

Small-scale changes of flower type composition



along a dune slack gradient

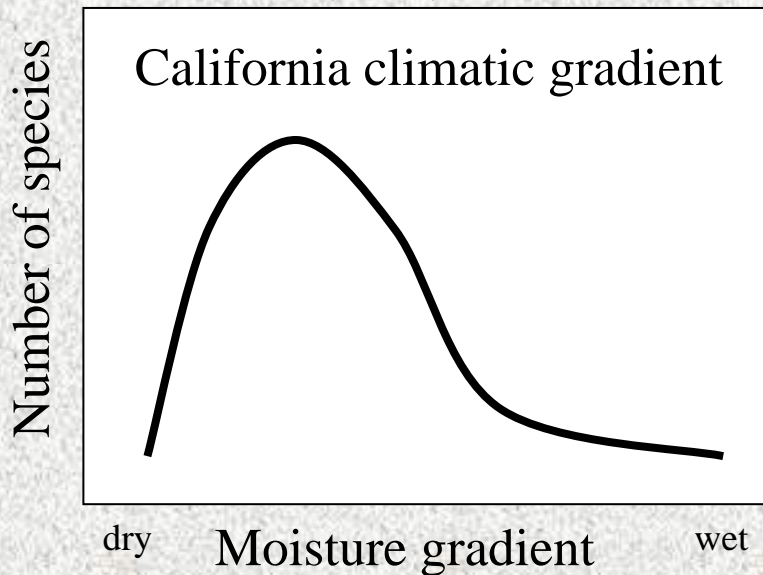


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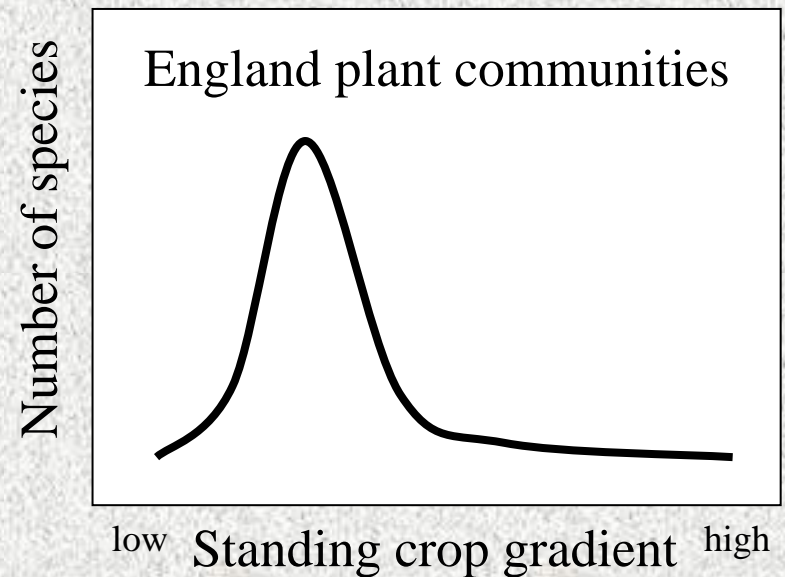
Introduction

- Relationship between environmental factors and plant species richness
 - Plant species richness of plant communities changes along environmental gradients

Whittaker (1975):

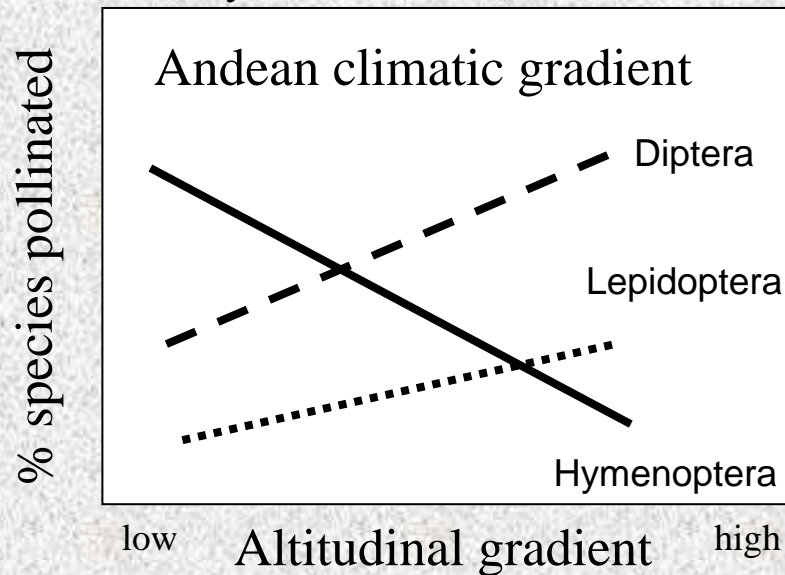


Al-Mufti et al. (1977):

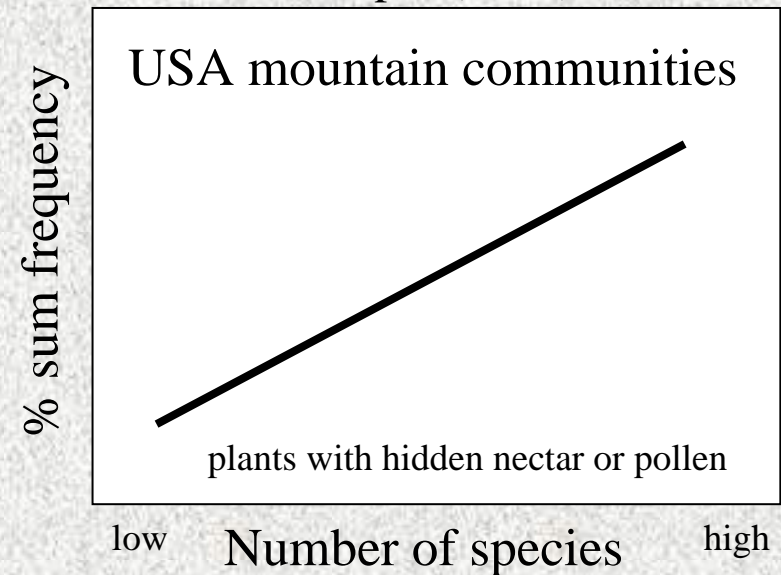


- Relationships with functional traits of plant species
 - Flower type composition of plant communities changes along environmental gradients
 - Flower type composition of plant communities changes with plant species richness

Arroyo et al. (1982):



Ostler & Harper (1978):



