Warm temperatures, cool sponges: the effect of increased temperatures on the Antarctic sponge *Isodictya* sp.

Marcelo González-Aravena[1,*], Nathan J. Kenny[2,3,*], Magdalena Osorio[1], Alejandro Font[1], Ana Riesgo[2] and César A. Cárdenas[1]

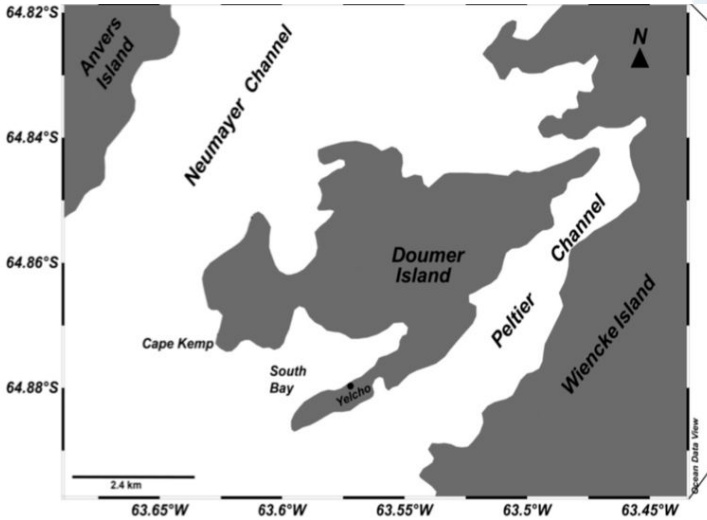
The Mutants

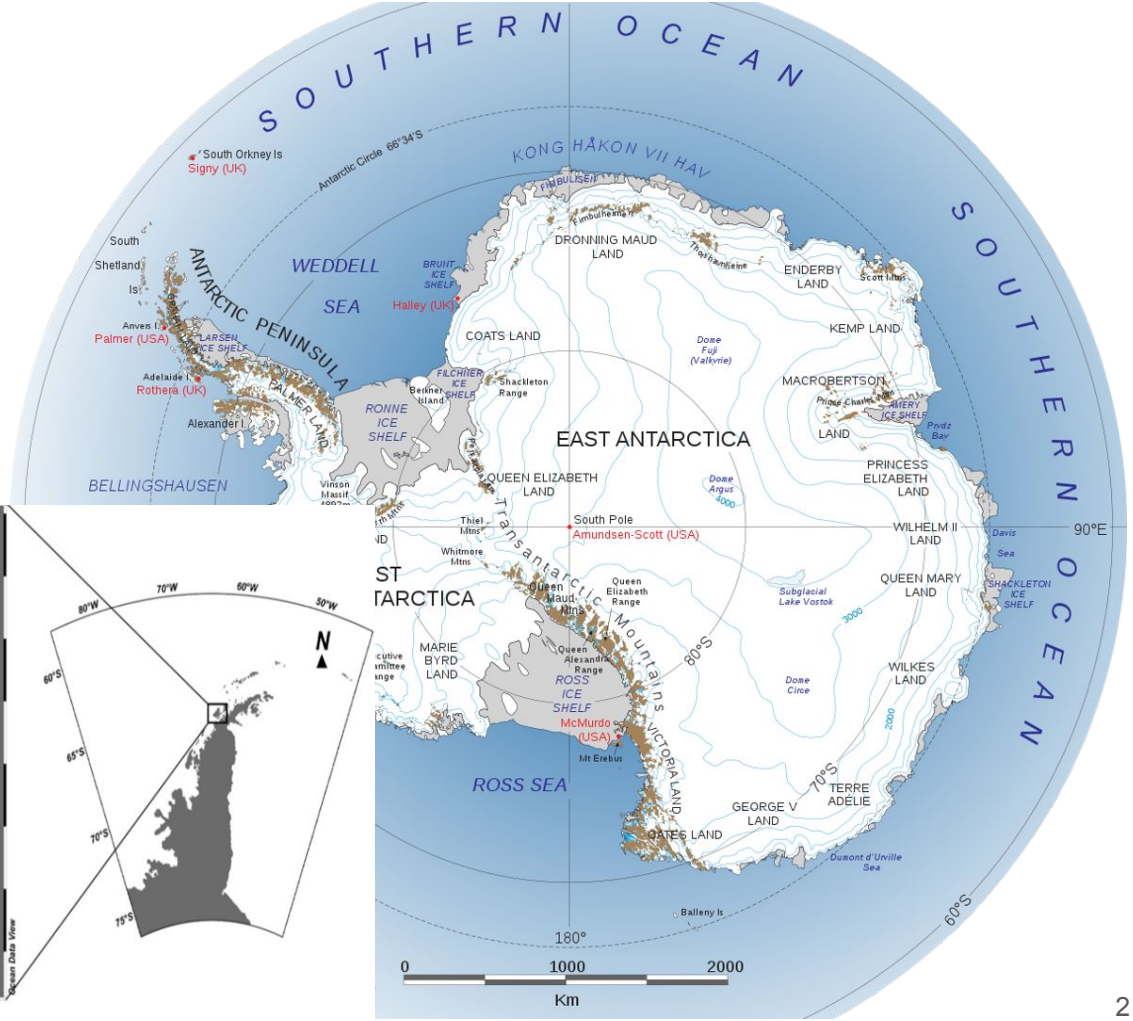
Kavi R. Acharya

Mudith Ekanayake

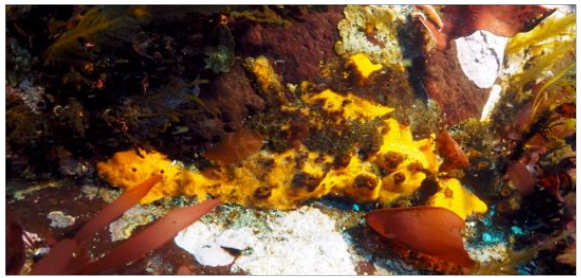
