

# Increased temperatures alter the postlarval American lobster transcriptome: the challenge of balancing cellular stress response

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## Introduction

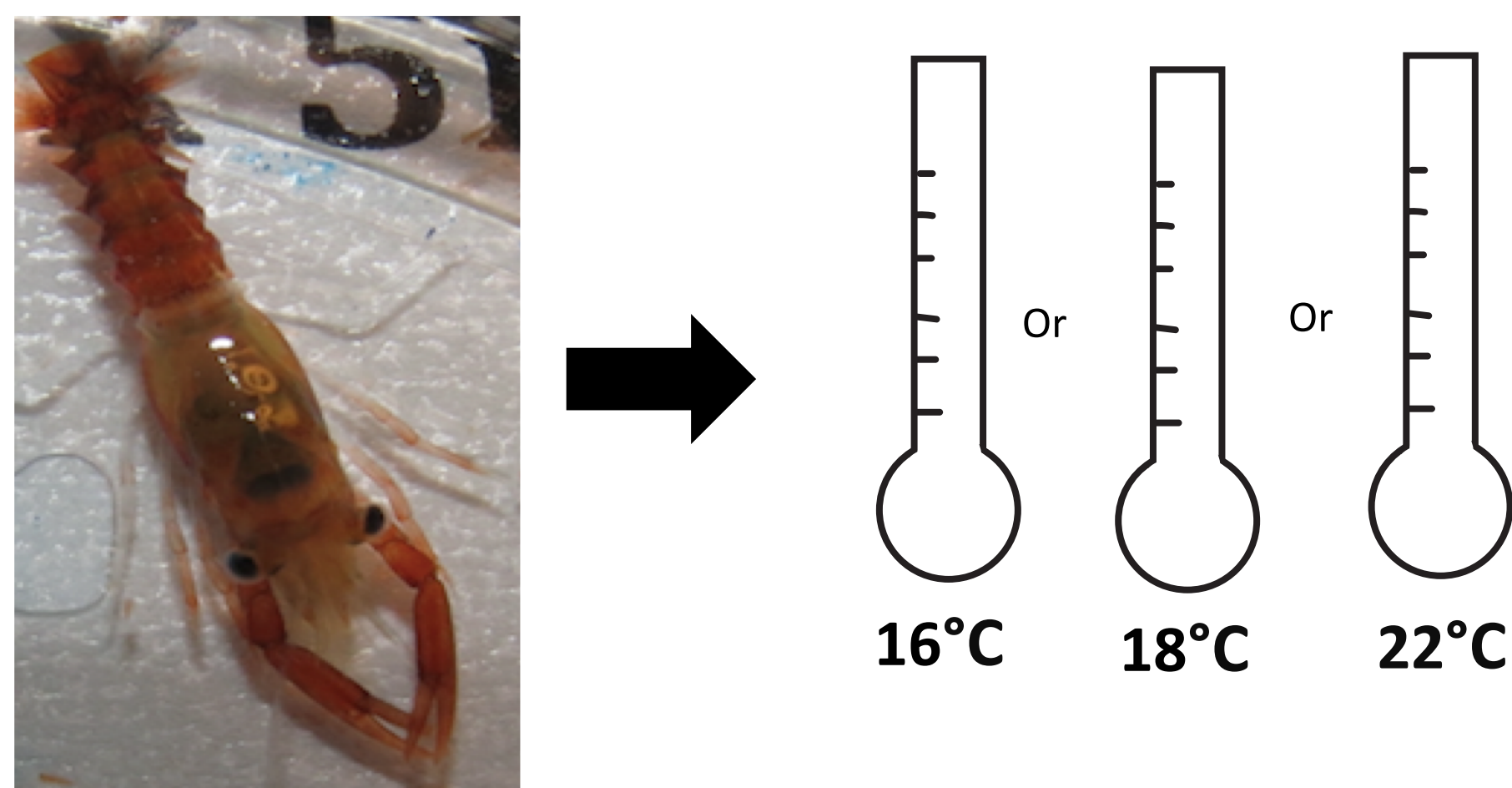
- The American lobster (*Homarus americanus*) is an economically critical species.
- Ocean temperatures continue to warm, but the sublethal effects on lobsters remain unclear.
- We utilized transcriptomics to uncover the molecular consequences of predicted warming scenarios on developing lobsters.
- Previous analyses suggest a potential trade-off between immunity and maintaining metabolic rates under a warmer environment<sup>1</sup>.
- Here, we further examine the consequences of increased temperatures on development of lobsters by focusing on the cellular stress response.