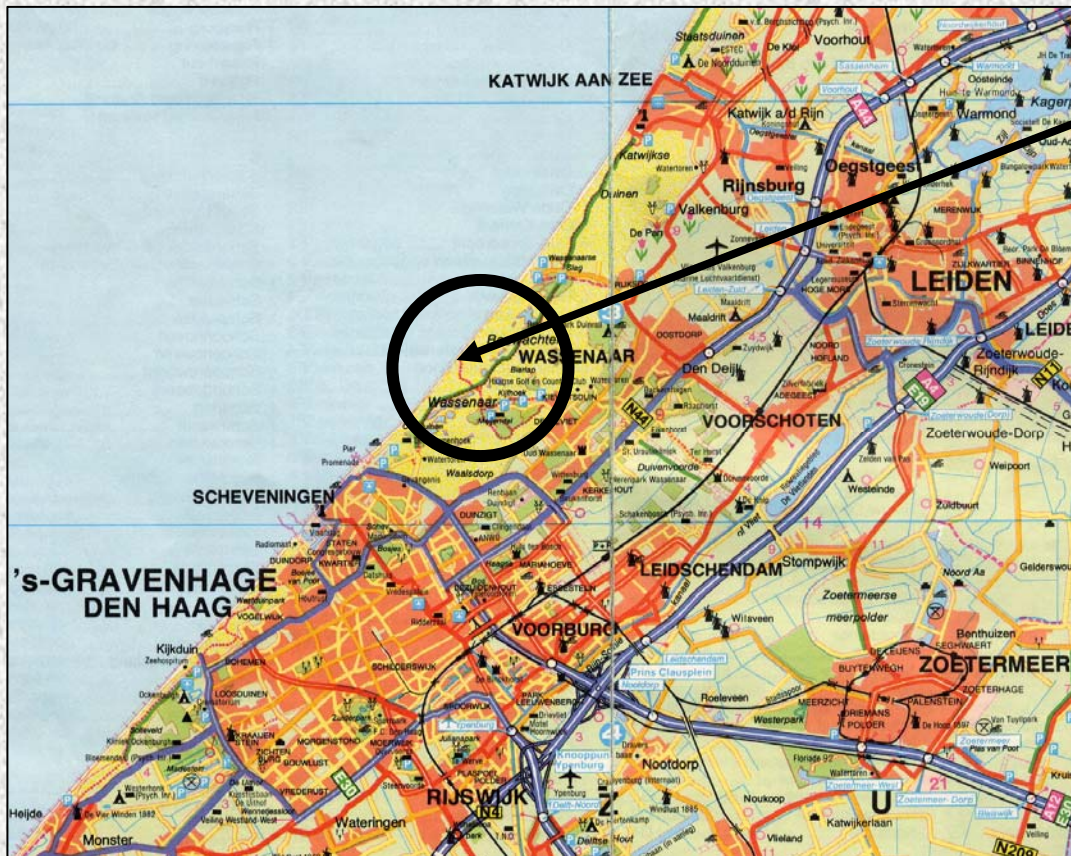
- These relationships are mainly documented
 - along altitudinal or latitudinal environmental gradients at a regional scale
 - for large sized plant communities
 - separate of each other
- The relationships were explained by mechanisms acting at a local and a fine scale
 - climatic conditions → pollinator assemblages → flower type spectra (local scale)
 - plant species richness → pollinator fidelity → flower diversity (fine scale)

- Dune slack gradient:
 - local scale changes of plant communities
 - flight range of pollinator assemblage > size of plant community
 - Explanation: Fine scale vs. local scale vs. regional scale (species pool of metacommunity)
- Research questions:
 - Are the regional scale relationships present along a local gradient of a vegetation complex?
 - Are environmental factors, plant species richness and flower type composition interrelated at the same time?
 - Discussion: What factors may determine flower type composition of plant communities at a local scale?

Materials and Methods

Study site

Costal dune slack in the Netherlands near The Hague,
300 m away from the sea with an area of 2,5 ha, yearly mown



study site



Species rich area with many rare plant species



Sampling design

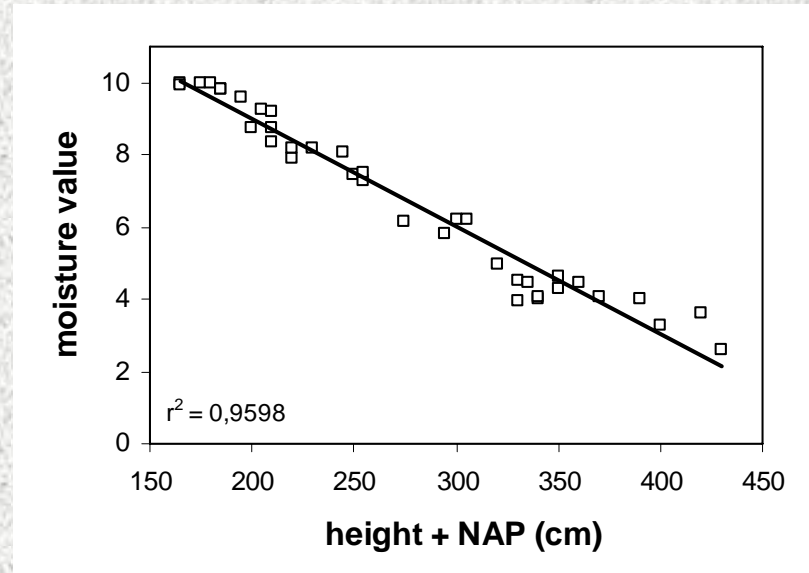
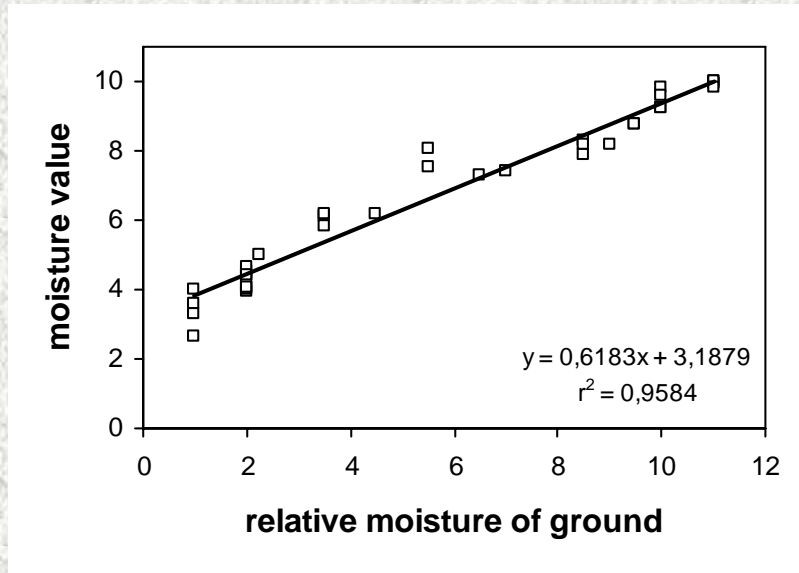
- Sampling design
 - Three transects each with about 12 x 2 samples of 1 m²
- Plant species richness
 - Number of higher plant species in a 1 m² sample

- Plant species abundance
 - Frequency of plant species in a 1m² sample

July 2001

Environmental factors

- Mean Ellenberg indicator values for moisture, nutrient availability, acidity and light



- Relative moisture of the ground and mean moisture values are positively correlated
- Height above NAP and moisture values are negatively correlated

Functional flower types

- Wind pollinated plants
- Insect pollinated plants

Levels of adaptation:

