Daniel Liesner, S. Rana, L. Harms, G. Pearson, S. Heinrich,
K. Bischof, I. Bartsch, G. Glöckner, K. Valentin

Increased heat resilience of intraspecific hybrids compared to inbred lineages of the kelp *Laminaria digitata*: physiology and transcriptomics

12th INTERNATIONAL PHYCOLOGICAL CONGRESS
22-26 March 2021, Chile

@lies_nerd

Photo of *L. digitata* by Inka Bartsch, used with permission

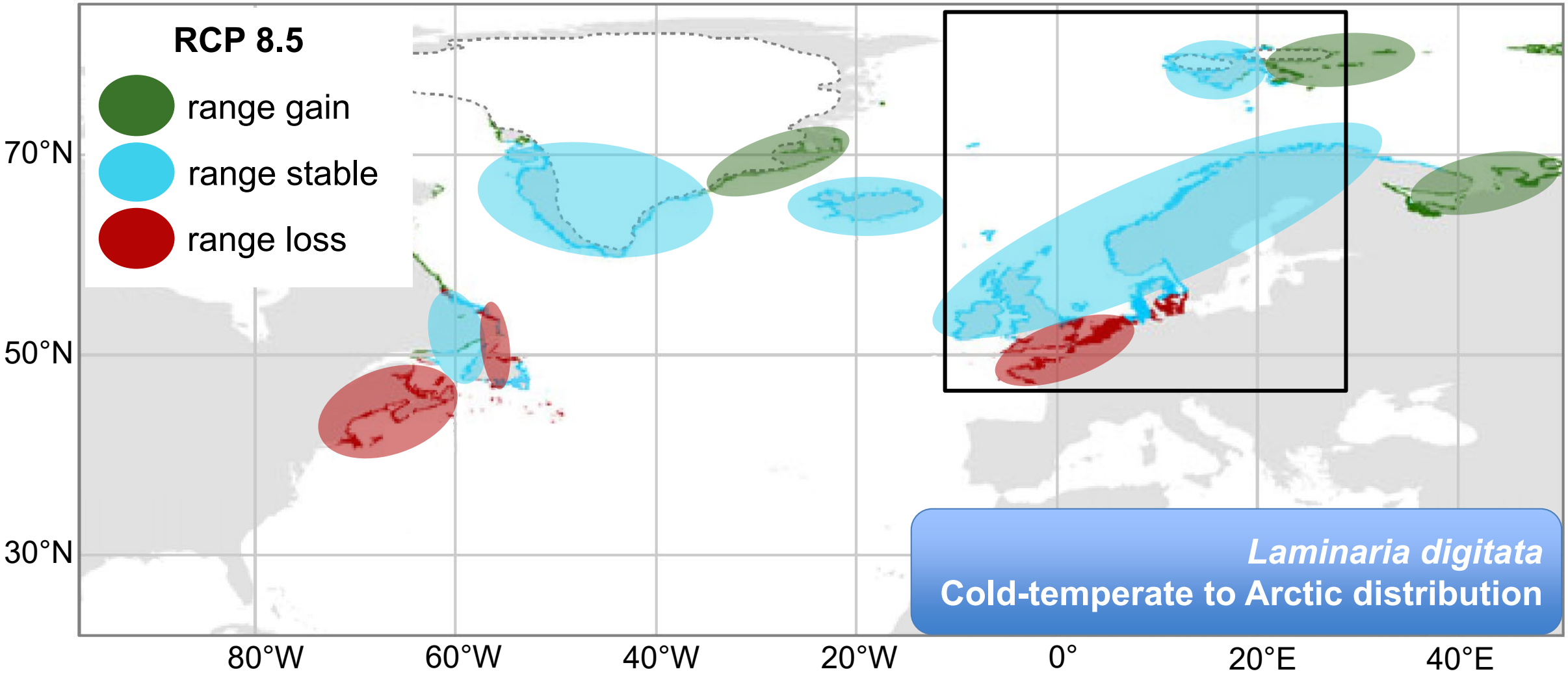
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

