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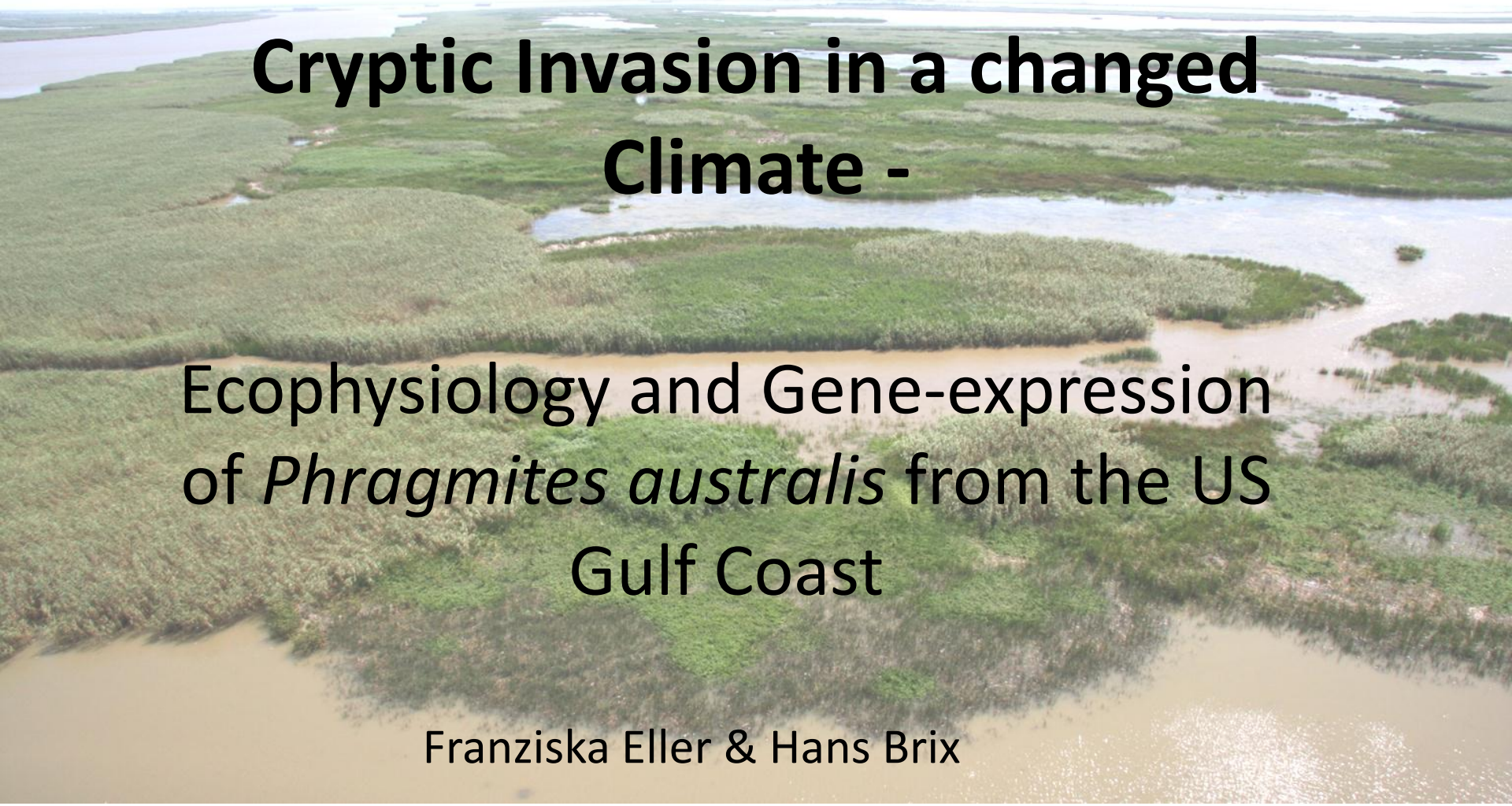


Cryptic Invasion in a changed Climate -

Ecophysiology and Gene-expression of *Phragmites australis* from the US Gulf Coast

Franziska Eller & Hans Brix

- **Cryptic invasion**
  - European lineage is displacing native stands
  - Gulf Coast (GC) is a Hot Spot of *Phragmites* diversity

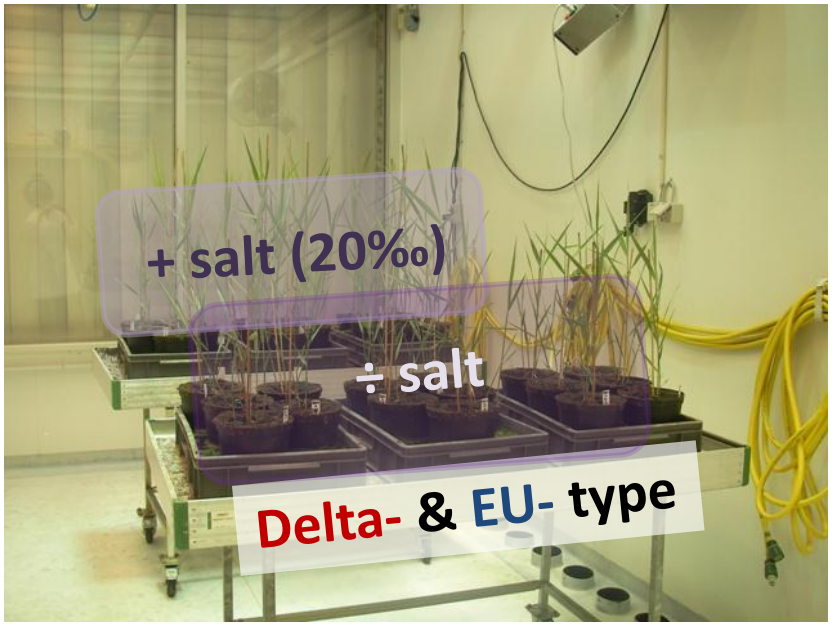
    - Delta-type → African/Mediterranean origin
    - EU-type → European invasive N-American population

