

Butterfly responses to weather anomalies depend on local adaptation and range position

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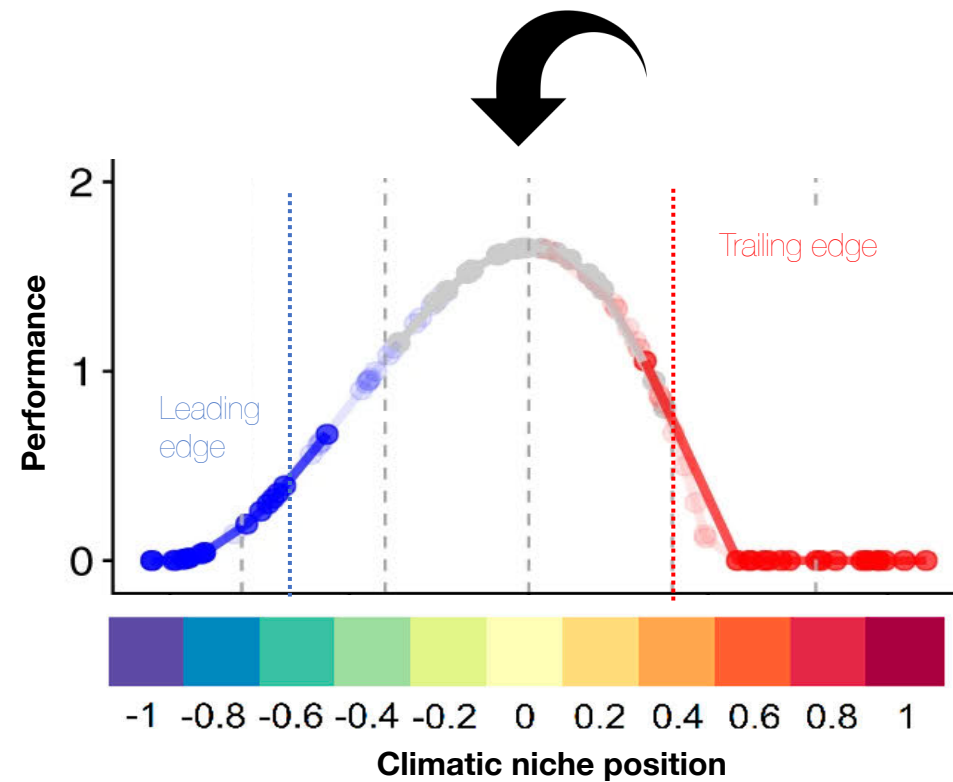


University of
Reading



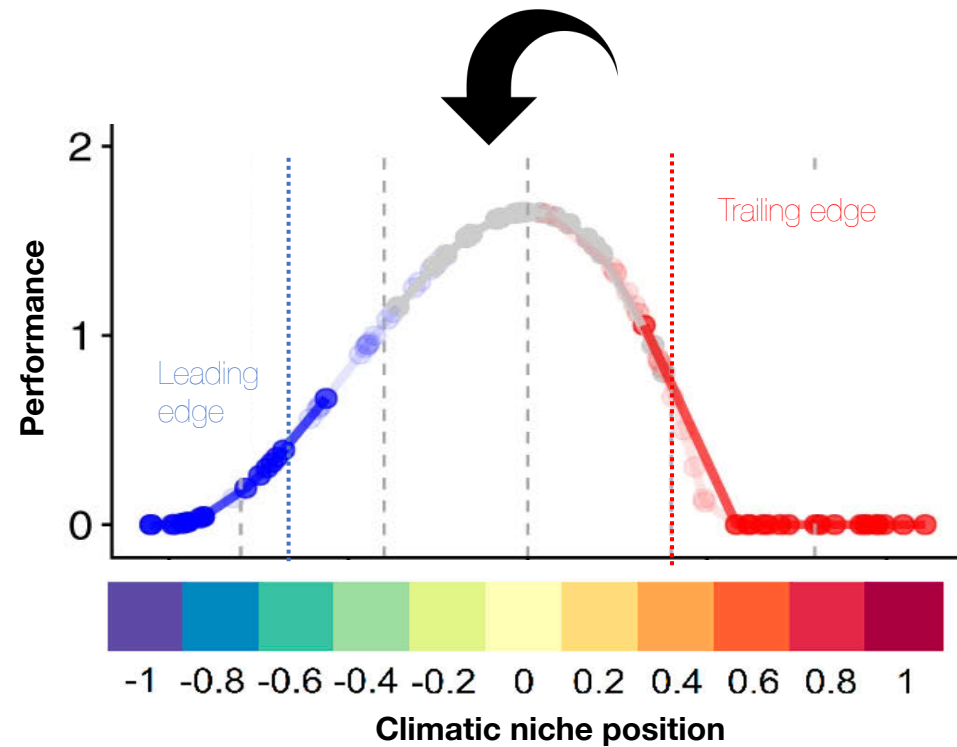
Aricia cramera
Photo: Antonio Sabido
Volunteer - BMS project

Species are expected to **best perform** close to the **centre of their niche**

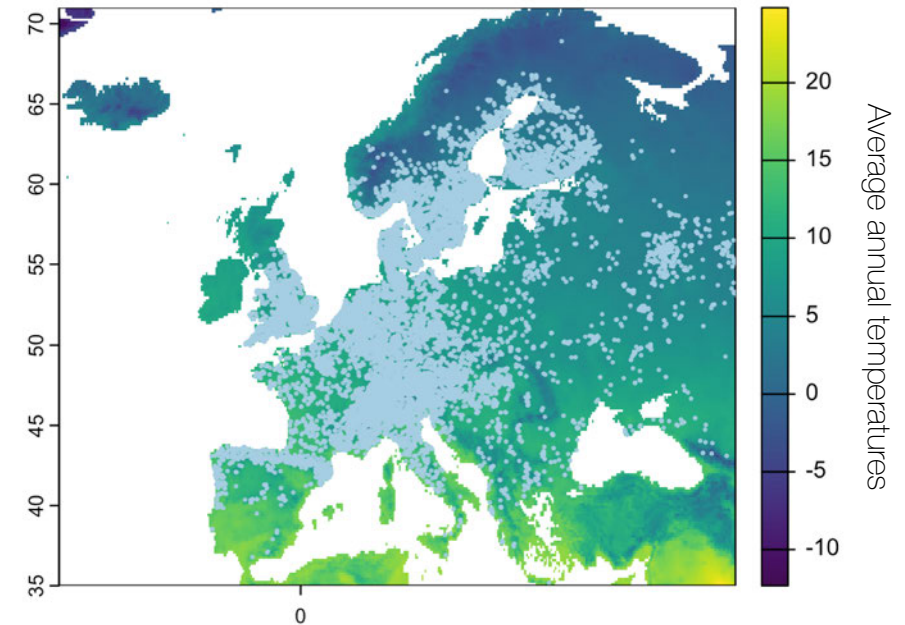


Simulated performance of a species populations across its niche positions

Species are expected to best perform close to the centre of their niche,
independently of their niche breadth

