Response of native plant communities and substrate characteristics to environmental conditions installed on green roofs

Research Track
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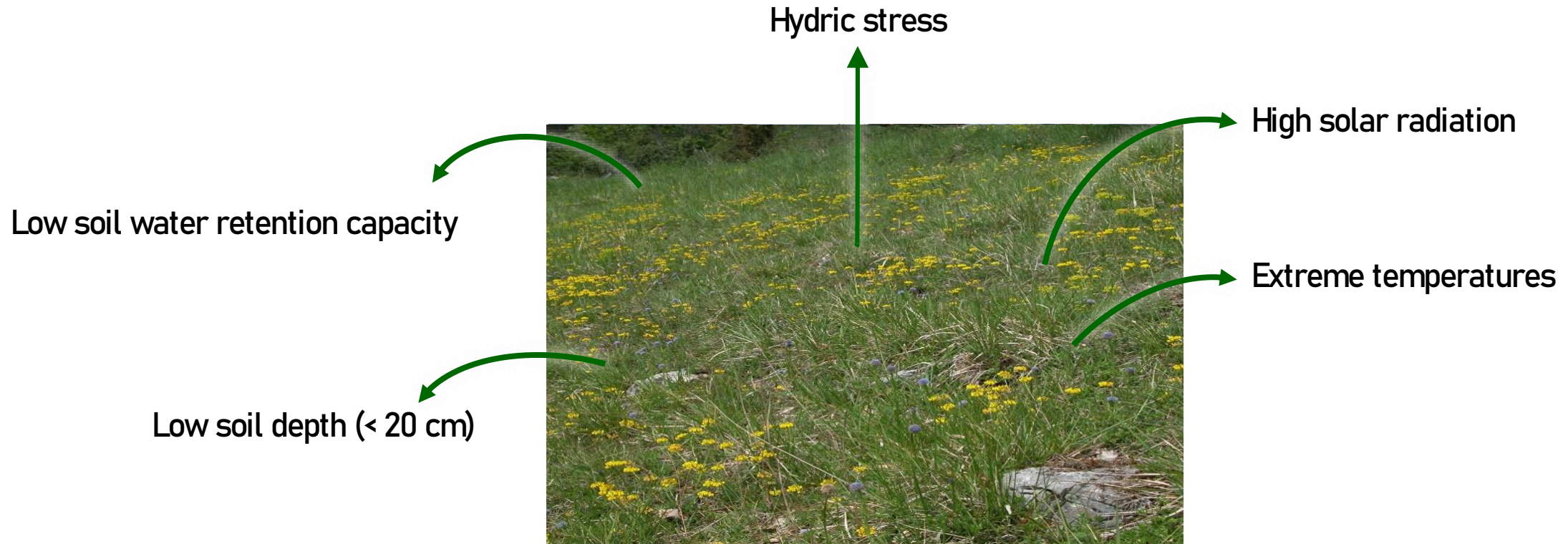

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Green roofs for living cities

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Extensive green roof : an analogous habitat

Hydric stress

High solar radiation

Low soil water retention capacity

Extreme temperatures

Low soil depth (< 20 cm)

Microenvironmental conditions

Microenvironmental conditions

Development of plant communities

Objectives

Can ExGRs support native species selected on the analogous habitat hypothesis?

How is the plant community influenced by time and micro-environmental conditions of the green roof?

