

Community response to variation in rainfall in a successional system



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How does variation in rainfall impact community structure?

Introduction

Communities are dynamic systems influenced by both abiotic and biotic perturbations.

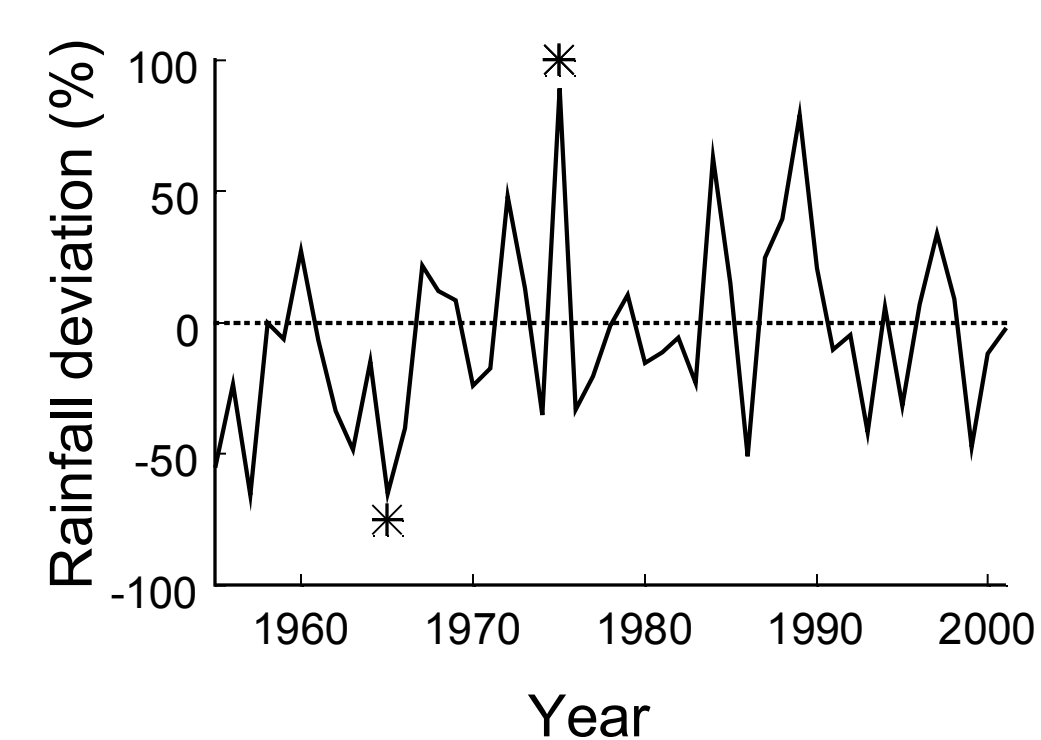
Perturbations influence community structure through shifts in resource availability.

However, the mechanisms by which communities respond to fluctuating resource levels are not well understood.

We examined species turnover dynamics using long-term successional data to determine the mechanisms behind community responses to variation in rainfall.

Methods

We used permanent plot data (BSS) to examine changes in community dynamics in response to fluctuations in rainfall.



Rainfall was measured as the deviation from normal growing season (May to July) rainfall. The most extreme events (*) occurred during 1965 and 1975.