Jaspreet K Rishi

Western Antarctic Peninsula





Study Design



4 hours

2080
IPCC-SRES

N=2/treatment

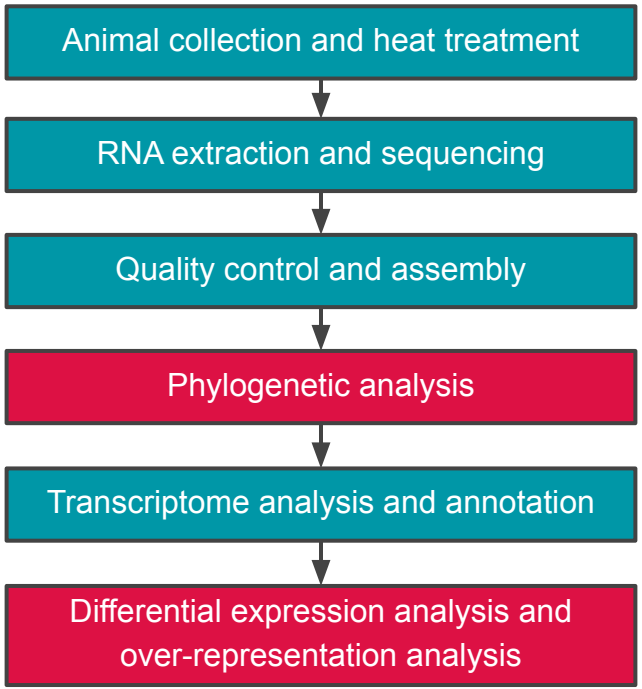
control → 0.5 °C

Heat shock → 3 °C, 5°C

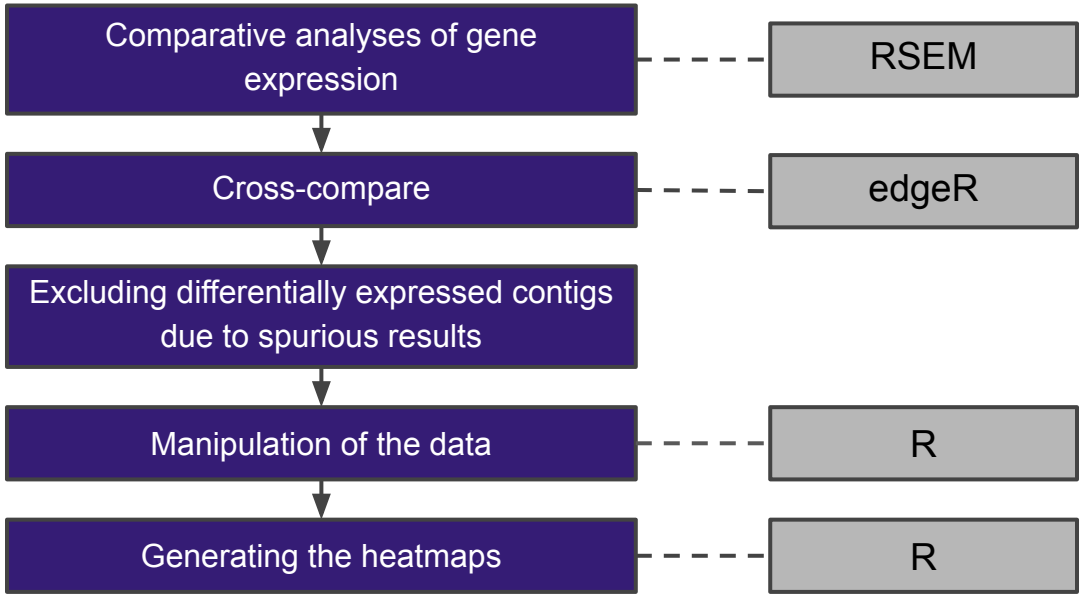
RNA isolation → amplification → QC (FastQC, Trimmomatic 0.33) → Assembled into reference transcriptome (Trinity version 2013_08_14)

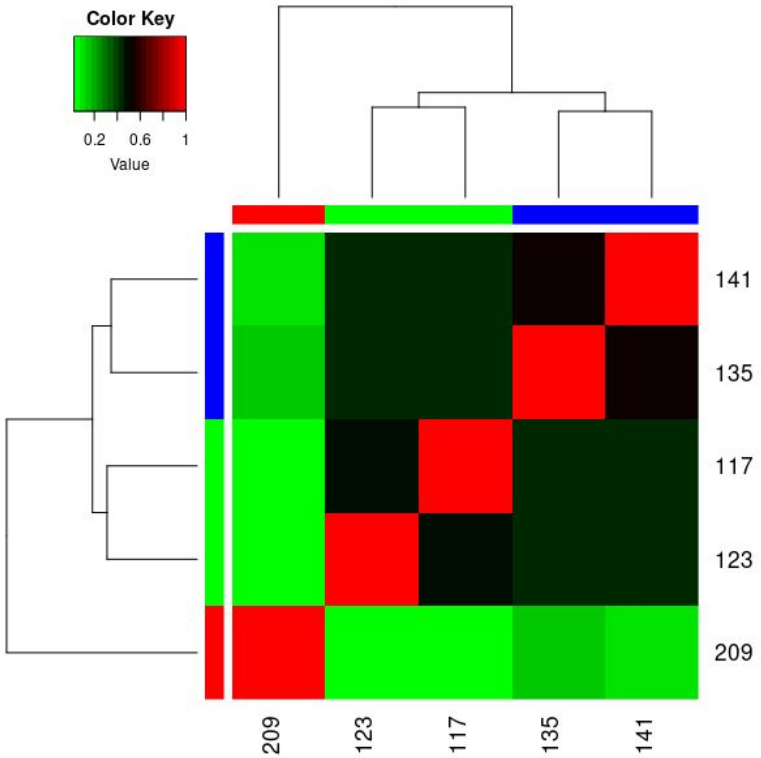
(DeconSeq version 0.4.3)