Are substrate characteristics influenced by microenvironmental conditions and vegetation evolution through time?
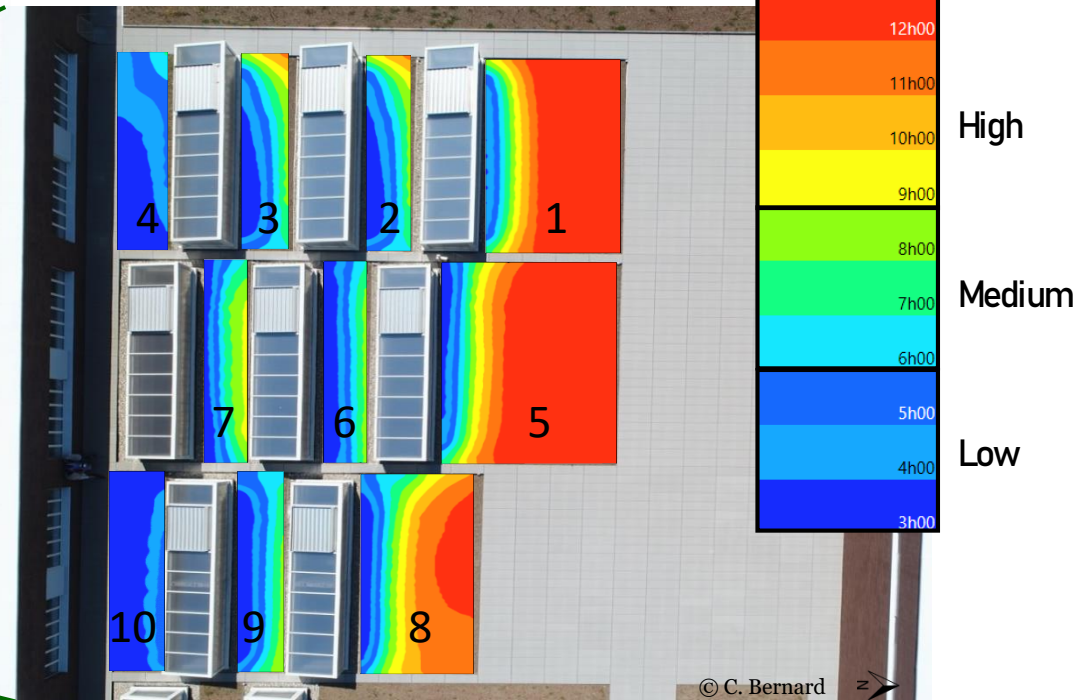
Studied green roof

Studied green roof

Number of hours of sun exposure

High
Medium
Low

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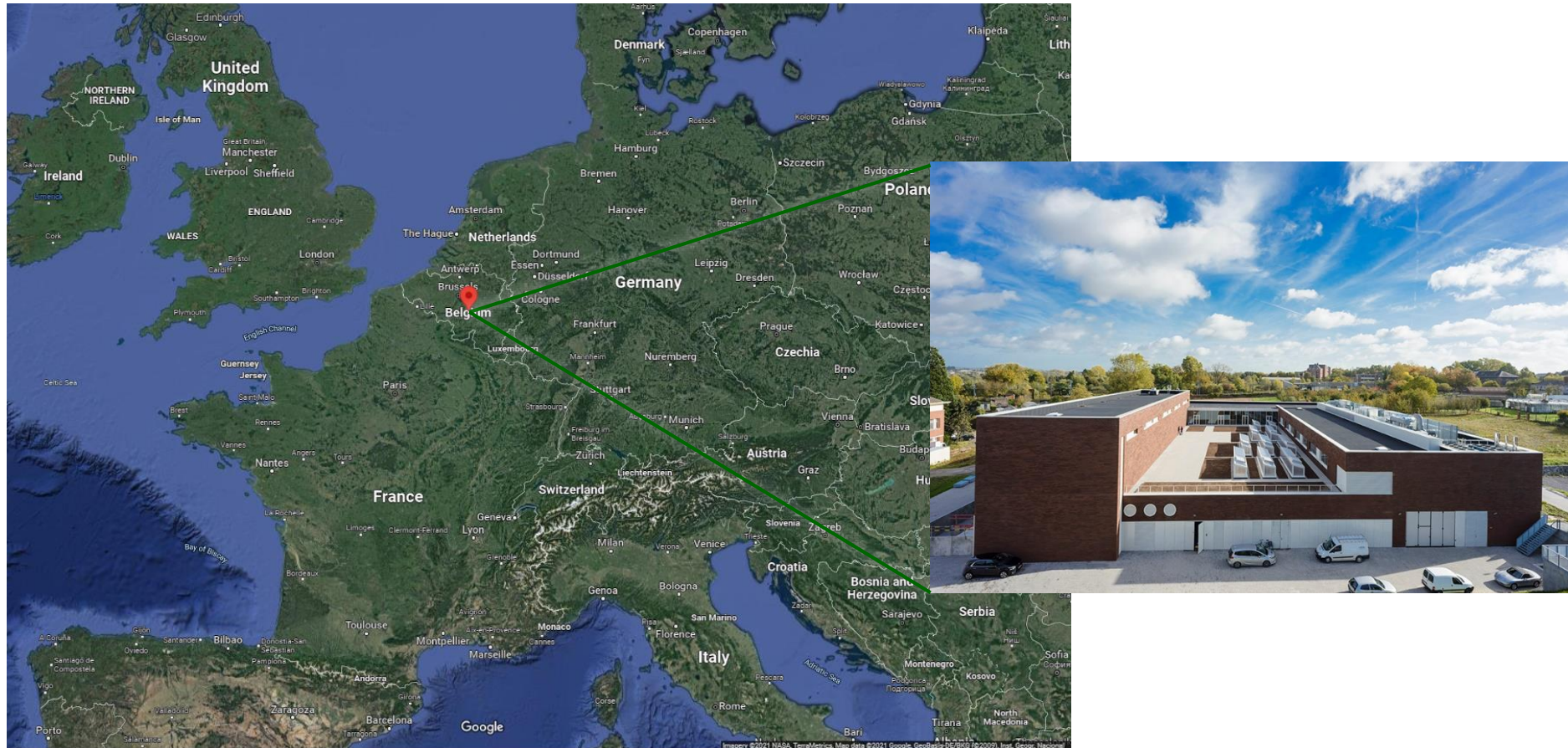
Studied green roof