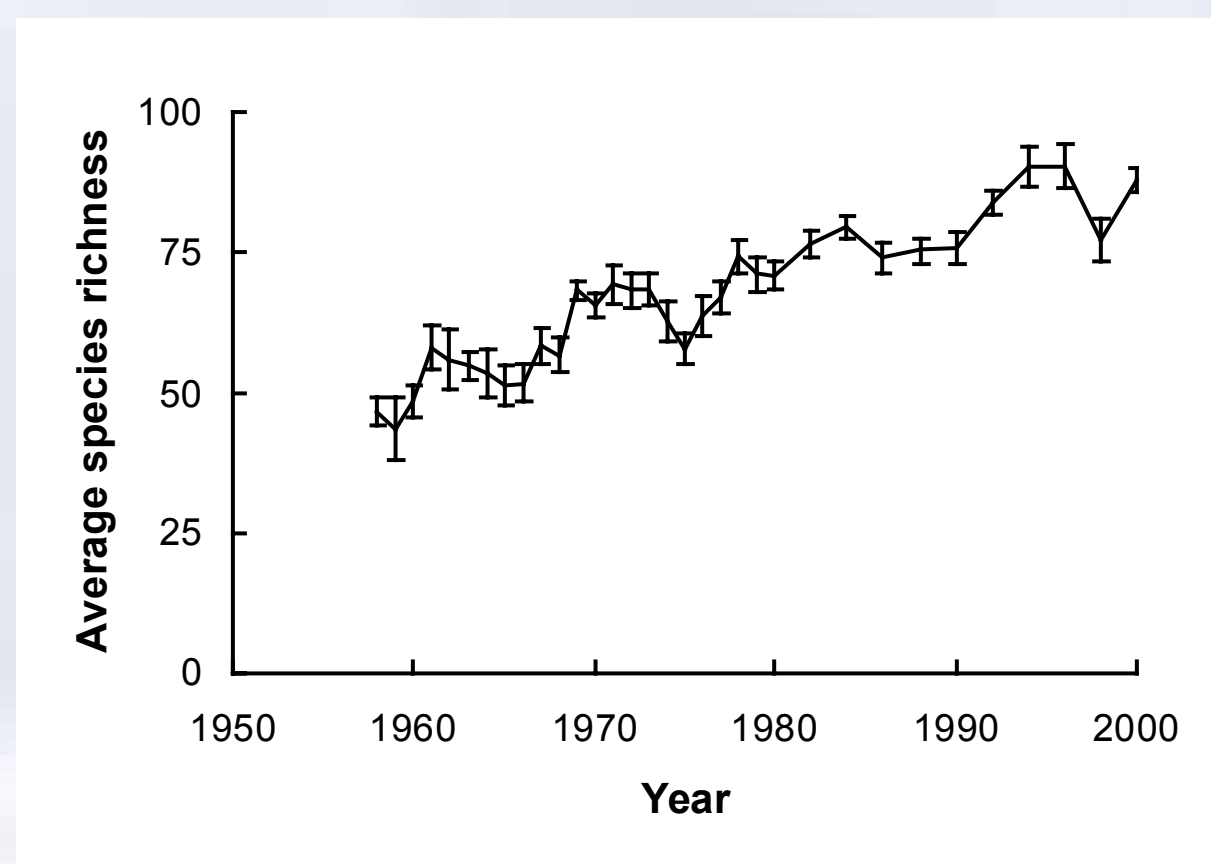
Wet = $> +25\%$
Dry = $< -25\%$
Ave = $0 \pm 25\%$
 $>>$ Wet = $>75\%$

We quantified field species richness, colonization and extinction rates for each year.

These values were related to rainfall variation during the sample year (t) and to the previous year's rainfall (t-1).

At the population level we related occurrences of each lifeform group to deviation at (t) and (t-1).

Frequency distributions were created to assess the probability of extinction based on frequency during maximum wet and dry years (*).