EU-type

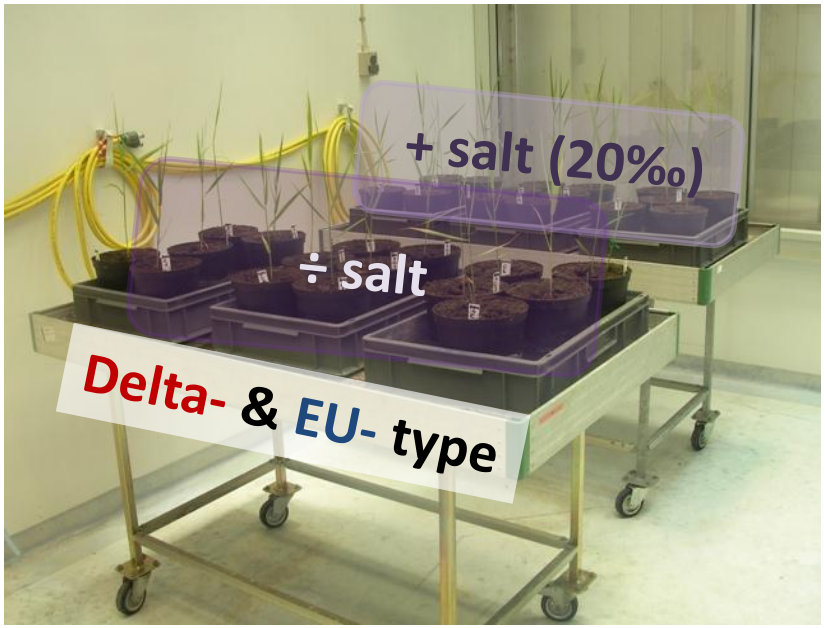
Delta-type

- **Investigation**
  - Which of the two competing reed-types is ecophysiologically superior?
    - Salinity
    - Future climate
  - Are there differences in gene-expression of genes related to stress-response and photosynthesis?

- **Experimental design**

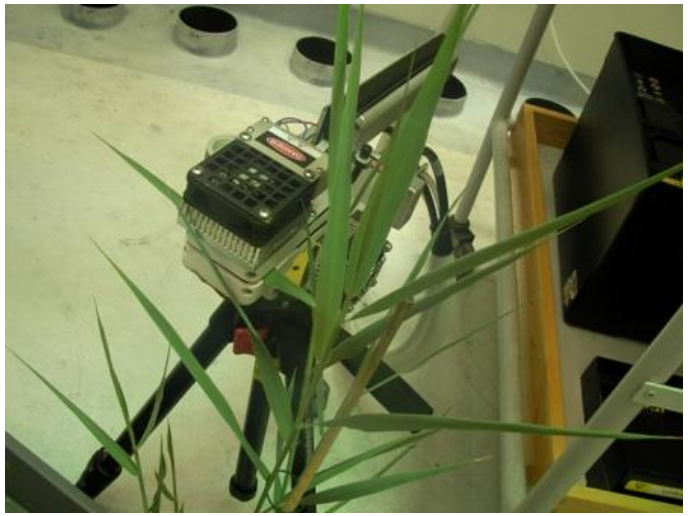


”Future climate” treatment
(24/19°C; 700 ppm CO_2)



Ambient treatment
(19/14°C; 385 ppm CO_2)

– 11 weeks of growth
– weekly measurement of growth parameters
– Gas-exchange: CO_2-response
Light-response



