Neighbourhood matters!

Plant survival and fitness is favoured in experimentally manipulated communities with high phylogenetic diversity

Chaves, R., Ferrandis, P., Ortiz, M. L., Escudero, A. & Luzuriaga, A.L.

Universidad Rey Juan Carlos

UCLM Universidad de Castilla-La Mancha

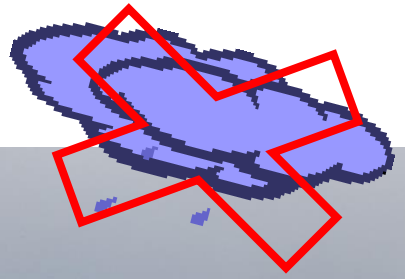
Área de Biodiversidad y Conservación

Anuales Work Group

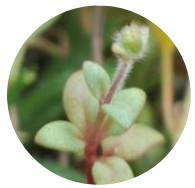
GYPWORLD A global iniciative to understand gypsum ecosystem ecology

Introduction

Gypsum soils

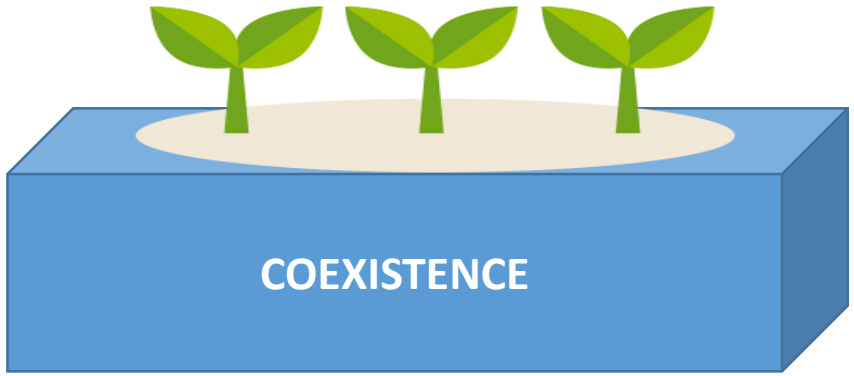


> 100 spp!

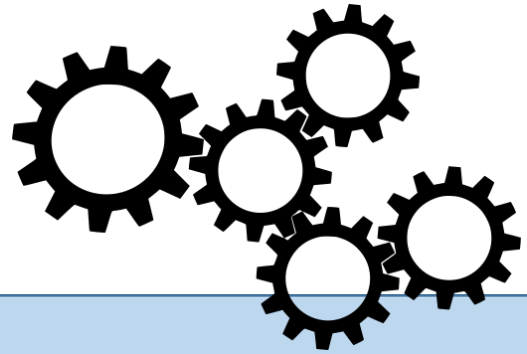


Community assembly

In 20 cm^2 15 - 25 different species!

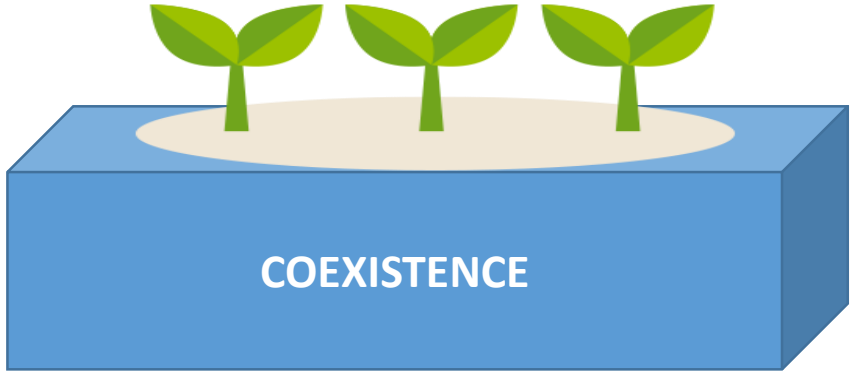


How can they coexist?

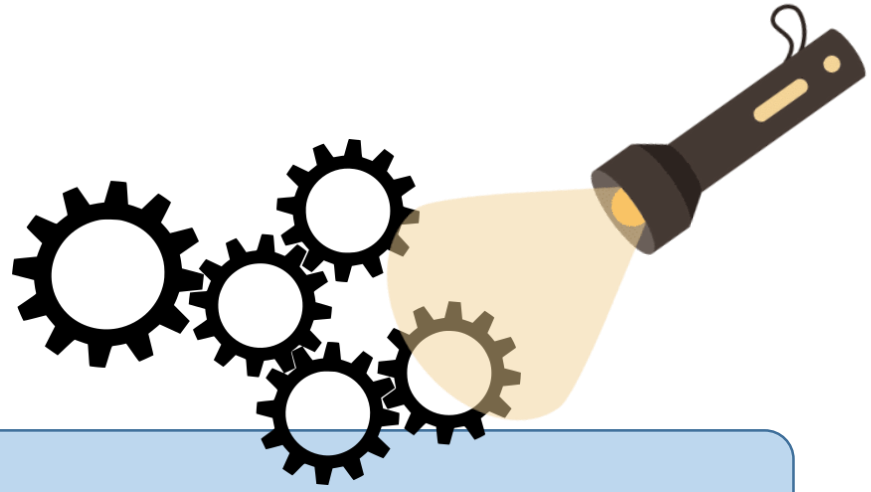


Mechanisms are not well-known yet

In 20 cm^2 15 - 25 different species!

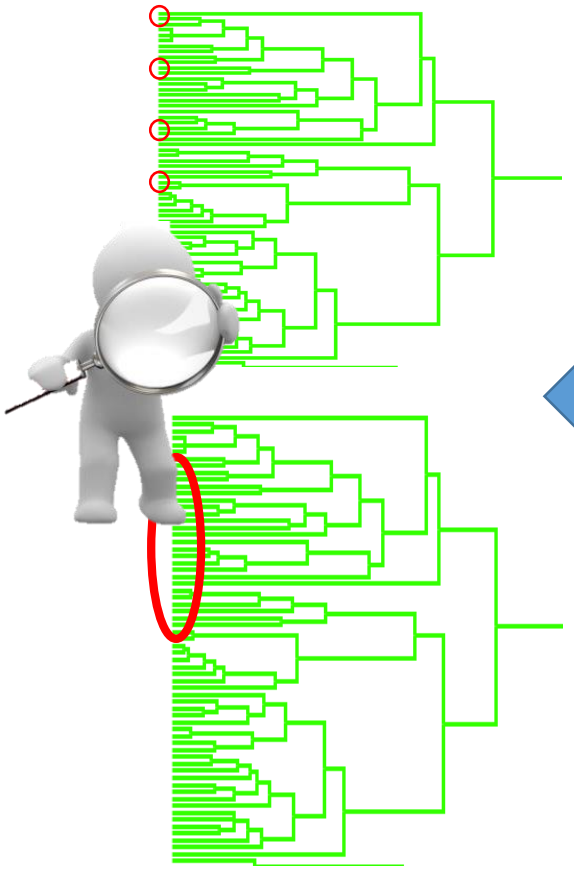


How can they coexist?



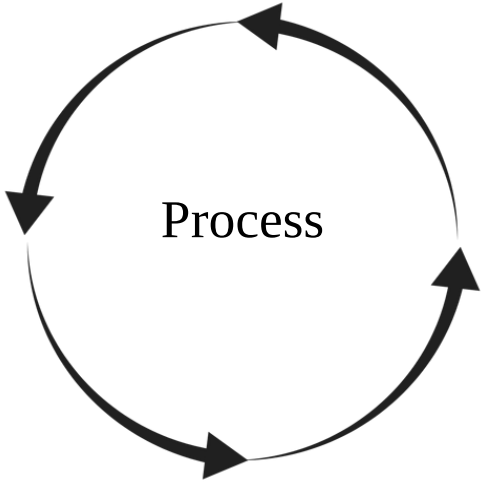
Mechanisms are not well-known yet

Phylogenetic diversity



Previous studies:

extrapolate

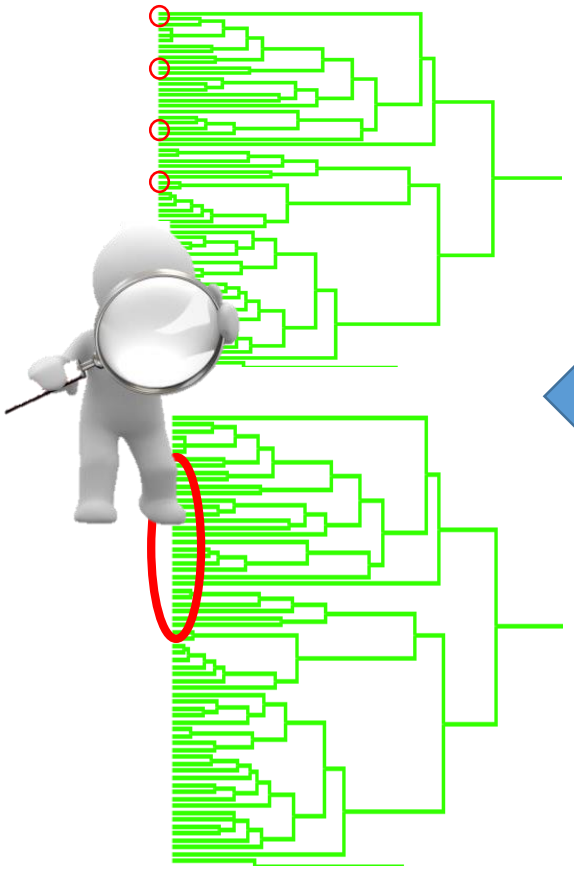


It is an interesting approach because it reflects:

- The evolutionary history of competing species
- Their ecological capabilities (al least in part)