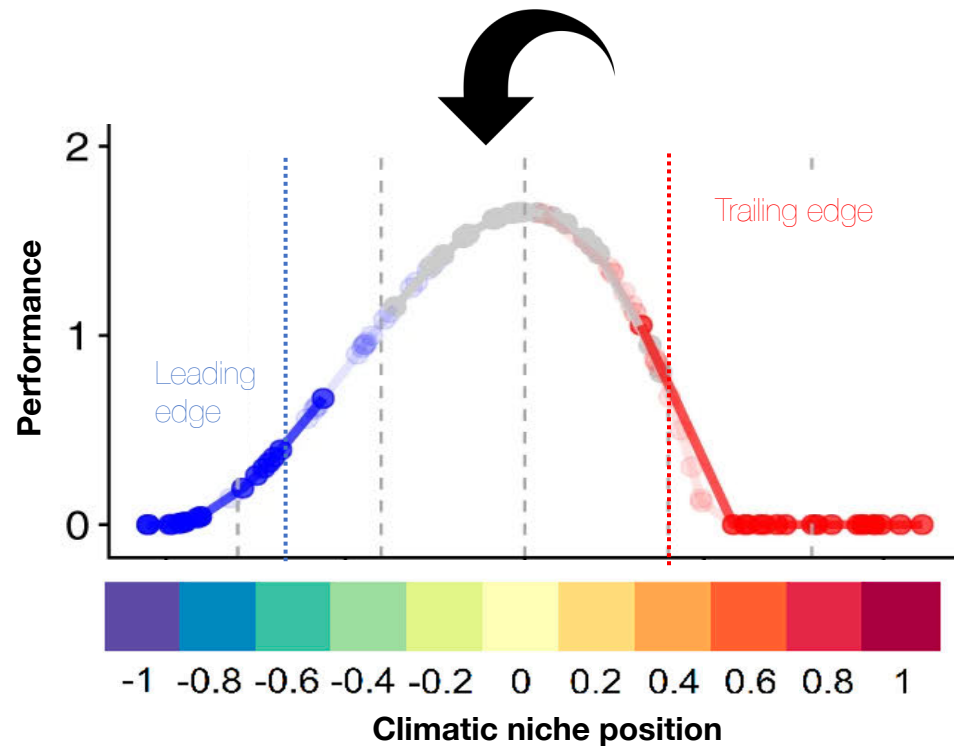


Simulated performance of a species populations across its niche positions

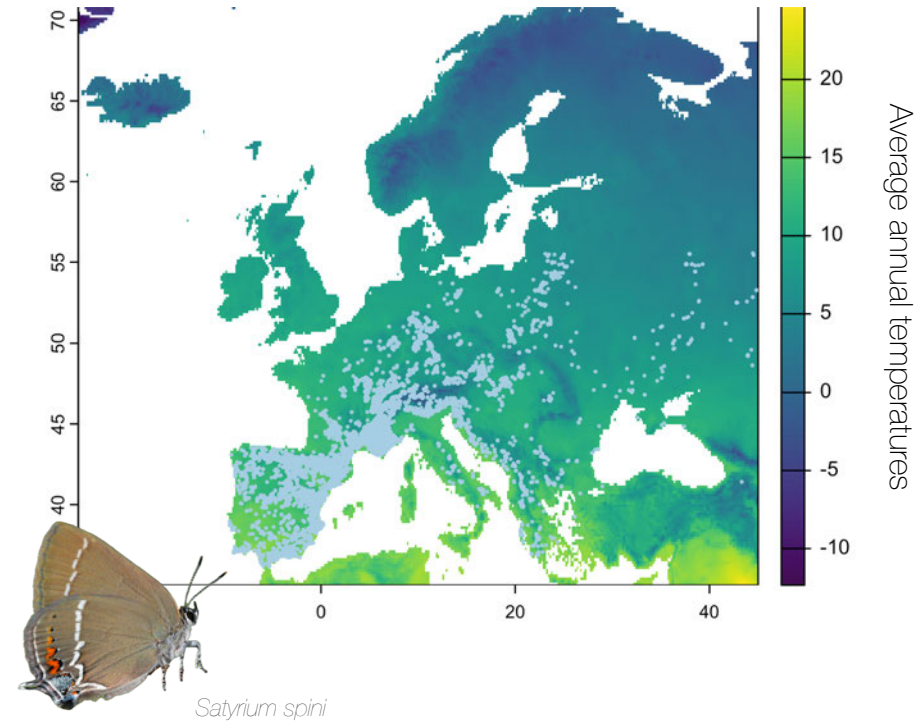


Ochloides sylvanus

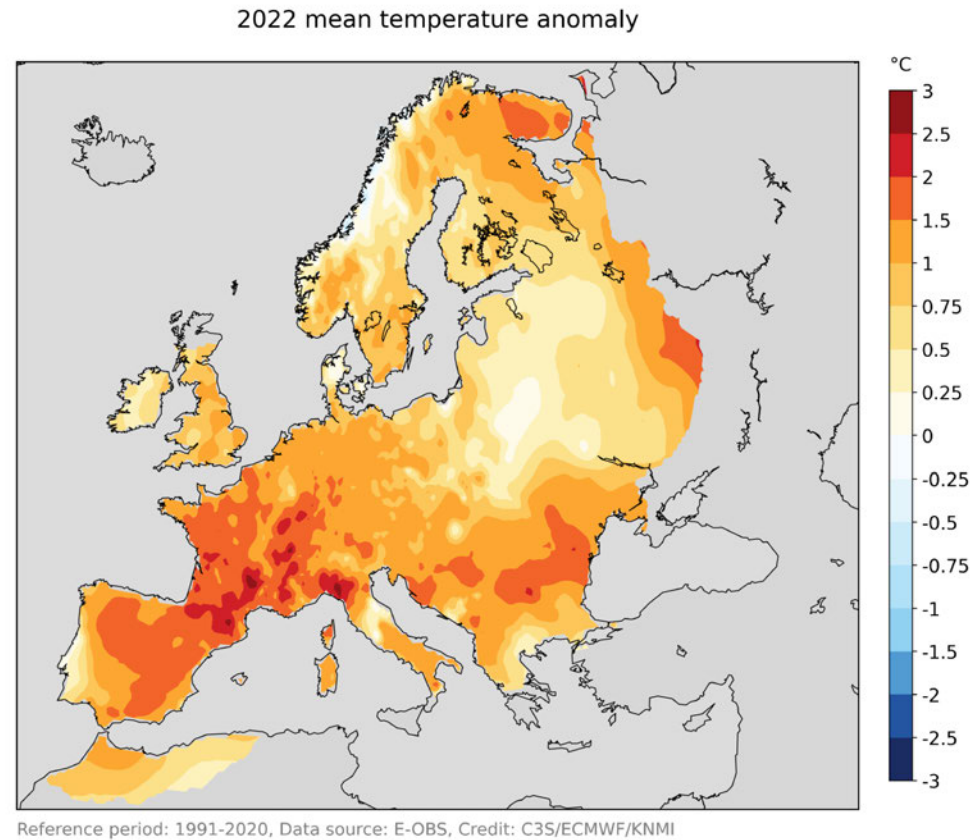
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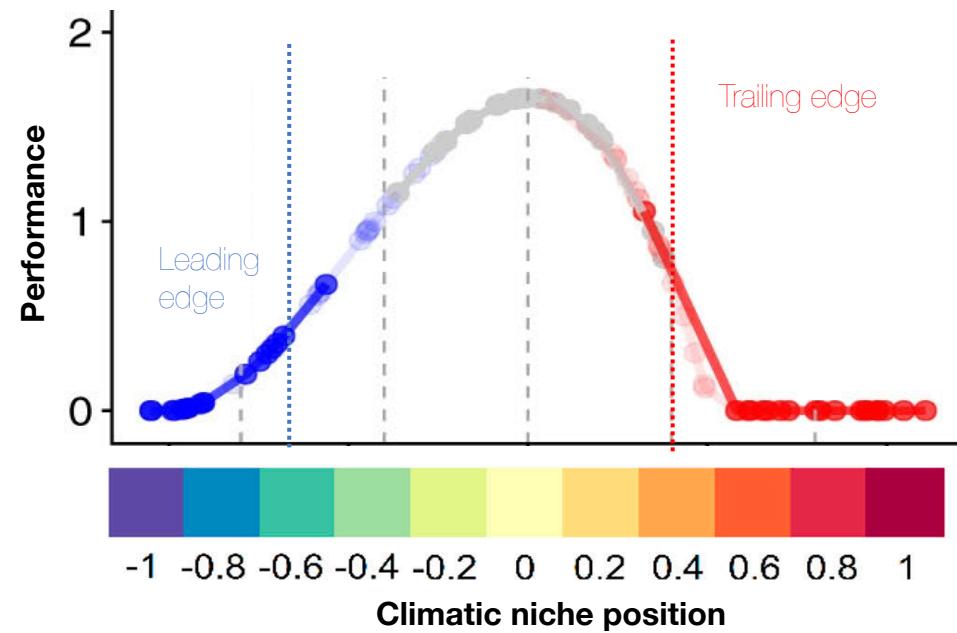
Simulated performance of a species populations across its niche positions