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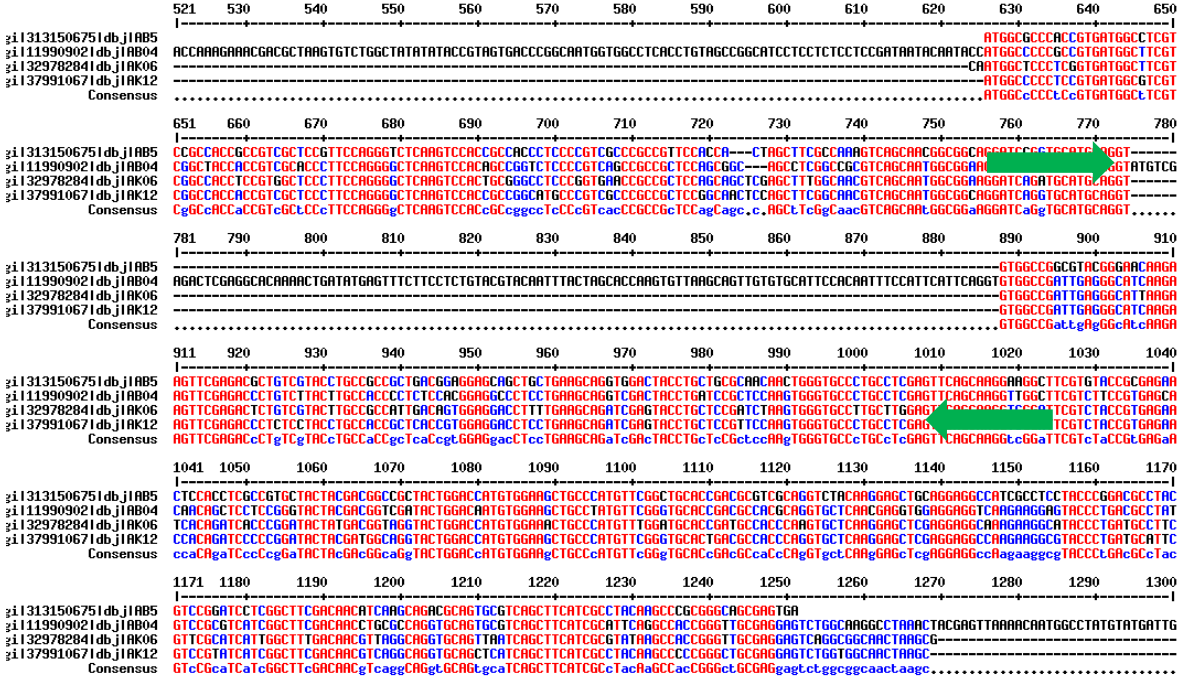
- Gene-expression analysis by RT-PCR
- Primers designed by alignment of homologue gene sequences of Poaceae



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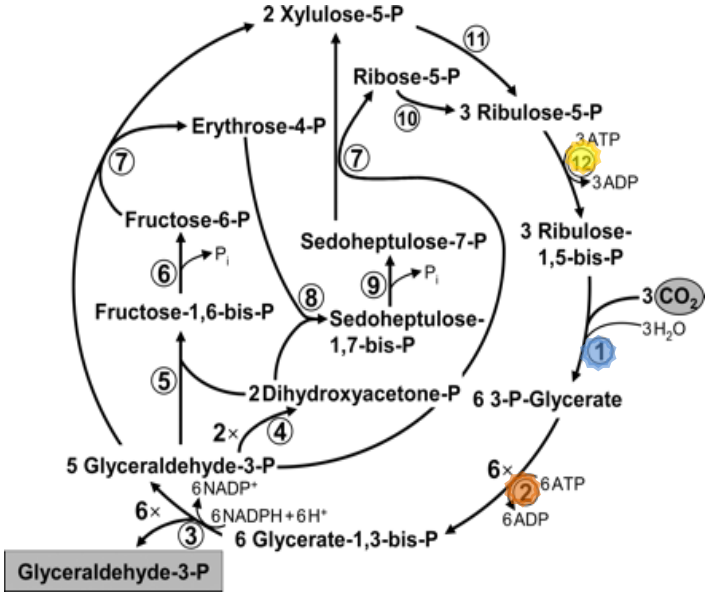
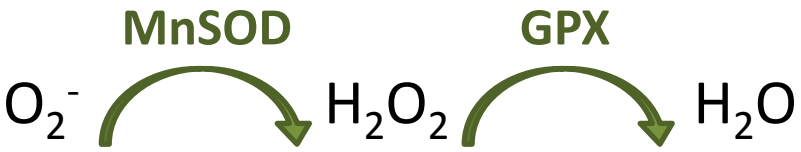
– Genes of interest
  - rbcS – small subunit of Rubisco
  - Phosphoglycerate kinase
  - Phosphoribulokinase



  - Na^+/H^+ antiporter
  - GPX – Glutathione peroxidase
  - MnSOD – Mn Superoxide dismutase