Phylogenetic diversity

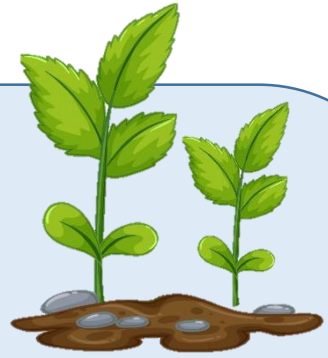
Previous studies:



extrapolate

Process

Divergence



Competence and Facilitation

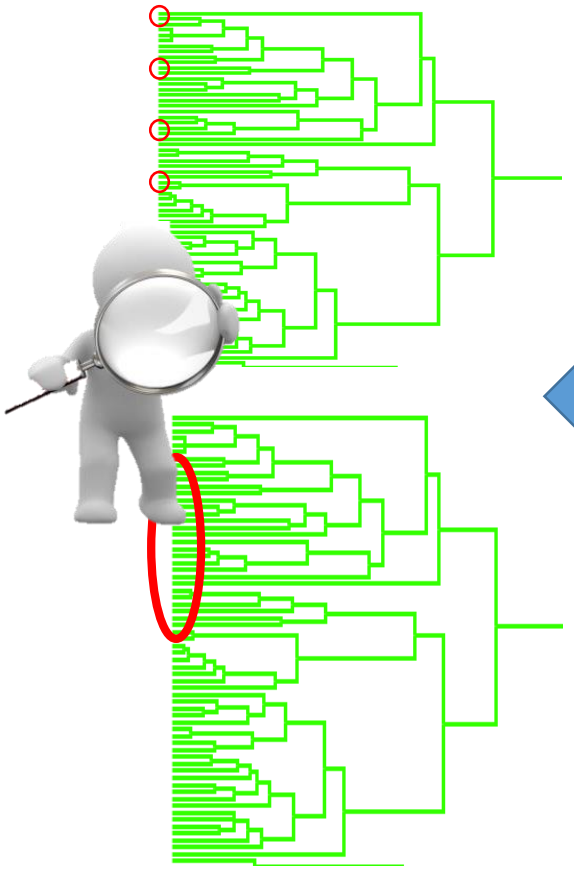
Convergence

Habitat filtering processes
(and others)

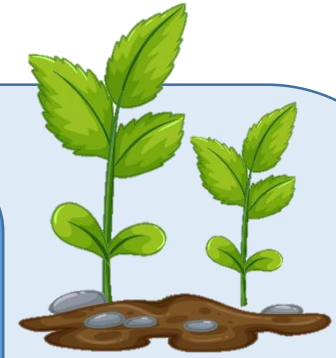
(Webb et al., 2002; Valiente-Banuet & Verdú 2007)

Phylogenetic diversity

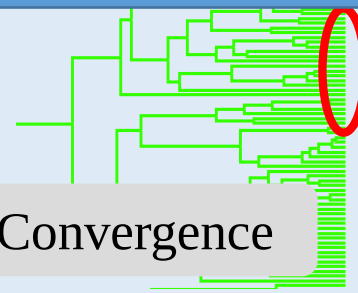
Previous studies:



What is about cause-effect relationships?



Competence and Facilitation



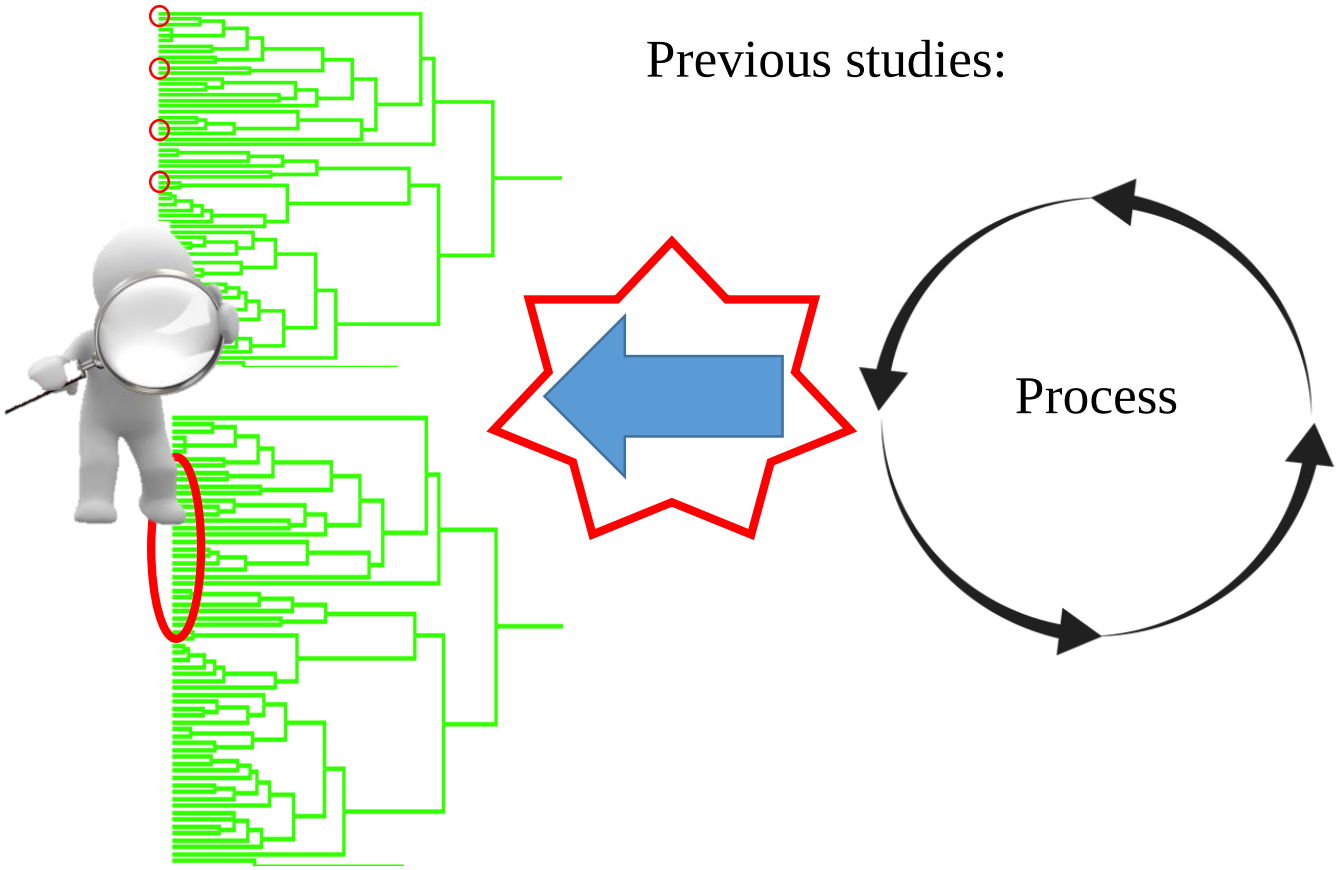
Convergence

Habitat filtering processes
(and others)

(Webb et al., 2002; Valiente-Banuet & Verdú 2007)

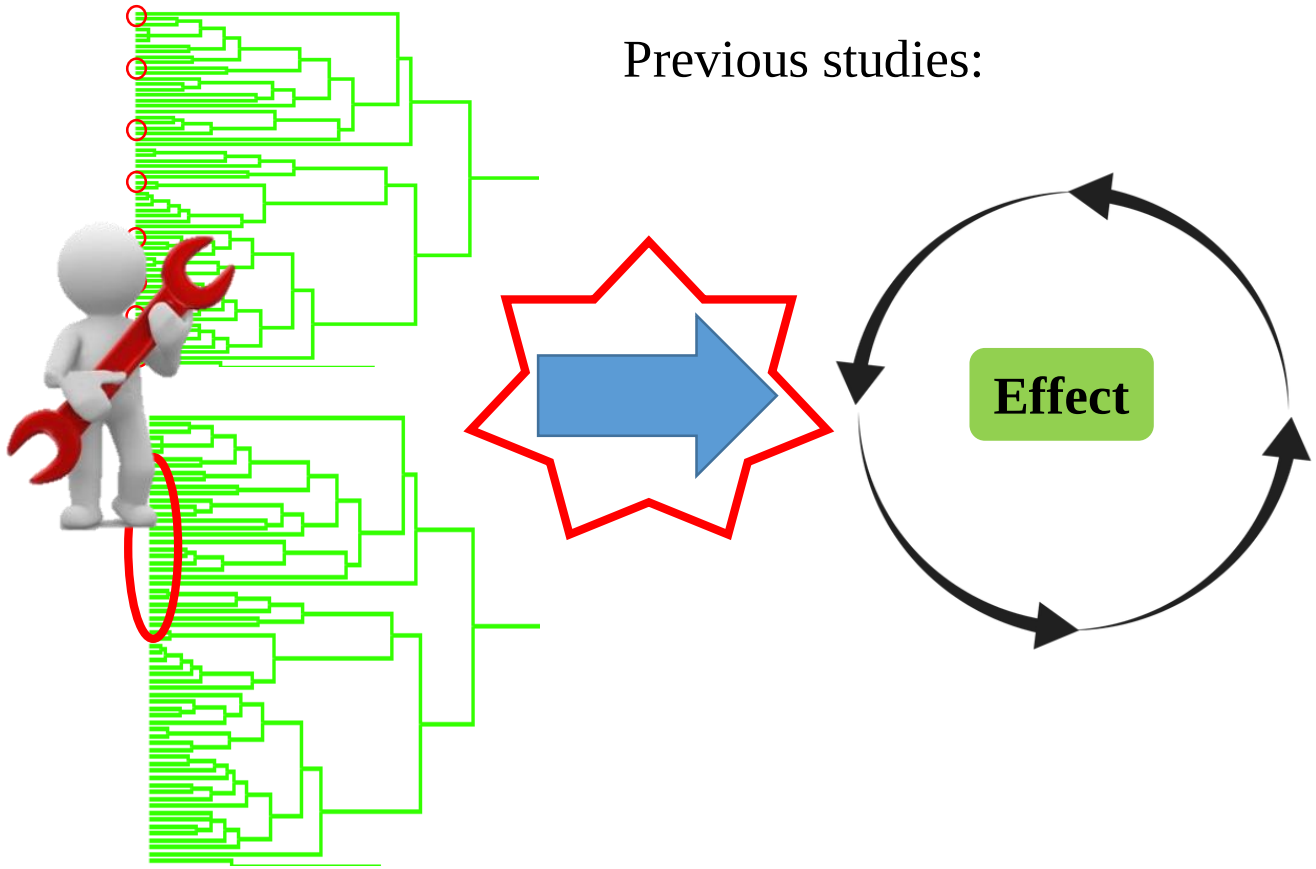
What is about cause-effect relationships?