29 species selected on the analogous habitat hypothesis seeded in 2017

Forbs

Grass

Succulent

Data collection

36 plots

2017   2018   2019   2020

Data collection

2020

Results : Floristic variation over time

	2018	2019	2020
Species richness	16	22	24

Precipitation, temperature and insolation in Uccle, spring
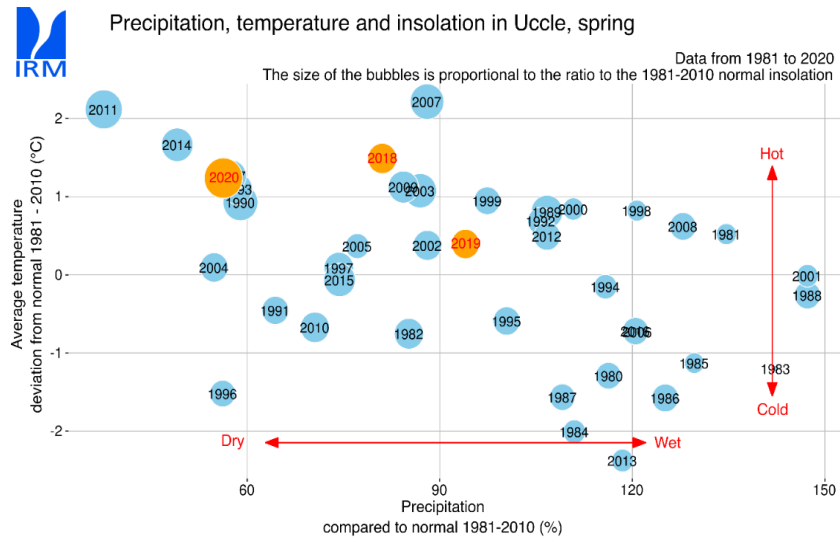
Results : Floristic variation over time

	2018	2019	2020
Species richness	16	22	24
% of seeded species observed	50%	75%	71,43%
Xerophytic species	18,7%		41,67%
Cover	25,50 ± 19,28%/m²	81,08 ± 50,30%/m²	35.44 ± 35.56%/m²

It works!