- Allophilic flowers
- Hemiphilic flowers
- Euphilic flowers

Wind flower



Insect flower



allophilic = simple



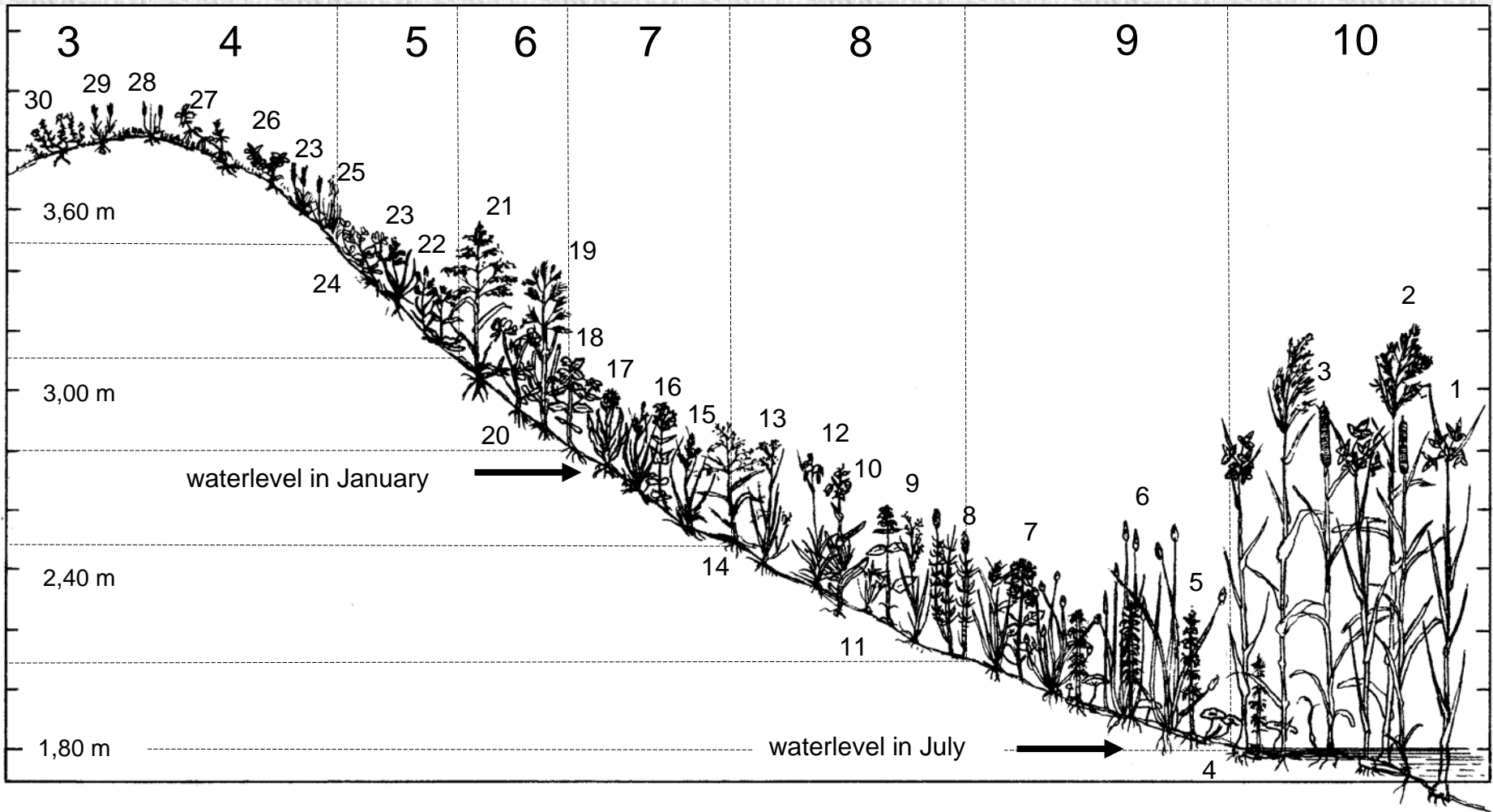
hemiphilic = intermediate



euphilic = complex

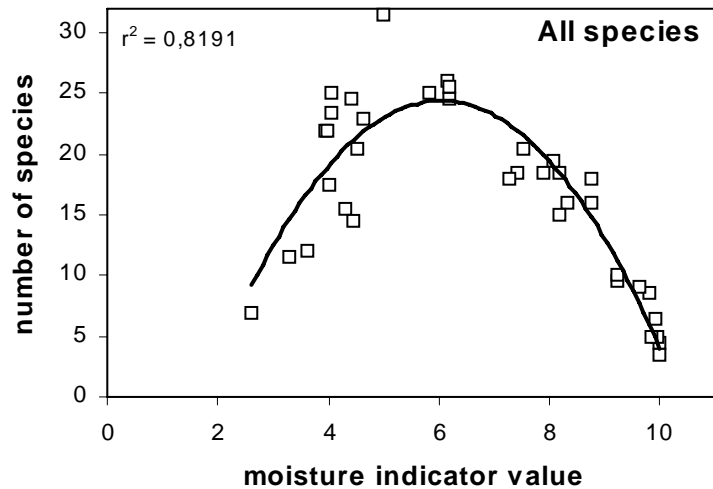


Results

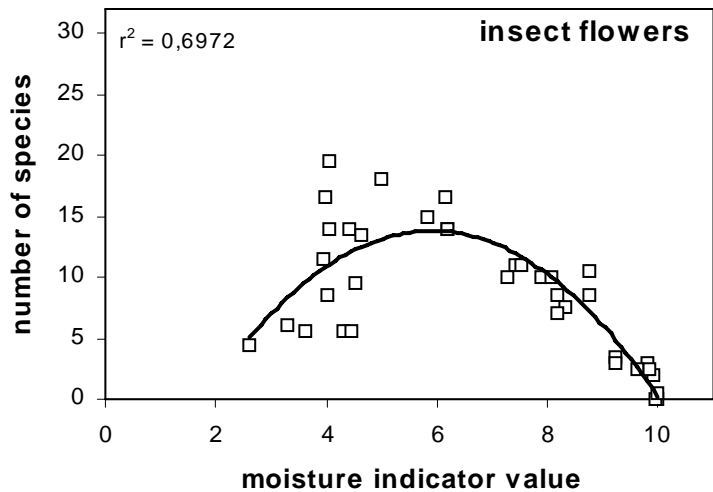


1 *Bolboschoenus maritimus*, 2 *Phragmites australis*, 3 *Typha latifolia*, 4 *Hydrocotyle vulgaris*, 5 *Hippuris vulgaris*, 6 *Eleocharis palustris*, 7 *Mentha aquatica*, 8 *Equisetum palustre*, 9 *Juncus articulatus*, 10 *Epipactis palustris*, 11 *Carex oedeni* en *Prunella vulgaris*, 12 *Carex flacca*, 13 *Juncus alpinoarticulatus*, 14 *Agrostis stolonifera*, 15 *Carex trinervis*, 16 *Gentianella amarella*, 17 *Dactylorhiza incarnata*, 18 *Rhinanthus angustifolius*, 19 *Helictotrichon pubescens*, 20 *Lotus corniculatus*, 21 *Holcus lanatus*, 22 *Luzula campestris*, 23 *Carex arenaria*, 24 *Ononis repens*, 25 *Festuca ovina*, 26 *Sedum acre*, 27 *Galium verum*, 28 *Phleum arenarium*, 29 *Koeleria macrantha*, 30 *Thymus pulegioides*.

Environment and plant species richness



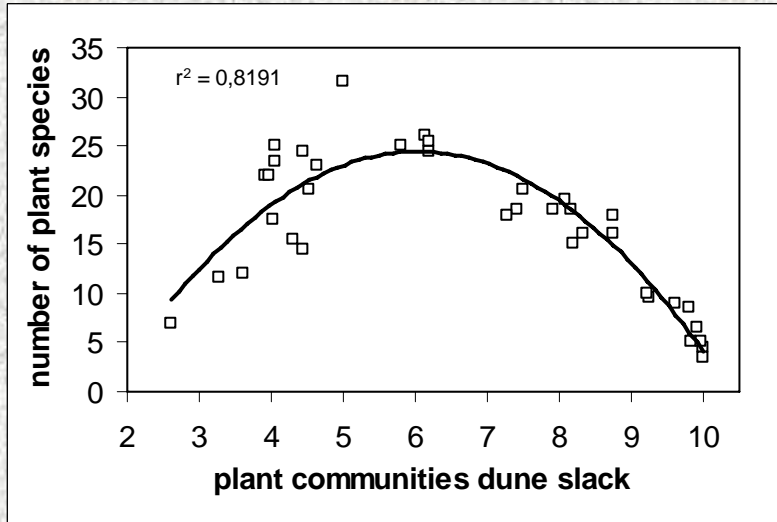
Plant species richness shows an optimum relationship with moisture values



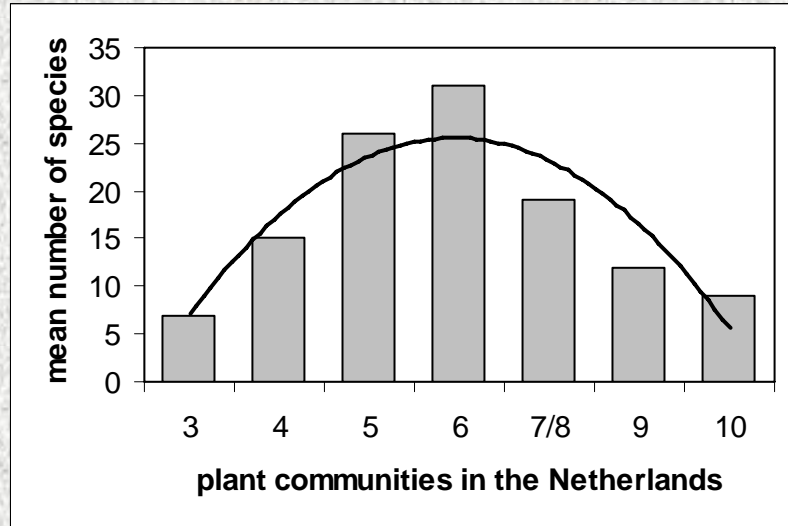
The same relationship exists between species with insect flowers and moisture