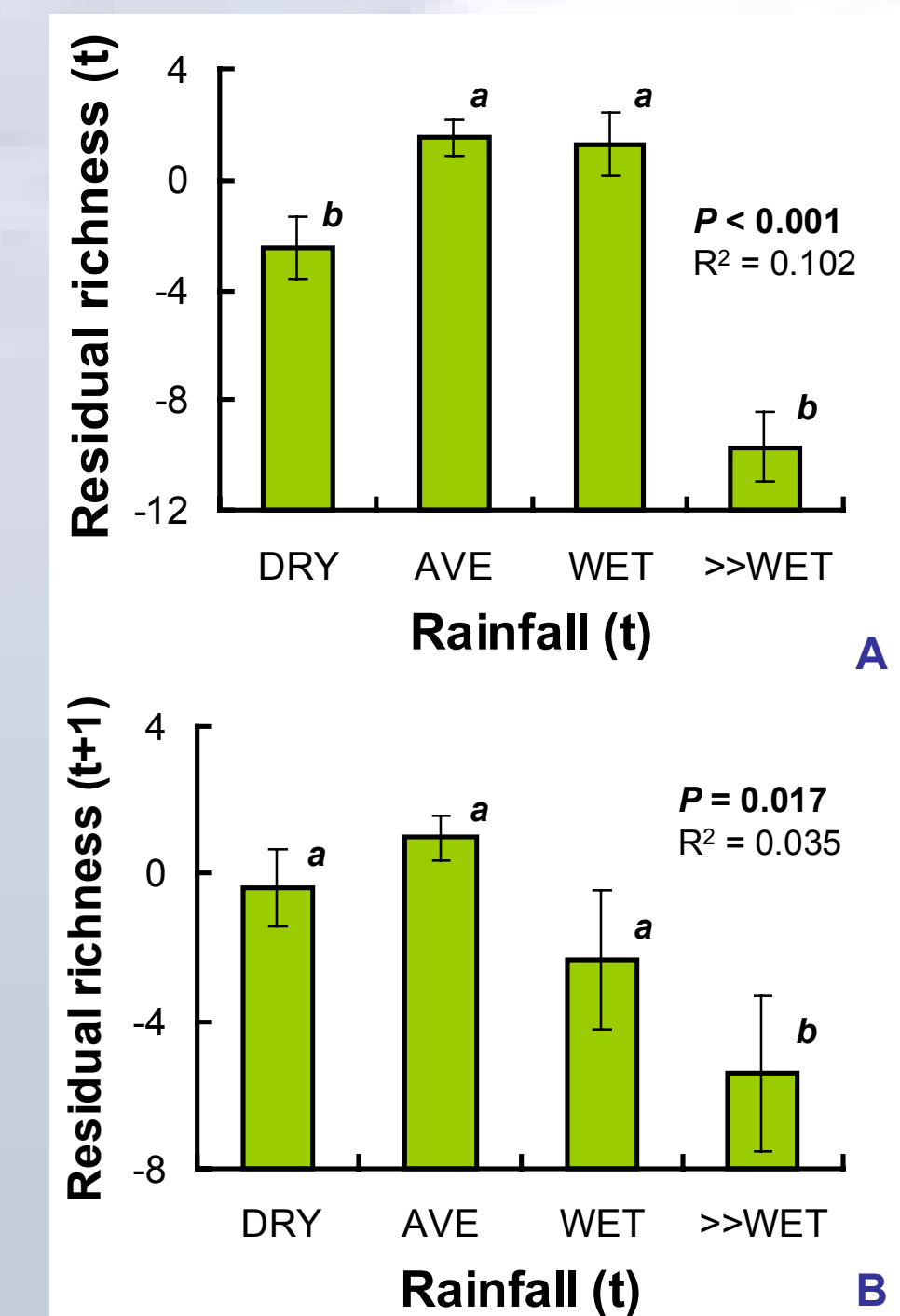


Annual variability in species richness is explained in part by rainfall.

We found that species richness declines in wet and dry years (A) and species richness remains low following wet years (B).

I. Species richness

Although the number of species in each field increases through succession, there is annual variability in field diversity.



Research findings

I. Community diversity changes with rainfall and is more strongly affected during wet and dry years.

II. Establishment limitation and competitive exclusion are mechanisms for community change in response to deviation in rainfall.

III. Rare, ruderal species are more strongly affected most likely due to:

- increased competition,
- establishment limitation resulting from high cover during wet years, and
- mortality during drought years.