Native flora can compose the plant community of an extensive green roof
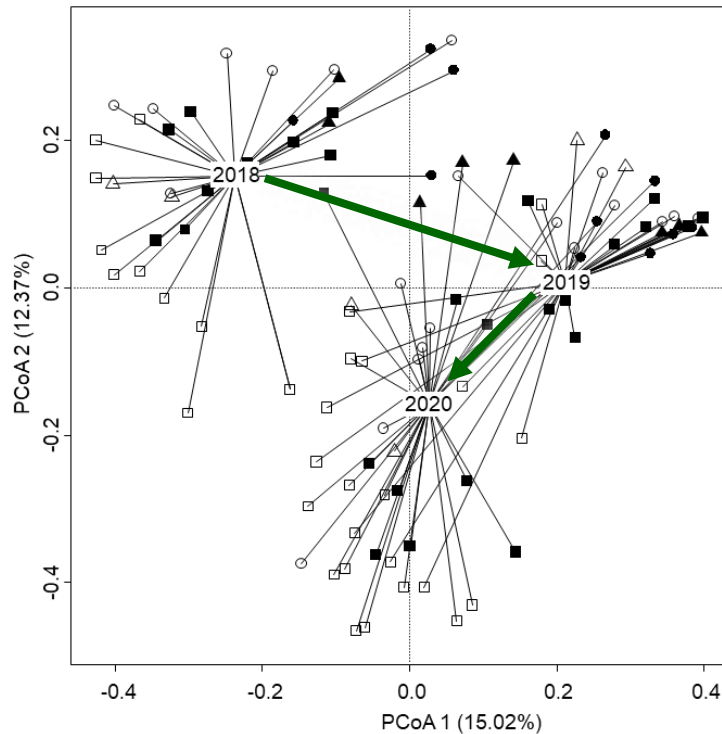
Increase in the number of species and cover over time
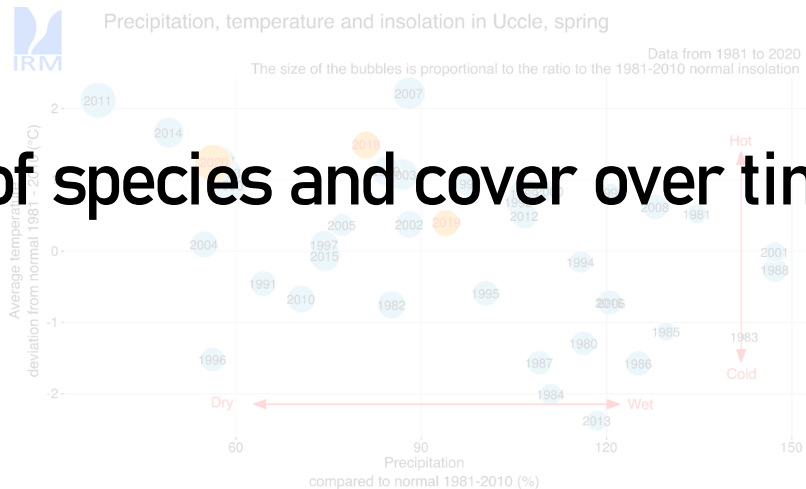
Precipitation, temperature and insolation in Uccle, spring

Data from 1981 to 2020

The size of the bubbles is proportional to the ratio to the 1981-2010 normal insolation

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Results : Floristic variation according to microenvironmental conditions

Effect of time

>

Effect of microenvironmental conditions

- low sun exposure, 12 cm
○ low sun exposure, 6 cm
▲ medium sun exposure, 12 cm
△ medium sun exposure, 6 cm
■ High sun exposure, 12 cm
□ High sun exposure, 6 cm

Figure 4: PCoA of vegetation cover A) Ordispiders are pooled by year. B) Correlation circle of species (correlation > 0.35 in absolute value with one of the two axes of the PCoA). Ant_odo: A. odoratum, Ant_vul: A. vulneraria, Bri_med: B. media, Bro_ere: B. erectus, Ech_vul: E. vulgare, Koe_mac: K. macrantha, Med_lup: M. lupulina, Rum_ace: R. acetosella

Results : Floristic variation according to microenvironmental conditions

2018 > 2019 > 2020

The plant community more differentiated with time than with environmental gradient