Previous studies:

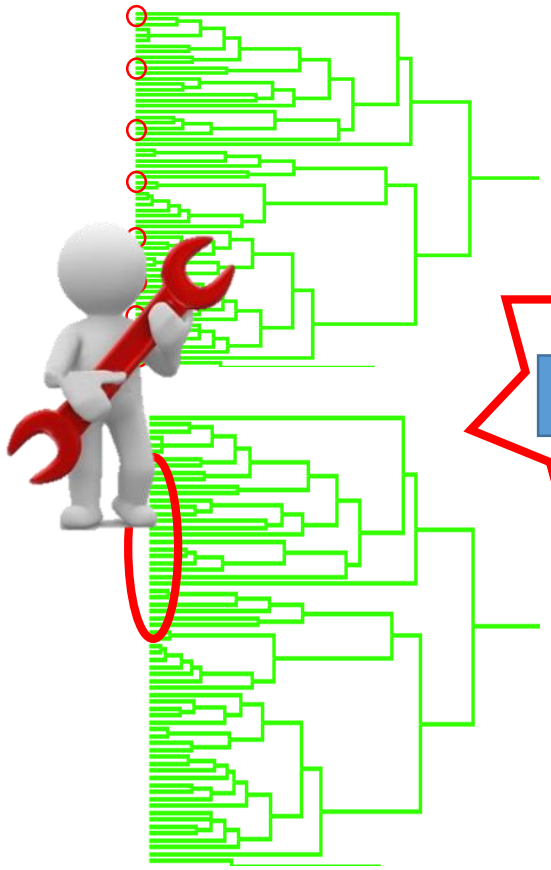


What is about cause-effect relationships?

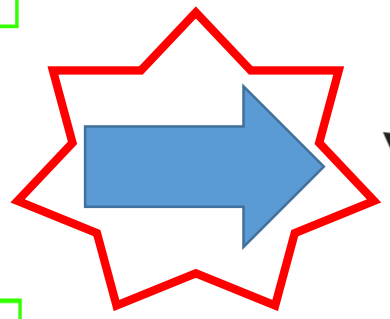
Previous studies:

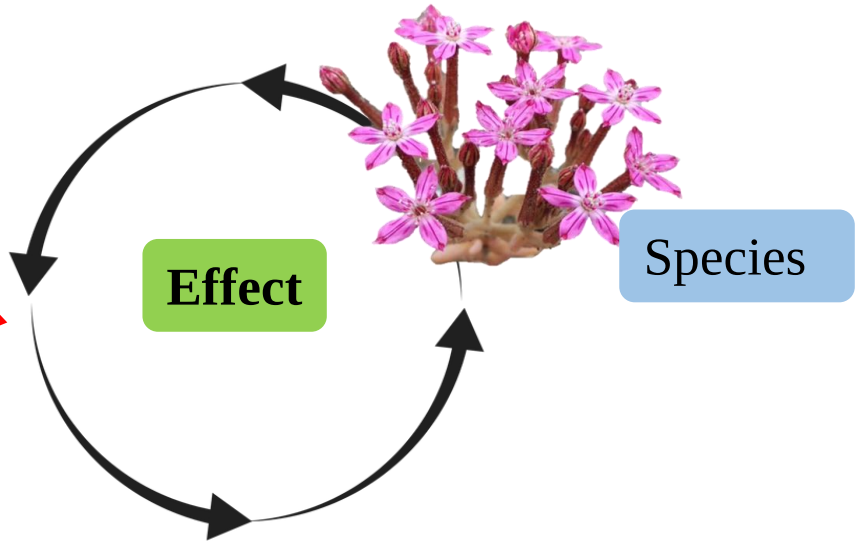


What is about cause-effect relationships?



Previous studies:

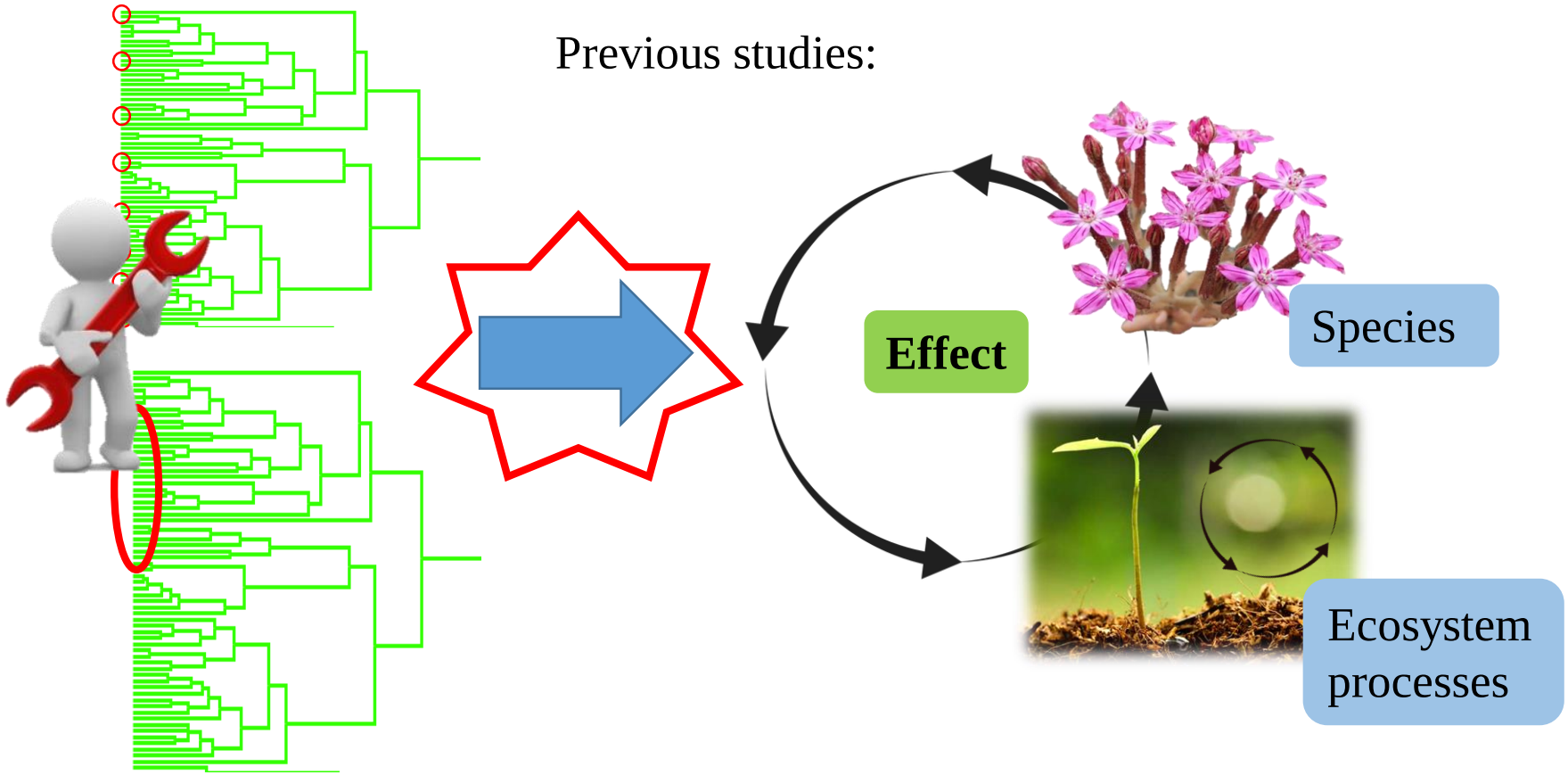




Species

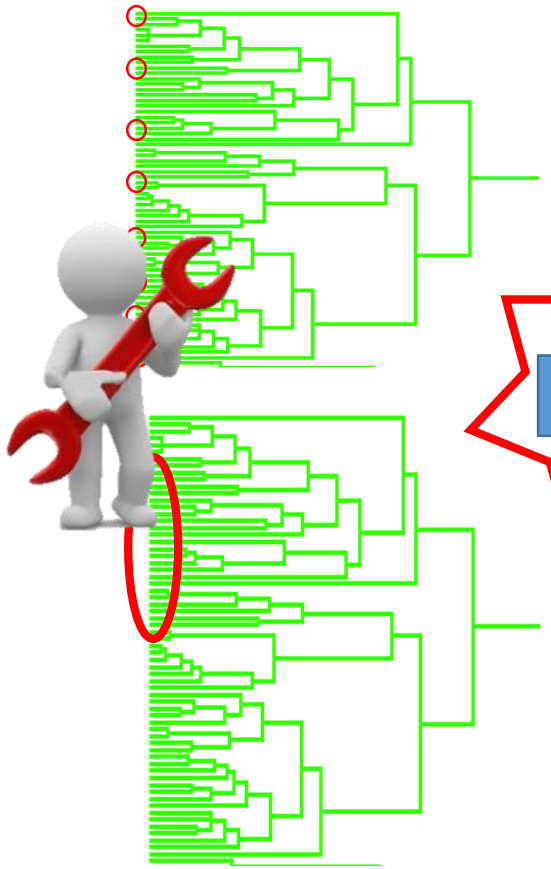
What is about cause-effect relationships?

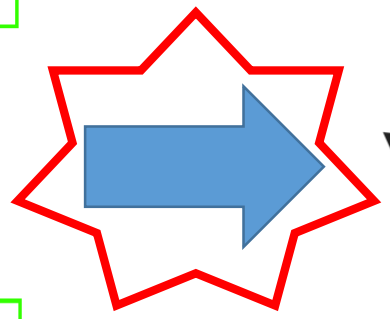
Previous studies:

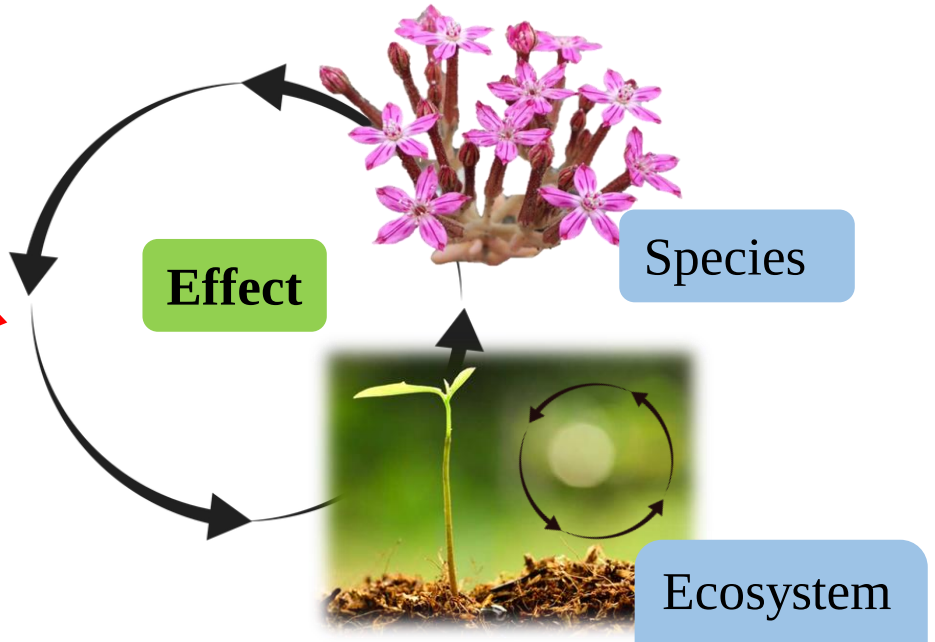


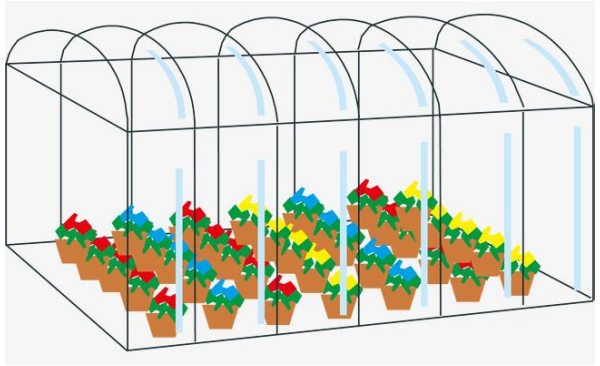
What is about cause-effect relationships?