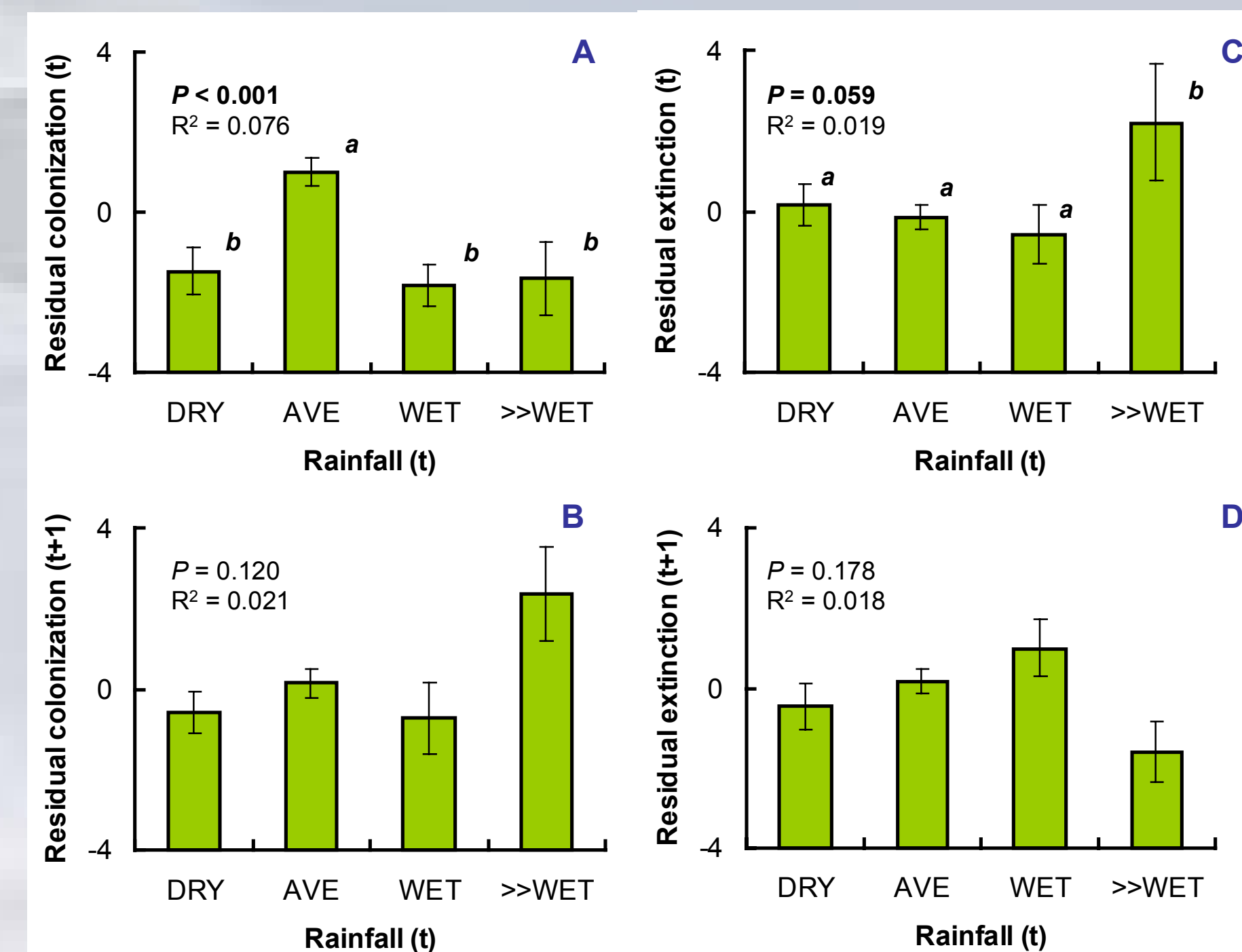
These results suggest that plant communities can have predictable responses to changes in resource availability.

This approach should be applied in other systems to test the predictability of vegetation change in response to resource fluctuations.

II. Species turnover

Declines in diversity are caused by decreased colonization (A-B) rates during wet and dry years and increased extinction (C-D) rates during wet years.