biodiversa

Universität Bremen

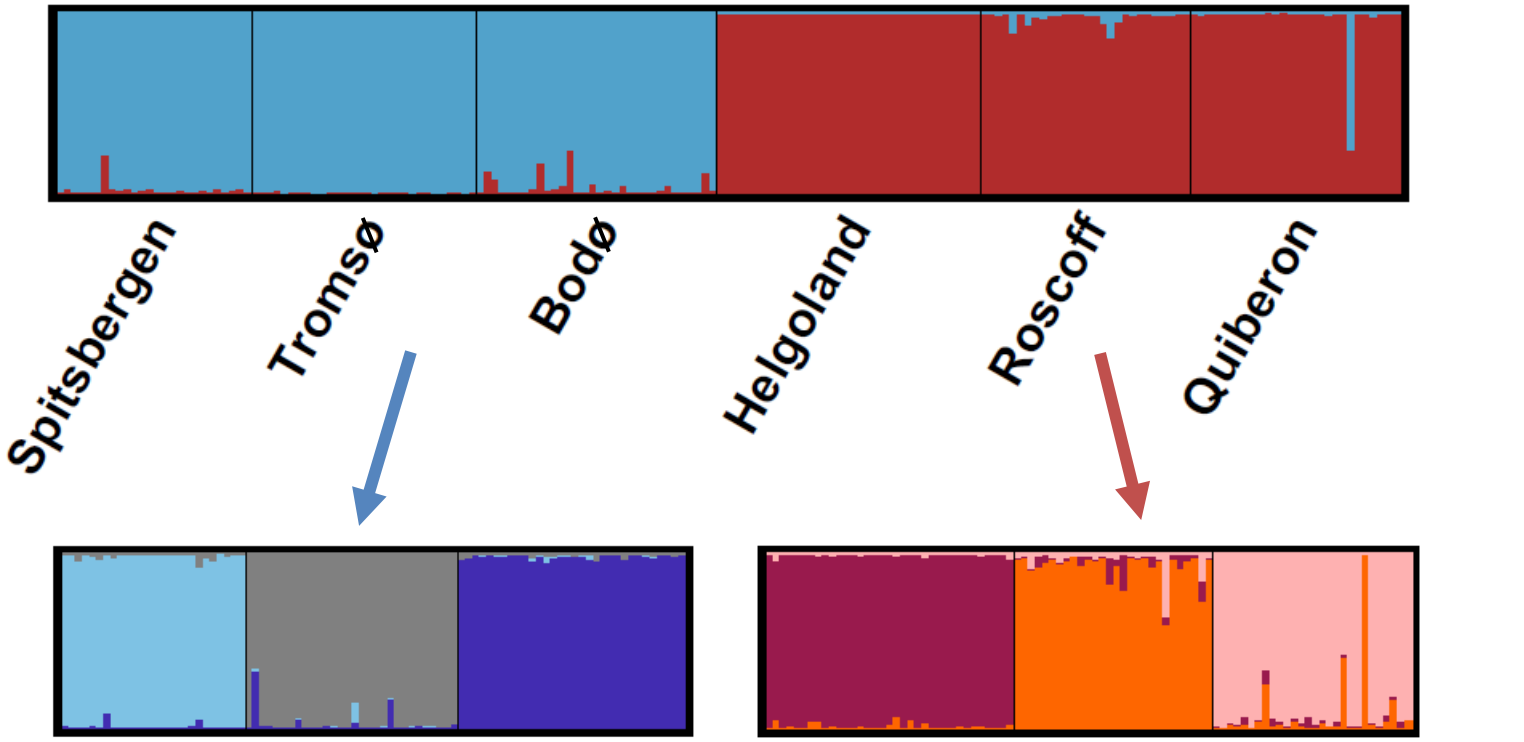
HELMHOLTZ

Distributional range shifts

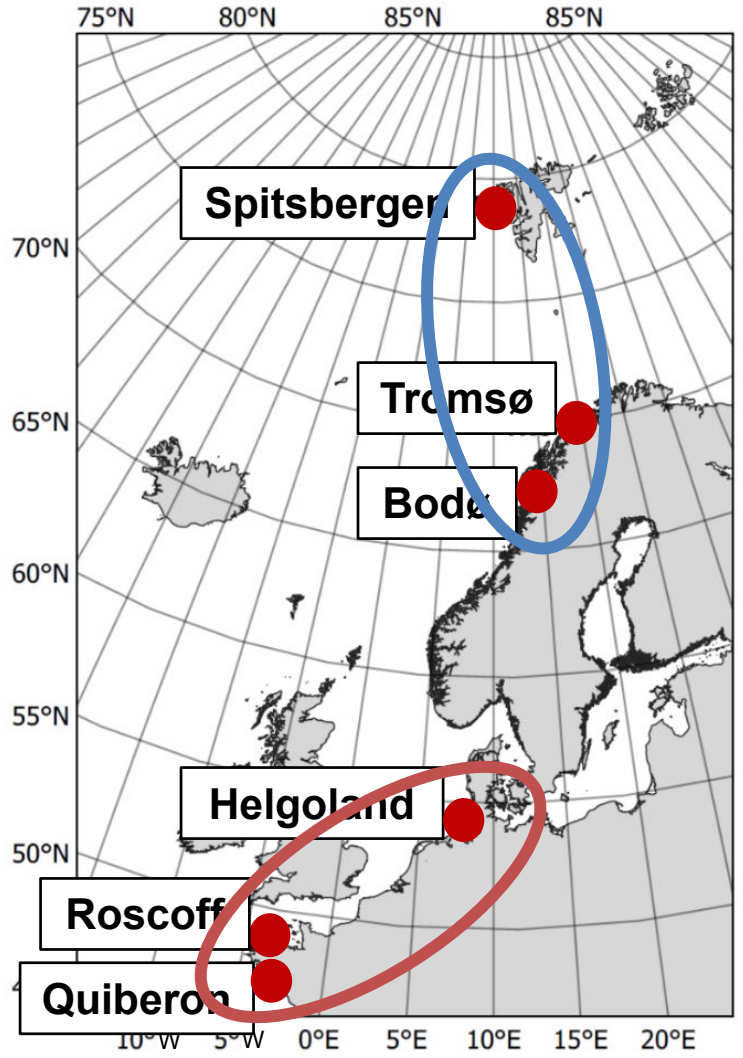


modified from Assis et al. (2018). Projected climate changes threaten ancient refugia of kelp forests … Global Change Biol.