Methods


Animal collection and heat treatment
RNA extraction and sequencing
Quality control and assembly
Phylogenetic analysis
Transcriptome analysis and annotation
Differential expression analysis and over-representation analysis

Differential expression analysis

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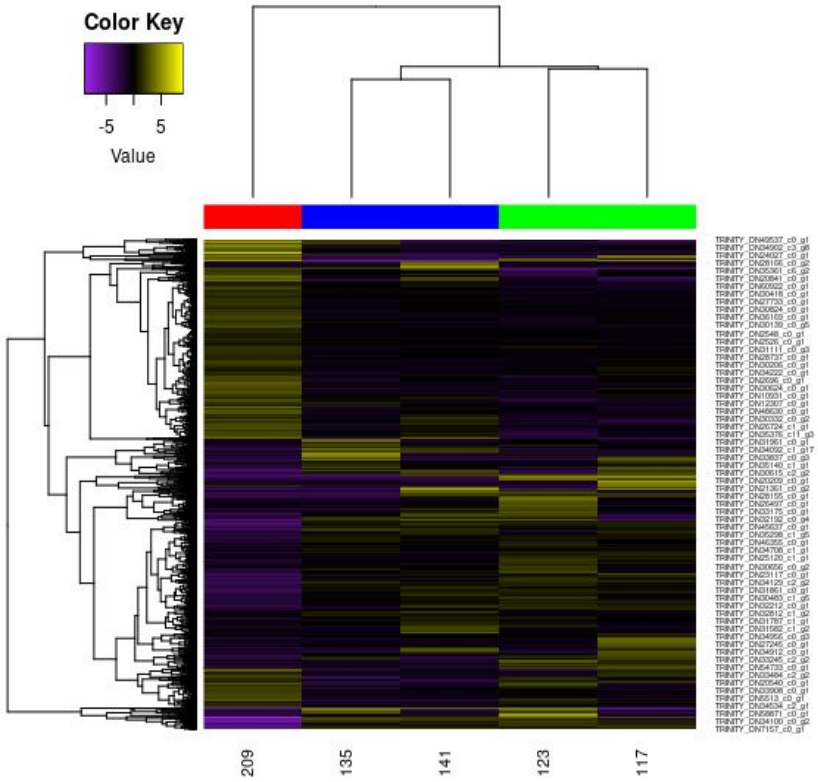
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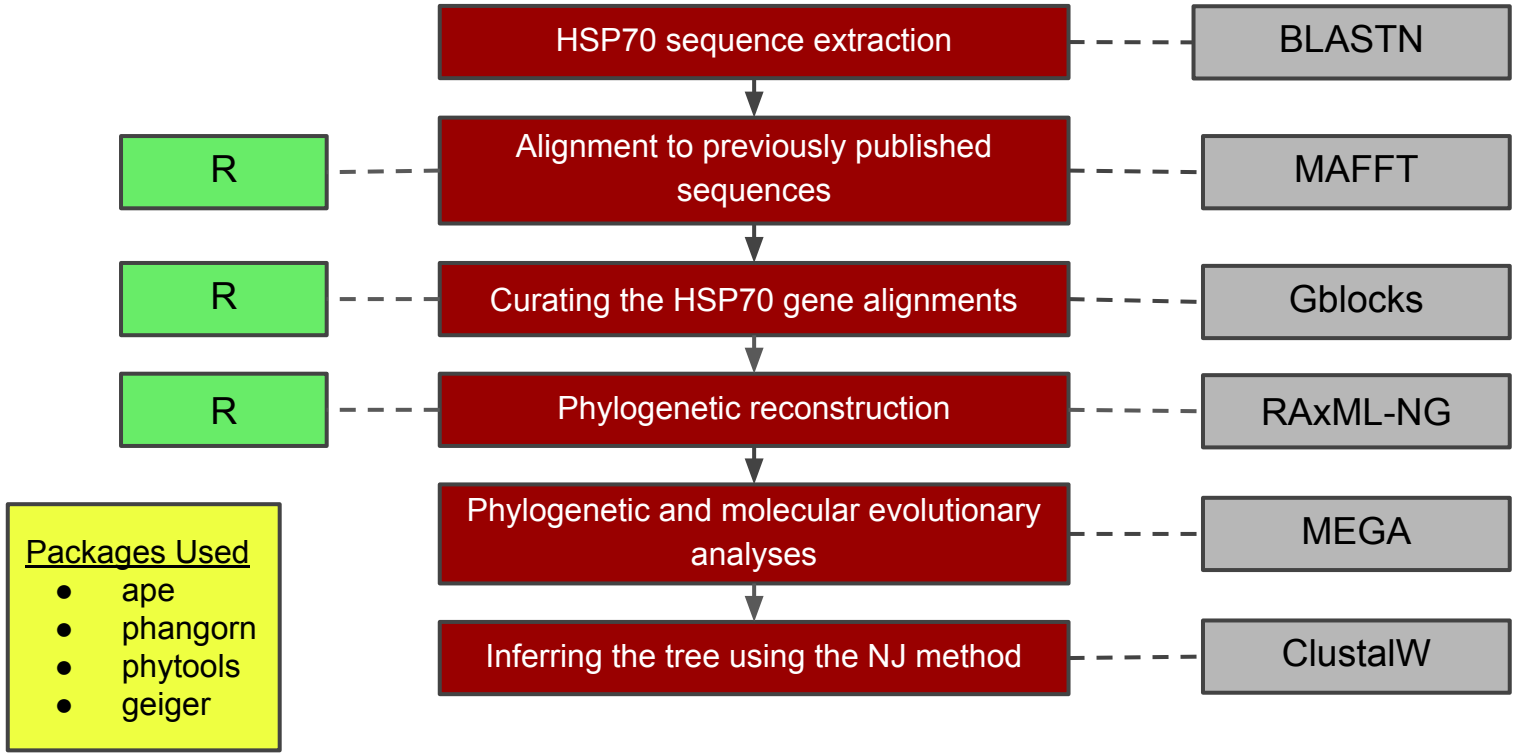
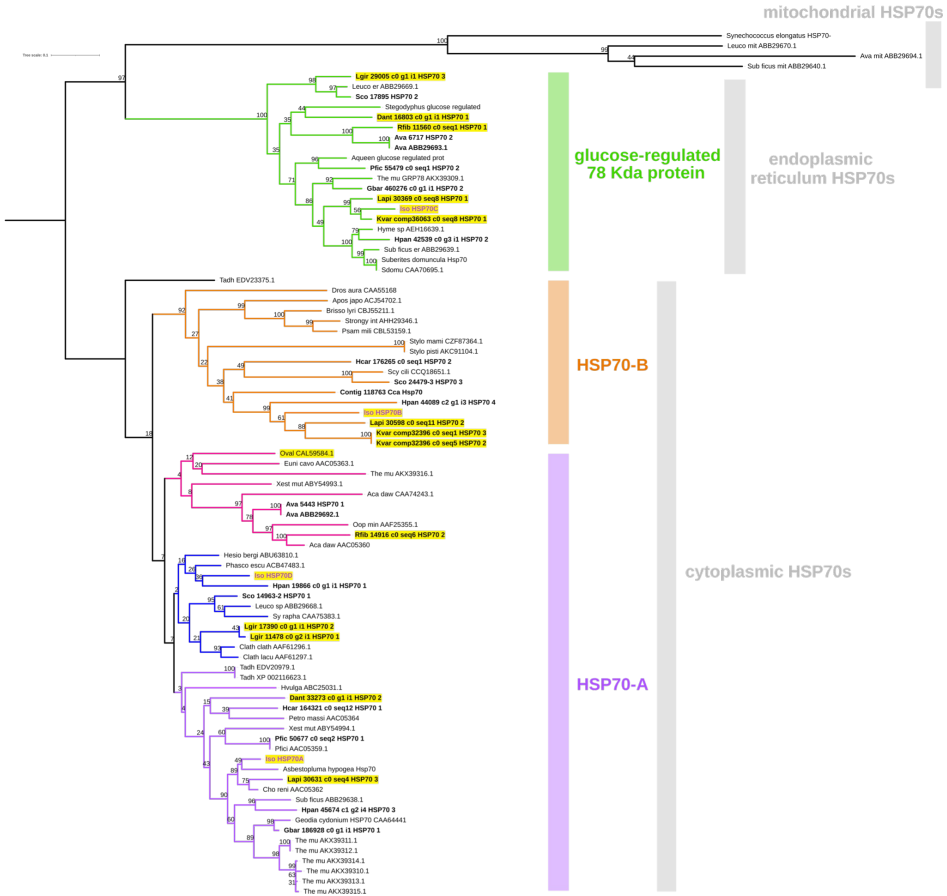
Phylogenetic analysis