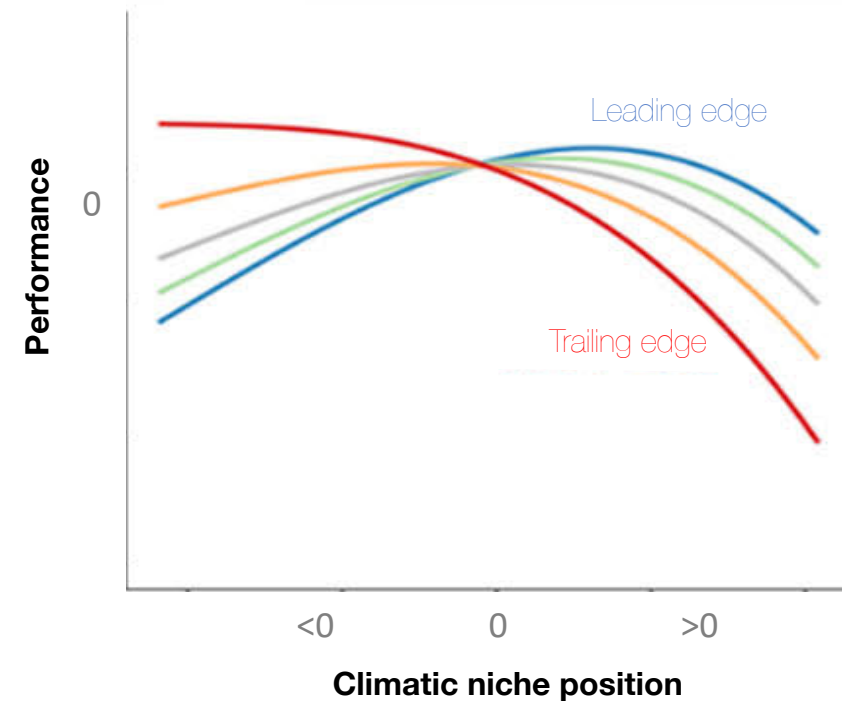
What happens to performance **when climatic anomalies occur?**



Species population **respond distinctly to climatic anomalies** as per their population location

