14th PROCEEDINGS of the ICZEGAR

International
Congress on the
Zoogeography and
Ecology of
Greece and
Adjacent
Regions

27-30 JUNE 2019
THESSALONIKI, GREECE

Assessment of the physiological response of the bath sponge *Spongia officinalis* to elevated temperature conditions through differential gene expression

Vasiliki Koutsouveli[1,2], Tereza Manousaki[1], Ana Riesgo[2], Jacques Lagnel[1,3], Spyros Kollias[4], Costas S. Tsigenopoulos[1], Christos Arvanitidis[1], Costas Dounas[1], Antonios Magoulas[1], Thanos Dailianis[1]*

[1] *Institute of Marine Biology, Biotechnology & Aquaculture, Hellenic Centre for Marine Research, Heraklion, Greece*
[2] *Life Sciences Department, Natural History Museum of London, UK*
[3] *INRA PACA, Montfavet Cedex, France*
[4] *Centre for Ecological and Evolutionary Synthesis, University of Oslo, Norway*
E-mail: thanosd@hcmr.gr

The Mediterranean bath sponge *Spongia officinalis* is currently threatened by recurrent mortality incidents in its native habitats. Although elevated temperature has been indicated as the underlying factor triggering these events, the molecular mechanisms involved in the organism's response to thermal stress are not yet described. We experimentally tested the effect of exposure to temperatures of varying intensity and span on the species' gene expression profile, replicating thermal gradients encountered in coastal habitats of the Eastern Mediterranean. *De novo* transcriptome assembly was performed on data produced by an Illumina HiSeq next-generation sequencing (NGS) platform and gene expression analysis was conducted among the different experimental conditions. Our analysis revealed major shifts in the organism's transcriptomic profile induced by temperatures corresponding to the standard seasonal maximum (27°C), triggering processes related to signal transduction and response to stimulus. Further elevation of temperature corresponding to local extremes (30°C) activated additional processes, including immune response and apoptosis. However, following prolonged exposure to the extreme temperature, signs of resilience were observed through overexpression of regular cellular functions. Our results highlight the generally recognized sensitivity of *S. officinalis* to environmental shifts, providing an insight into the molecular mechanisms involved in the process. Furthermore, they suggest an innate capacity for thermal tolerance at the current extremes, implying a combination of factors and not solely temperature as the lethal agent. This sheds light on the mechanisms of pressure induced by ocean warming to its most sensitive receptors, coastal sessile invertebrates.
This research was funded by the action "Reinforcement of Postdoctoral Researchers" of the operational programme "Human Resources Development, Education and Life Lifelong Learning" and was co-financed by the European Social Fund (ESF) and the Hellenic Republic.

Keywords: ecology, marine, climate change, transcriptomics, Porifera

Assessment of the physiological response of the bath sponge Spongia officinalis to elevated temperature conditions through differential gene expression

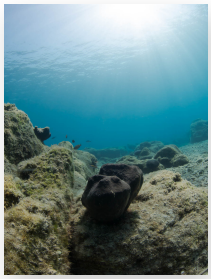
Koutsouveli V[1,2], Manousaki T[1], Riesgo A[2], Lagnel J[1,3], Kollias S[4], Tsigenopoulos CS[1], Arvanitidis C[1], Dounas C[1], Magoulas A[1], **Dailianis T[1*]**

1 Institute of Marine Biology, Biotechnology & Aquaculture, Hellenic Centre for Marine Research, Heraklion, Greece
2 Life Sciences Department, Natural History Museum of London, UK
3 INRA PACA, Montfavet Cedex, France
4. Norwegian Sequencing Centre, Centre for Ecological and Evolutionary Synthesis, University of Oslo, Norway

14th ICZEGAR 27-30 JUNE 2019, THESSALONIKI, GREECE

1. An imperilled species in a warming Mediterranean

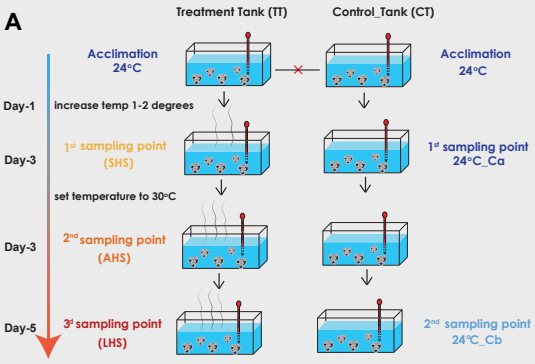
The Mediterranean bath sponge *Spongia officinalis* is threatened by recurrent mortality incidents in its native habitats. Although elevated temperature has been indicated as the underlying factor triggering these events, the molecular mechanisms involved in the organism's response to thermal stress are not yet described.