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Synechococcus elongatus HSP70-
Leuco mit ABB29670.1
Ava mit ABB29694.1
Sub ficus mit ABB29640.1
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endoplasmic reticulum HSP70s
Lgir 29005 c0 g1 i1 HSP70 3
Leuco er ABB29669.1
Sco 17895 HSP70 2
Stegodyphus glucose regulated
Dant 16803 c0 g1 i1 HSP70 1
Rfib 11560 c0 seq1 HSP70 1
Ava 6717 HSP70 2
Ava ABB29693.1
Aqueen glucose regulated prot
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Gbar 460276 c0 g1 i1 HSP70 2
Lapi 30369 c0 seq8 HSP70 1
Iso HSP70D
Kvar comp38063 c0 seq8 HSP70 1
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Hpan 42539 c0 g3 i1 HSP70 2
Sub ficus er ABB29639.1
Suberites domuncula Hsp70
Sdomu CAA70695.1
HSP70-B
Tadh EDV23375.1
Dros aura CAA55168
Apos japo ACJ54702.1
Brisso lyri CBJ55211.1
Strongy int AHH29346.1
Psam mill CBL53159.1
Stylo mami CZF87364.1
Stylo pisti AKC91104.1
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Scy cili CCQ18651.1
Sco 24479-3 HSP70 3
Contig 118763 Cca Hsp70
Hpan 44089 c2 g1 i3 HSP70 4
Iso HSP70B
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Kvar comp32396 c0 seq1 HSP70 3
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HSP70-A
cytoplasmic HSP70s
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Phasco escu ACB47483.1
Iso HSP70D
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Pfic AAC05359.1
Iso HSP70A
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Lapi 30631 c0 seq4 HSP70 3
Cho reni AAC05362
Sub ficus ABB29638.1
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Geodia cydonium HSP70 CAA64441
Gbar 186928 c0 g1 i1 HSP70 1
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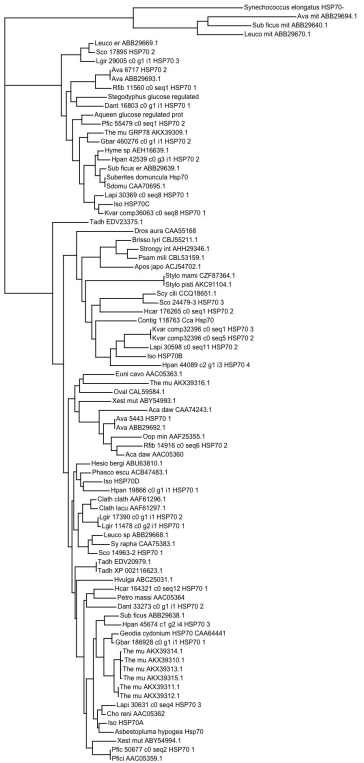
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Ava 8717 HSP70 2
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Aqueen glucose regulated prot
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Psam mil CBL53159.1
Apos japo ACJ54702.1
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Contig 118763 Cca Hsp70
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Geodia cytonium HSP70 CAA64441
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The mu AKX39310.1
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The mu AKX39315.1
The mu AKX39311.1
The mu AKX39312.1
Lapi 30631 c0 seq4 HSP70 3
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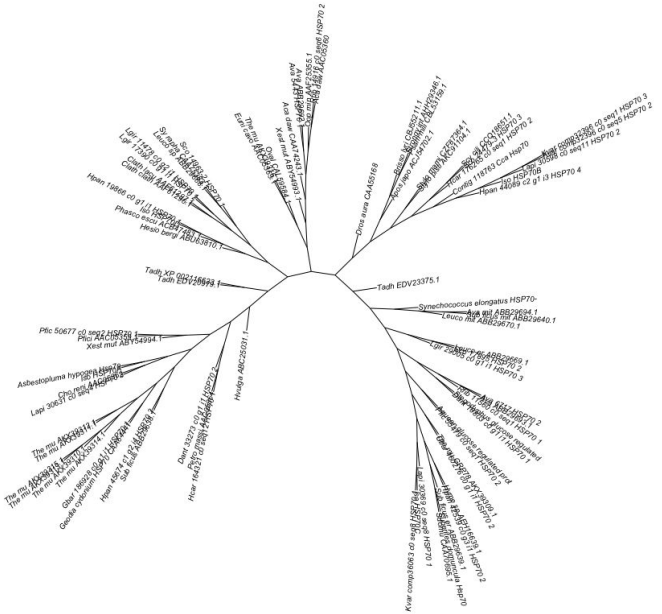
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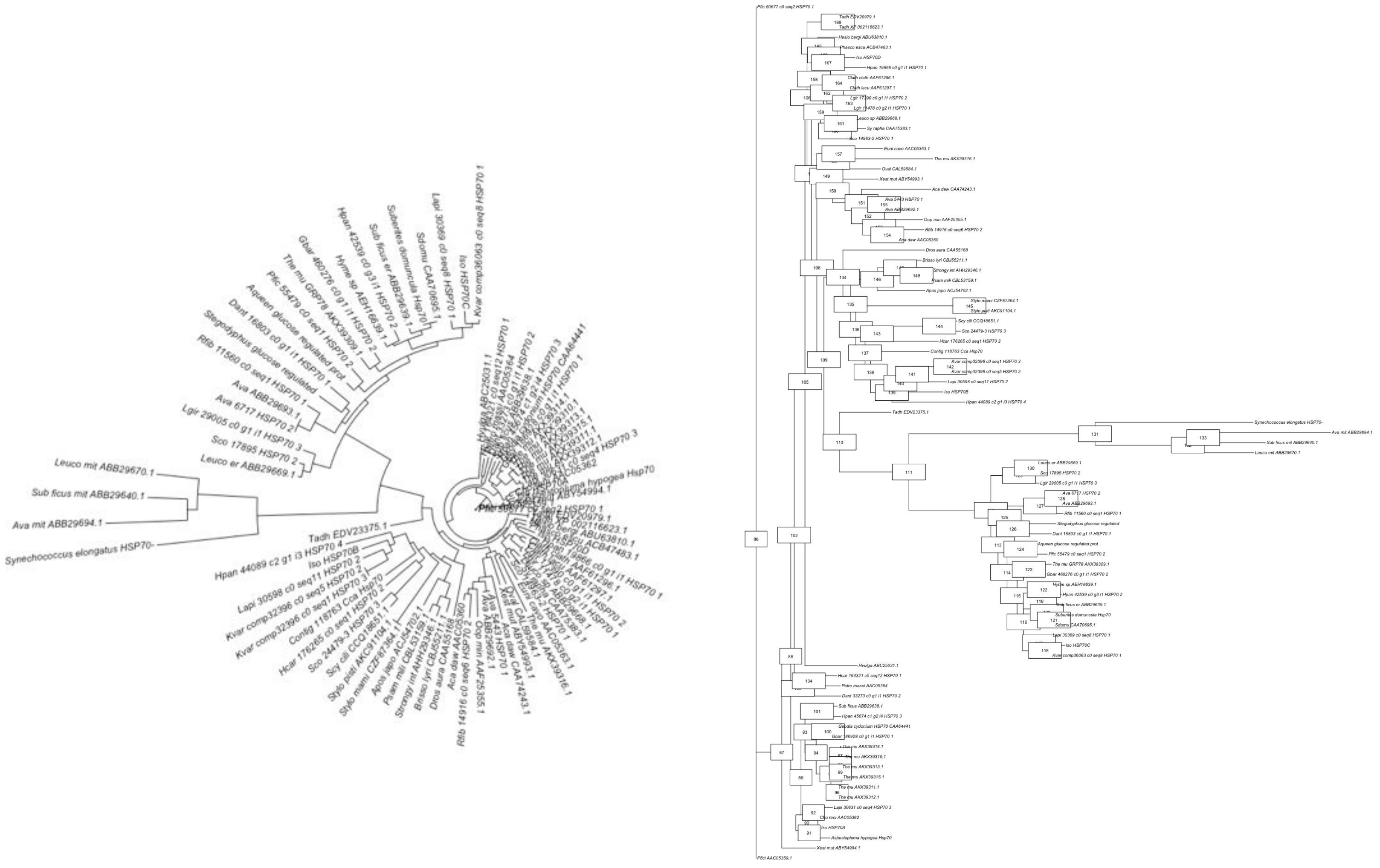