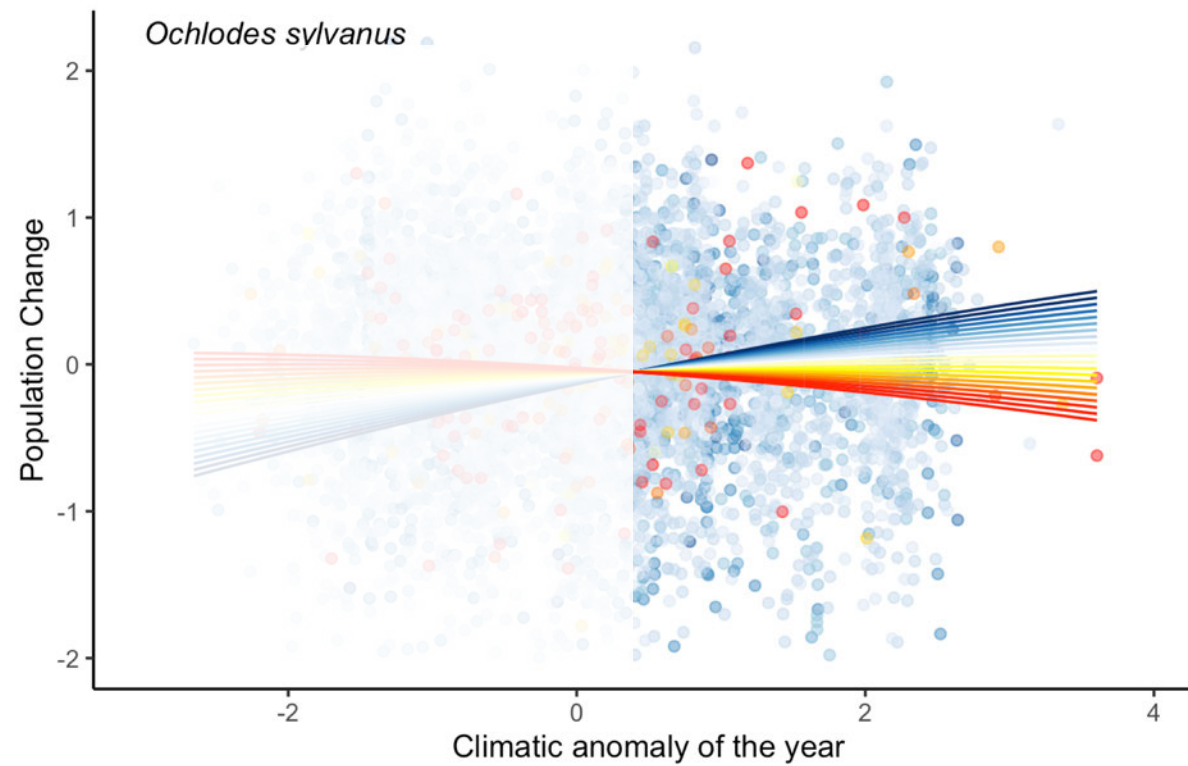


Simulated performance of a species populations across its niche

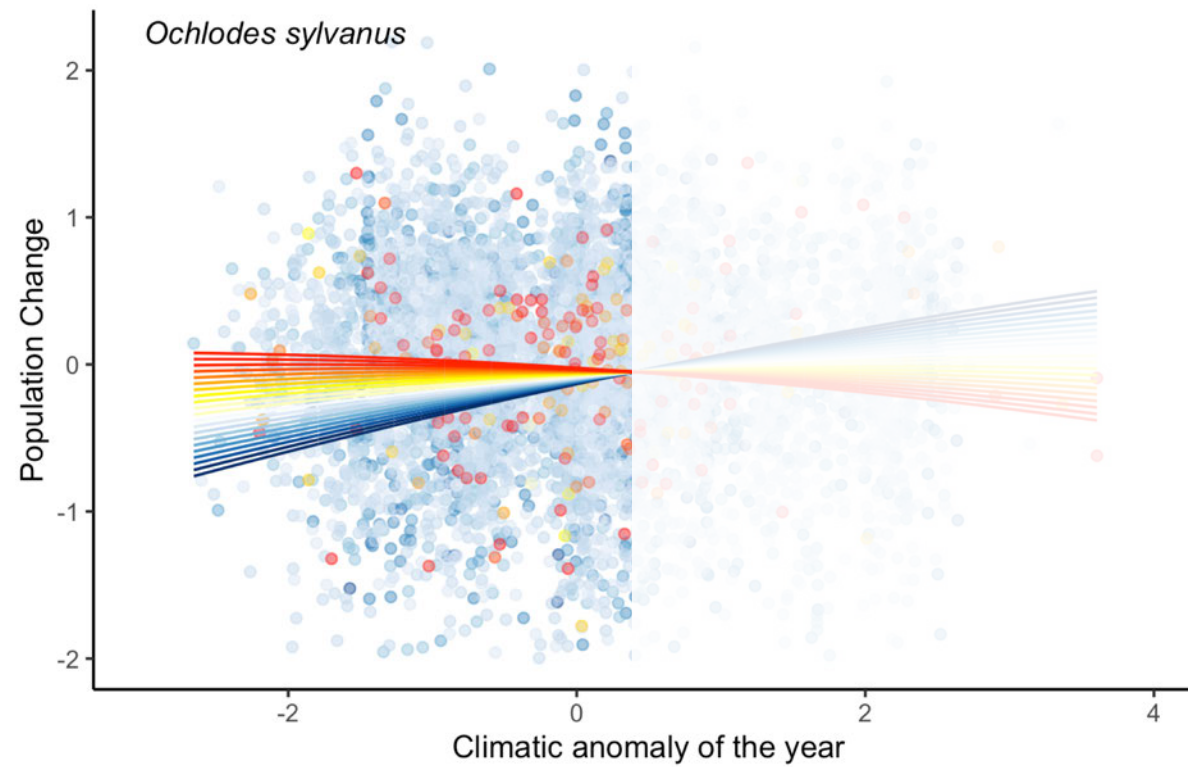


Simulated performance of a species populations when climatic anomalies occur across its niche

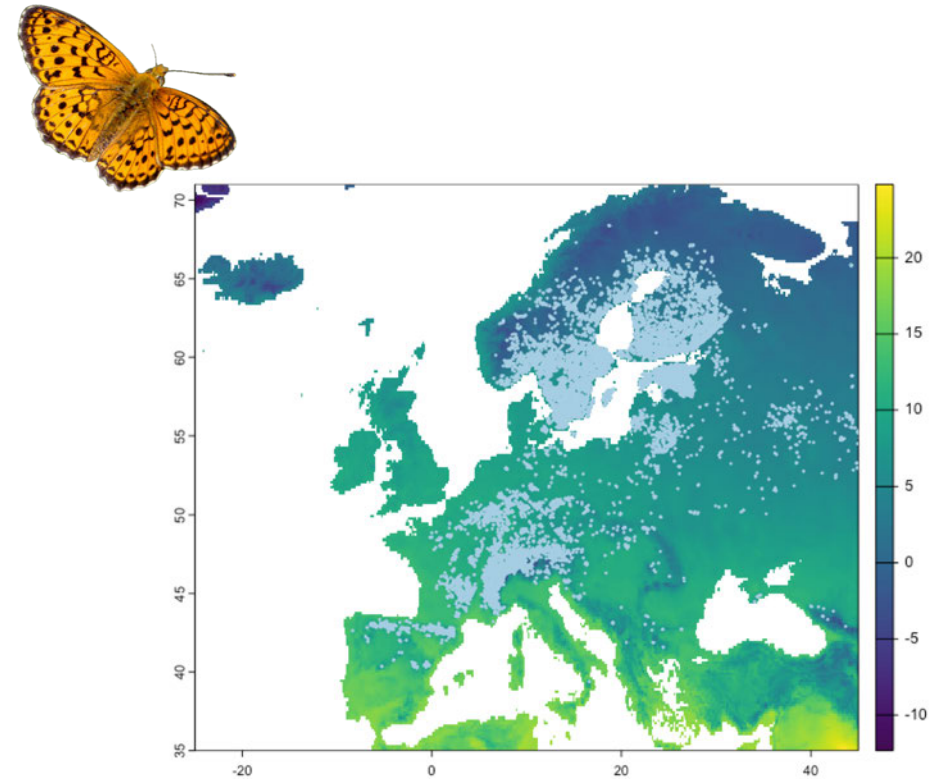
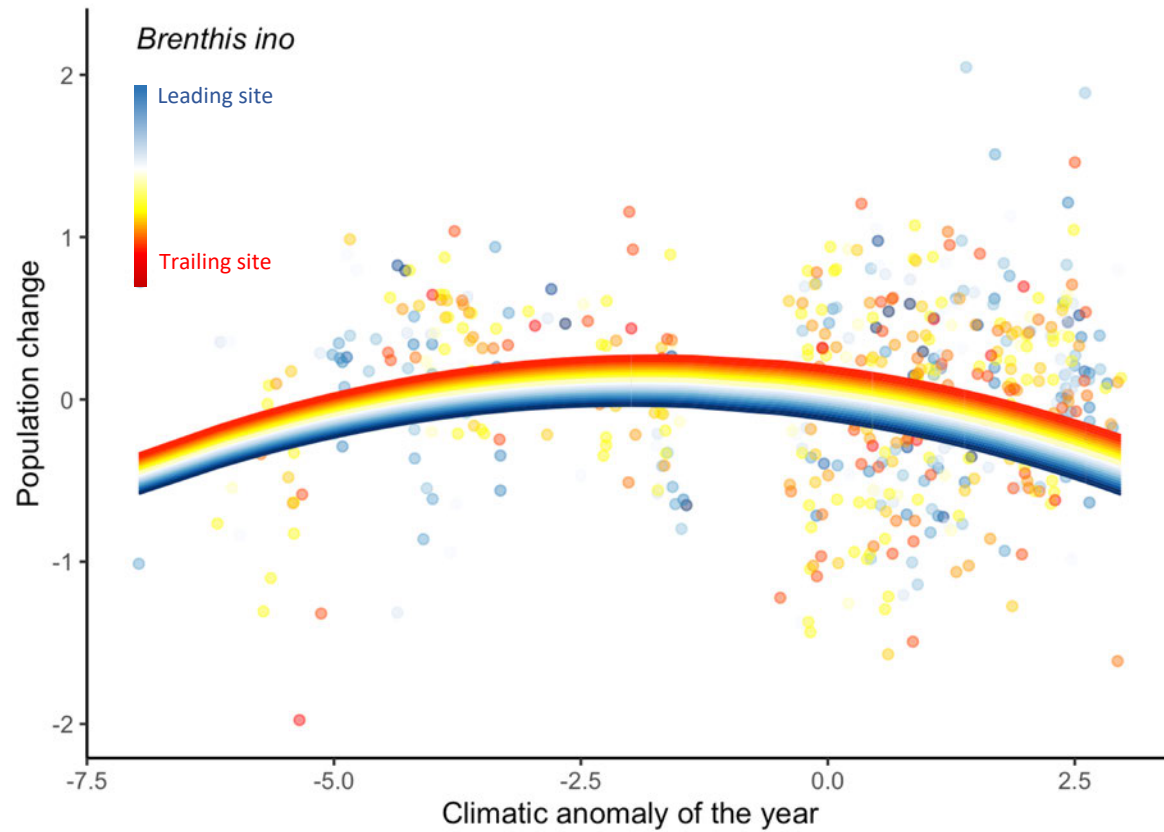
For example, a large-scale **heatwave** increases population **growth** of the Large Skipper
at **leading (cold) sites** but reduces it at **trailing (hot) sites**



And, a large-scale **cold anomaly** decreases population **growth** of the Large Skipper
at **leading (cold) sites** but increases it at **trailing (hot) sites**