Previous studies:

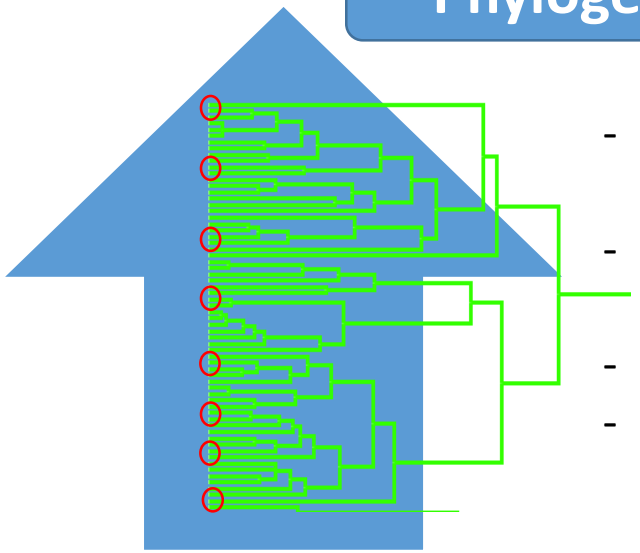




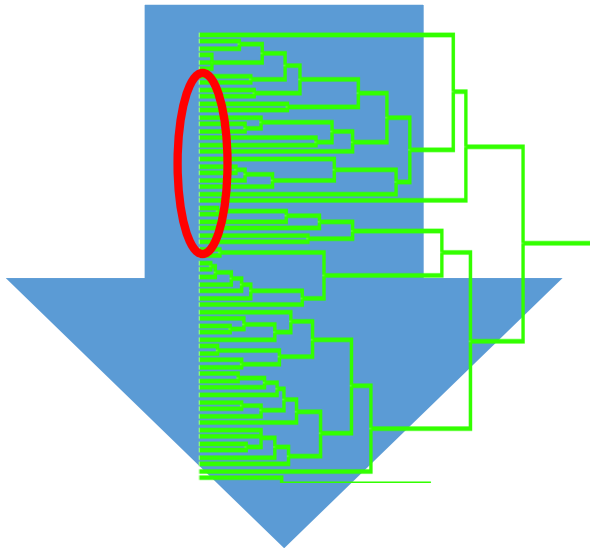




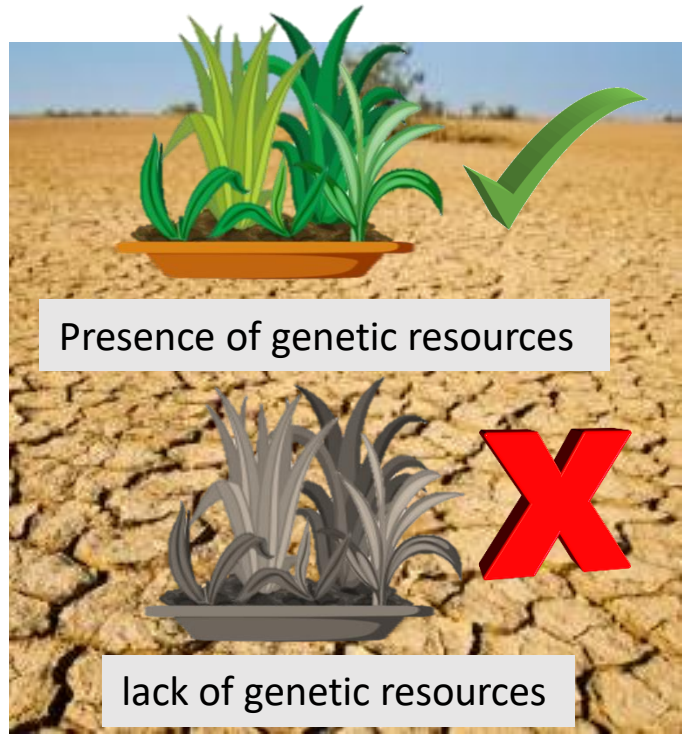
Phylogenetic diversity



- Promote plant productivity and ecosystem stability
- Less prone to compete for the same resources
- Can benefit from facilitative interactions.
- Niche complementarity

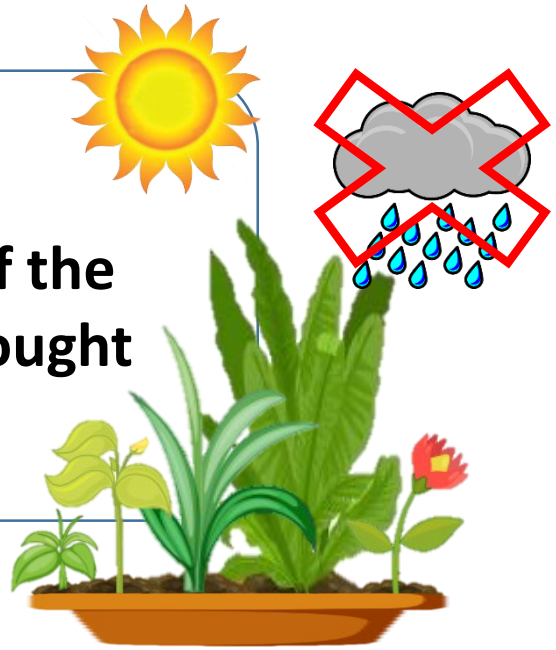


- if there is a conservative trend of functional traits…



Question

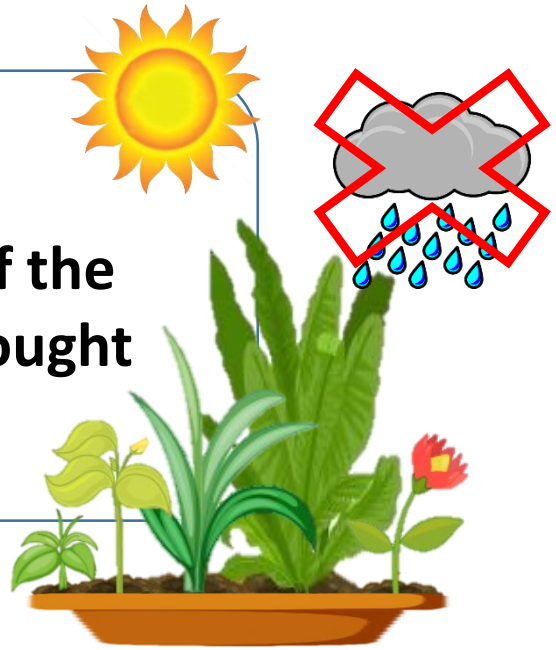
We wanted to evaluate if the phylogenetic structure of the plant community determine individual response to drought



Question

We wanted to evaluate if the phylogenetic structure of the plant community determine individual response to drought

Survival

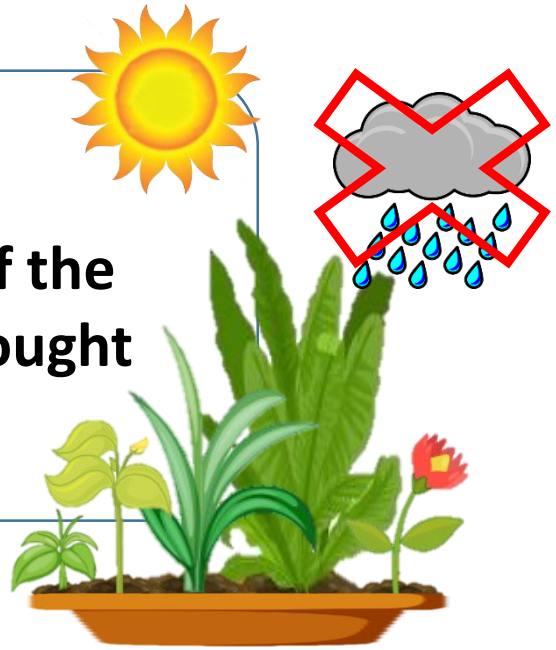


Question

We wanted to evaluate if the phylogenetic structure of the plant community determine individual response to drought

Survival

Fitness

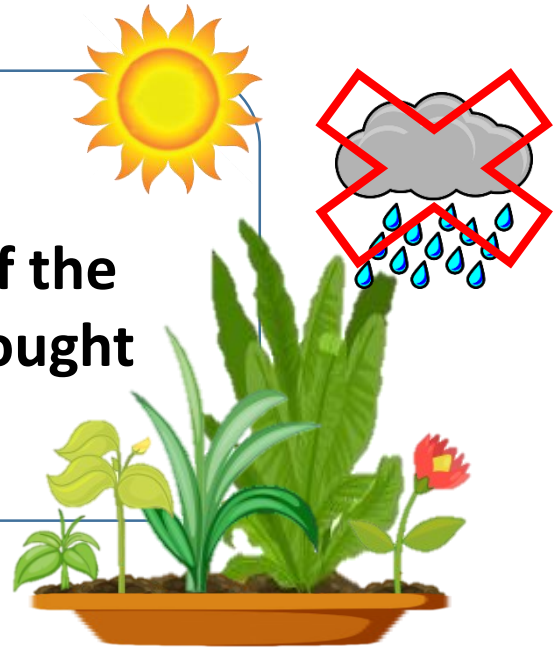


Question

We wanted to evaluate if the phylogenetic structure of the plant community determine individual response to drought