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Psam mili CBL53159.1
Apos japo ACJ54702.1
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Stylo pisti AKC91104.1
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Kvar comp32396 c0 seq1 HSP70 3
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Iso HSP70B
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Leuco mit ABB29670.1
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Aqueen glucose regulated prot
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Hpan 42539 c0 g3 i1 HSP70 2
Sub ficus er ABB29639.1
Suberites domuncula Hsp70
Sdomu CAA70695.1
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Iso HSP70C
Kvar comp36063 c0 seq8 HSP70 1
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Hcar 164321 c0 seq12 HSP70 1
Petro massi AAC05364
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Sub ficus ABB29638.1
Hpan 45674 c1 g2 i4 HSP70 3
Geodia cydonium HSP70 CAA64441
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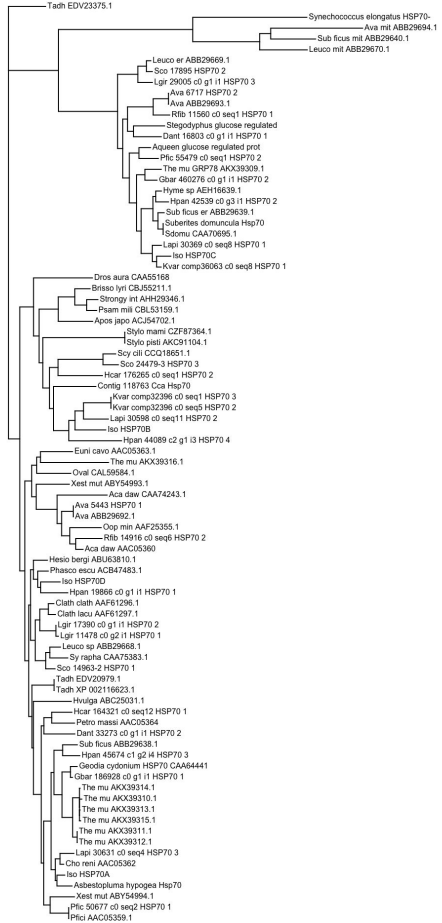
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Sub ficus ABB29638.1
Hpan 45674 c1 g2 i4 HSP70 3
Geodia cydonium HSP70 CAA64441
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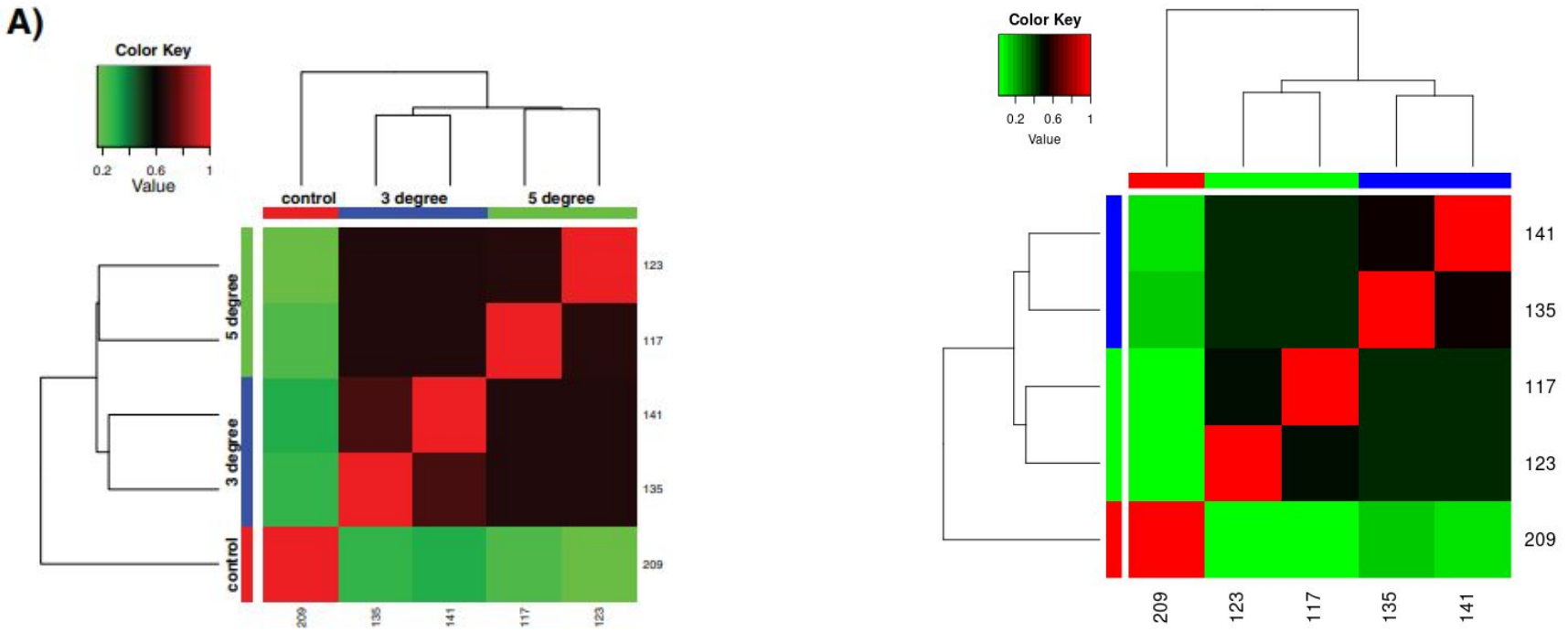
The mu AKX39312.1
Lapi 30631 c0 seq4 HSP70 3
Cho reni AAC05362
Iso HSP70A
Asbestopluma hypogea Hsp70
Xest mut ABY54994.1
Pfic 50677 c0 seq2 HSP70 1
Pfici AAC05359.1