Two clades of *L. digitata*



Structure analyses, *n*=26–35; K=2 / K=3

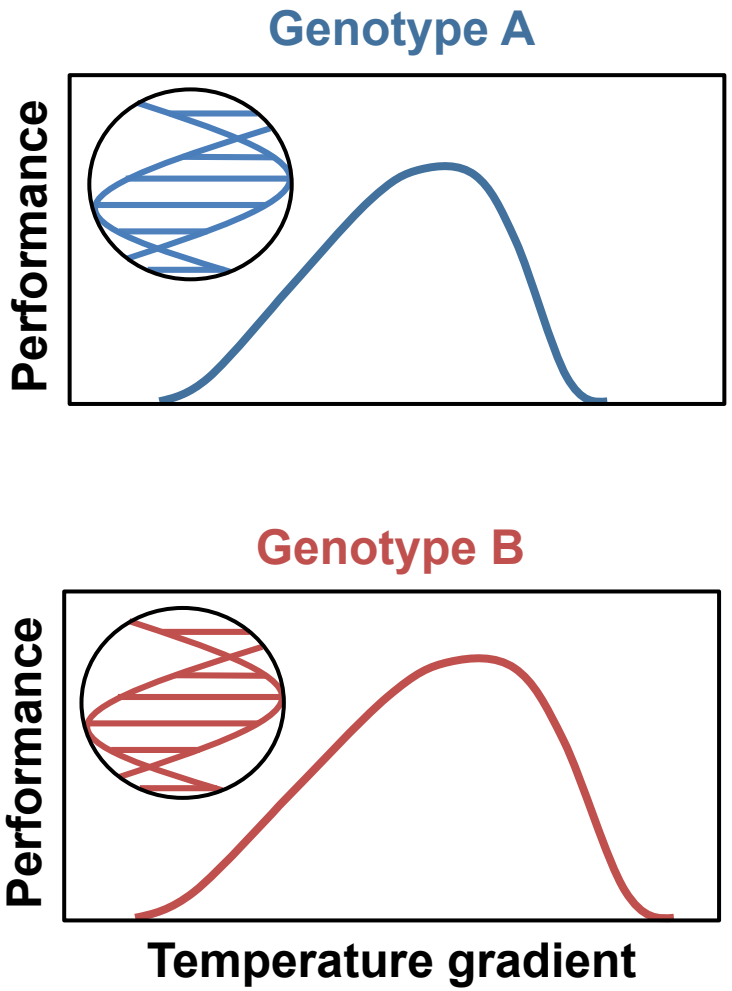


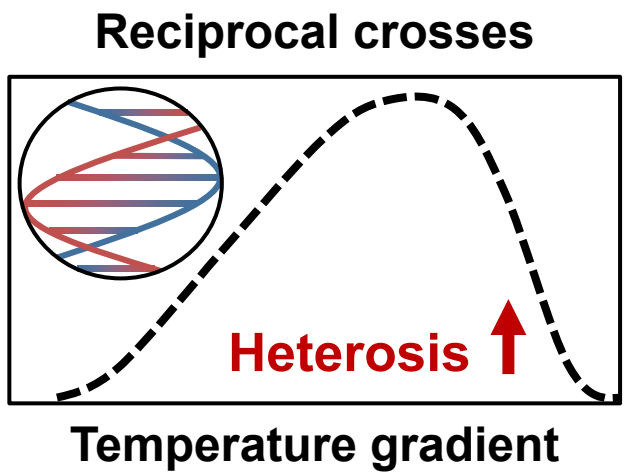
Divergence into a northern and a southern clade.

Uniform upper thermal limit.

Liesner et al. (2020). Heat stress responses and population genetics of the kelp *Laminaria digitata* (Phaeophyceae) across latitudes … Ecol Evol.

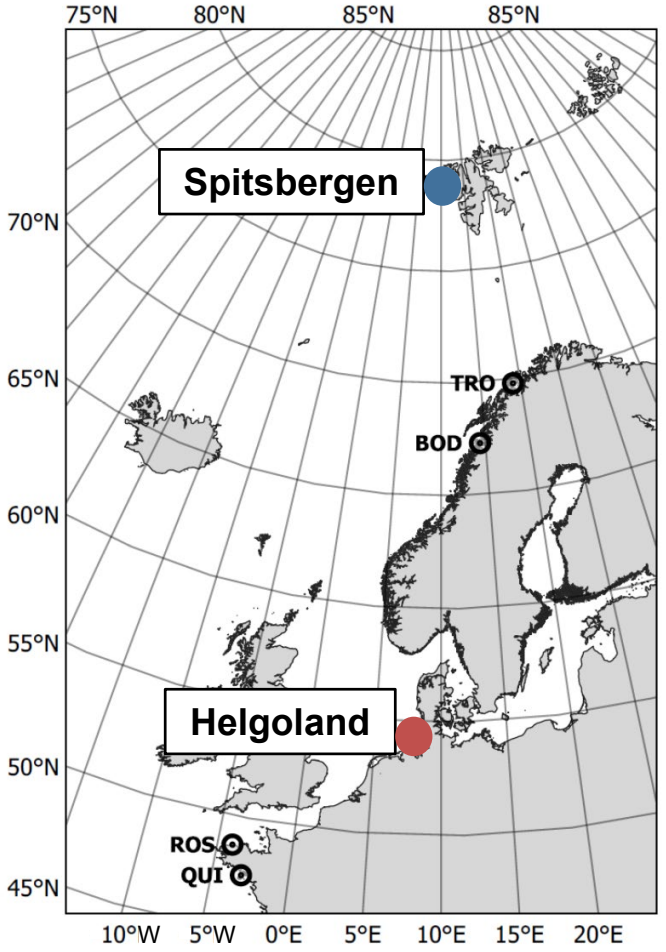
Thermal tolerance through outbreeding?