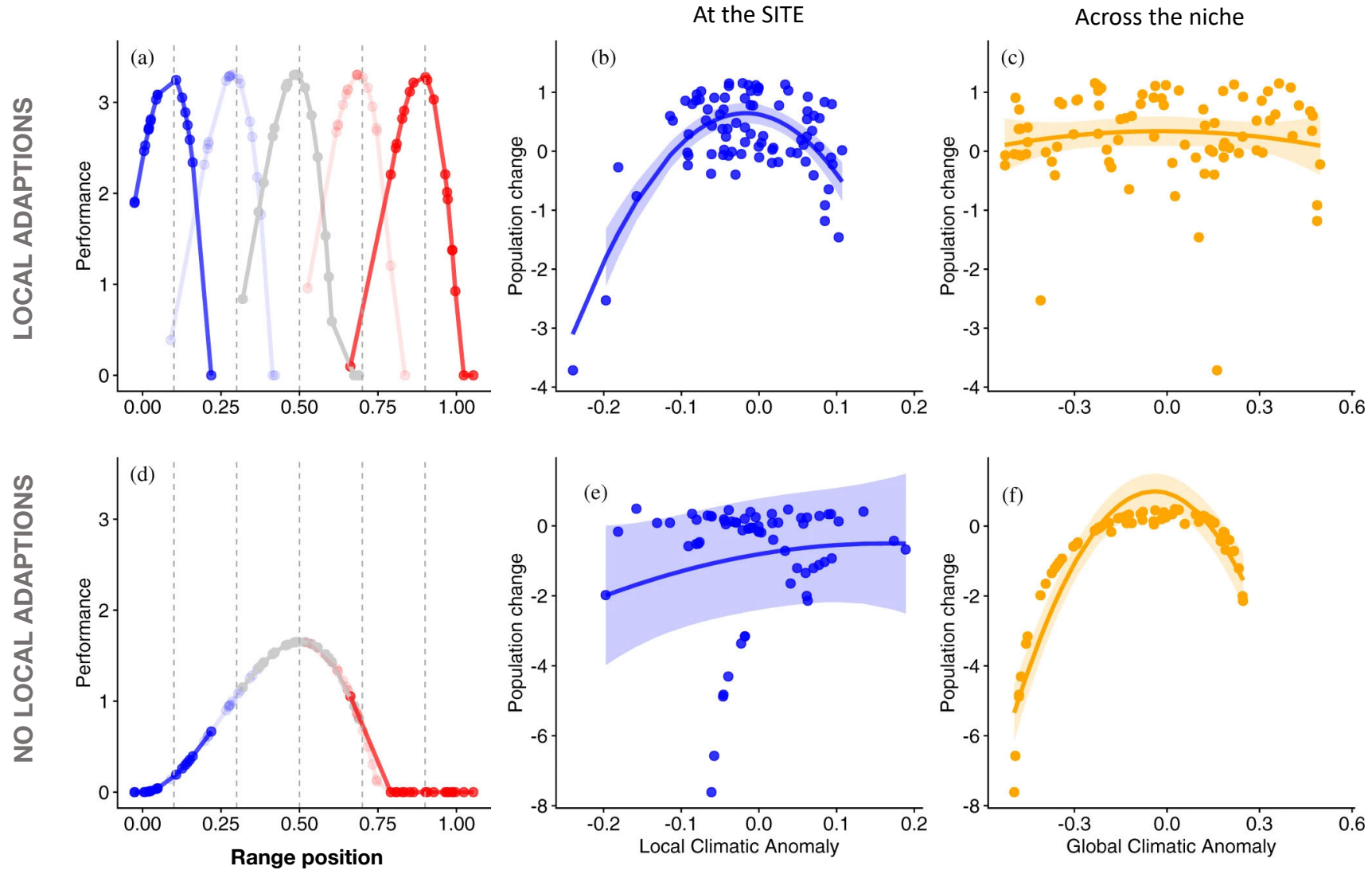


However, not all species respond that way to climatic anomalies,
some species show similar population growths at all sites



Why populations of some species respond synchronically to large-scale climatic anomalies?

H1: Species show **local adaptations**, i.e. best performing at their **site** independently of their location

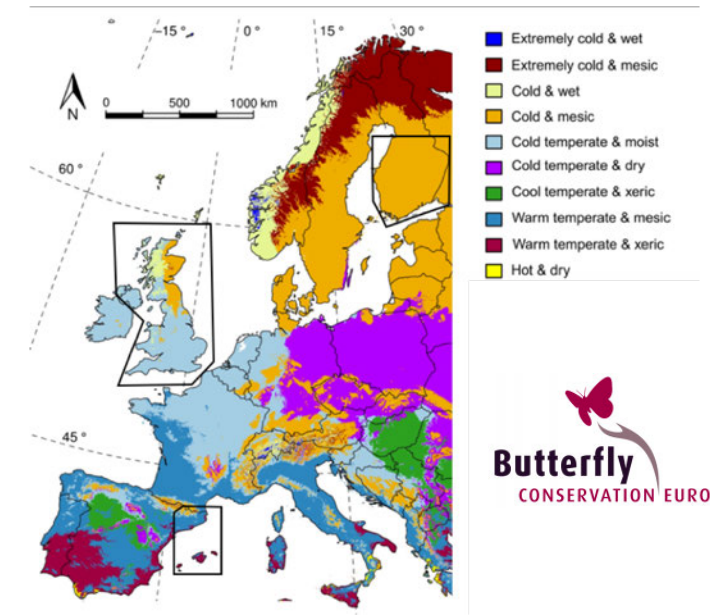


A comparative multiple species analysis to test for adaptations to climatic anomalies (at the site and at the entire distribution).

Count data of 143 butterflies species.

Along 172 sites within six European bioclimatic regions in three different countries.

During 18y of data collected weekly from March to April by volunteers (eBMS).



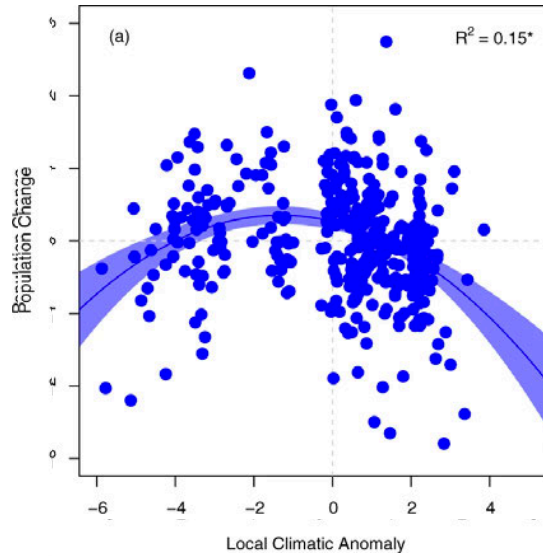
Bioclimatic regions across Europe, marked those areas covered by the study.



A group of eBMS-volunteers during a course in Barcelona
Photo: Xavi Redon.