Environment and plant species richness

Local scale



Regional scale

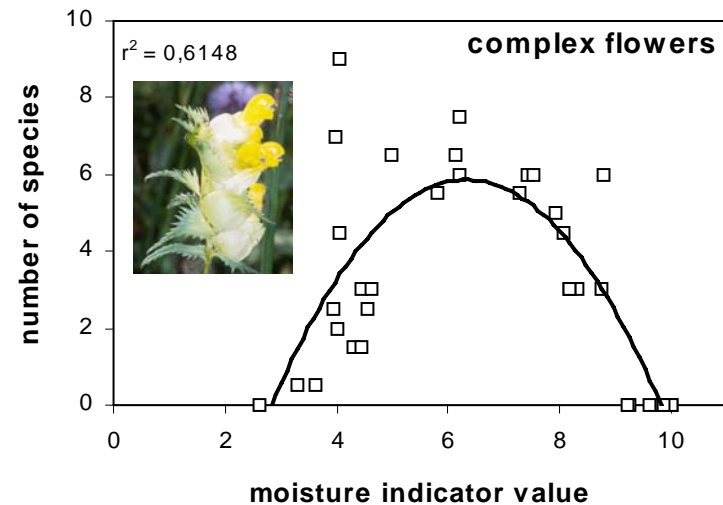
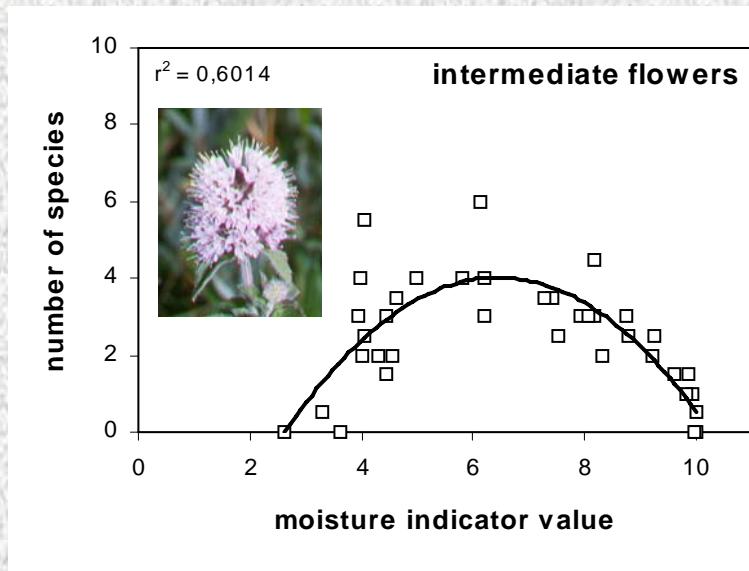
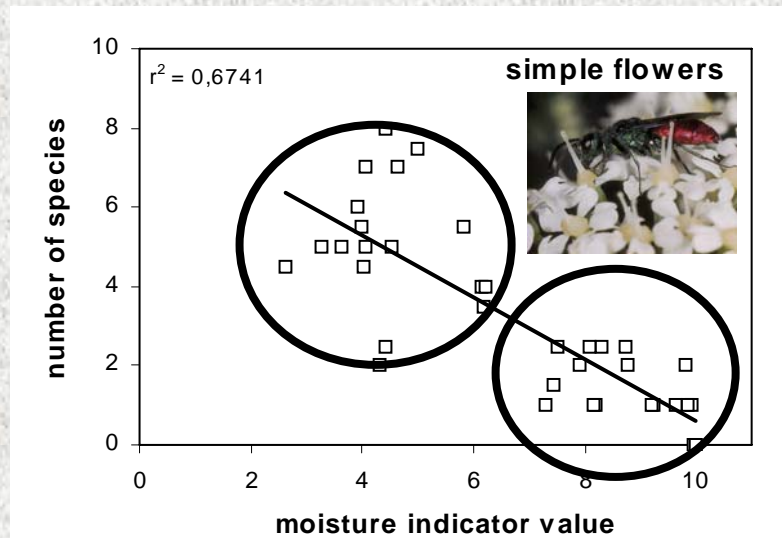


3 Ammophiletea, 4 Tortulo-Koelerion, 5 Polygalo-Koelerion, 6 Molinio-Arrhenatheretea, 7/8 Parvocaricetea, 9 Sparganio-Glycerion, 10 Phragmition australis (Schaminée et al. 1995-1998)

- Species numbers along a local gradient resemble mean species numbers at a regional scale.

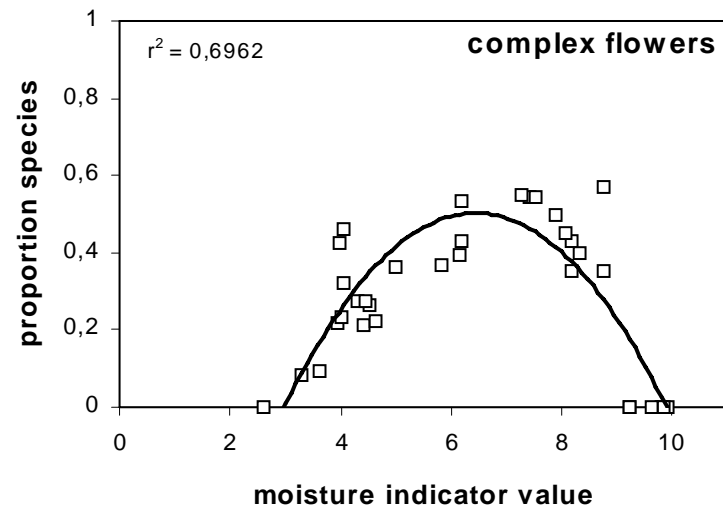
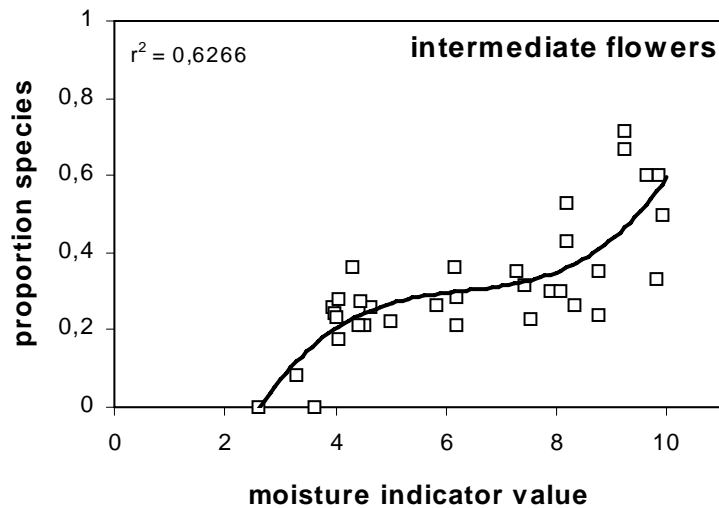
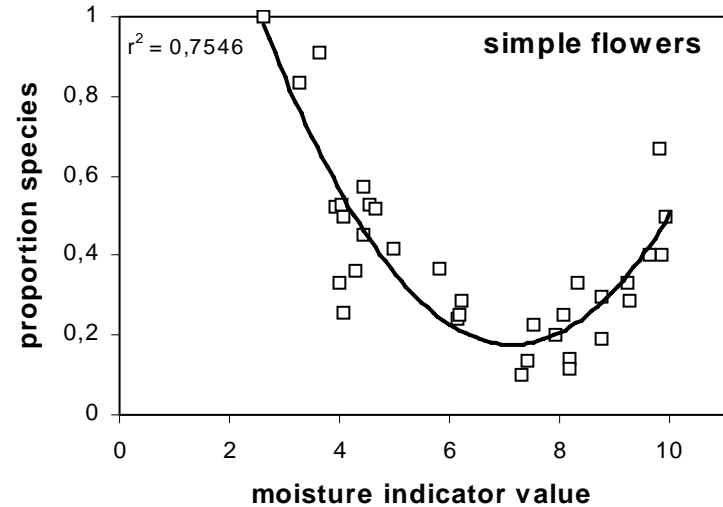
Environment and species richness of flower types