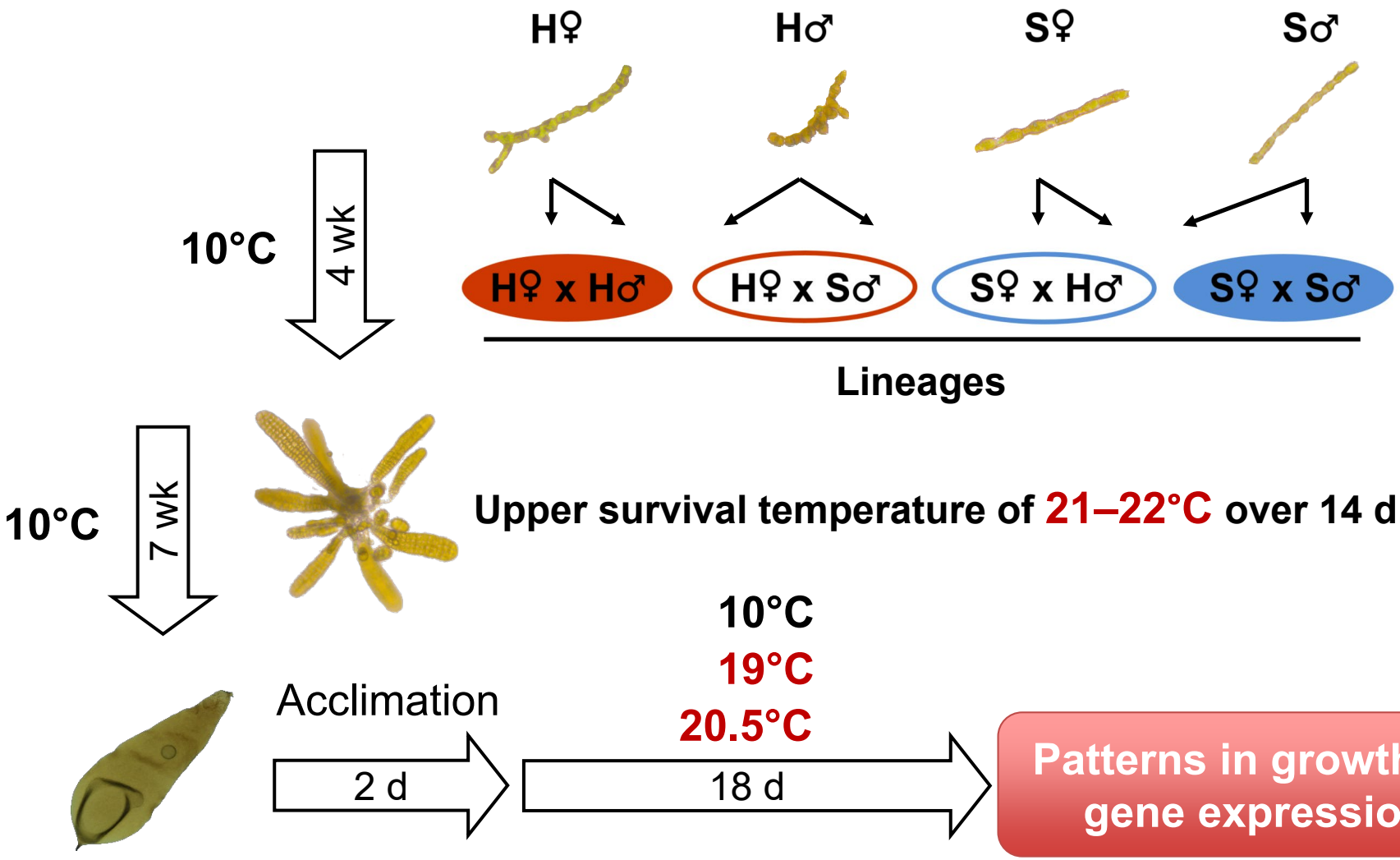
?

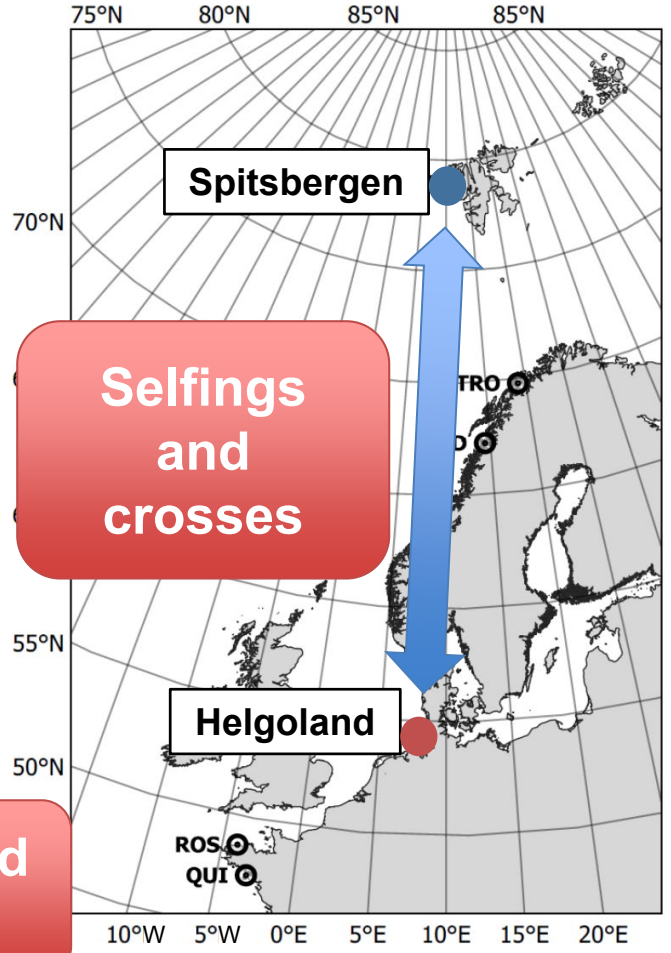
Does outbreeding among differentiated genotypes improve thermal tolerance?



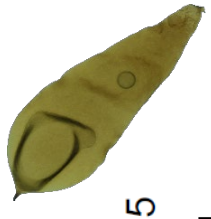
Hochholdinger & Hoecker (2007). Towards the molecular basis of heterosis. Trends Plant Sci.