Some species respond better to the climatic anomalies occurring at their site, while others to anomalies occurring at their niche

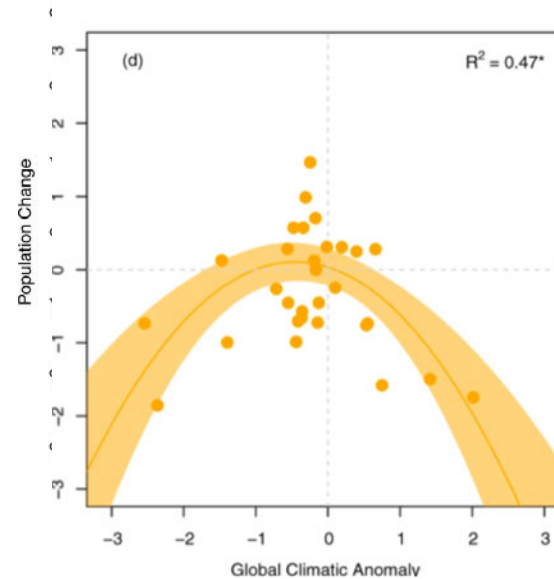
LOCAL ADAPTIONS



Brenthis ino

Populations changes best explained (R^2) by the anomalies from average local conditions

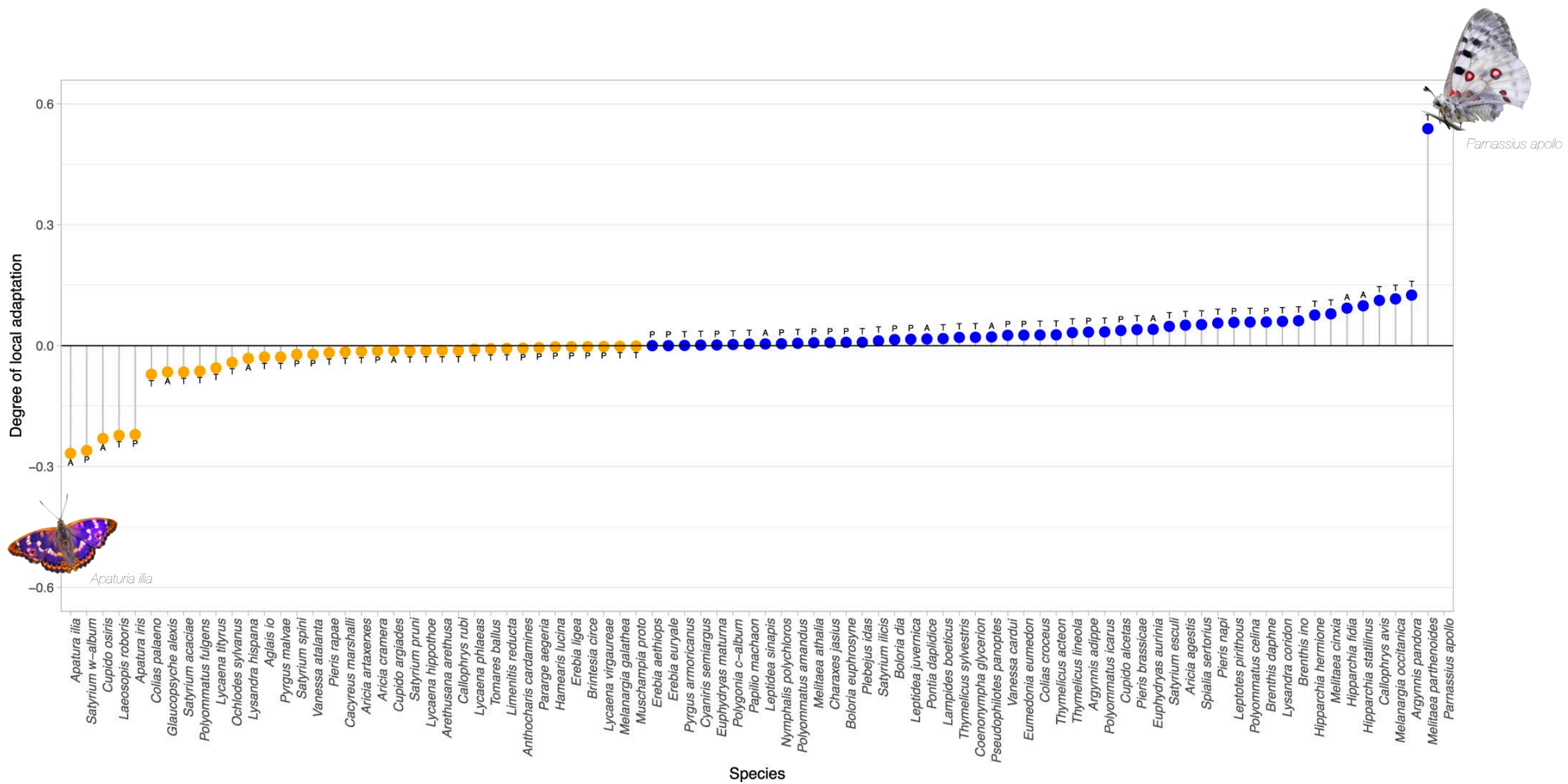
NO LOCAL ADAPTIONS



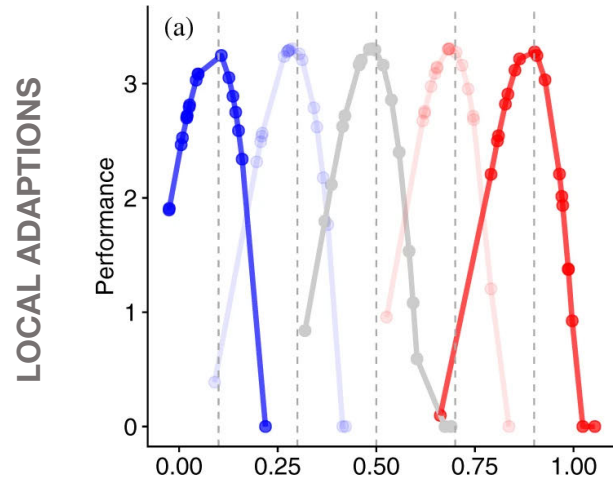
Cupido osiris

Populations changes best explained (R^2) by the anomalies from average conditions of their niche

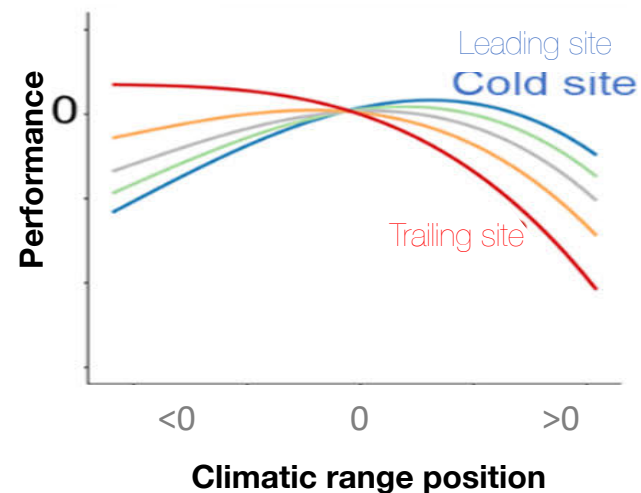
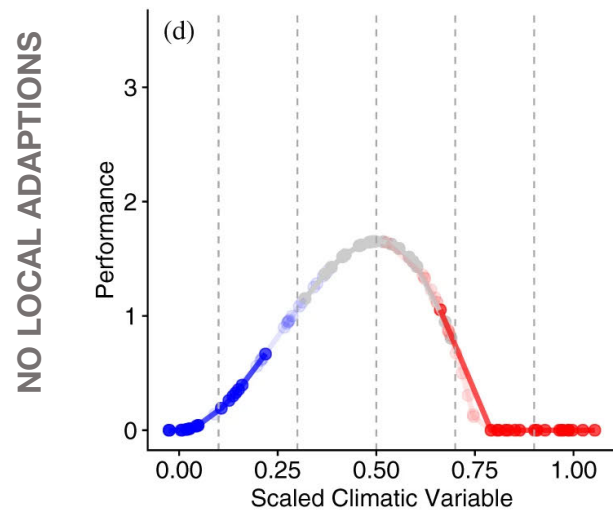
There is a **continuum of adaptation** between species, from most **locally** adapted to most **niche-adapted**