Flower types differ in their species richness pattern along the moisture gradient



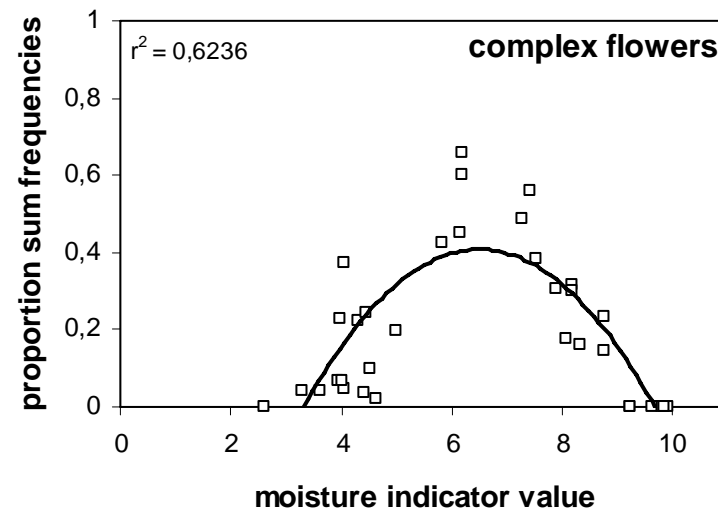
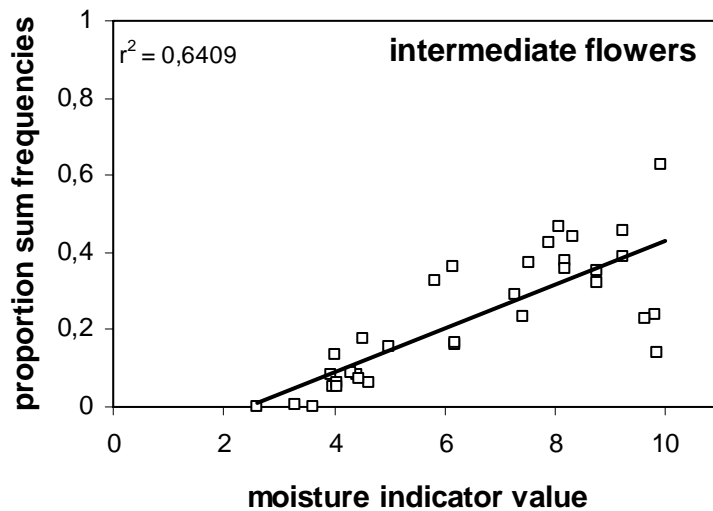
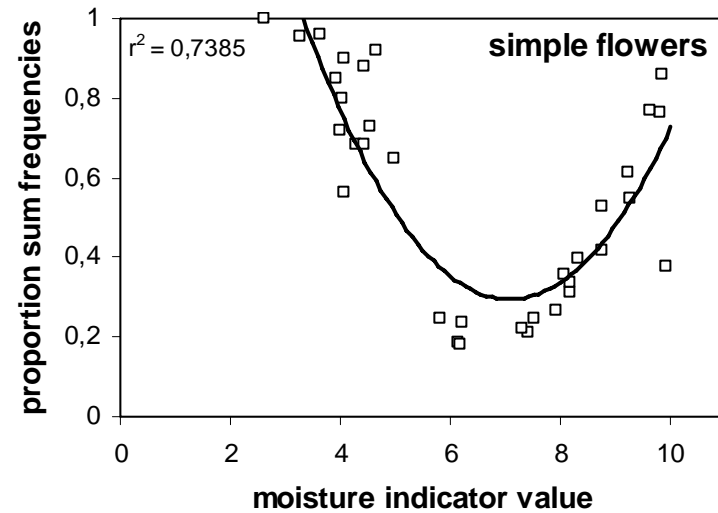
Environment and flower type composition

Flower types differ in their relative abundance of species along the moisture gradient



Environment and flower type composition

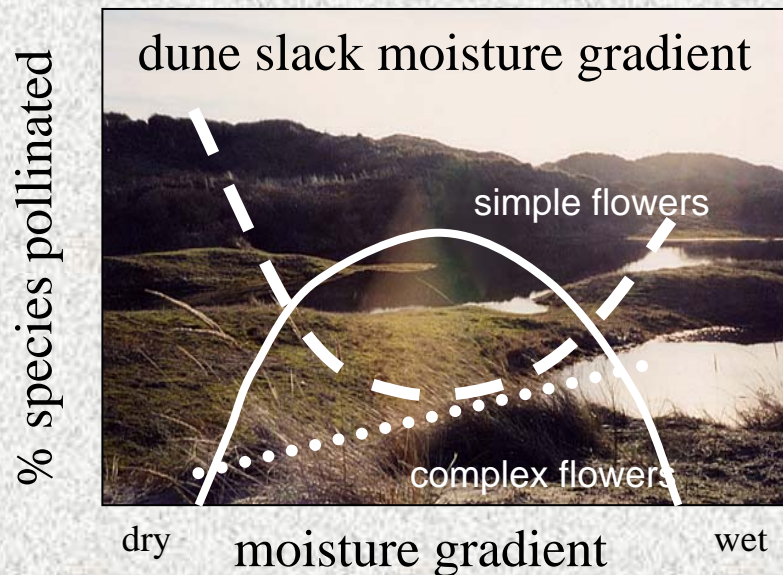
The same fine-scale pattern can be seen for the relative abundance of individuals



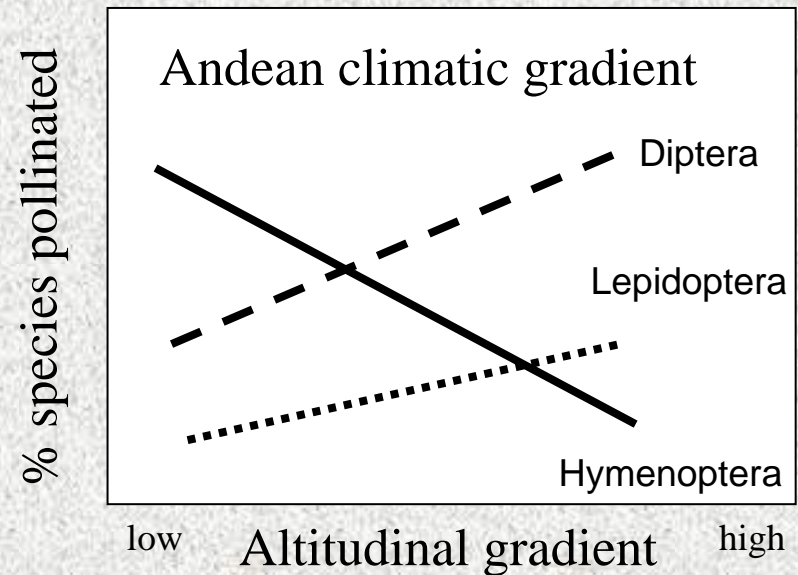
Environment and flower type composition

- Flower type composition change at a local scale regularly with moisture.
- This is a novel finding with no examples at a regional scale. However, it is in one line with changes of flower type composition due to severity of habitats

