GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN IN PUBLICA COMMODA SEIT 1737

MAX-PLANCK-INSTITUT FÜR MULTIDISZIPLINÄRE NATURWISSENSCHAFTEN

Evolutionary Genomics: Consequences of Biodiverse Reproductive Systems (EvoReSt)

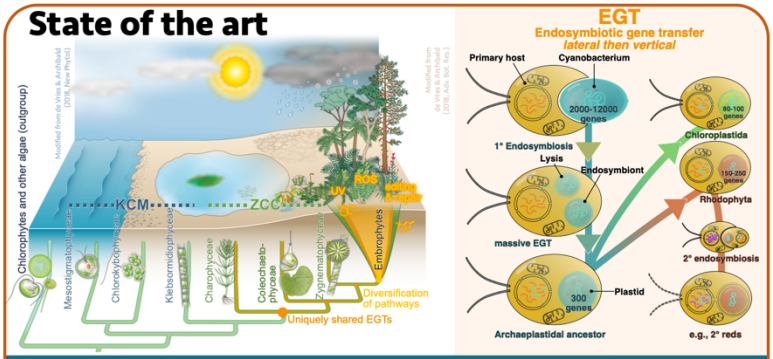
EvoReSt

B3

Consequences of endosymbiotic gene transfer & mosaicism in embryophyte pathways

Jan de Vries

State of the art



Hypothesis: Inherited EGT made unique contributions to algal diversification & plant terrestrialization, visible in gene families (1) and rates (2).

Objectives

Macro

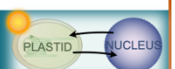
- Quantify: contribution of EGT to the diversification of gene families salient to specialized metabolic pathways, and plastid–nucleus communication

Micro

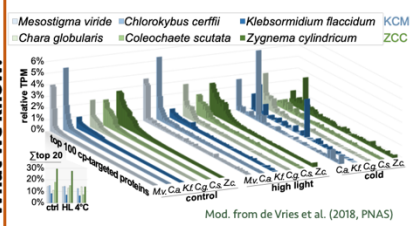
- Scrutinize: lineage-specific differences in mutation rates in organelles, transferred genes and those genes identified in project 1

PhD 1 - Macroevolutionary

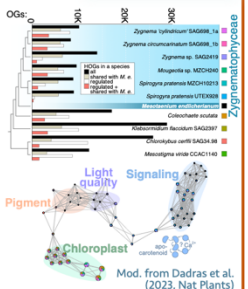
Q: How did EGT contribute to gene evolution in nucleo-plastid interaction?



What we know:



Mod. from de Vries et al. (2018, PNAS)



Mod. from Dadras et al. (2023, Nat Plants)

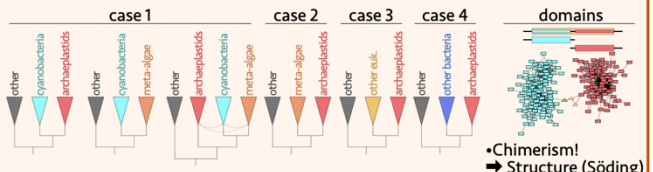
streptophyte algae close to land plants:

- plastid-associated responses stand out

➡ Implications for genetic plastid-nucleus interactions

What we will do:

- Use a phylodiverse dataset of eukaryotes and bacteria
- We will quantify (a) genes & (b) domains derived from EGT
  (a) employ clustering followed by high-throughput ML trees
  (b) employ networks and MosaicFinder/FusedTriplets



- Chimerism!

➡ Structure (Söding)

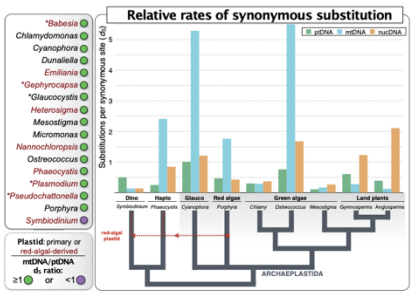
➡ Identify diversified genes in plastid-nucleus interaction

➡ Probe the (streptophyte) algae | land plant divide

GRK Collaborations: Daniel on LGT, Hörandl & Scheu organello-nucleo interactions & pathways, S. de Vries on cyanobiont

PhD 2 - Microevolutionary

Q: What was & is the fate of EGTs/genetic material across the diversity of photosynthetic eukaryotes?



Mod. from Smith (2015, GBE)

- plastid genomes: lower predicted mutation rates than mitochondria BUT land plants often have higher mutation rates in their plastid genomes

➡ Does it hold?

➡ When did this emerge?

- Mitochondrial, plastid, and nuclear genomes (min. 2)
- Between species d_S will be calculated with a min. of 3 species per taxonomic group
- For missing key groups, the plastid will be sequenced (Daniel)

dataset I:	dataset II:	analyses step I:	analyses step II:	analyses step III:	analyses step IV:
sample nuclear and organellar genomes across photosynthetic eukaryotes	sequence and add organellar genomes from missing key groups	identify 'numts' & 'nupts'	identify lineage-specific duplications	identify age of transfer for 'numts' & 'nupts'	substitution rates for: nuclear, mito, cp, numts, nupts

➡ Differences in mutation rates of EGTs and in organelles

➡ d_S along the (streptophyte) algae | land plant divide

➡ How do the genes identified in project 1 evolve?

GRK Collaborations: Söding on novel d_S, Daniel on sequencing

References

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2. de Vries J, Archibald JM. Plastid autonomy versus nuclear control over plastid function. In: Adv. Bot. Res. 85 Elsevier: New York (2018)
3. de Vries J et al. Embryophyte stress signaling evolved in the algal progenitors of land plants. Proc Natl Acad Sci USA 115: E3471-E3480. (2018)
4. Dadras A, ..., de Vries J. Environmental gradients reveal stress hubs predating plant terrestrialization. Nat Plants 9:1419-1438. (2023)
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6. Jachait P-A, ..., Bapteste E. MosaicFinder: identification of fused gene families in sequence similarity networks. Bioinformatics 29: 837-44. (2013)

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