## Aims

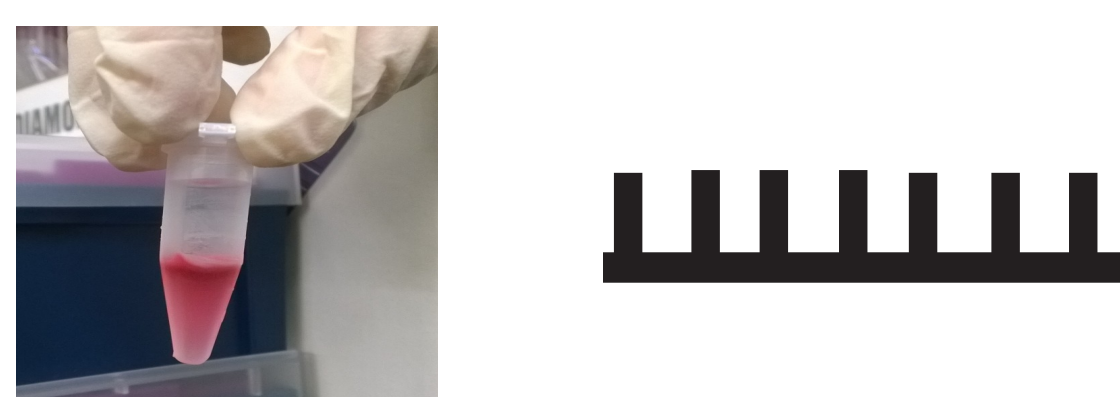
- To determine if the shift in the transcriptome found in postlarvae reared at higher temperatures reflects physiological trade-offs with developmental consequences.
- To understand the impact of increased temperatures on the cellular stress response in postlarval lobsters.

## Methods

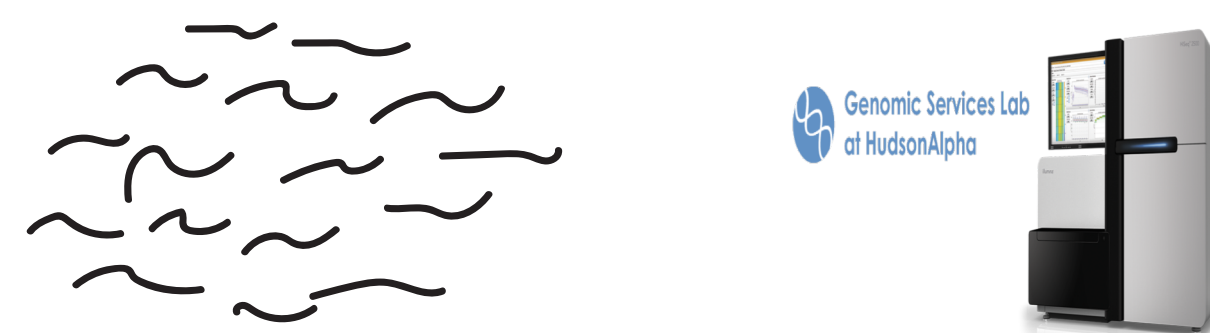
### 1. Larvae collected & reared until the postlarval stage



### 2. RNA extraction



### 3. cDNA library preparation & RNA-sequencing (Illumina)

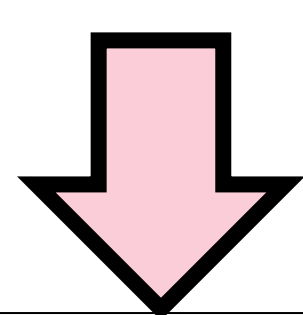


### 4. De Novo transcriptome assembly & quality control

### 5. Mapping & count processing



### 6. Differential expression calculation with DESeq2



### 7. Annotation and visualization of top 100 differentially expressed transcripts for each treatment comparison



Figure 1. Workflow of the methods.