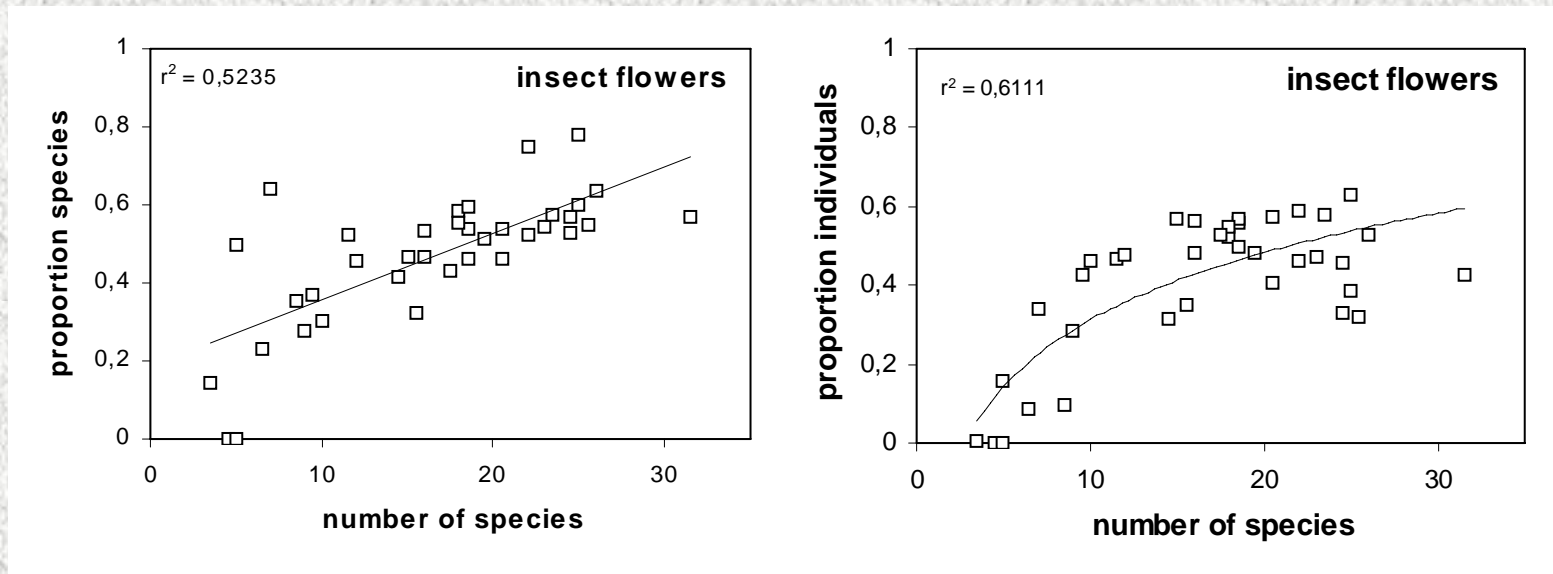
Local scale



Regional scale



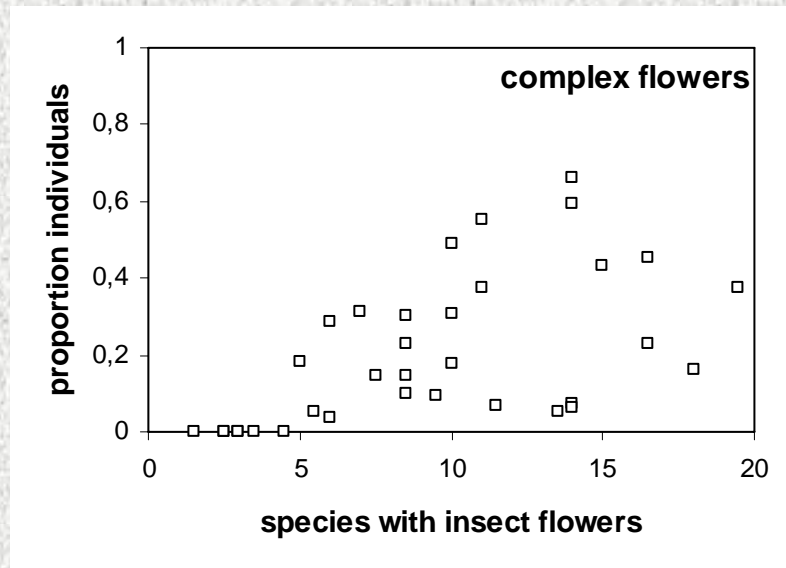
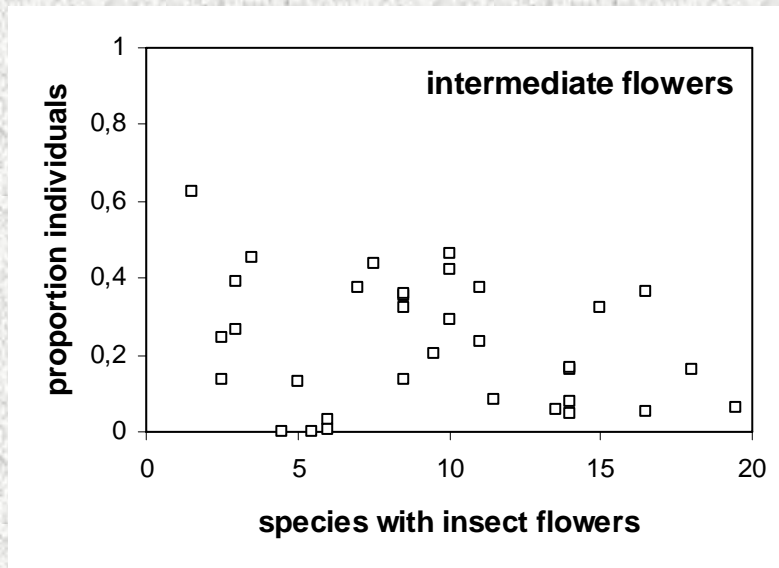
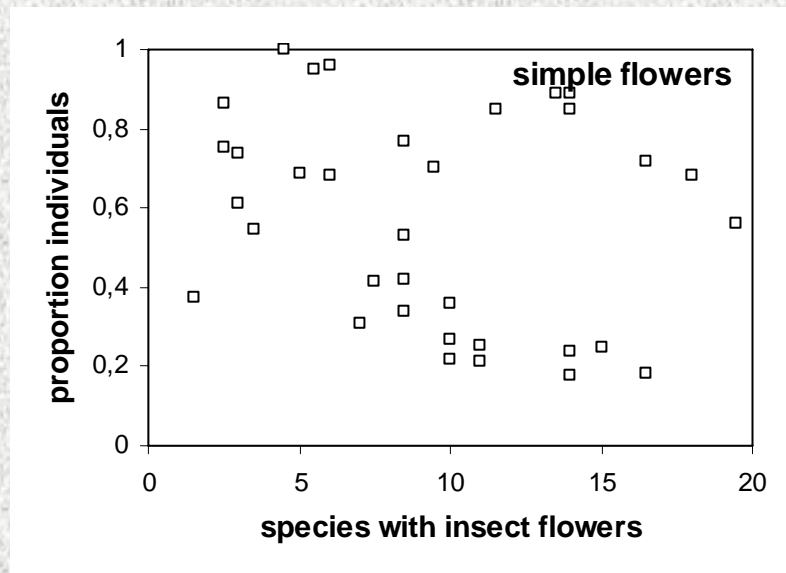
Species richness and flower type composition



The relative abundance of species with insect flowers increase with increasing species richness