© Thanos Dailianis

2. Experimental design

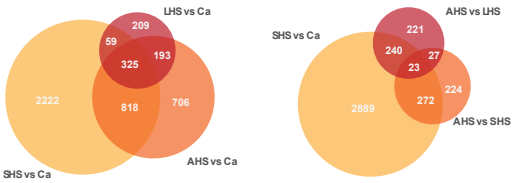
We tested the effect of exposure to temperatures of varying intensity and span on the species' gene expression profile, replicating thermal gradients currently prevailing in coastal habitats of the Eastern Mediterranean.



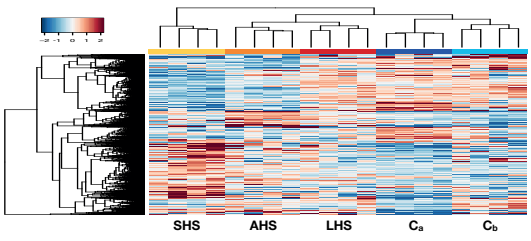
SHS: Short-term Heat Shock | AHS: Acute Heat Shock | LHS: Long-term heat shock

3. Transcriptome reconstruction

De novo transcriptome assembly was performed on data produced by an Illumina HiSeq™ next-generation sequencing (NGS) platform and gene expression analysis was conducted among the different experimental conditions.



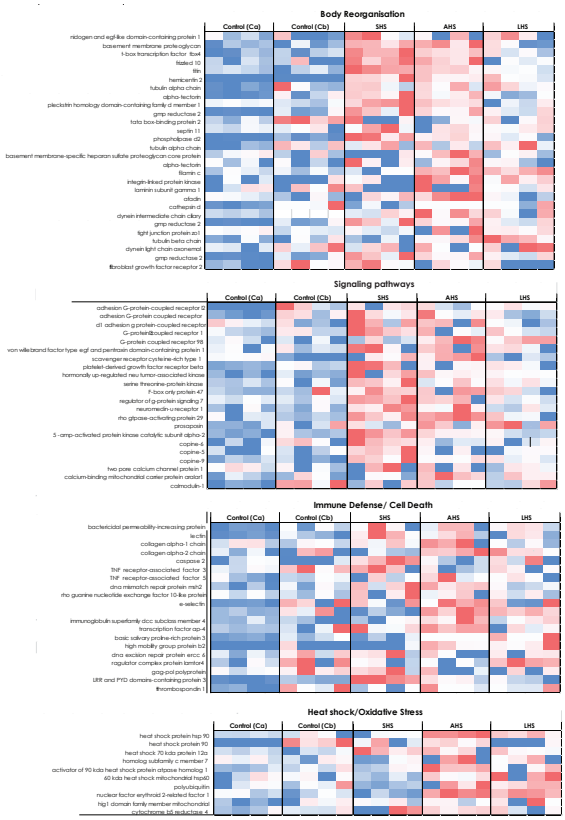
Number of differentially expressed genes in each condition (SHS, AHS, LHS) compared to the control condition (C_a).



Differentially expressed genes, based on adjusted p value< 0.01 along the experimental conditions (SHS, AHS, LHS). Colors from blue to red indicate the increasing expression.

4. Differential gene expression

The analysis revealed major shifts in the organism's transcriptomic profile induced by temperatures corresponding to the standard seasonal maximum (27°C), triggering processes related to signal transduction and response to stimulus. Further elevation of temperature corresponding to local extremes (30°C) activated additional processes, including immune response and apoptosis. However, following prolonged exposure to the extreme temperature, signs of resilience were observed through overexpression of regular cellular functions.



Relative expression level of target genes along the experimental conditions (SHS, AHS, LHS) grouped by functional types. Expression levels increase from blue to red.

5. Acute stress and capacity for resilience

Our results highlight the generally recognized sensitivity of *S. officinalis* to environmental shifts, providing an insight into the molecular mechanisms involved in the process. Furthermore, they suggest an innate capacity for thermal tolerance at the current extremes, implying a combination of factors and not solely temperature as the lethal agent. This sheds light on the mechanisms of pressure induced by ocean warming to its most sensitive receptors, coastal sessile invertebrates.

This research was implemented through an IKY scholarship funded by the action "Reinforcement of Postdoctoral Researchers" of the operational programme "Human Resources Development, Education and Life Lifelong Learning" with priority axes 6, 8, 9 and was co-financed by the European Social Fund (ESF) and the Hellenic Republic.