Sample correlation matrix for the five samples used in the final cross-comparison



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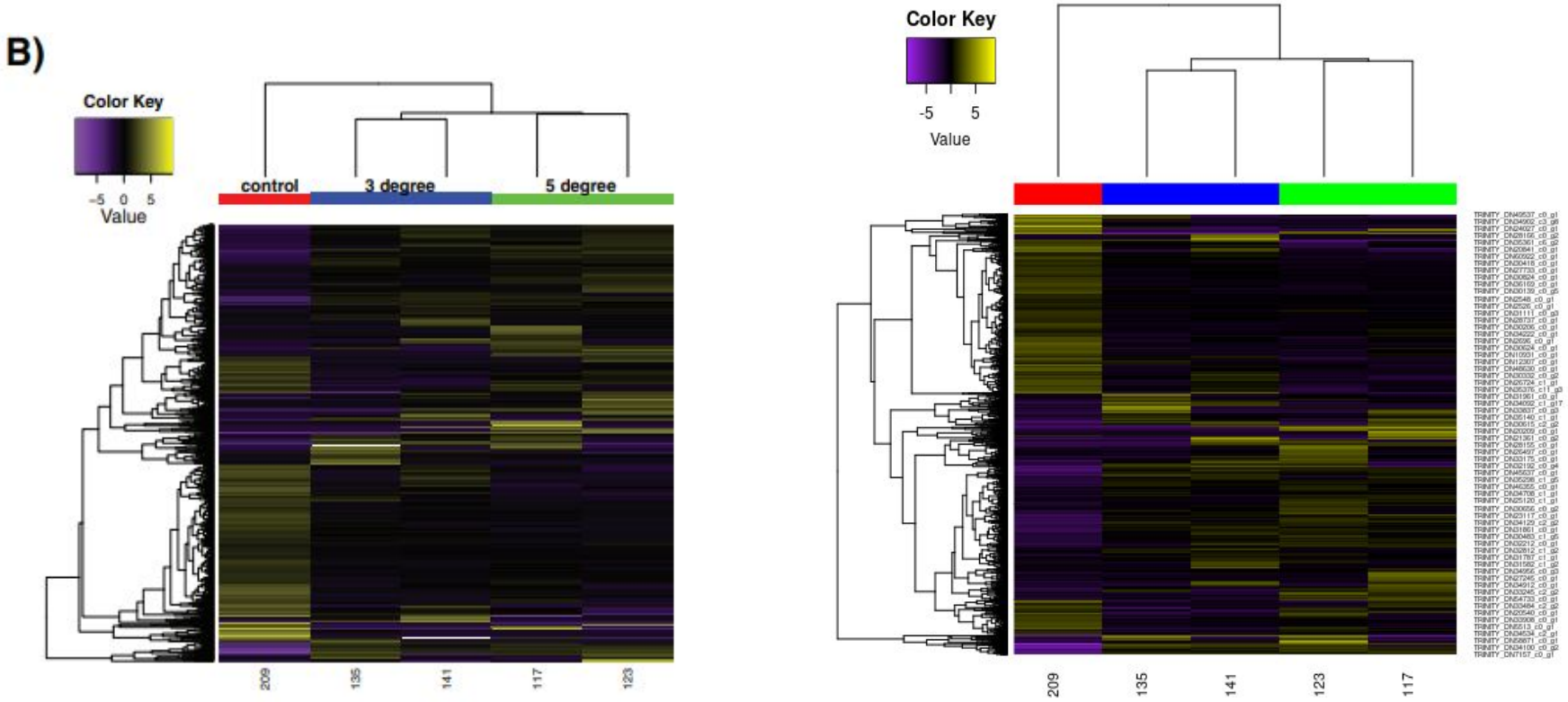
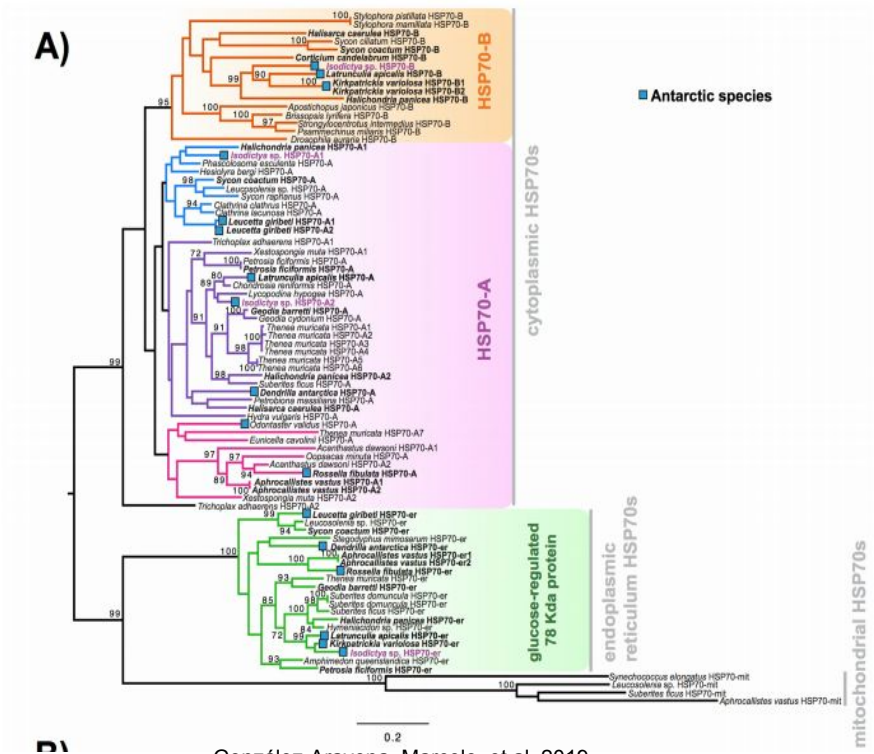
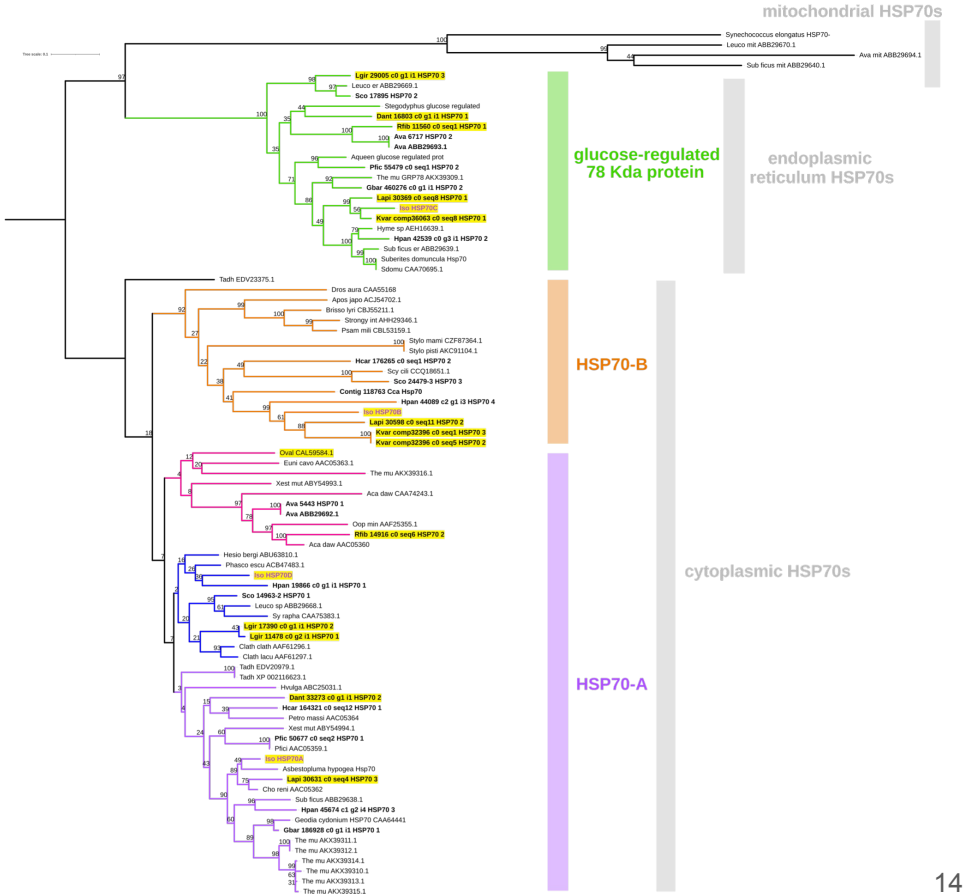
Relative expression of each differentially expressed contig across all the samples



González-Aravena, Marcelo, et al. 2019

Maximum likelihood-derived phylogeny of HSP70 sequences





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Conclusions

- 3-5 degree increase showed little change in response indicating even a little increase in temperature can alter the response and cause stress.
- Findings corroborated with previous conclusions regarding the transcriptomic response to acute thermal stress, while suggesting specifically that cold adapted sponges may have a limited range of tolerance to increased temperatures.