Species richness and flower type composition

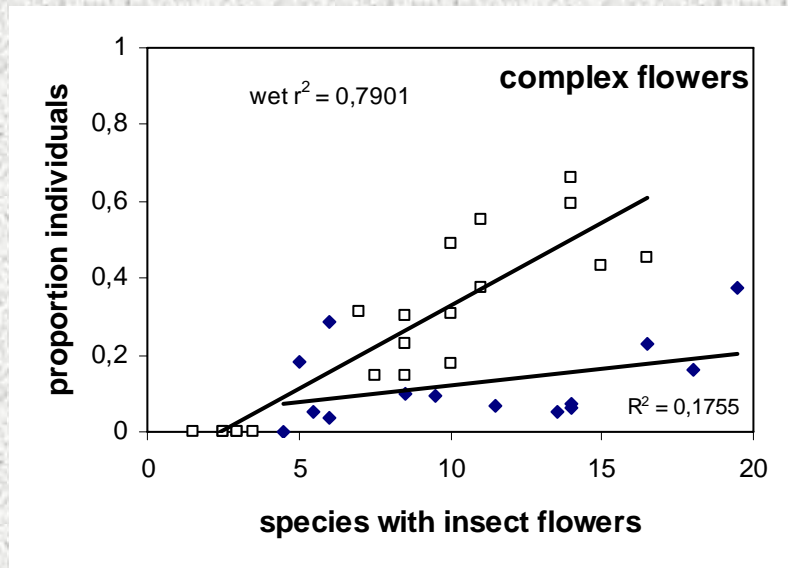
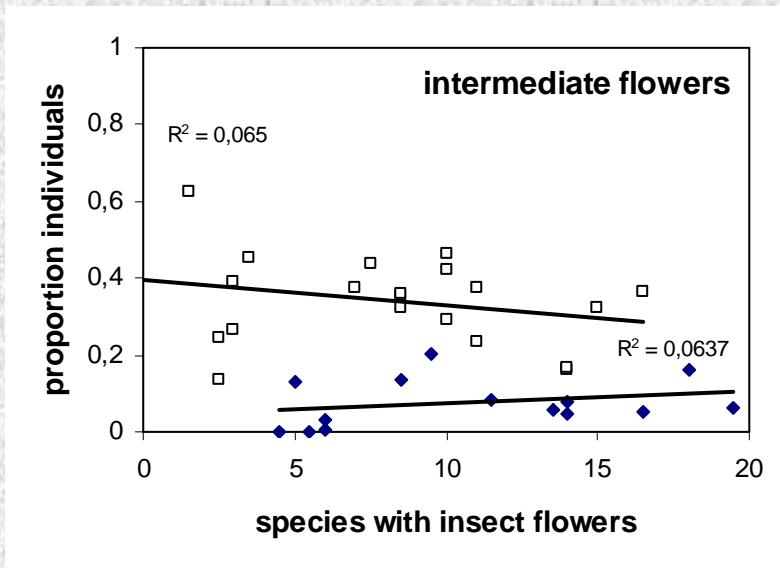
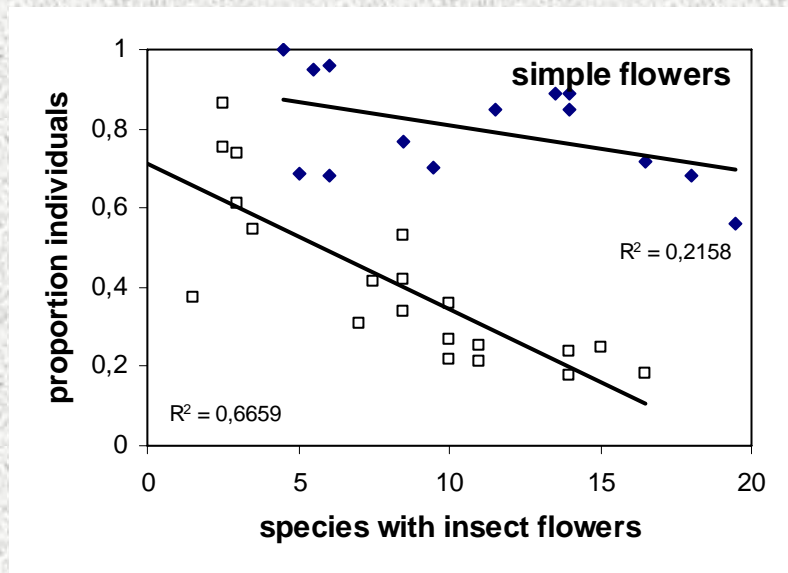
No significant relationship if the whole gradient is taken into account



Species richness and flower type composition

Wet part: Proportion of plants with simple flowers decrease and with complex flowers increase

Dry part: no significant relationships



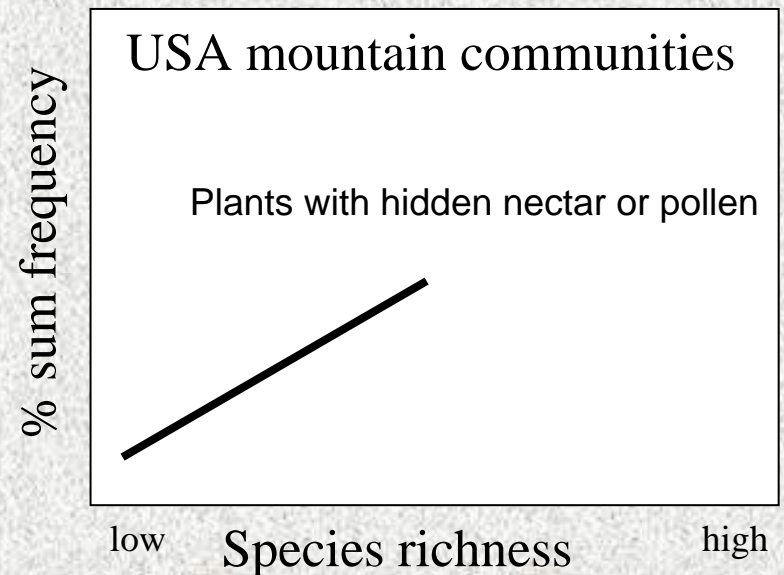
Species richness and flower type composition

- Flower type composition is correlated with plant species richness at a local scale as well as at a regional scale.
- The differences at a local scale resemble the differences at a regional scale. They are even larger in the dune slack.

Local scale

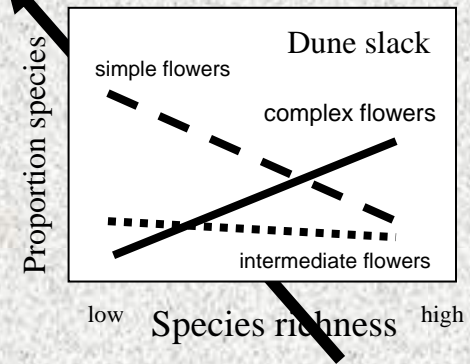
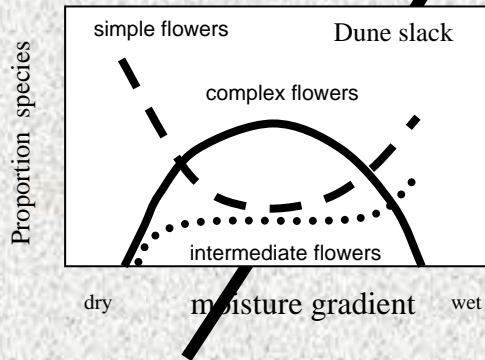