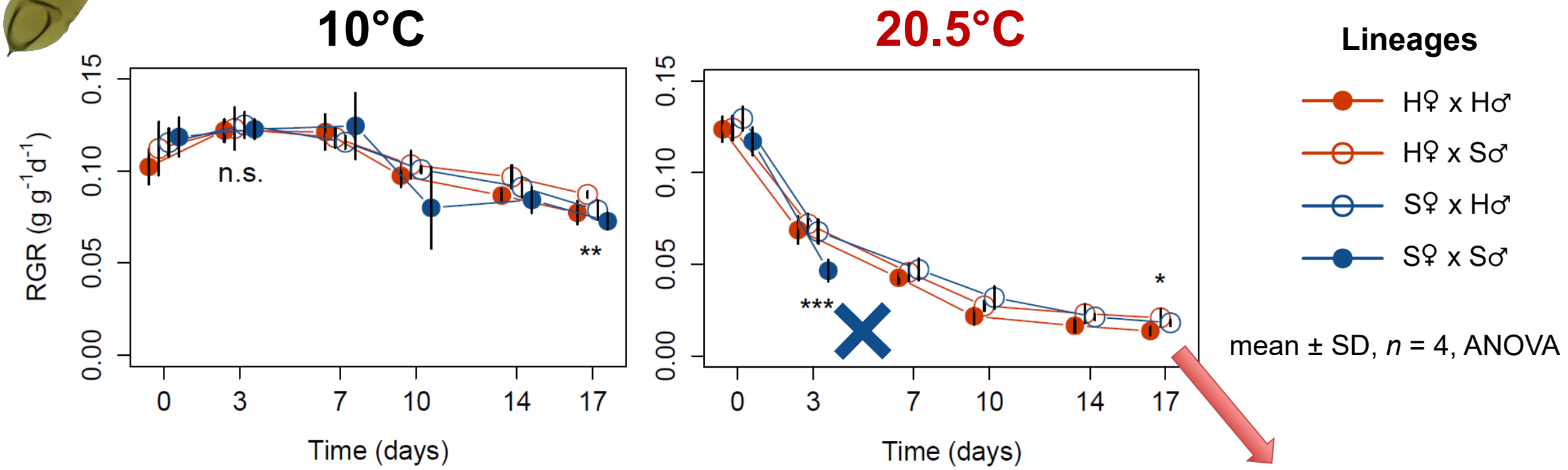
Experimental design





Growth of macroscopic sporophytes

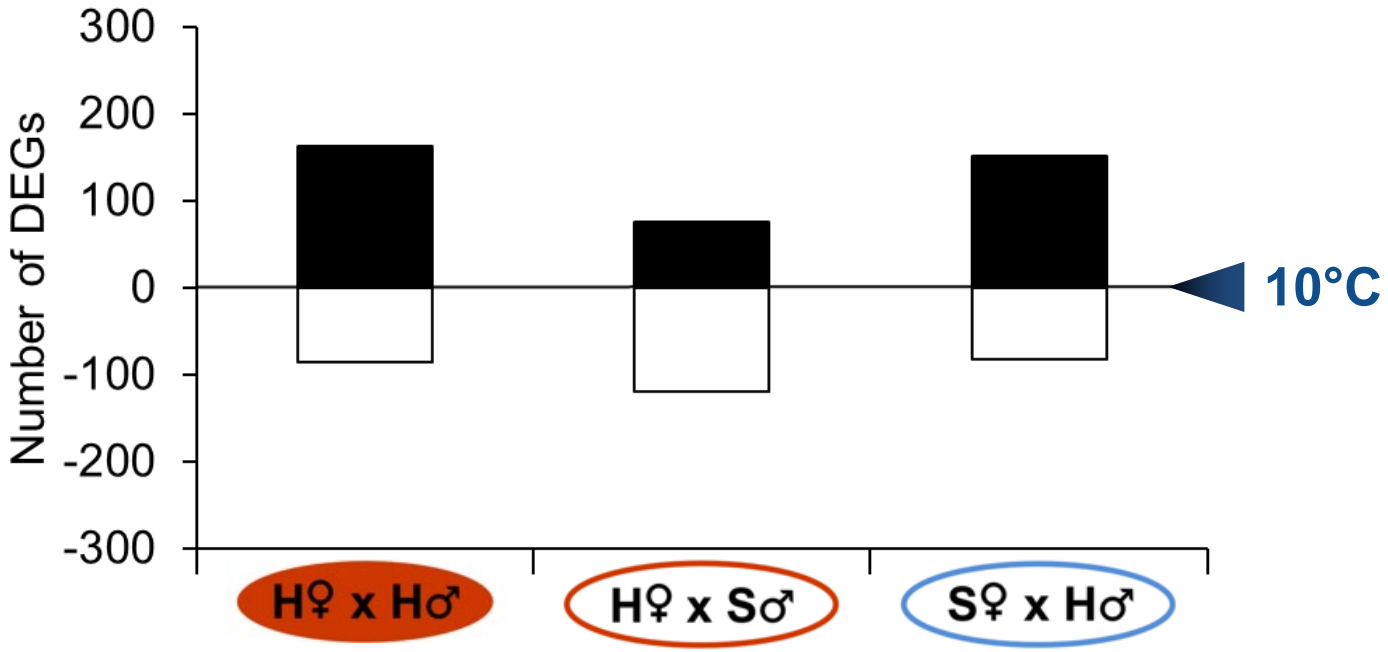




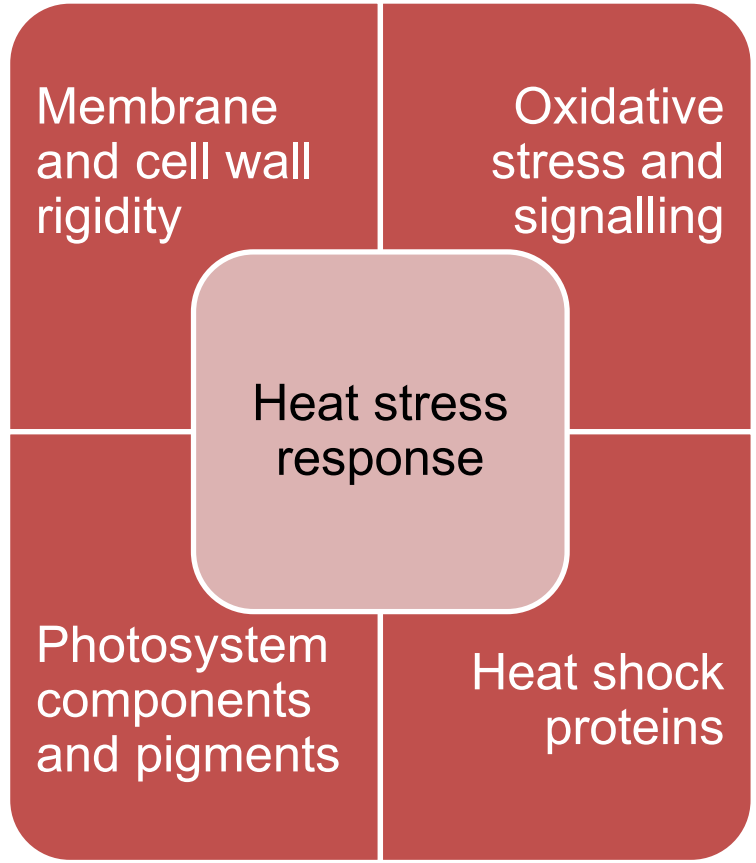
Viable sporophytes in both reciprocal crosses.

Differential gene expression?

Differential gene expression: Heat stress response

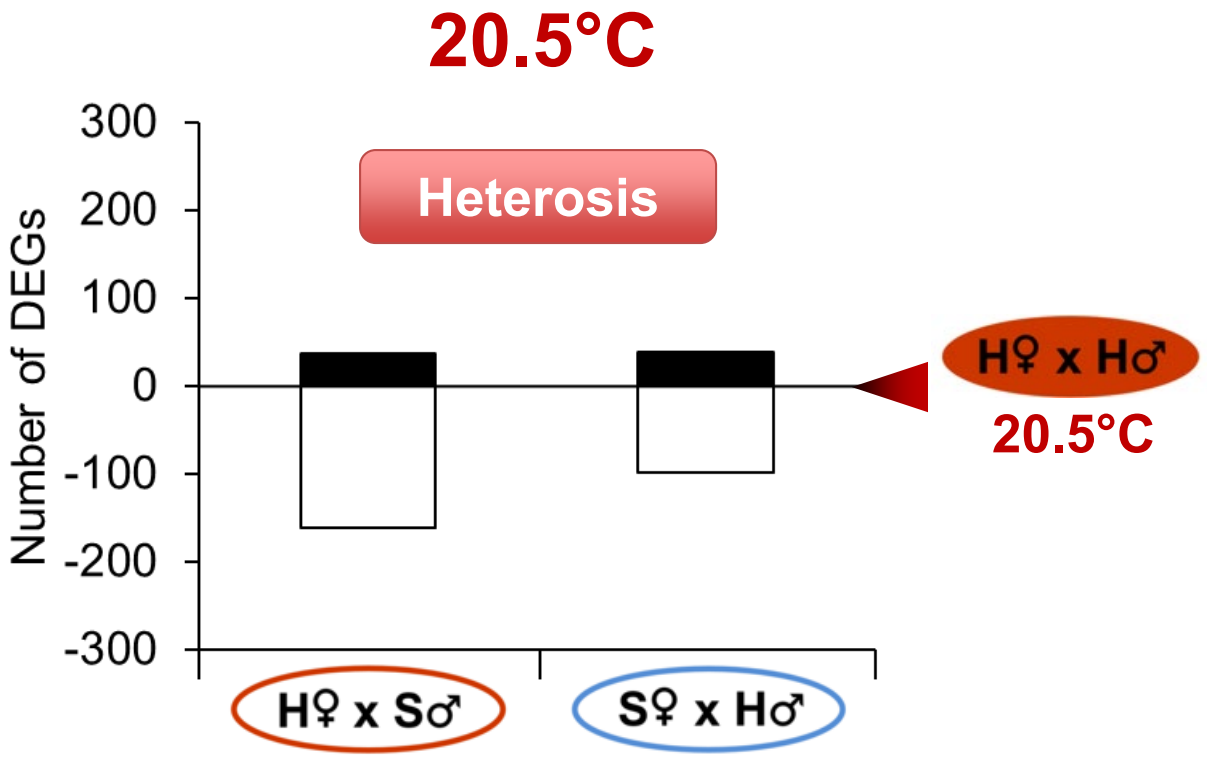


n = 3, DESeq2 ($p < 0.001$, $\log_2 FC > 2$)



Kültz (2005). Molecular and evolutionary basis of the cellular stress response. Annu Rev Physiol.
Zhang et al. (2020). Exploring core response mechanisms to multiple environmental stressors via a genome-wide study … J Phycol.
Liesner et al. (in prep.). Evidence for increased heat resilience of intraspecific hybrids compared to inbred lineages of the kelp *Laminaria digitata* …