## Results

### Over-expression of protein domains associated with cellular stress response in postlarvae reared at 18°C

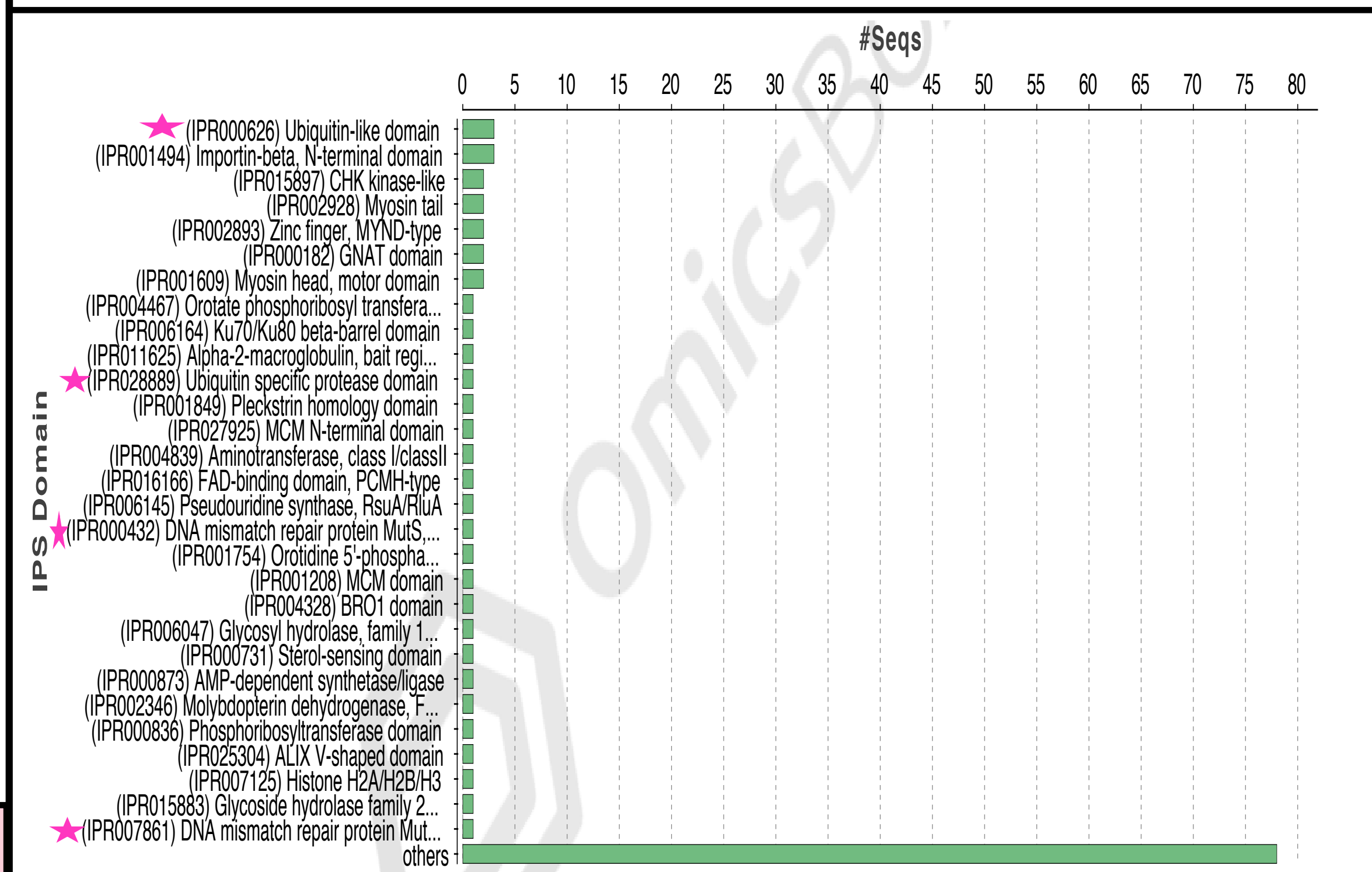


Figure 2. Distribution of InterProScan protein domains associated with transcripts significantly over-expressed in postlarvae reared at 18°C relative to those reared at 16°C. The stars indicate protein domains related to cellular stress response.

