**Anticipating global tipping points using ecological indicators: climate change, eutrophication and chemical pollution**

BRANQUINHO1\* C., MUNZI1 S., PINHO1,2 P., AUGUSTO1,3 S., CRUZ de CARVALHO1 R., MATOS1,4 P., NUNES A.1,4, BARROS C.1,5

*1 Centro de Biologia Vegetal, Faculdade de Ciências da Universidade de Lisboa, Campo Grande Lisboa, Portugal.*

*2 CERENA, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal.*

*3 TECNATOX group, Chemical Engineering Department, Universitat Rovira i Virgili, Tarragona, Spain*

*4 CESAM-Centre for Environmental and Marine Studies, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal*

*5 Laboratoire d'Ecologie Alpine, UMR CNRS 5553, Université Joseph Fourier, Grenoble, France*

Contact: [cmbranquinho@fc.ul.pt](mailto:cmbranquinho@fc.ul.pt) <mailto:youremial@gmail.com>

As a result of human activities and climate change, ecosystems are experiencing changes from local to global scales. The high impact of these changes leads to the proposal of a new era –Anthropocene. Scientists have been attempting to quantify environmental, economic and social limits to human activities on Earth. On a global change framework some authors analyzed the safety of 9 planetary systems (variables of high importance to global habitability) and concluded that the rate of climate change and eutrophication already crossed the safety boundaries of the earth system, whereas chemical pollution, albeit important, has not yet been quantified. Ecosystems have critical thresholds, the so-called tipping points, at which the system changes abruptly to an alternative state. Once that threshold is crossed, a switch back to the initial state of the system may be impossible leading to losses in biodiversity, ecosystem services and human well-being. These tipping points are extremely difficult to forecast, thus reliance on early-warning signals indicating the imminence of a critical threshold is key. The first signs of ecosystem response to global change drivers are either too small or too complex to be measured by conventional means. Moreover, it is not possible to predict the integrated effect of multiple variables acting on the ecosystem just relying on the driver’s measure. Therefore, it is proposed to use measurable and integrated ecological surrogates of the structure, composition and function of ecosystems, named ecological indicators. In a global change framework it is critical to compare the impact of global environmental policies worldwide, in order to support the 3 United Nations (UN) conventions: biodiversity, climate change and desertification. The underlying conceptual hypothesis is that it is possible to identify and develop integrated EI of the effects of global change drivers (climate change, eutrophication and chemical pollution) on ecosystem structure and function. Those ecological indicators should have early-warning potential and be as universal as possible. Thus, it will be possible to track global changes in a comparable way (worldwide) predicting and developing strategies to steer away from thresholds.

Acknowledgements to FCT-MEC for: PTDC/AAC-CLI/104913/2008, SFRH/BPD/75425/2010, SFRH/BD/51407/2011, SFRH/BD/51419/2011 and Investigador FCT contract.