Differential gene expression: Heterosis



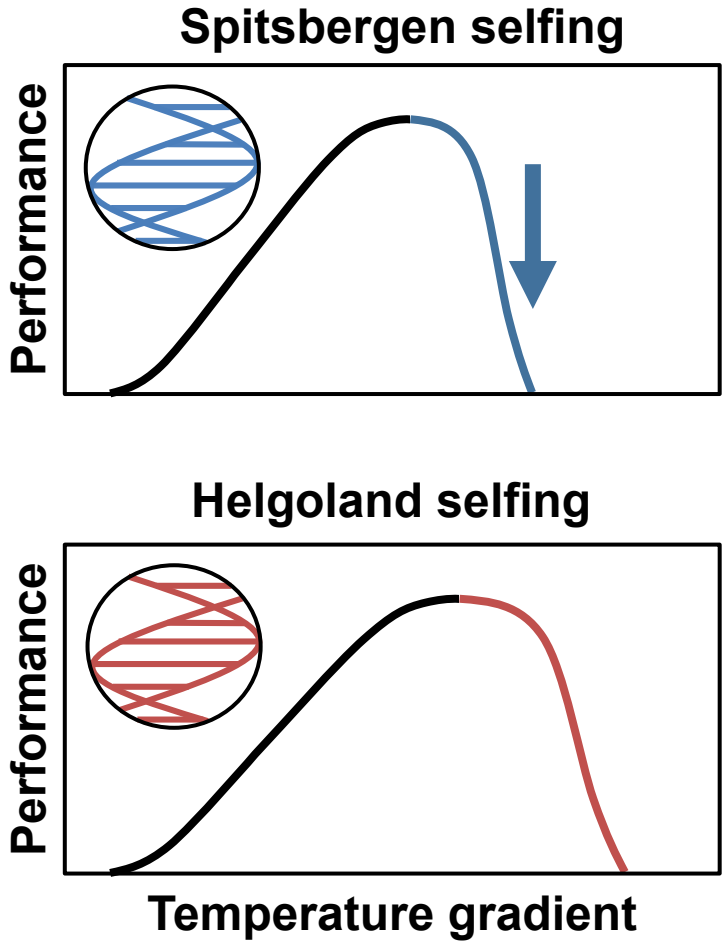
n = 3, DESeq2 ($p < 0.001$, $\log_2 FC > 2$)

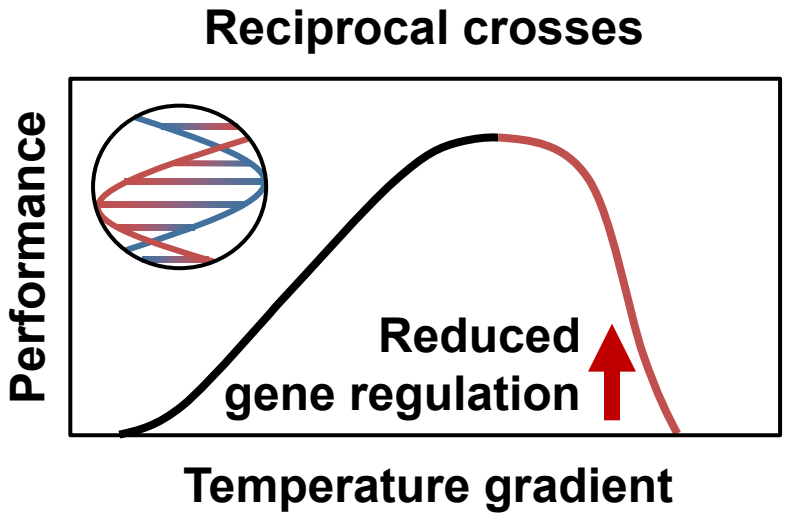
Reduced gene expression in the reciprocal crosses.

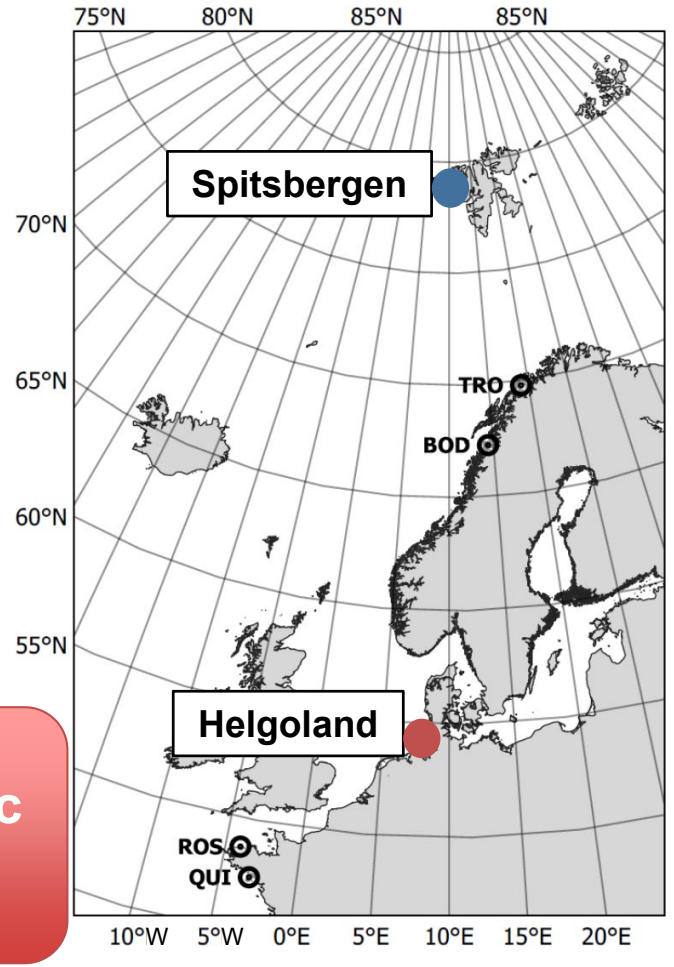
Lower metabolic cost for similar growth response and heat tolerance.