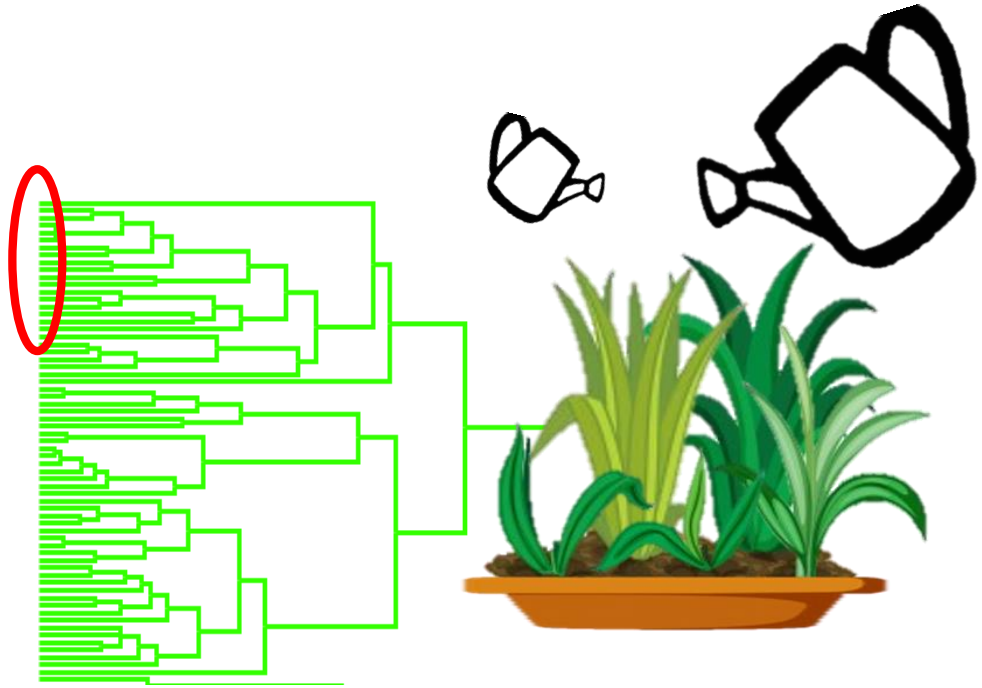
Survival

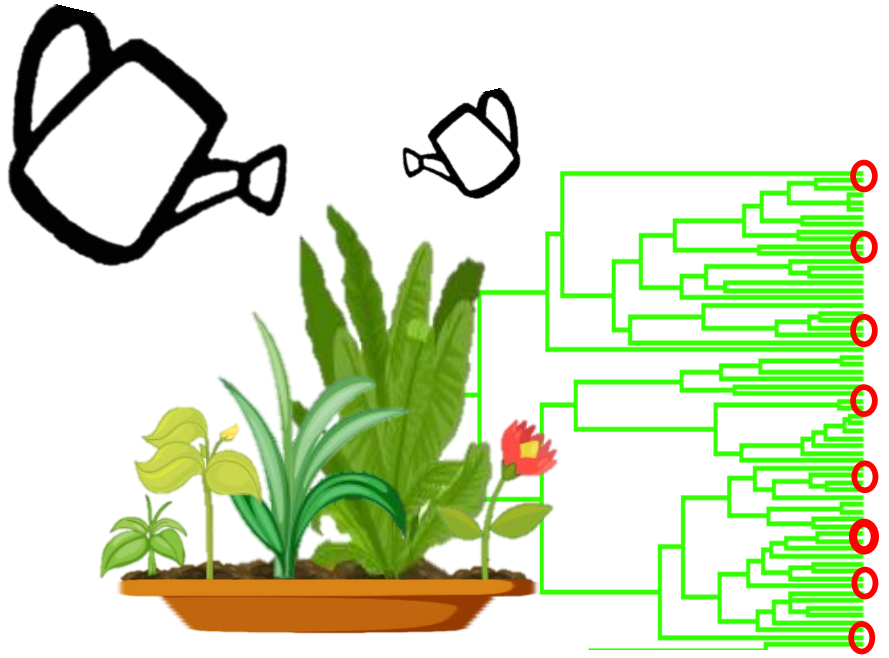
Fitness



Experimentally manipulate the phylogenetic diversity of each specific assembly

Materials and methods





Low phylogenetic diversity

(PSV = 0.3)

Two combinations of species

Seven species per plot

Ten plants per species (70 plants per plot)

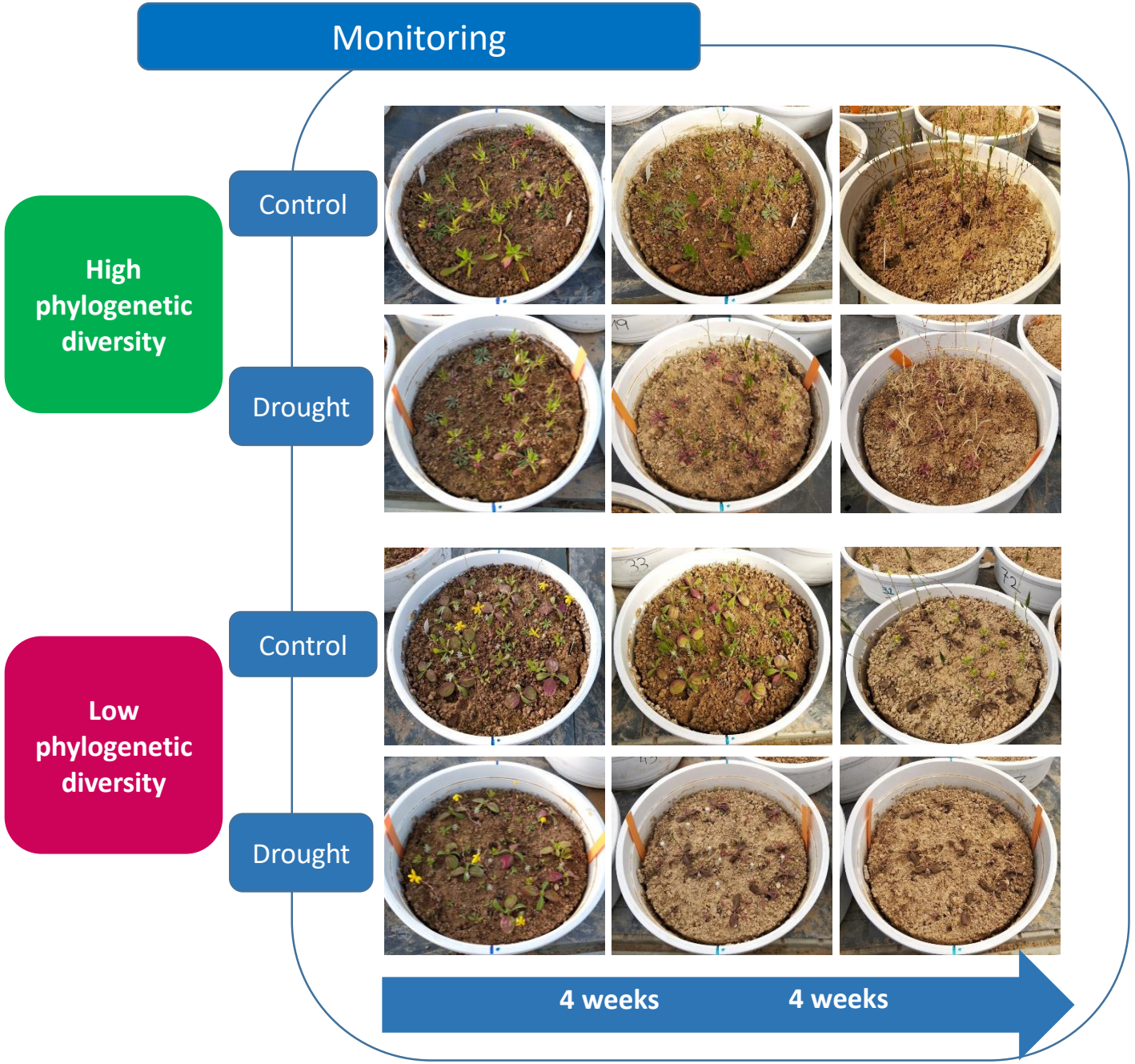
High phylogenetic diversity

(PSV = 0.8)

Two combinations of species

Seven species per plot

Ten plants per species (70 plants per plot)


Monitoring
High phylogenetic diversity
Control
Drought
Low phylogenetic diversity
Control
Drought
4 weeks
4 weeks

Measurements

n = 110 plots

7700 plants

Survival

(every two weeks)

Flower phenology

(every week)

Number of plants in fruit

Statistic analyses

GLM

Fixed factors: Irrigation and Phylogenetic Scenarios

Covariable: Time

GLMM

Random factor: Plot

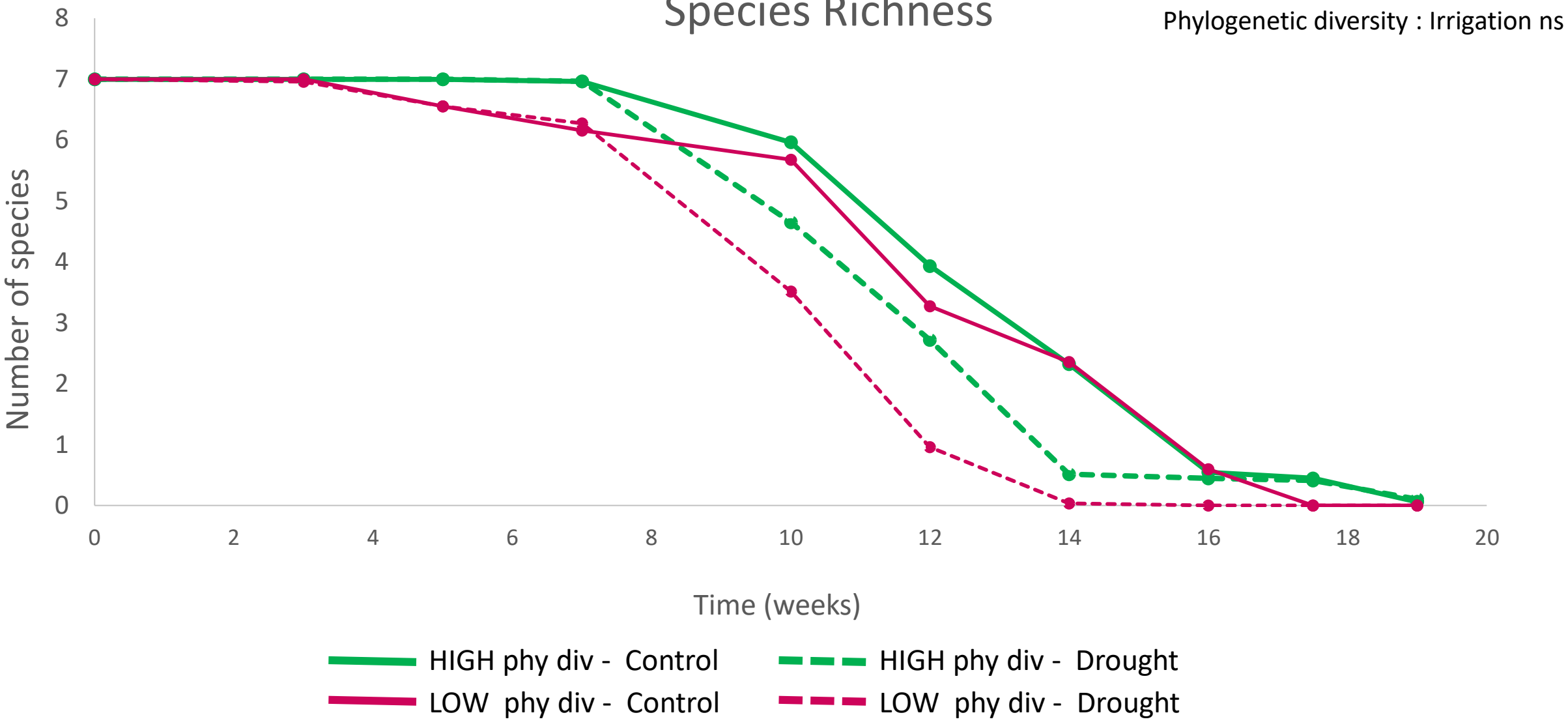
Fixed factors: Irrigation and Phylogenetic Scenarios