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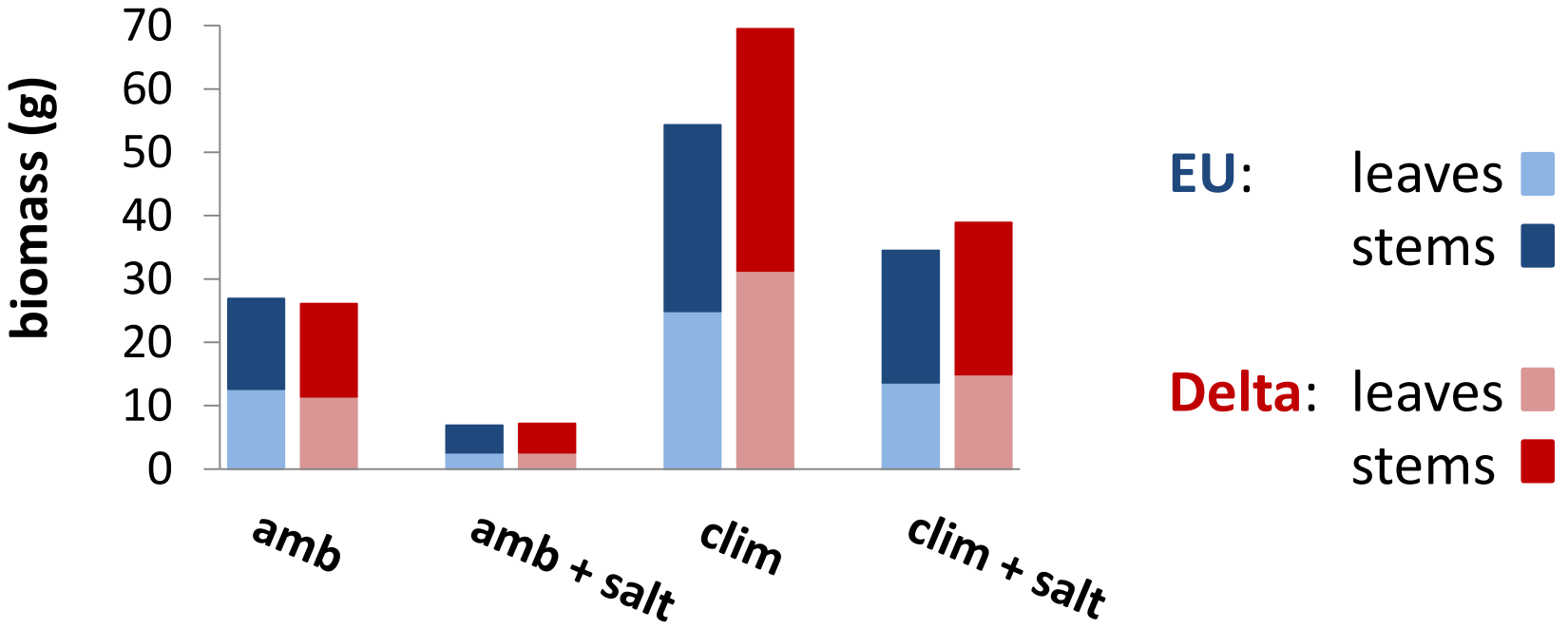
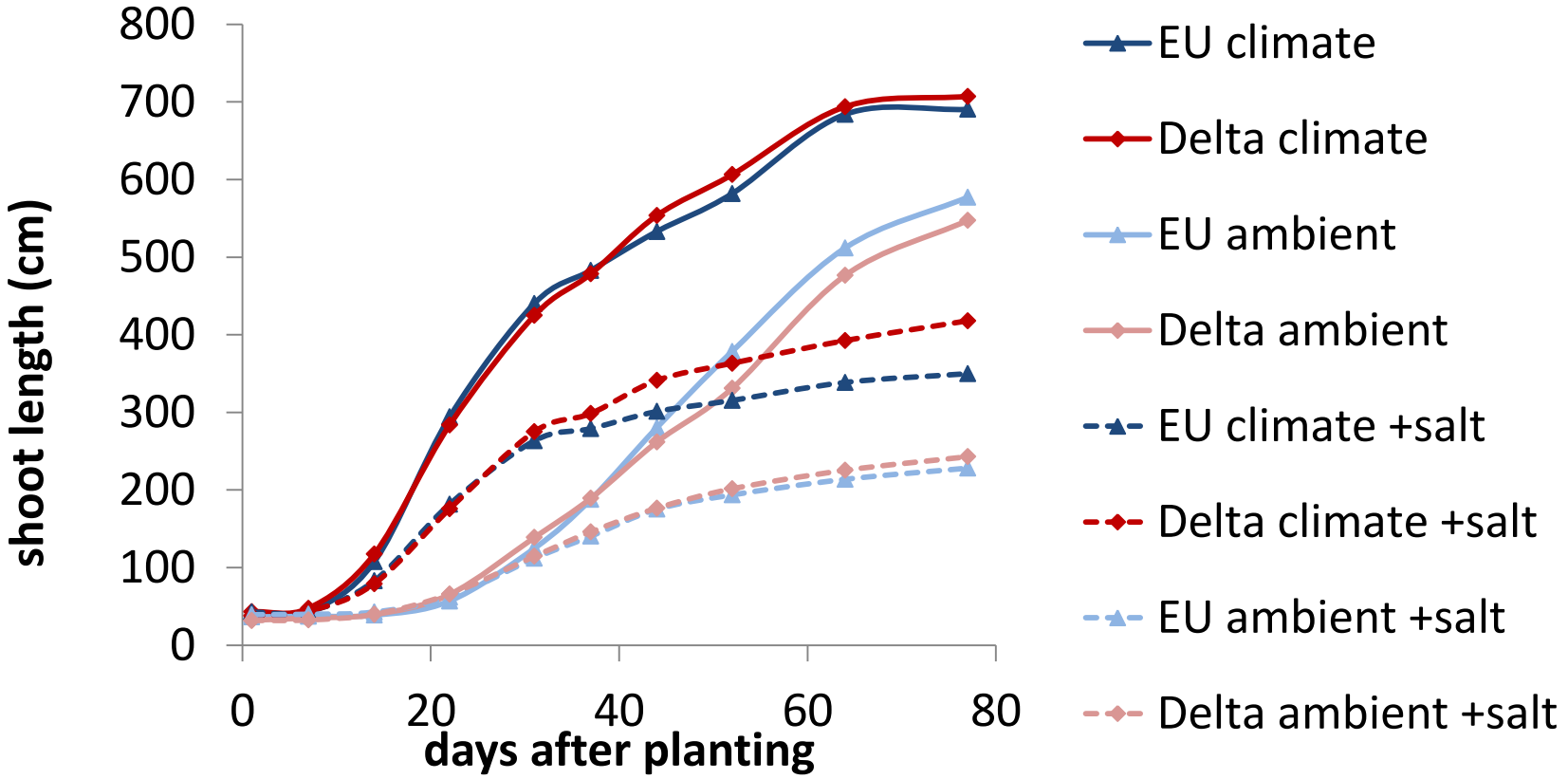
- **Results**

