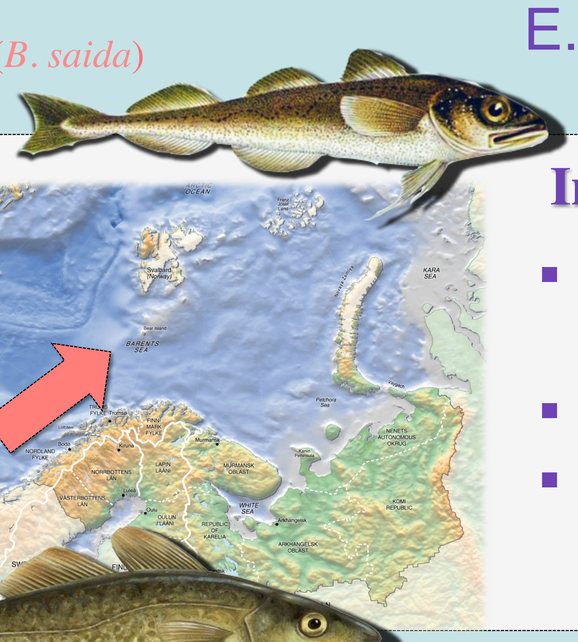
BIOACID
Biological Impacts of Ocean ACIDification

Consortium 4: Species interaction at distribution boundaries
WP 4.2: Mitochondrial and cellular energy budget

Effects of OAW on the functioning of fish heart mitochondria

E. Leo, D. Storch. H-O Pörtner, F.C. Mark

Polar cod (*B. saida*)



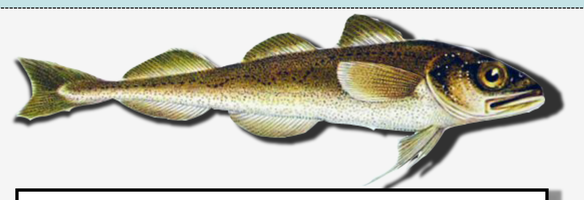
Atlantic cod (*G. morhua*)

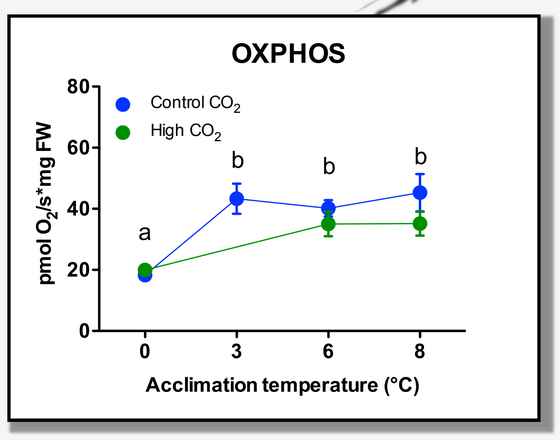
Introduction:

- Distribution areas of Polar cod (*Boreogadus saida*) and Atlantic cod (*Gadus morhua*) are increasingly overlapping in the waters around Svalbard.
- The heart plays a key role in setting the thermal tolerance of fishes.
- OAW may affect the cardiac mitochondrial metabolism and cause an impairment of ATP demand/production.

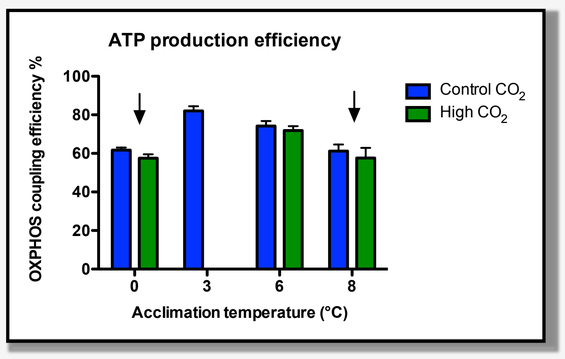
Objectives:

- Study if and how OAW alters cardiac mitochondrial metabolism in fish.
- Investigate the acclimation potential of fish heart metabolism.
- Year 2100 predictions for the Arctic: +2.5°C-1170μatm CO_2

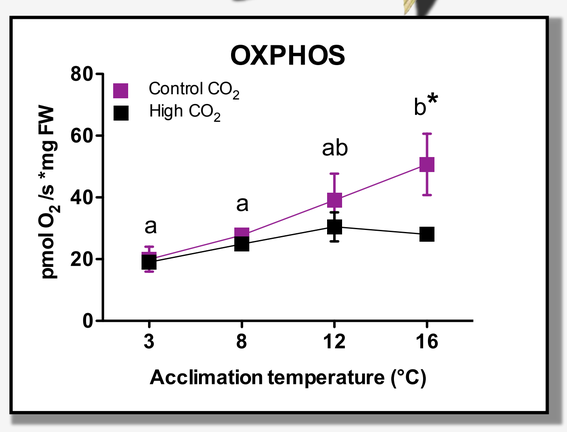




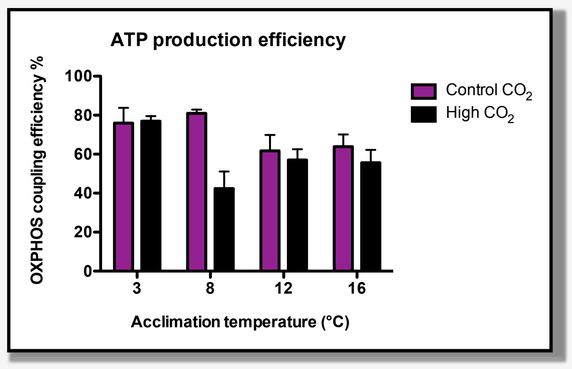
Polar cod OXPHOS (oxidative phosphorylation) increases between the lower end of the thermal window (0°C) and the preferred temperature (3°C) and then remains unchanged up to 8°C, moreover it is not affected by high PCO_2.



ATP production efficiency is maximal at 3°C and drops significantly at the limits of the thermal window.



Oxidative phosphorylation capacity (OXPHOS) of Atlantic cod increases progressively with rising temperature. OXPHOS is reduced at 16°C under high PCO_2.



ATP production efficiency is maximal at 8°C and declines at higher temperatures to achieve the minimum at 16°C.

Conclusion:

Polar cod has limited capacity to adjust its cardiac mitochondrial metabolism to increasing temperatures, consistent with the adaptation to the cold and stable Arctic waters.

Atlantic cod is able to adjust its mitochondrial metabolism with rising temperature indicating higher thermal acclimation capacity. However the exposure to high PCO_2 reduces the phosphorylation capacity in Atlantic cod at the upper thermal limit, indicating a loss in plasticity and thus, a narrowing of the animals' thermal window under ocean acidification.

Alfred Wegener Institut Helmholtz-Zentrum für Polar-und Meersforschung- www.awi.de -BIOACID Phase II Final Meeting Kiel 6 - 7 Oct. 2015

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Correspondence:
Elettra Leo
PhD student
Alfred Wegener Institut, Bremerhaven
elettra.leo@awi.de