Covariable: Time

Results and Discussion

GLM

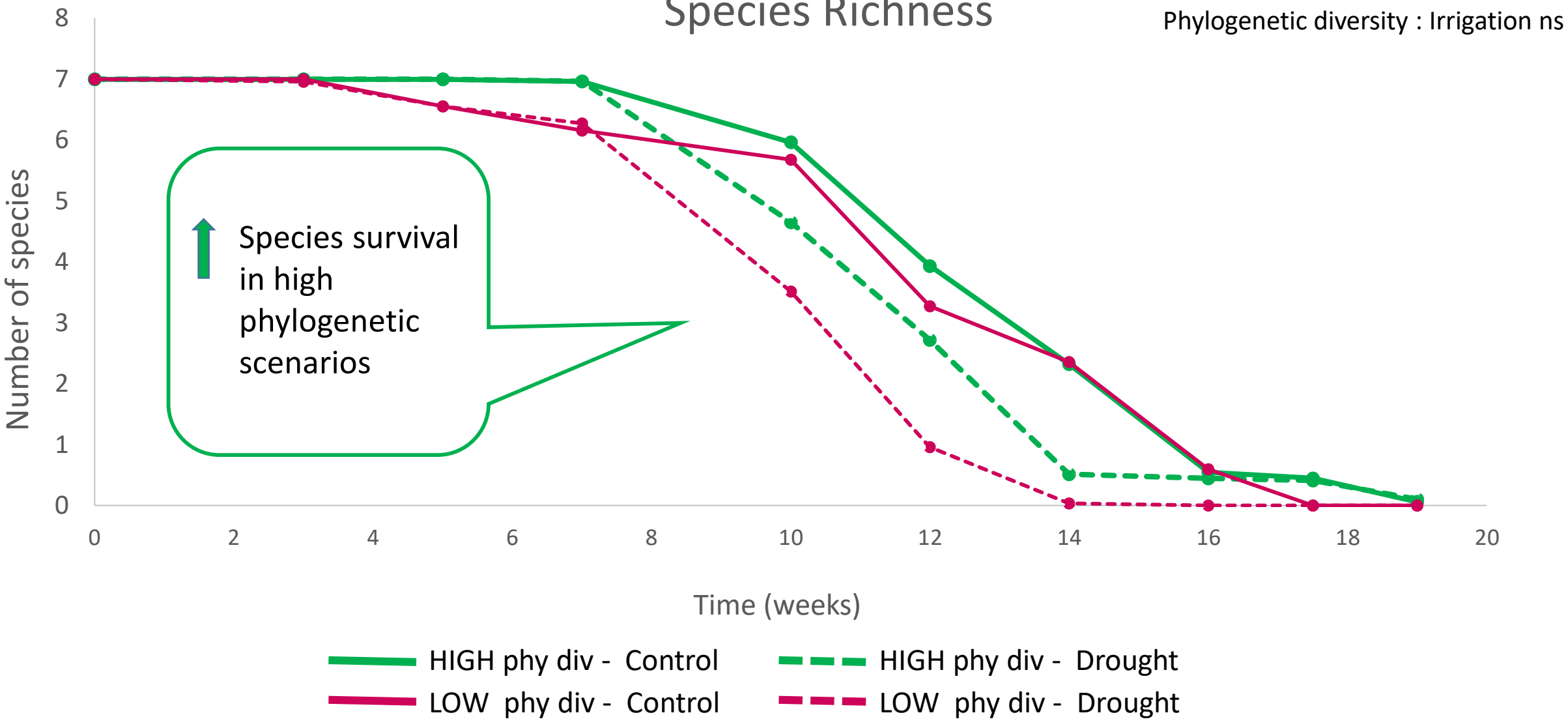
Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ns