BUT

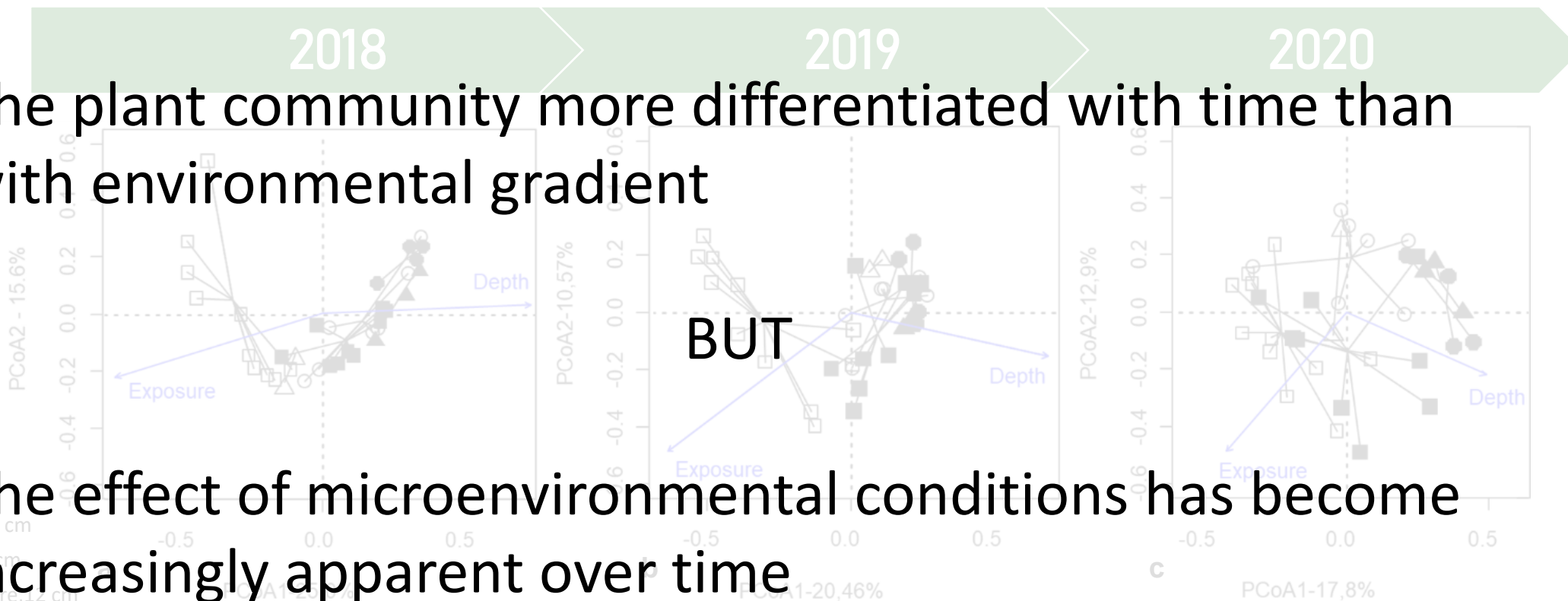The effect of microenvironmental conditions has become increasingly apparent over time

- low sun exposure, 12 cm
- low sun exposure, 6 cm
- medium sun exposure, 12 cm
- medium sun exposure, 6 cm
- High sun exposure, 12 cm
- High sun exposure, 6 cm

Figure 5: PCoA of vegetation cover for each year a) 2018, b) 2019 and c) 2020. Ordispiders are pooled by combination of substrate depth and sun exposure modalities.

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Results : Substrate parameters over time and according to microenvironmental conditions

Effect of time

| Substrate parameters	Progress	P value t test
P (mg/100g)	↗ 12.63 % ± 8.72 %	<0.001
K (mg/100g)	↗ 65.11 % ± 20.75 %	<0.001
C (g/Kg)	↘ 60.52 % ± 5.98 %	<0.001
N (%)	↘ 44.44 % ± 5.56 %	<0.001
C/N	↘ 31.14 % ± 2.86 %	<0.001
Water pH	↘ 1.38 % ± 1.38 %	<0.001
Clay (%)	↘ 0.70 % ± 0.85 %	<0.001
Silt (%)	↘ 4.12 % ± 2.98 %	<0.001
Sand (%)	↗ 4.92 % ± 3.37 %	<0.001

All parameters changed over time

Effect of sun exposure and plant cover

This influence of plant cover on substrate parameters could increase the differentiation of plant communities according to microenvironmental conditions over time