### Over-expression of transcripts associated with cellular stress response in larvae reared at 18°C and 22°C

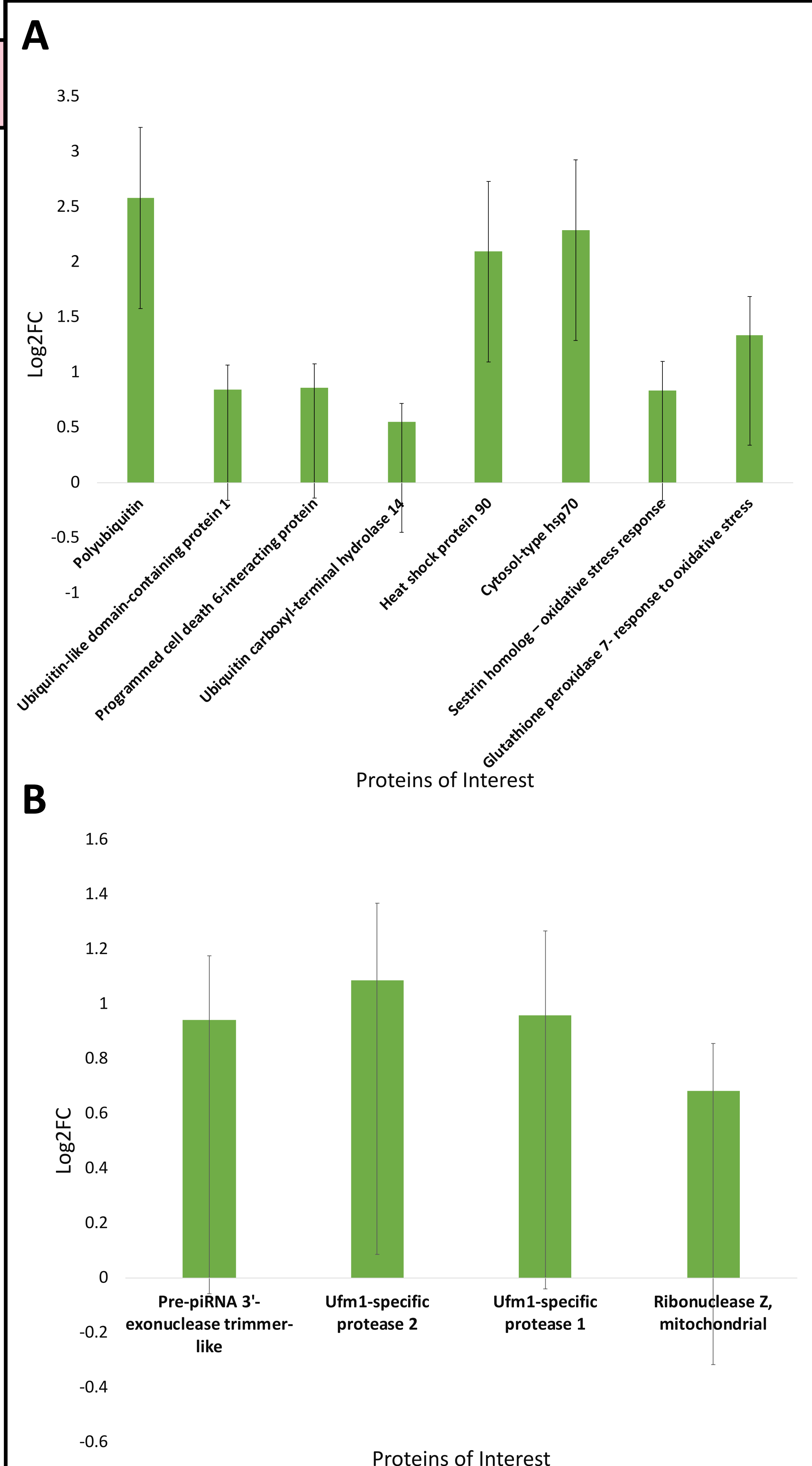


Figure 3. Bar charts showing expression (as mean Log2FC and SE) of transcripts annotated to proteins related to cellular stress response that were significantly over-expressed in postlarvae reared at 18°C (A) and reared at 22°C (B) relative to those reared at 16°C.

## Results

- Postlarvae reared at 16°C vs. 22°C had a total of 2,542 differentially expressed (DE) transcripts while lobsters reared at 16°C vs. 18°C had a total of 422 DE transcripts.
- Although there were more DE transcripts between the 16°C and 22°C treatments than the 16°C and 18°C treatments, we see more heat shock proteins and other cellular stress response components significantly over-expressed in postlarvae reared in 18°C.
- Interestingly, no heat shock proteins were in the top 100 differentially expressed transcripts in the 16 vs. 22°C comparison.
- KAAS analysis found significant over-expression of transcripts in the phospholipase signaling pathway and Akt signaling pathway in postlarvae reared at 22°C which are pathways activated in response to oxidant injury<sup>2</sup>.

## Take Home Messages

- Altered transcriptomes at higher temperatures may reflect a shift in energy allocation at the molecular level.
- Postlarvae exposed to higher temperatures significantly over-expressed cellular stress components at levels up to 6x greater than those exposed to current temperatures.
- The cellular stress response is an energy demanding phenomenon that requires under-expression of other cellular processes, potentially threatening successful development<sup>3</sup>.
- This work provides a foundation in understanding how temperature impacts the cellular stress response of American lobsters and their development.

## Future Directions

- Further analysis of current transcriptomics results.
- Additional 'omics research across a variety of life stages<sup>3</sup>.
- A fully annotated reference genome is critical missing piece in genetic analysis of American lobsters.

## Acknowledgements

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## References

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