de Nadal et al. (2011). Controlling gene expression in response to stress. Nat Rev Genet.
Liesner et al. (in prep.). Evidence for increased heat resilience of intraspecific hybrids compared to inbred lineages of the kelp *Laminaria digitata* …

Thermal tolerance through outbreeding





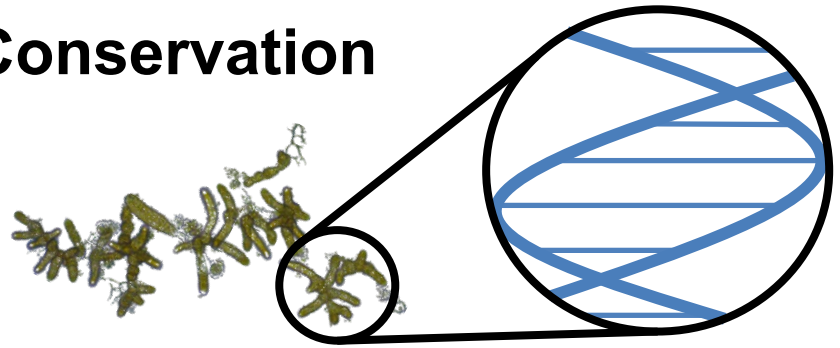


Thermal trait inheritance through female and male parent.

Intraspecific heterosis

Applications and perspectives

Conservation

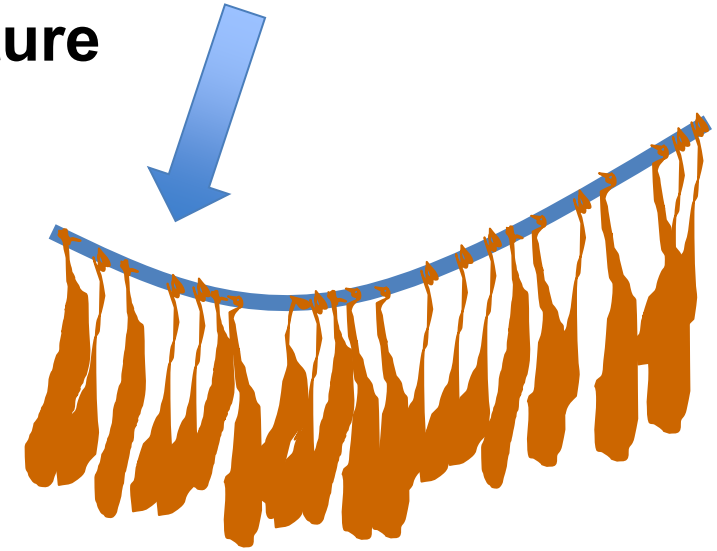


Tolerance

Heterosis

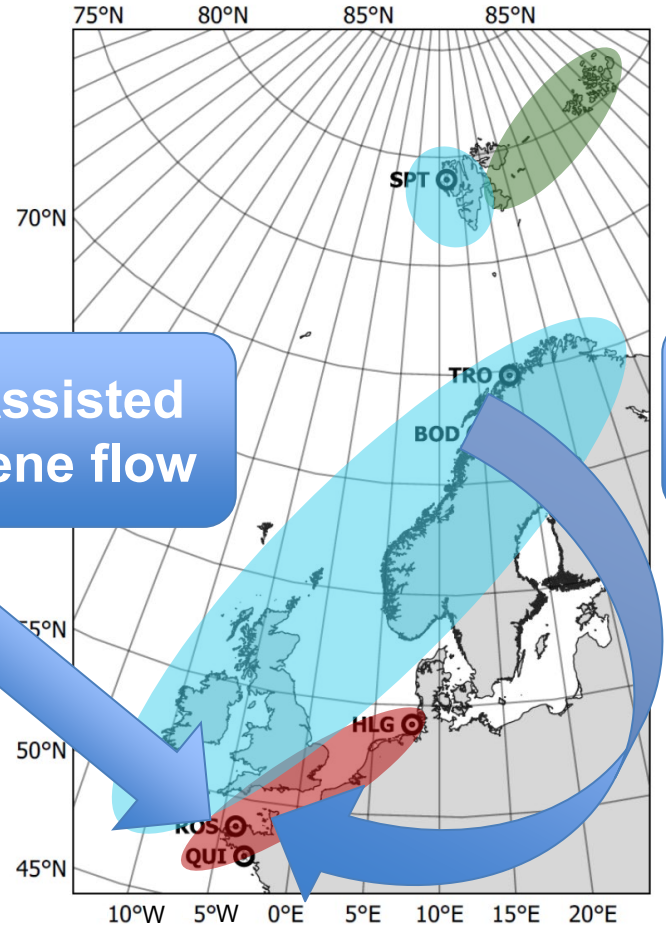
Gametophyte seed bank

Mariculture



Assisted adaptation

Assisted gene flow



Genetic rescue

Coleman et al. (2020). Restore or redefine: future trajectories for restoration. Front Mar Sci.

Thank you!

I thank DFG Deutsche Forschungsgemeinschaft for funding within the ERA-Net Cofund biodiversa program MARFOR (VA 105/25-1).

Personal thanks to

Neusa Martins
Myriam Valero
Louise Fouqueau
Cátia Monteiro
Huiru Li
Andreas Wagner
Claudia Daniel