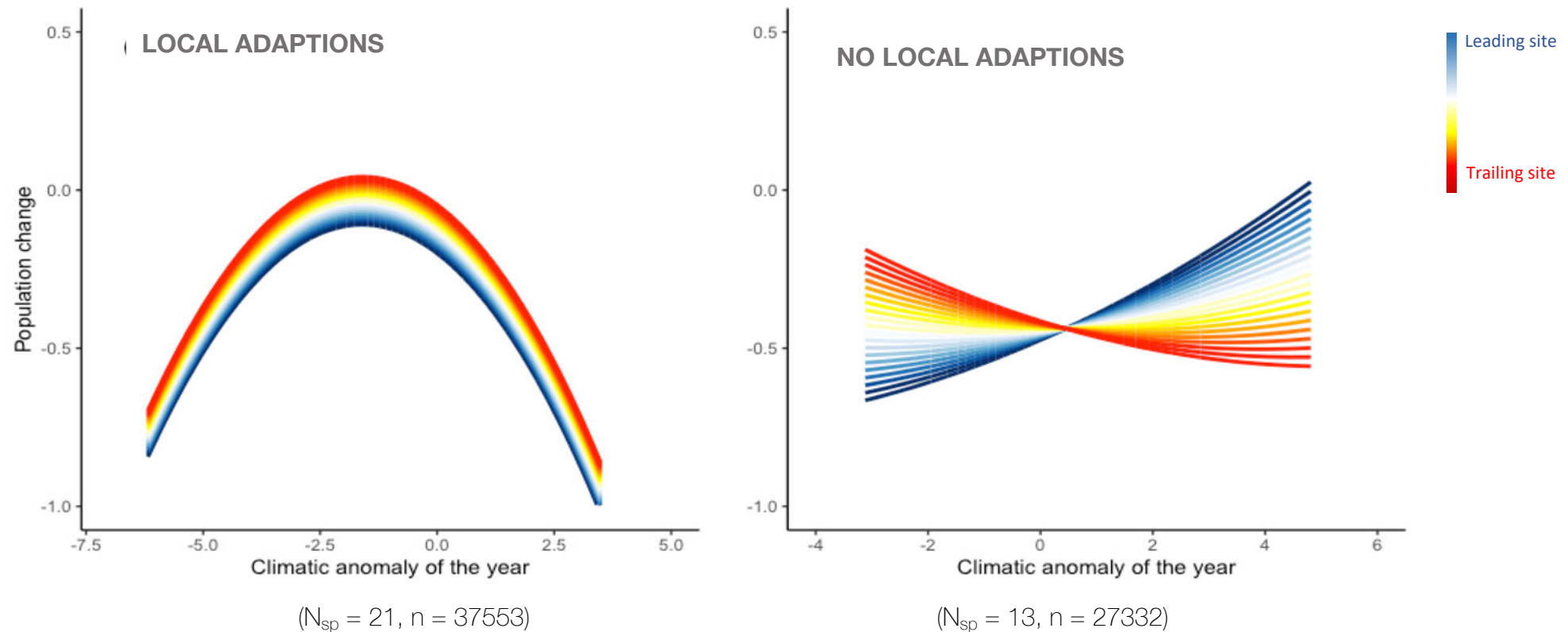
H2: The degree of **local adaptation** mediates species **populations** responses to local climatic anomalies across their climatic niche



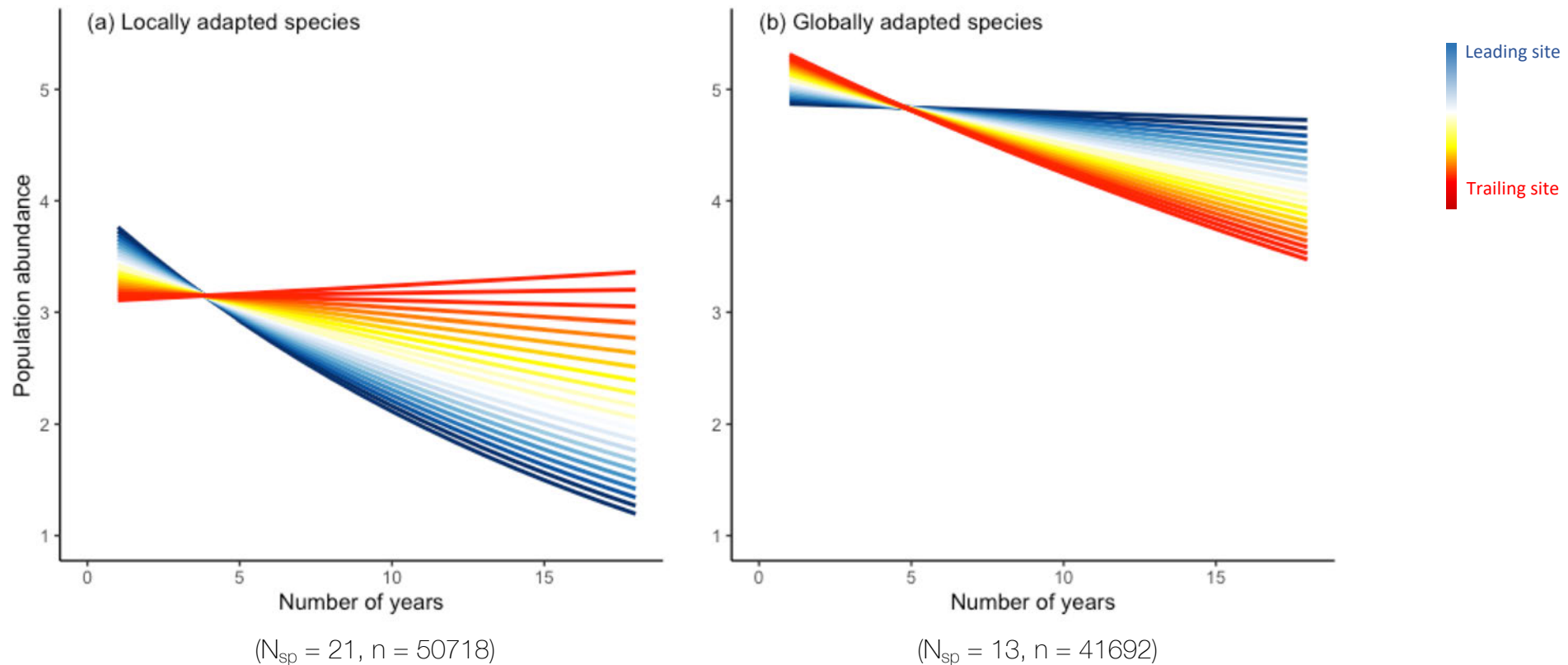
Populations performance of locally adapted species independent across sites, all anomalies will displace all populations from their optimum



The **positive or negative effect** of climatic anomalies depends on the degree of **local adaptation** of the species **and** on the **population position** within its range (niche)



As a result, population trends of locally adapted species showed stable abundances over time at the trailing margin, but steep declines at the leading; while the rest showed a steeper decline at the trailing