Regional scale

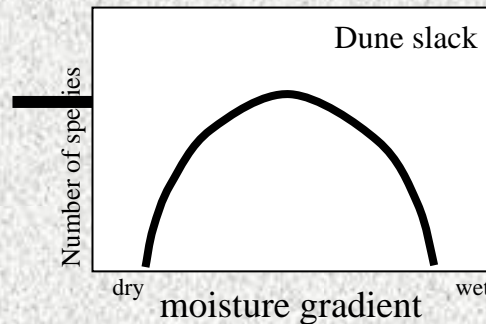


Conclusions

Flower type composition

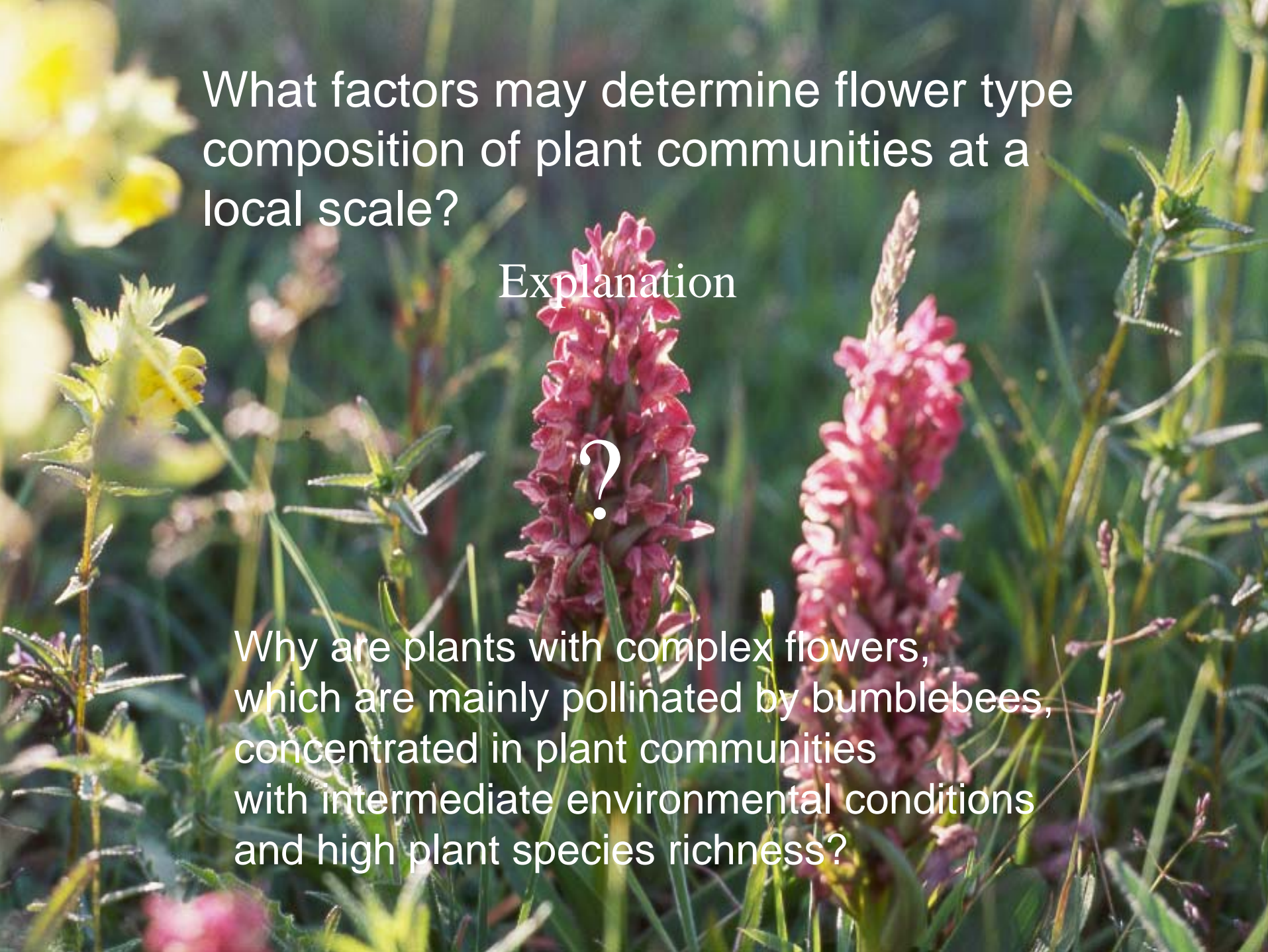


Moisture of the ground



Plant species richness (with insect flowers)

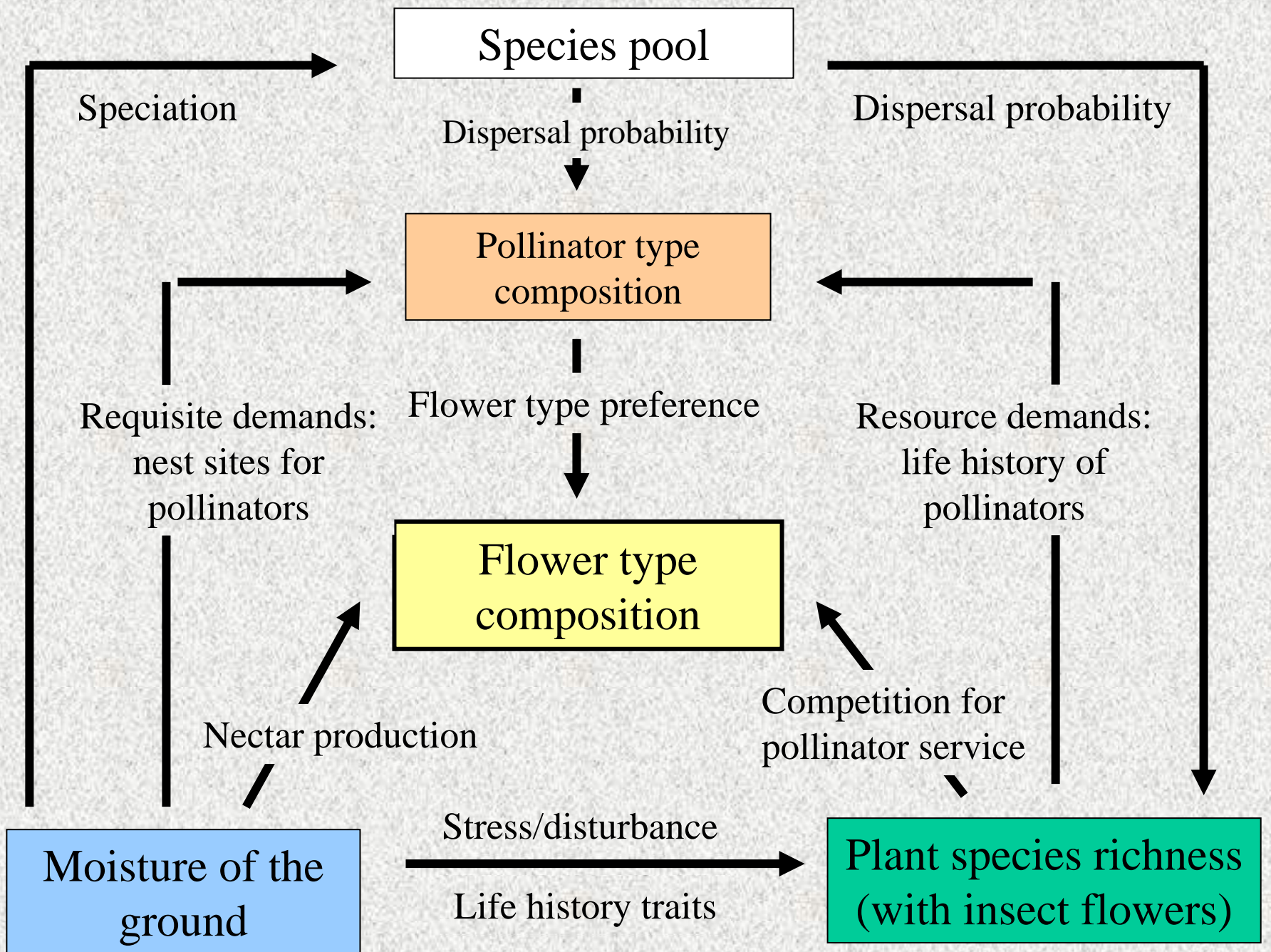
- Local gradient relationships = regional gradient relationships.
- Environmental factors, plant species richness and flower type composition are interrelated at the same time.

A photograph of a field of flowers. In the center, a tall, slender spike of small, bright pink flowers stands out. To its right, another similar spike is visible, though slightly out of focus. The background is filled with various green plants and other flowers, including a prominent yellow flower in the upper left corner. A large, white question mark is superimposed over the central pink flower spike.

What factors may determine flower type
composition of plant communities at a
local scale?

Explanation

Why are plants with complex flowers,
which are mainly pollinated by bumblebees,
concentrated in plant communities
with intermediate environmental conditions
and high plant species richness?



Acknowledgments

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