Integrated management of coastal ecosystems: a new approach

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Introduction

- ✓European Union legal frameworks (WFD-MSFD) for the protection and conservation of environments and wetlands do not take into account genetic diversity

- ✓No tools have been used on this direction

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 23 October 2000
establishing a framework for Community action in the field of water policy

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 17 June 2008
establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

Introduction

✓ Ecosystems' ecological quality is being assessed from a macrobenthic perspective

✓ Ecological quality assessment by means of biodiversity indices

BQI-family
BQI-species
Δ+
M-AMBI
H'
$BENTIX_{family}$
BENTIX
Δ+
ES(10)
BOPA

Introduction

✓Microorganisms are generally overlooked and not being taken into account

✓They drive biogeochemical processes that are critical for maintaining the planet in a habitable state

✓Need to understand the genetic basis of marine microbial biogeochemistry and ocean processes

Introduction

- ✓It is only recently that both phylogenetic and biological functional inventories have begun to be integrated in ways which can enable the main biological processes within a whole ecosystem to be inferred

- ✓Need to move from the description of organisms to functional analysis

Lagoons

- ✓ Shallow
- ✓ Spatial and temporal fluctuating conditions
- ✓ Variety of habitats
- ✓ Dystrophic crises
- ✓ Human activities
- ✓ Small number of tolerant species

Lagoons of Amvrakikos Gulf

- ✓ Protected by Ramsar convention
- ✓ Aquaculture activities
- ✓ Dystrophic crisis events

The approach

✓Burrowing polychaetes may influence significantly the bacterial sediment communities through changes in oxygenation and redox potential of surficial and burrow-lining sediments

✓The available surface area for diffusive exchange between anoxic pore-water and the overlying water is augmented, creating new surfaces for microbial colonization at the oxic-anoxic interface

✓Bacterial biofilms can either inhibit or induce larval settlement of polychaetes

The approach

✓Hypoxic conditions
✓High concentrations of hydrogen sulfide

→ Sulfate-reducing bacteria (*dsr* gene)

✓Burrower
✓Abundant species
✓Haplotypic distribution patterns correlated to the sediment redox changes

→ *Nephtys hombergii* (*COI* gene)

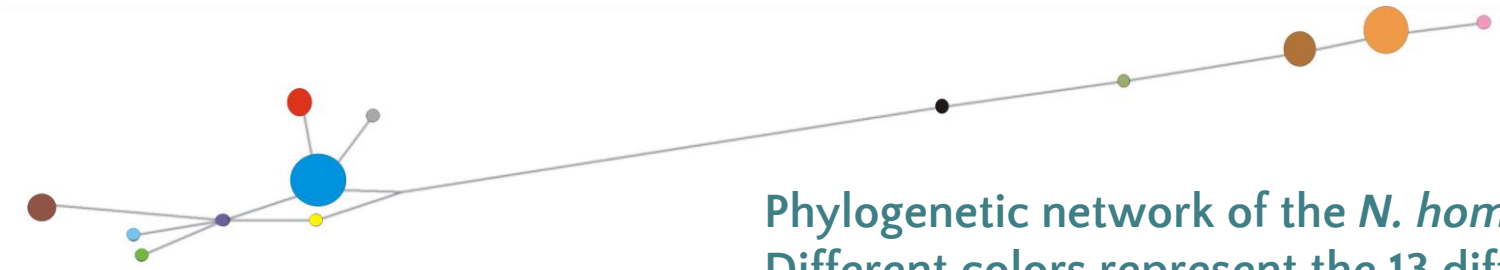
The method

A combination of the different levels of biological diversity has been attempted taking into consideration the non-random co-occurrence of certain taxa,
whether this may refer to species, haplotypes or OTUs.

- ✓ The C-score index (EcoSimR package)
  → to quantify patterns of taxa co-occurrence

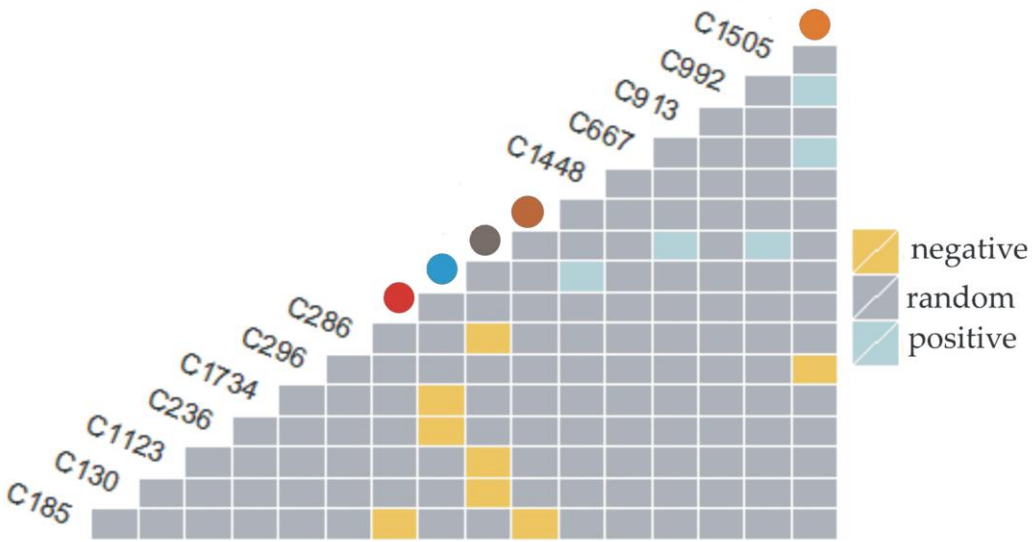
- ✓ Triangular taxa co-occurrence matrix (cooccur package)