Parameter	Main factors			Interactions		
	Genotype	Salt	Climate	Genotype × Salt	Genotype × Climate	Salt × Climate
Final biomass	0.4	406.7***	566.5***	0.3	2.3	0.1
Leaf dry mass	1.5	77.7***	111***	0.5	2.7	2.8
Stem dry mass	3.1	36.1***	109.6***	0.7	2.4	0.1
Leaf production rate	0.6	66.1***	308.5***	0.0	0.0	11.7**
Shoot production rate	0.3	9.2**	162.9***	0.1	0.2	5.5*
Shoot elongation rate	4.2*	681.4***	152.8***	7.9**	1.2	19.3***
Quantum yield	3.9	0.6	38.1***	0.3	0.3	0.4
P_{max}	4.8*	6.5*	37.4***	0.2	0.1	21.9***
Light compensation pt.	0.2	0.3	60.5***	0.1	0.6	8.9**
Dark respiration	2.7	0,0	17.2***	0.0	0.0	8.9**
Light saturation pt.	2.3	9.0**	10.7**	0.2	0.3	40.5***
CO_2 compensation pt.	0.5	11.7**	21.7***	0.1	0.9	3.1
V_{cmax} (carboxylation rate)	5.5*	2.1	38.2***	0.9	0.0	0.3
J (electron transport)	5.5*	0.0	5.9*	0.9	0.1	0.5
E (transpiration rate)	1.2	38.5***	10.6**	0.2	0.3	19.9***
Water use efficiency	2.5	9.5**	0.7	0.6	0.8	0.7

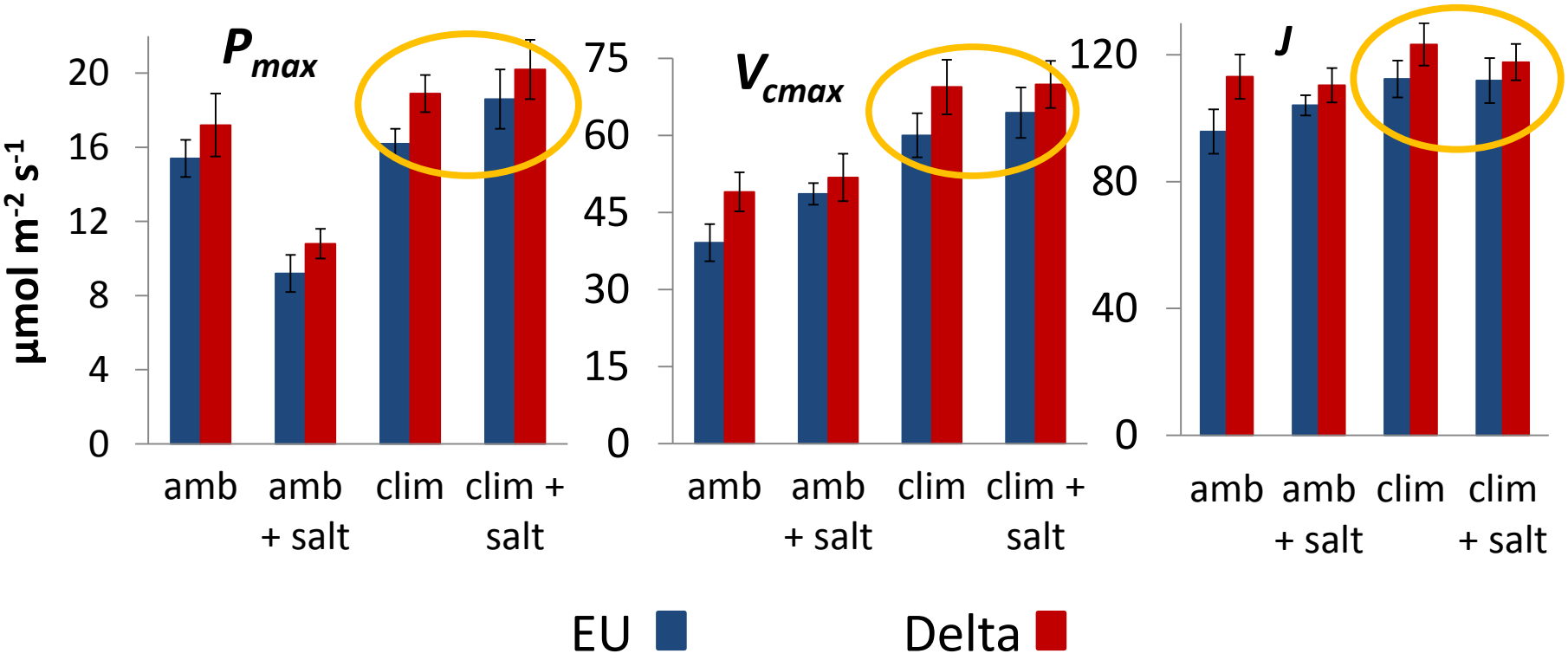
– Future climate enhanced growth & biomass
– Salt stress diminished growth **but:** less severe under future climate conditions