Results and Discussion

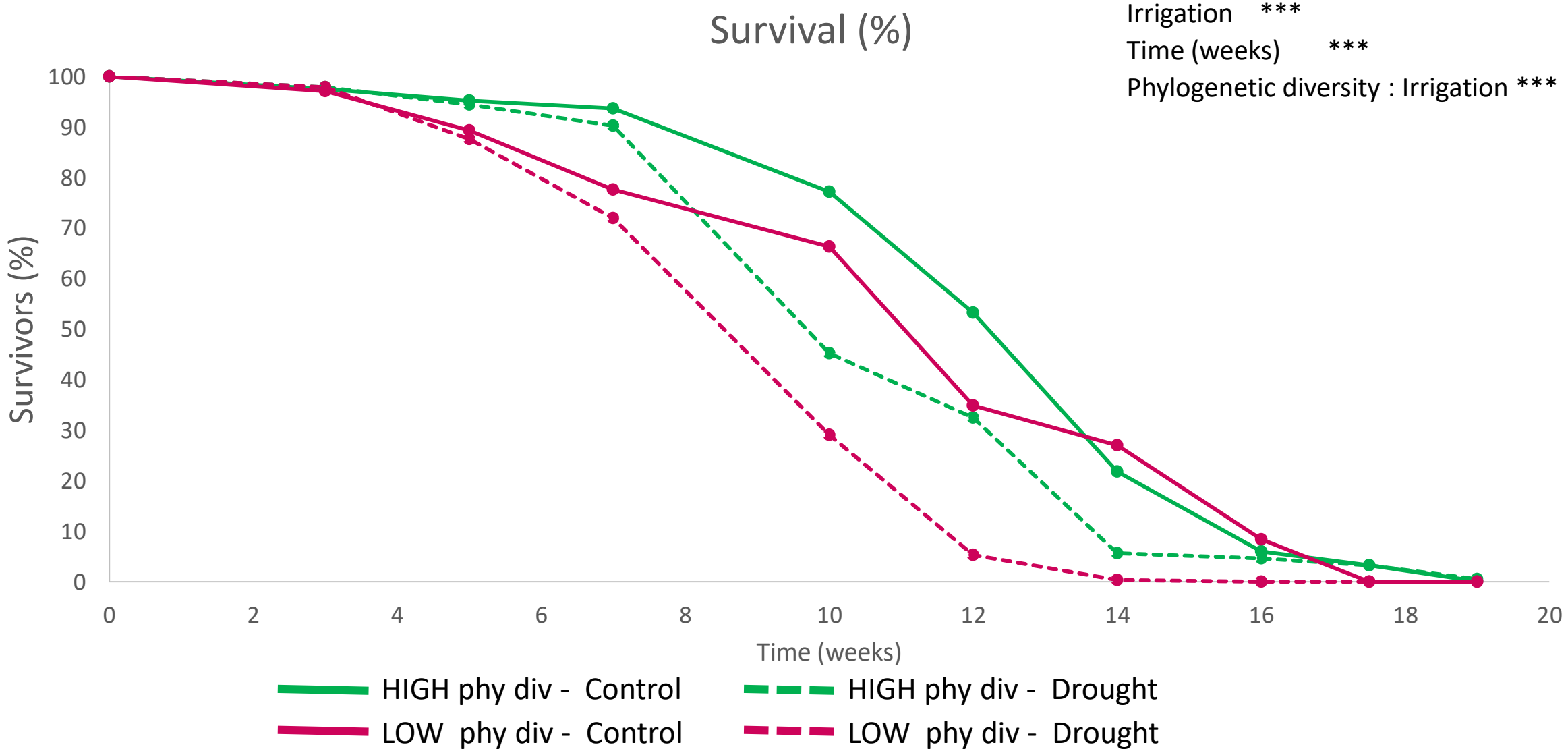
GLM

Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ns



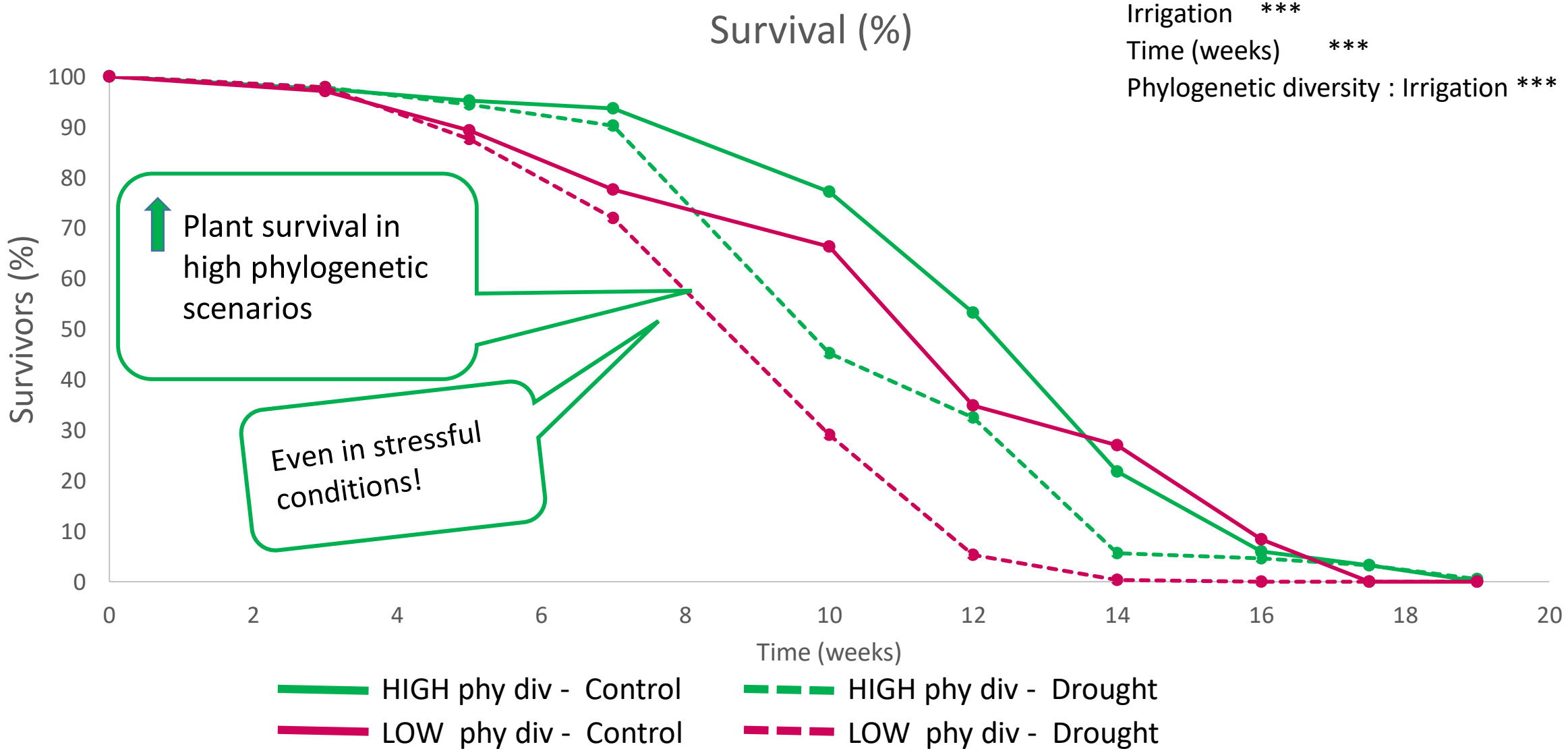
GLMM

Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ***



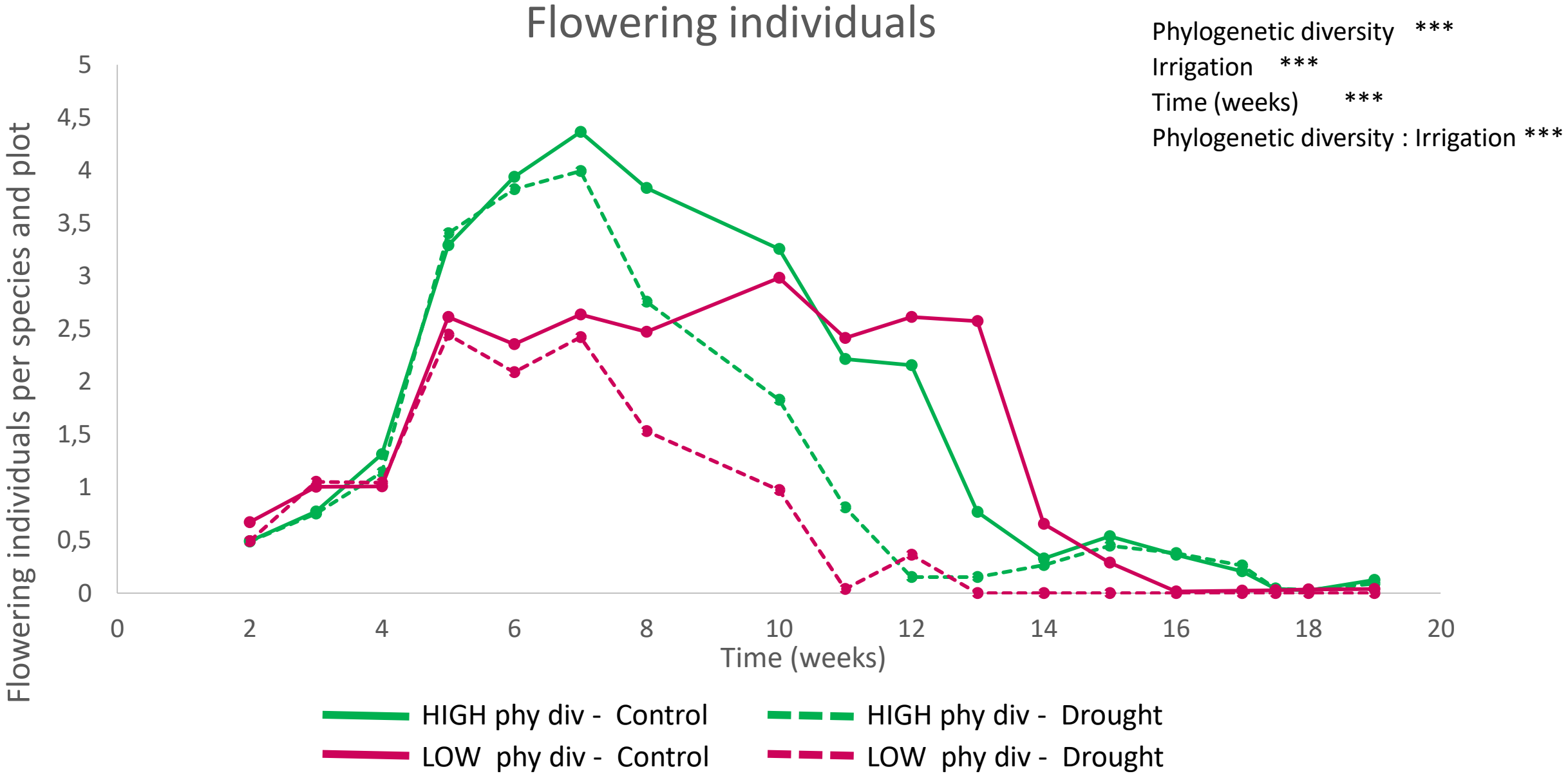
GLMM

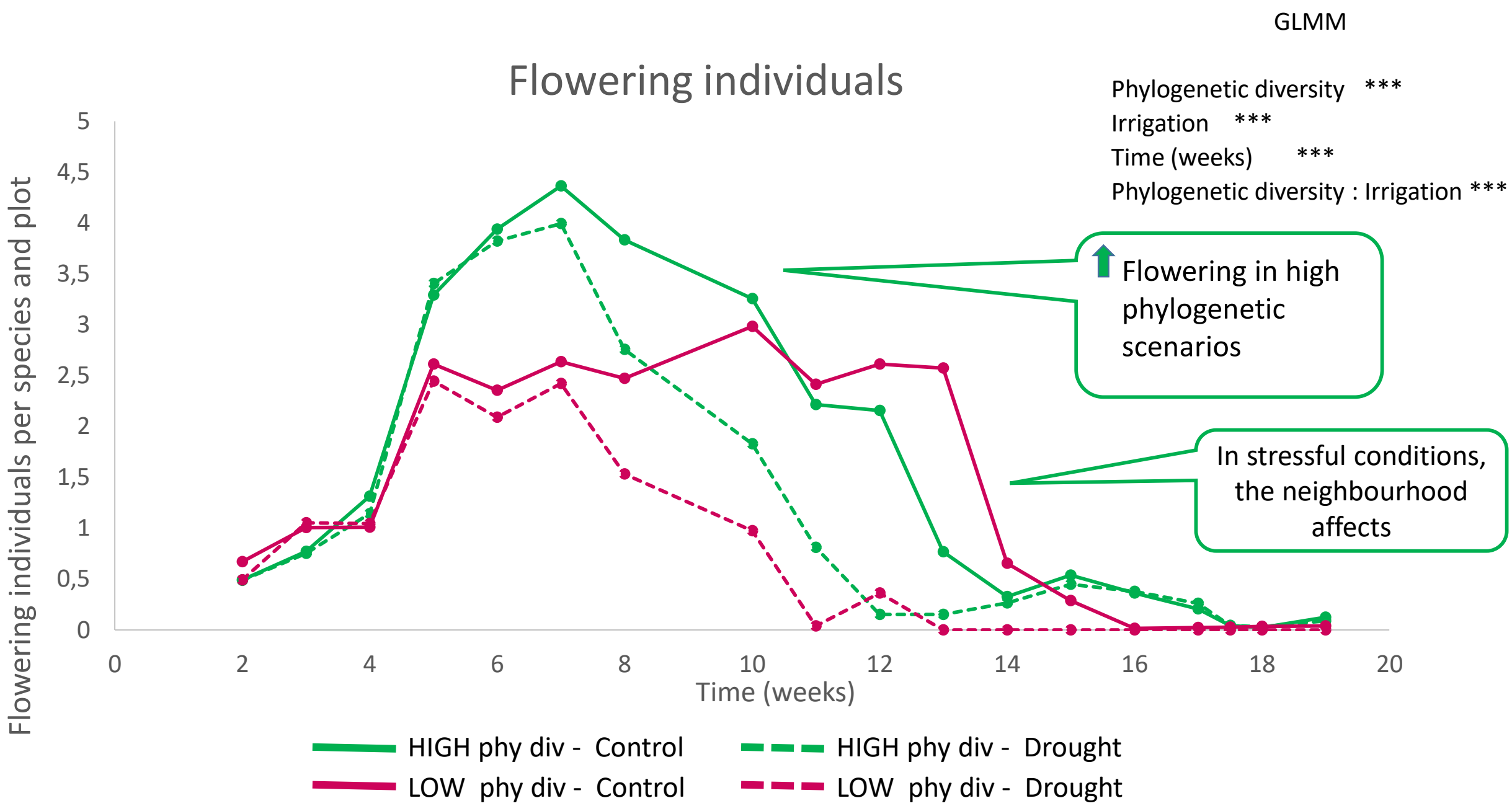
Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ***



