant, M. Bulling, L.R. Teal, A. Grémare, J.C. Duchêne, and Martin Solan. 2010. Indirect effects of non-lethal predation on bivalve activity and sediment reworking. Journal of Experimental Marine Biology and Ecology 395(1):30-36.

Norkko J., C.A. Pilditch, S.F. Thrush, and R.M.G. Wells. 2005. Effects of food availability and hypoxia on bivalves: the value of using multiple parameters to measure bivalve condition in environmental studies. Marine Ecology Progress Series 298:205-218.

Thrush Simon F., Judi E. Hewitt, Max Gibbs, Carolyn Lundquist, and Alf Norkko. 2006. Functional role of large organisms in intertidal communities: community effects and ecosystem function. Ecosystems 9 (6):1029-1040.

Thrush Simon F., Judi E. Hewitt, Paul K. Dayton, Giovanni Coco, Andrew M. Lohrer, Alf Norkko, Joanna Norkko, and Mariachiara Chiantore. 2009. Forecasting the limits of resilience: integrating empirical research with theory. Proceedings of the Royal Society B: Biological Sciences: rspb20090661.

Townsend Michael, Simon F. Thrush, Judi E. Hewitt, Andrew M. Lohrer, Lisa Mccartain. 2014. Behavioural changes in the Tellinid bivalve *Macomona liliana* (Iredale, 1915) following exposure to a thin terrigenous sediment deposition event: evidence from time-lapse photography. Cahiers de Biologie Marine 55: 475-483.

Woodin Sarah Ann, S. Wethey David, and Nils Volkenborn. 2010. Infaunal hydraulic ecosystem engineers: cast of characters and impacts. Integrative and Comparative Biology 50(2):176-187.