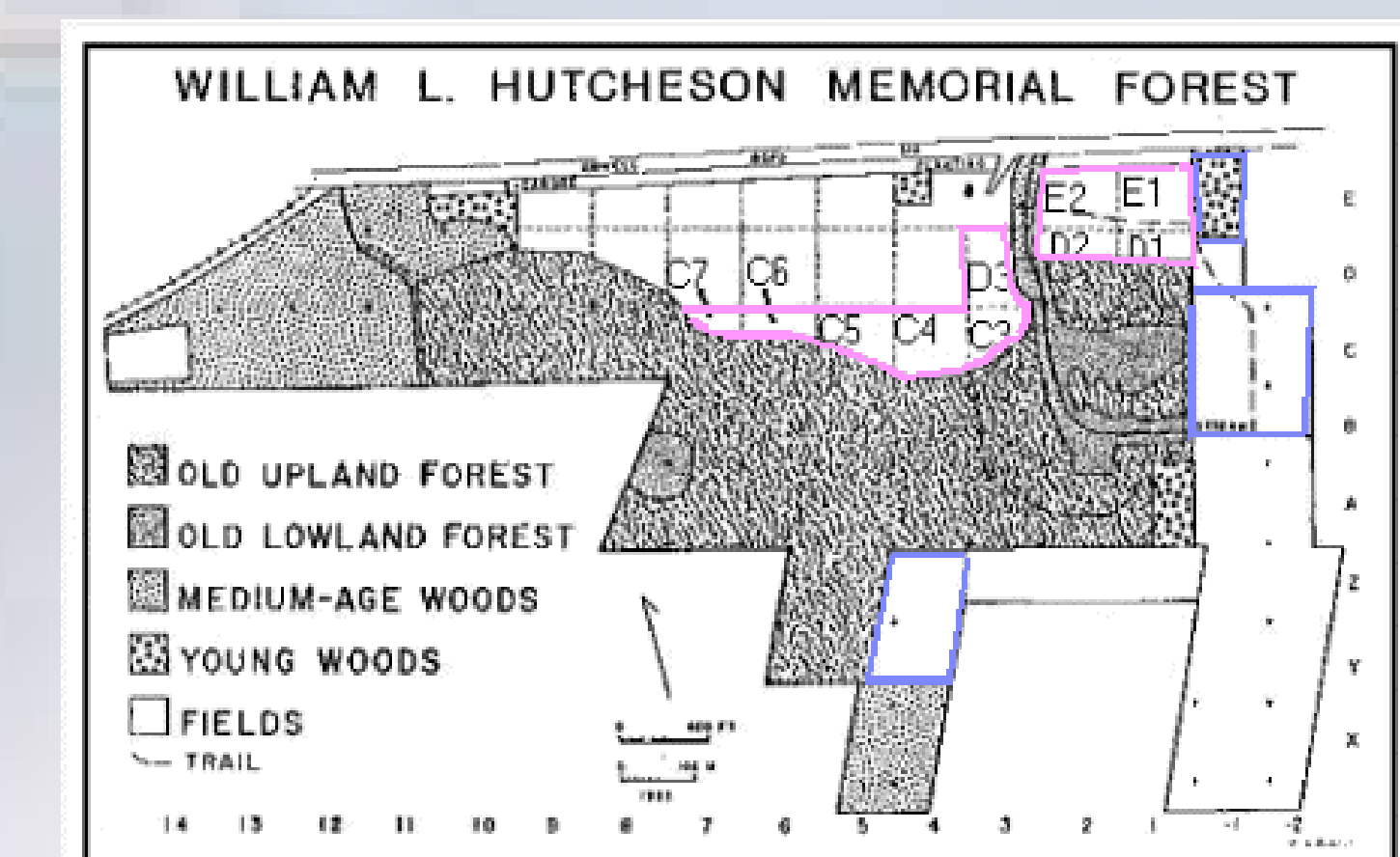
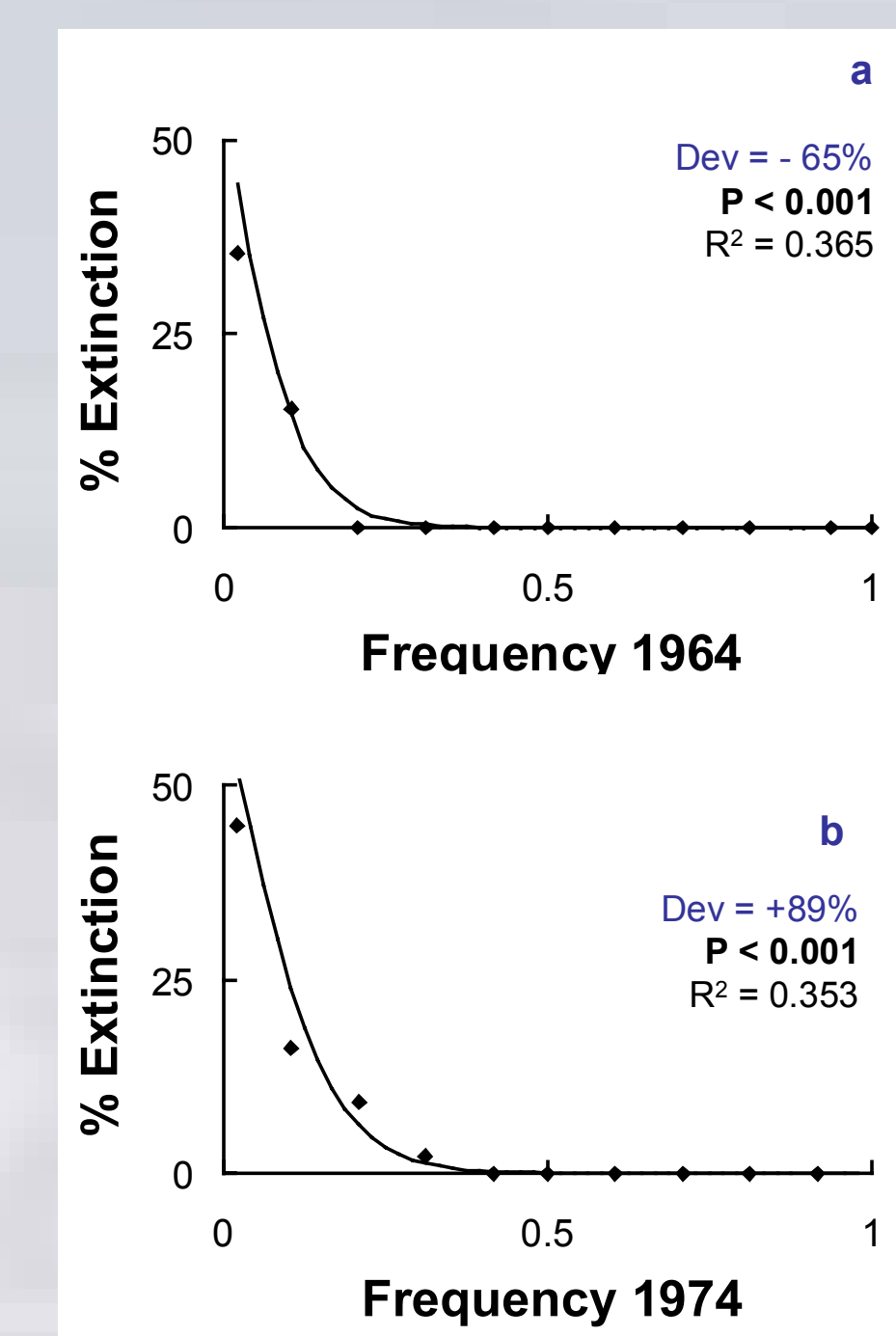
We found no effects of extreme wet and dry years on species turnover in subsequent years.



III. Population responses

Rare species were most strongly affected during dry (a) and wet (b) years.

Additional analyses have shown that ruderal (annual, biennial and perennial) species are more strongly affected during extreme years than trees, shrubs or lianas.



Buell-Small Succession Study (BSS)

The BSS includes ten fields abandoned from agriculture beginning in 1958. Vegetation dynamics have been followed in 48 permanently marked 0.5 x 2.0 m plots in each field. www.ecostudies.org/bss