Results

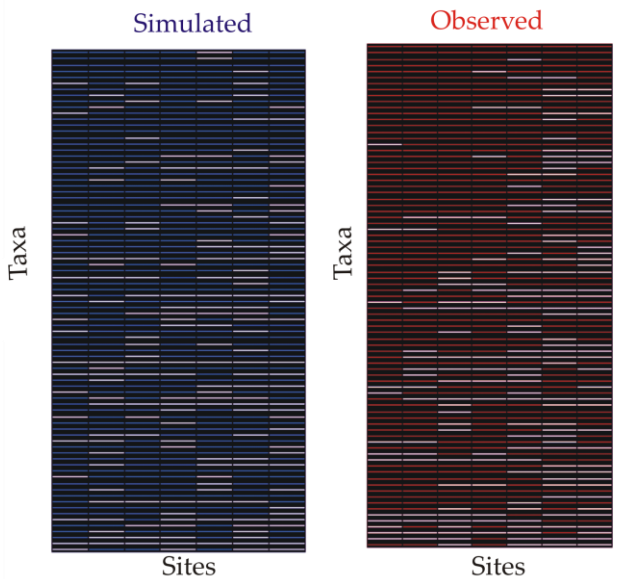


Phylogenetic network of the *N. hombergii*
Different colors represent the 13 different haplotypes

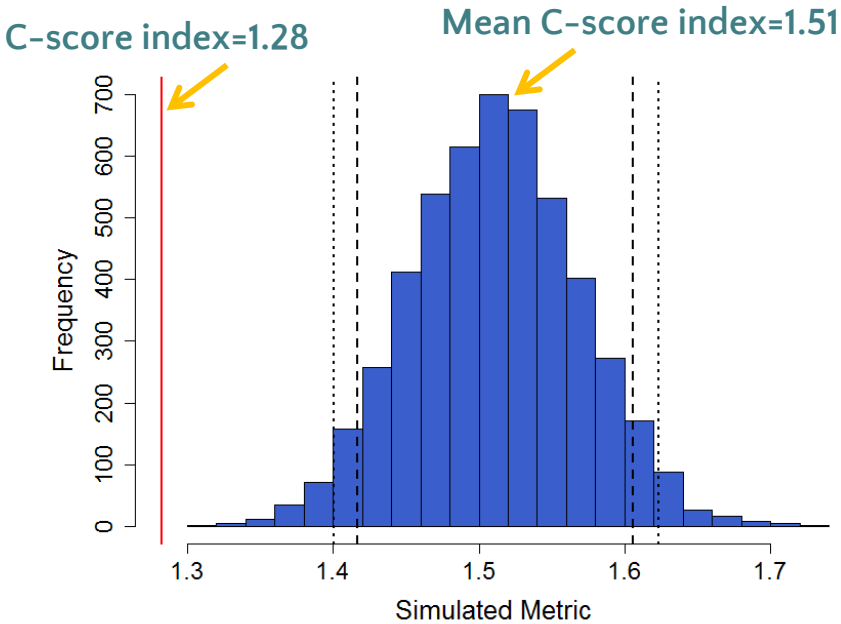
Taxa co-occurrence matrix of the significantly important interrelations (P<0.05)
Colored circles represent the haplotypes
The codes represent different bacteria OTUs



Results - C-score index analysis



The matrices show the taxa occurrence per site. On the left is the simulated pattern representing the occurrences by chance, while on the right the pattern from the observed data is shown.



The bar graph shows the values of the C-score index by the simulated data, dashed lines represent the standard deviation, while the red line shows the index value from the observed data (P-value < 0.01)

Conclusions

✓Significantly lower value of the observed C-score vs the simulated one shows that the taxa are not distributed by chance among the sites but the assemblages are structured based on organisms co-occurrence

✓Some of the polychaete haplotypes seem to co-occur with specific bacteria OTUs, while other haplotypes do not appear to co-exist with certain OTUs

Conclusions

✓The analysis infers that haplotypic distribution is interrelated to the bacterial functional diversity

✓The macro-environmental conditions formed by the sulfate-reducing bacterial activity may play a role on the intra-specific diversity structure

✓The haplotypic patterns appear to be shaped rather by adapting to the habitat, defined by bacterial exertion, than by chance

Conclusions

✓ Positive co-occurrence may prove to be an important stepping stone towards a more holistic management of such ecosystems

✓ Such an approach could provide more insight in the conservation of vulnerable ecosystems relative to the functional diversity of the taxa

LIFE WATCH GREECE

Thank you

Φορέας Διαχείρισης
Υγροτόπων Αμβρακικού
Amvrakikos Management Body