2020

Conclusion
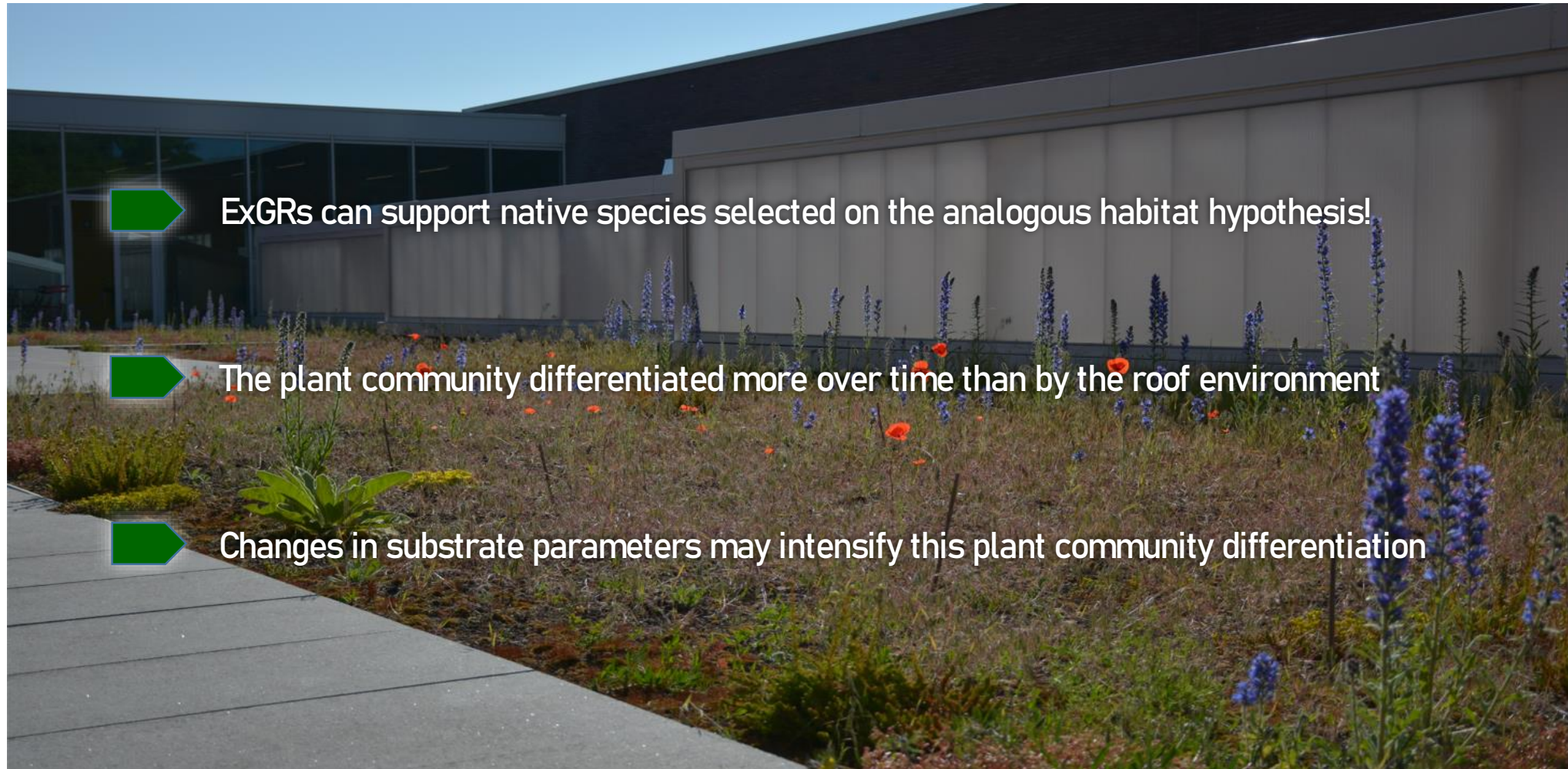
ExGRs can support native species selected on the analogous habitat hypothesis!

The plant community differentiated more over time than by the roof environment

Changes in substrate parameters may intensify this plant community differentiation

Thank you!