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USE OF EXERGY TO DETECT AND MEASURE PERTURBATIONS AFFECTING *POSIDONIA OCEANICA* (L.) DELILE MEADOWS: CHARACTERIZATION IN THE SEDIMENTARY COMPARTMENT

Abstract
Within the scope of the European Water Framework Directive, it seems important to characterize state and evolution of marine ecosystems in a global way. So, it is proposed to use both thermodynamic indicators called exergy (Ex) and specific exergy (Ex_{sp}) in Posidonia oceanica *meadows. Aims of this project are to detect and measure perturbations owed to nutrients loading and mechanical spoiling in the Mediterranean coastal zone. It will be led in the Bay of Calvi, on the microbenthic loop (organic matter, bacteria, microphytobenthos and meiofauna) and will be divided in two parts: sampling in different zone of the meadow and* in situ *experiments. In the end of this study, it will be possible to give a diagnostic on the health of* P. oceanica *meadow and to determine how this health will evolve, thanks to the introduction of the exergy in a model.*

Key-words: exergy, microbenthic loop, nutrients, *Posidonia oceanica*, Mediterranean Sea.

Introduction:

Within the scope of the European Water Framework Directive, it is important to characterize state and evolution of marine ecosystems in a global way. To estimate the integrity of the Mediterranean coastal zone, it is proposed to use exergy (Ex) and specific exergy (Ex_{sp}) in *Posidonia oceanica* meadows. Those concepts come from thermodynamics and give an estimation of the distance between an ecosystem at a given state and thermodynamic equilibrium, which correspond to an inorganic soup (Jørgensen *et al.*, 2005a). Thus, the more an ecosystem is organised and close to climax state, the farer from this equilibrium it will be and the higher exergy it will present.
The exergy index (Ex) is a good measure of the capacity of an ecosystem to move closer or away form climax state. It is formulated by: $Ex = \sum_{i}^{n} \beta_i . C_i$, where β_i is a weighting factor which gives a specific weight to each *i*th group of organisms of the ecosystem, and where C_i is the biomass of each *i*th group. The factor β is an estimation of the quantity of information present in the biomass and corresponds to a measure of the complexity of this biomass (De Wit, 2006; Jørgensen *et al.*, 2005b).
Specific exergy (Ex_{sp}) takes into account the way of an ecosystem uses available resources, independently of their quantity, *i.e.* exergy divided by the total biomass of the ecosystem (Marques *et al.*, 2003).

In this project, those indicators will be calculated for the microbenthic loop (organic matter, microphytobenthos, meiofauna and bacteria) of *P. oceanica* meadows because it is one of the most important sub-system in the marine environment and because it reacts quickly to perturbations.
Aims of this project are to elaborate and validate a new method, based on exergy, to detect and measure effects of perturbations owed to nutrients loading and mechanical spoiling in the Mediterranean coastal zone.

Material and methods

This project takes place in the Bay of Calvi, Corsica, France. Samples will be taken in different zone of the Bay: the oceanographic station STARESO (10 m), STARESO (20 m), Alga Beach (10 m), Calvi fish farm (20 m), Calvi sewage (20 m) and *in situ* experiments (nutrients enrichment, transplantation, pulling out of shoots) will also be led in STARESO, at 10 m depth.

At each site, sediment cores will be taken in March, June and November to determine biomasses of every parts of the microbenthic loop (Gambi & Dappiano, 2004) and to calculate different diversity index (Jørgensen *et al.*, 2005a). Other cores will be taken to determine sediment granulometry and redox potential. Nutrients content of interstitial water will be quantify (Gobert, 2002) and the density of the meadow will be estimated too (Soullard *et al.*, 1994).

Ex and Ex_{sp} will be calculated using β factors coming from Jørgensen (2005b) and results will be compared with diversity index. Correlations will also be established with all the environmental parameters in order to qualify their influence on Ex and Ex_{sp}.

Expectations

At the end of this study, it will be possible to give a diagnostic on the health of a *P. oceanica* meadow and to determine how this health will probably evolve, thanks to the introduction of exergy in a model.

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