Take Home Messages

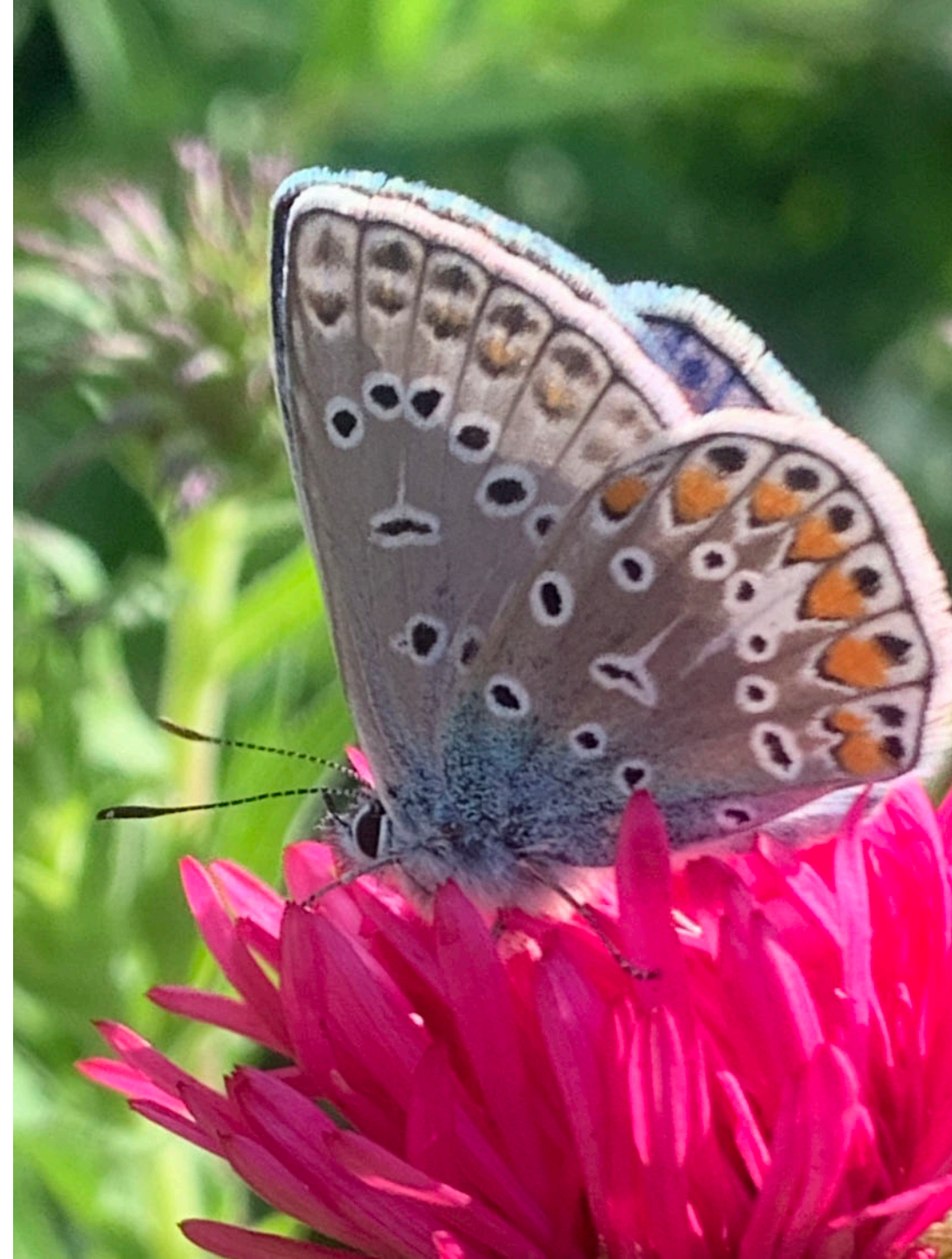
NO LOCAL ADAPTIONS

Above average **anomalies** favour leading populations of non adapted species & disfavour trailing

Below average **anomalies** favour trailing populations of non adapted species & disfavour leading

LOCAL ADAPTIONS

All climatic **anomalies** disfavour locally adapted species but trades-off may disfavour leading populations



The team thanks you for listening

with special thanks to all BMS volunteers across Europe



Tom Oliver



Luke Evans



Constan Stefanescu



Reto Schmucki,

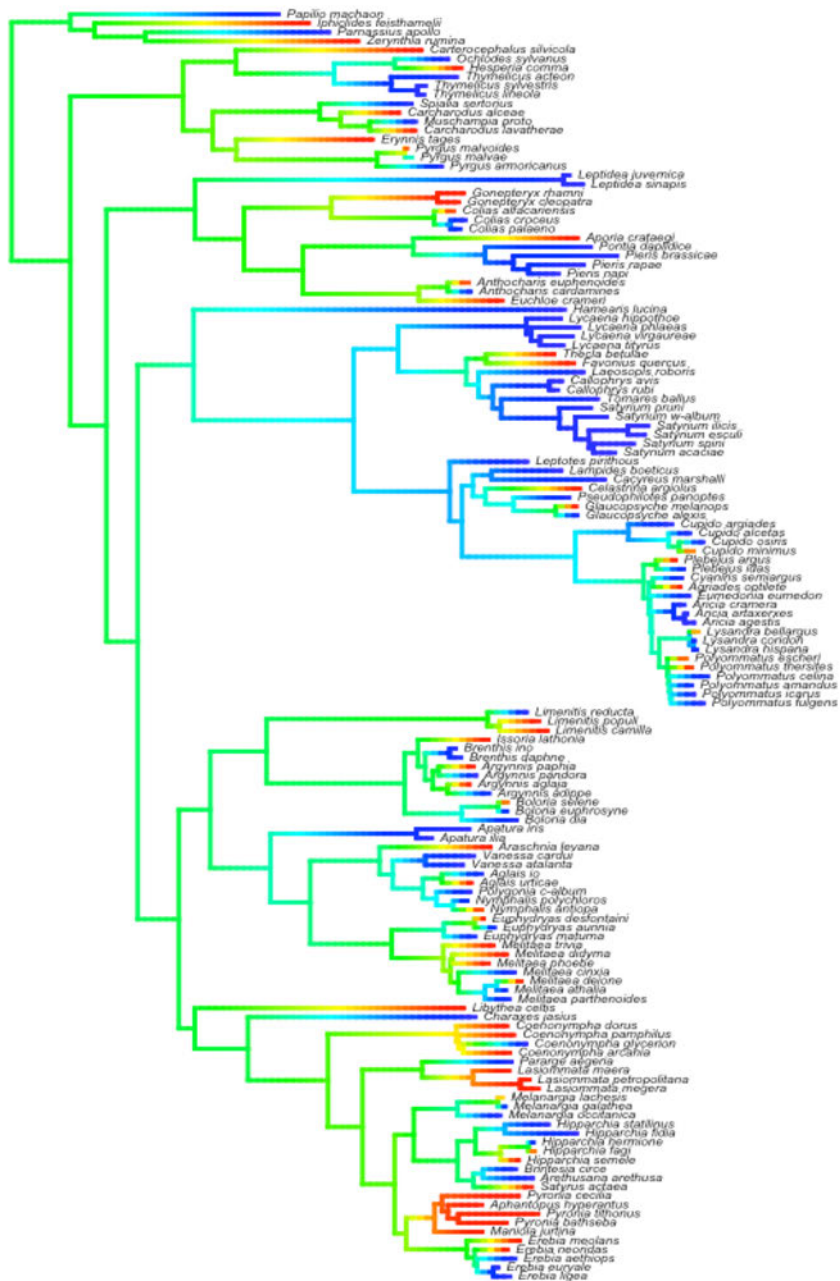


David Roy



Mikko Kuussaari





The degree of local adaption has **phylogenetic signal** explaining ca. 80%

But not by mobility or reproduction rate