GLMM

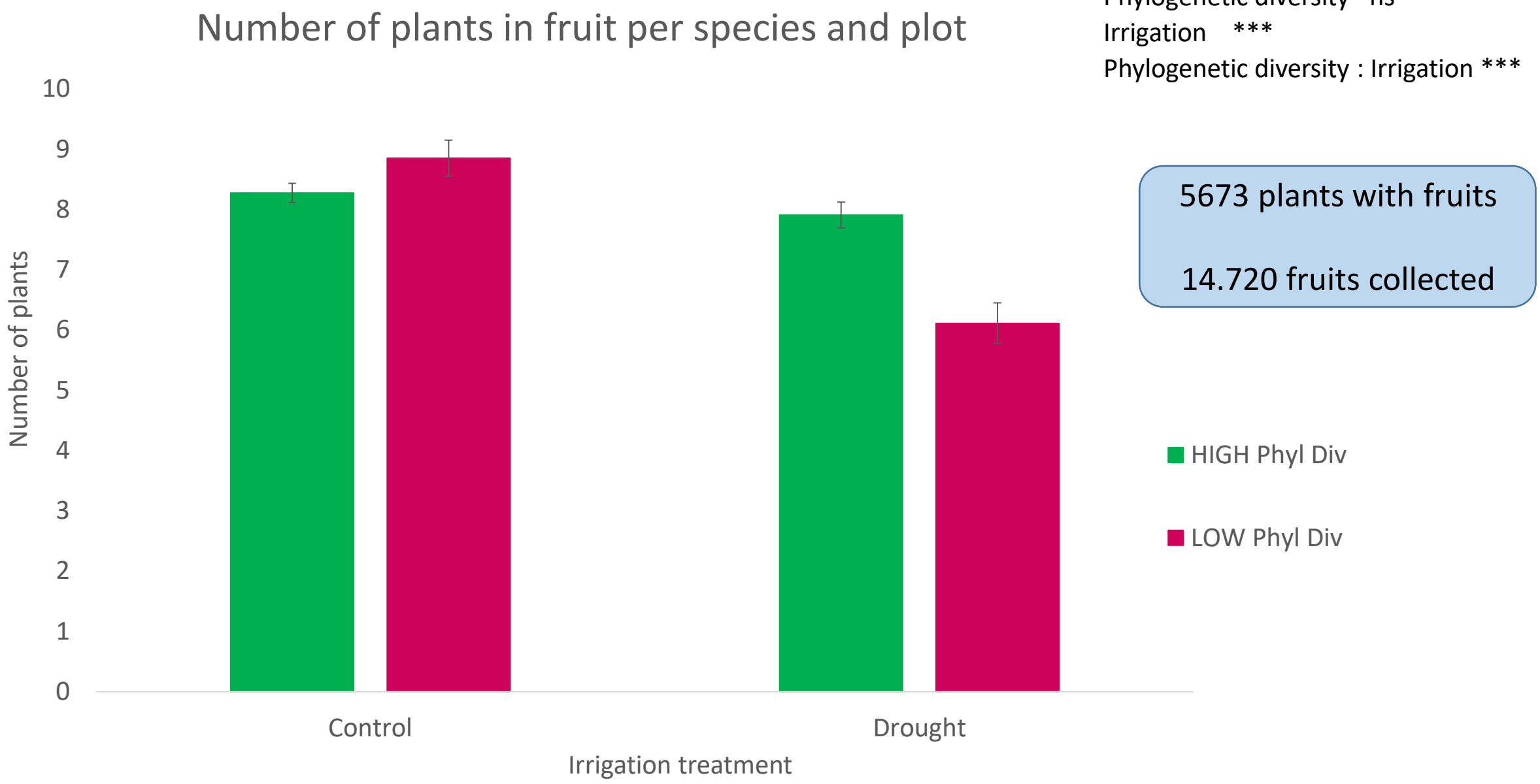
Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ***




GLMM
Phylogenetic diversity ***
Irrigation ***
Time (weeks) ***
Phylogenetic diversity : Irrigation ***
Flowering individuals
Flowering individuals per species and plot
Time (weeks)
Flowering in high phylogenetic scenarios
In stressful conditions, the neighbourhood affects
HIGH phy div - Control
HIGH phy div - Drought
LOW phy div - Control
LOW phy div - Drought

GLMM

Phylogenetic diversity ns
Irrigation ***
Phylogenetic diversity : Irrigation ***

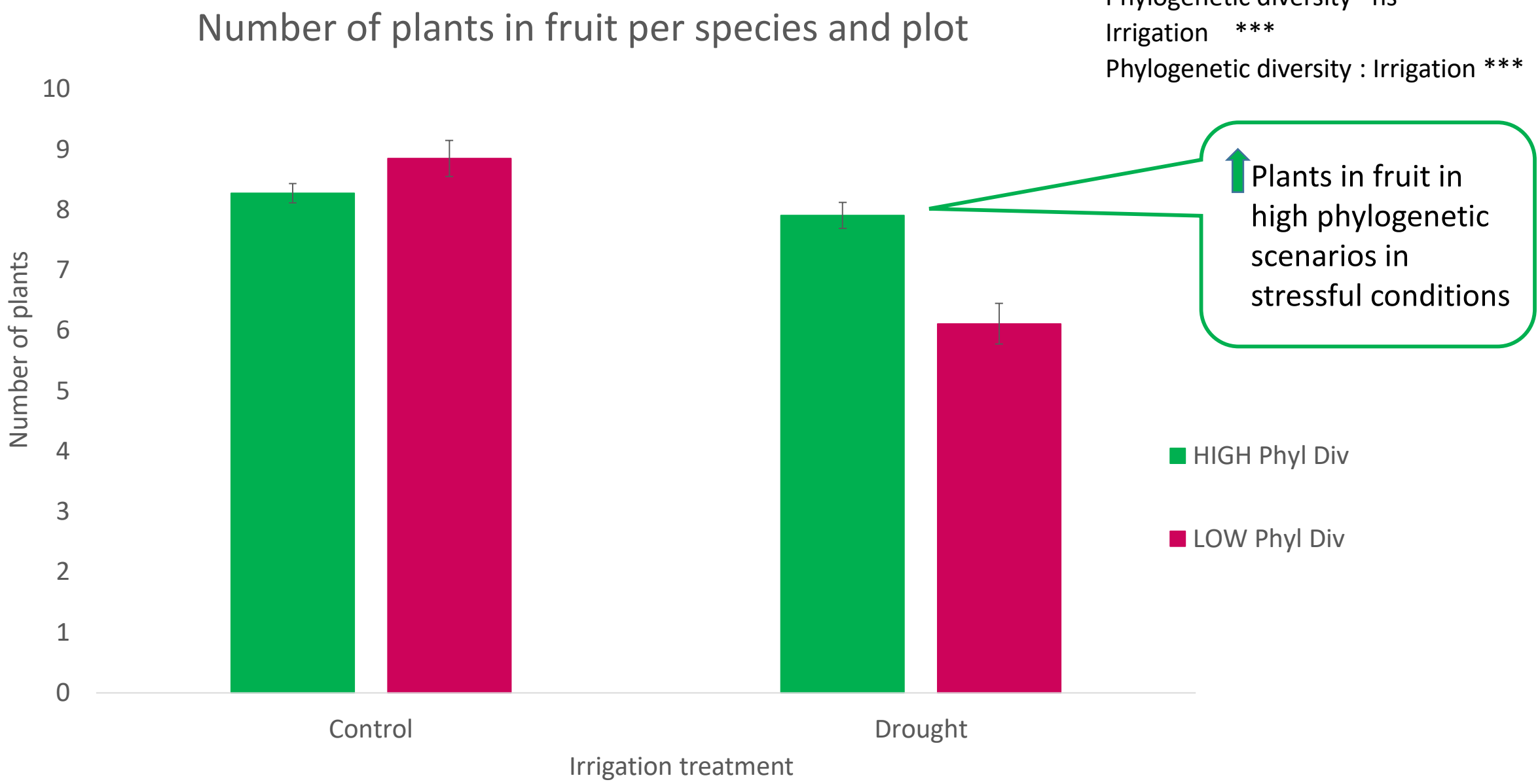


5673 plants with fruits

14.720 fruits collected

GLMM

Phylogenetic diversity ns
Irrigation ***
Phylogenetic diversity : Irrigation ***

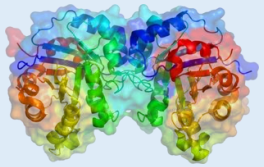


Ongoing work…

Fruit production

Fruit set

Vegetative dry mass



Phosphatase

β-Glucosidase

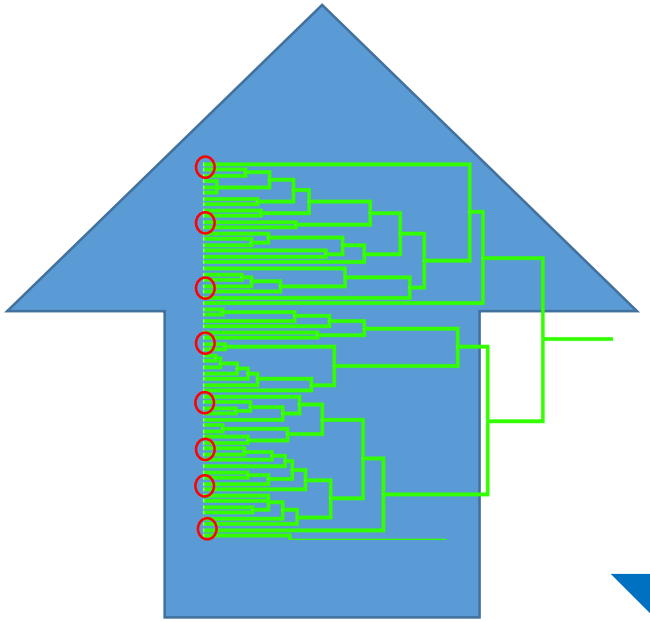
Arylsulfatase

Enzymatic activity

Nutrient content

Conclusions

General trend



RESISTANCE

COEXISTENCE

High Phylogenetic Diversity

Higher Fitness

HIGH DIVERSITY

Conclusions

Phylogenetic diversity of the neighbourhood

Conclusions

Phylogenetic diversity of the neighbourhood

Determines:

-Species richness
- Plant survival
- Flowering phenology
- Plants in fruit

THANK
YOU SO MUCH
FOR THIS!

Acknowledgments

Universidad Rey Juan Carlos

ÁREA DE BIODIVERSIDAD Y CONSERVACIÓN

GYPWORLD
A GLOBAL INICIATIVE TO UNDERSTAND GYPSUM ECOSYSTEM ECOLOGY

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Dirección General de Investigación e Innovación
CONSEJERÍA DE EDUCACIÓN E INVESTIGACIÓN
Comunidad de Madrid

Anuales
Work Group

- ROBERTO LÓPEZ RUBIO

- STUDENTS OF BIOLOGY, ENVIRONMENTAL SCIENCES AND COMPUTING (URJC)