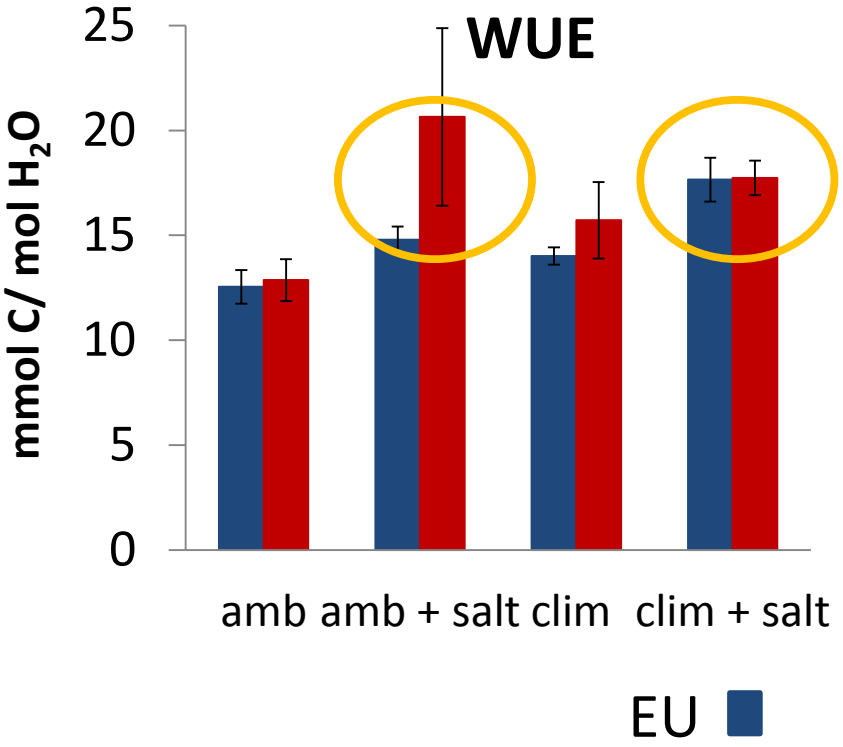
– **Shoot elongation rate** – only significant difference between of genotypes (growth)

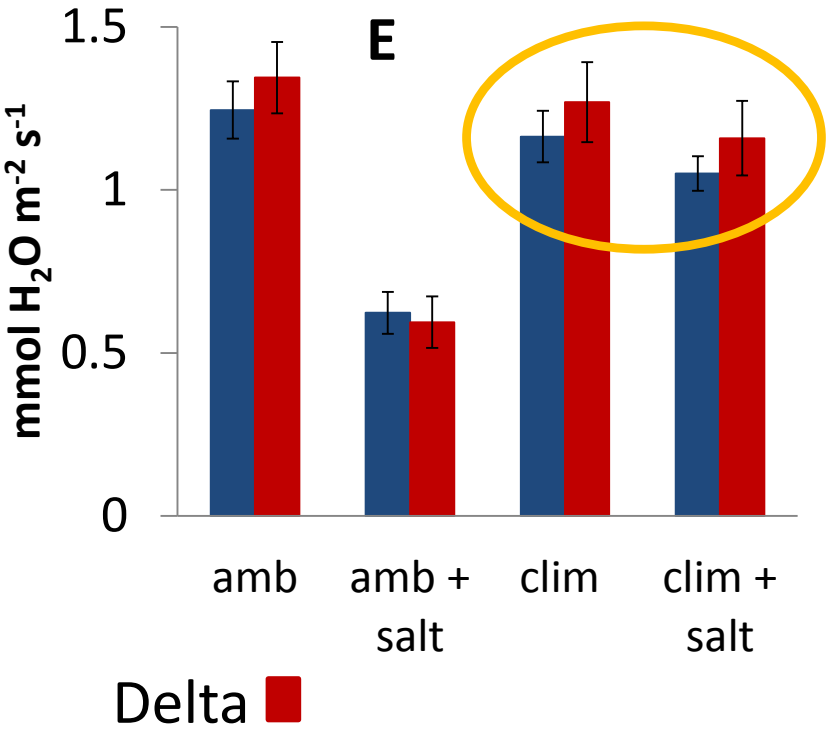


– **P_{max}, V_{cmax}, J**: only significant difference between genotypes (physiology)



- **WUE (P_{max}/E)**: high under salt stress
- **E (transpiration rate):** little salt impact in future climate

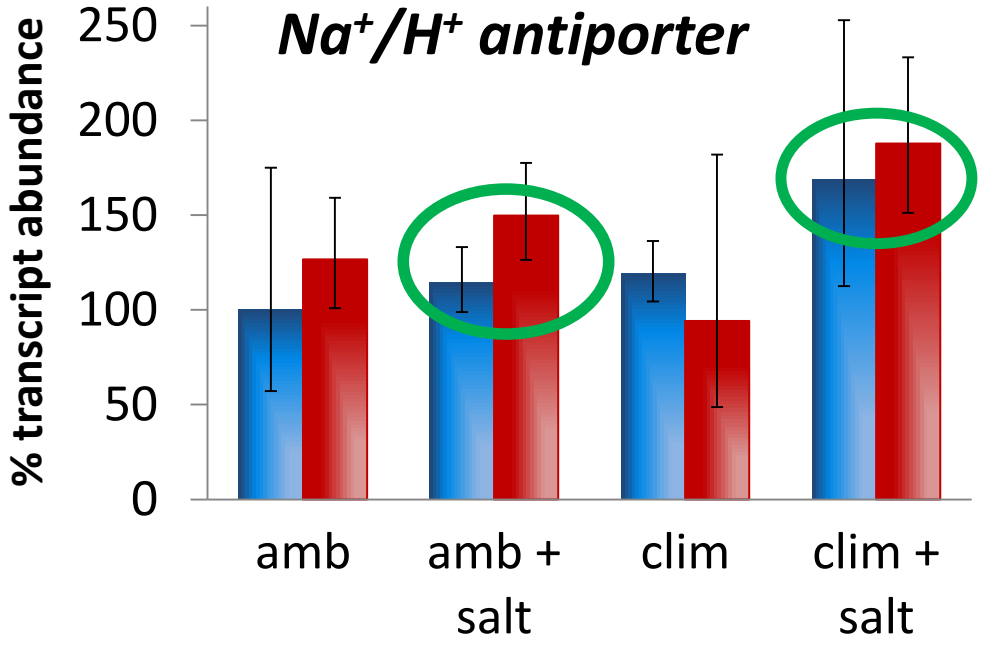




– no significant differences in gene expression

→ *tendency*

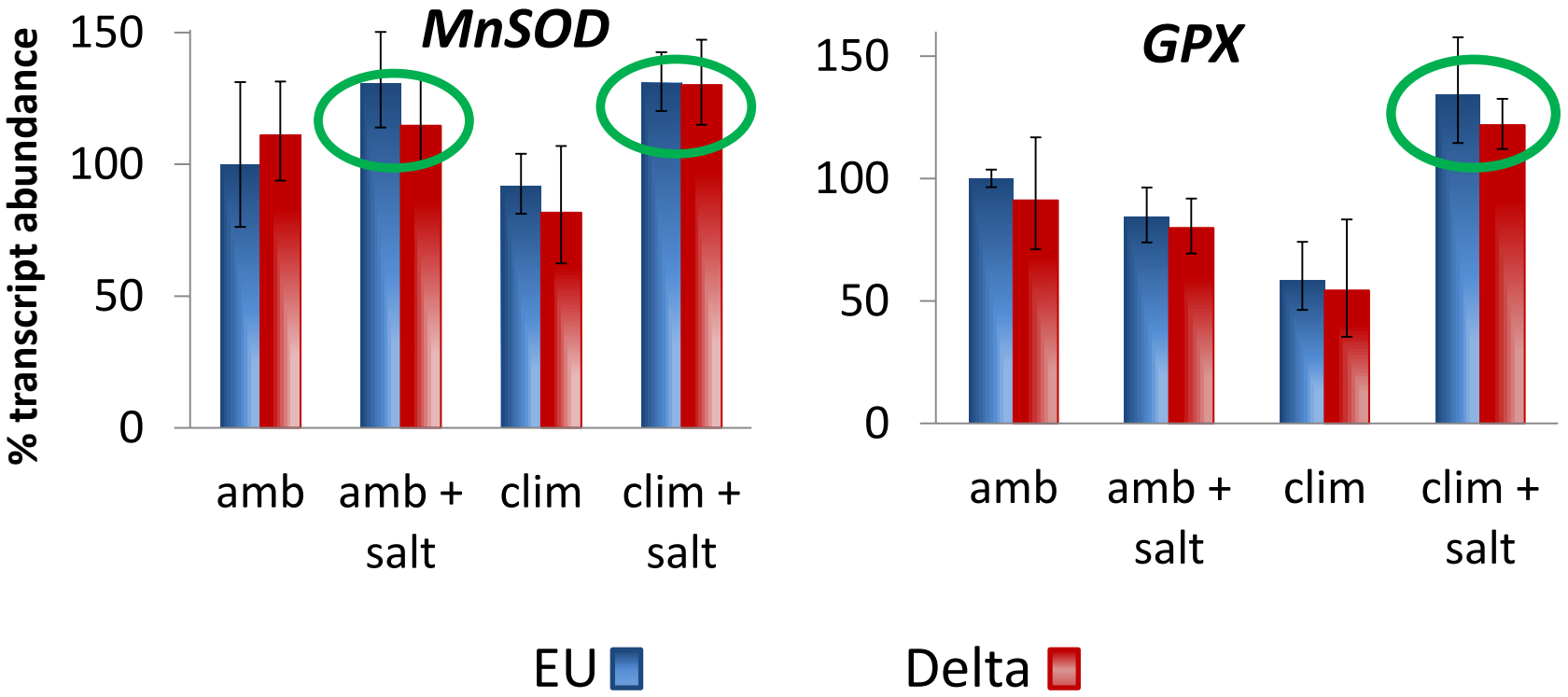
– **Salt stress related genes:**



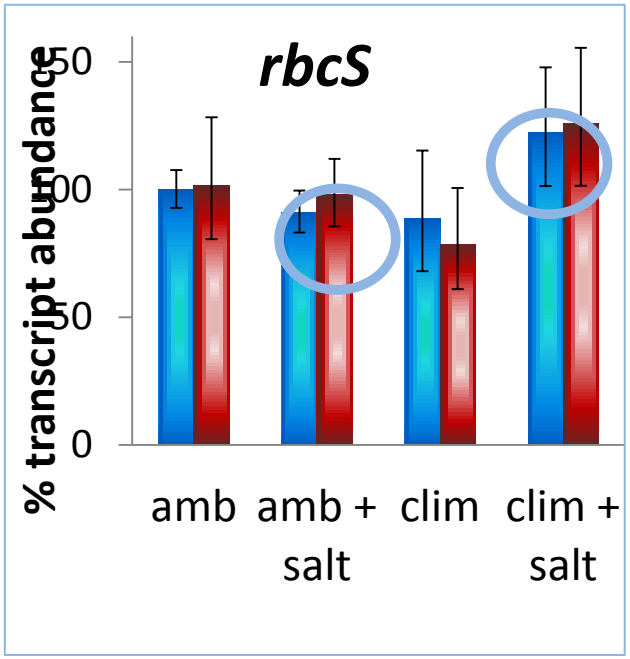
– Up-regulation under salt stress, especially in future climate

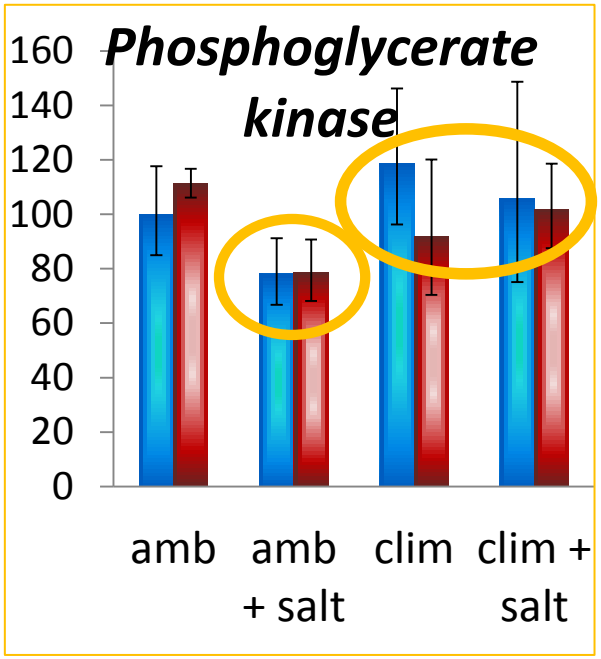
EU Delta

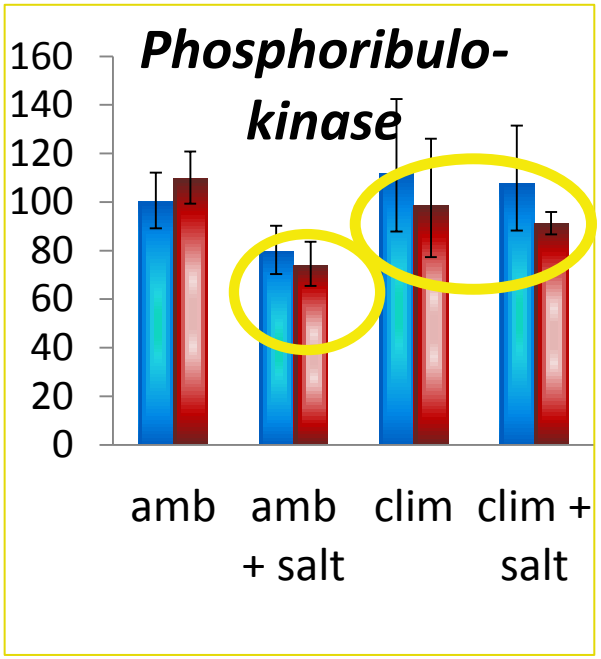
– General stress response (oxygen-scavenging enzymes)
– Up-regulation under salt stress



- **Calvin Cycle related genes:**
- Down-regulation under salt-stress only in ambient climate







EU Delta

– Amelioration of salt stress under ↑ [CO_2] and ↑ temperature:

- ↑ WUE, ↑ C-uptake
- ↑ assimilates for osmotic adjustment
- Osmotic adjustment by ion uptake
- Induction of specific salt stress genes in future climate (GPX)

- **In conclusion**
  - Which of the two competing reed-types is ecophysiologically superior?
    - Delta-type: superior (SER) and few physiological traits
    - Salinity: unfavorable but not severely
    - Future climate: favors growth and withstanding salt stress

→ *Will the Delta-type outcompete the EU-type in the field?*

- Are there differences in gene-expression of genes related to stress-response and photosynthesis?
- **Are those differences reflected in parameters?**

  - In ”future climate + salt” treatment:

    - high transcript abundance
    - high photosynthesis
    - large biomass

→***Yes!*** *(largely)*

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