

The Response Of Plant Species To Soil pH: Replacing Expert Judgement By Measured Responses



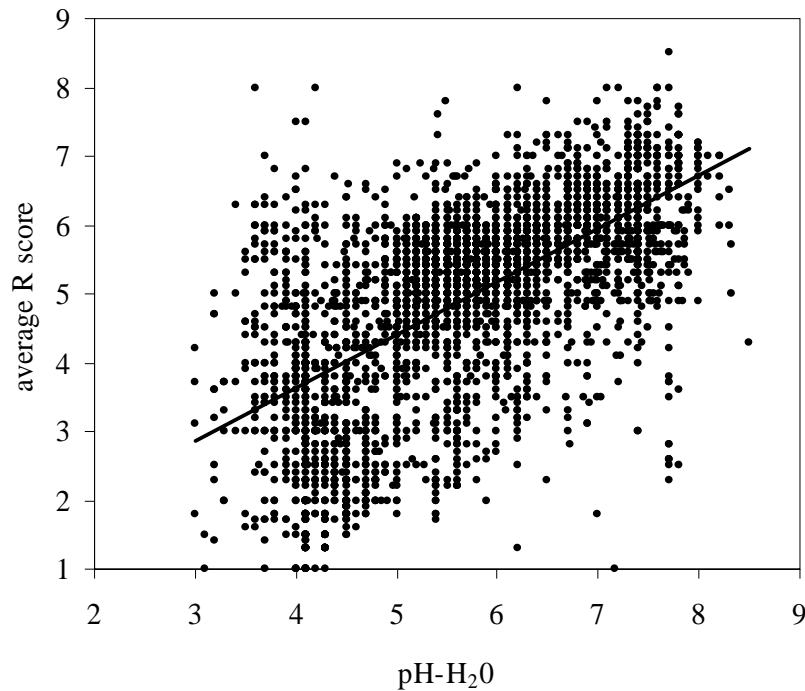
Wieger Wamelink
Paul Goedhart
Han van Dobben
Frank Berendse

Goal

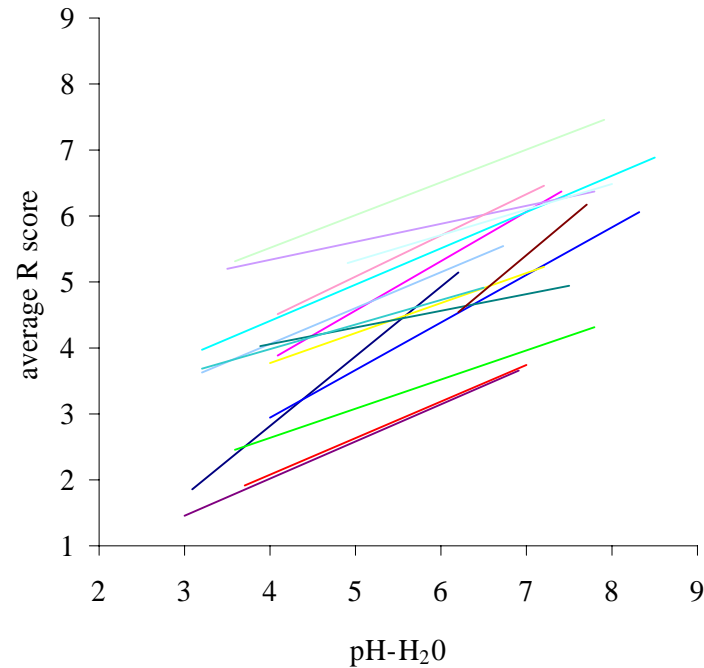
Replacing expert judgement (like Ellenberg indicator values)
by field data



Why?



Large uncertainty in the translation from Ellenberg indicator values into physical units



Differences between vegetation types

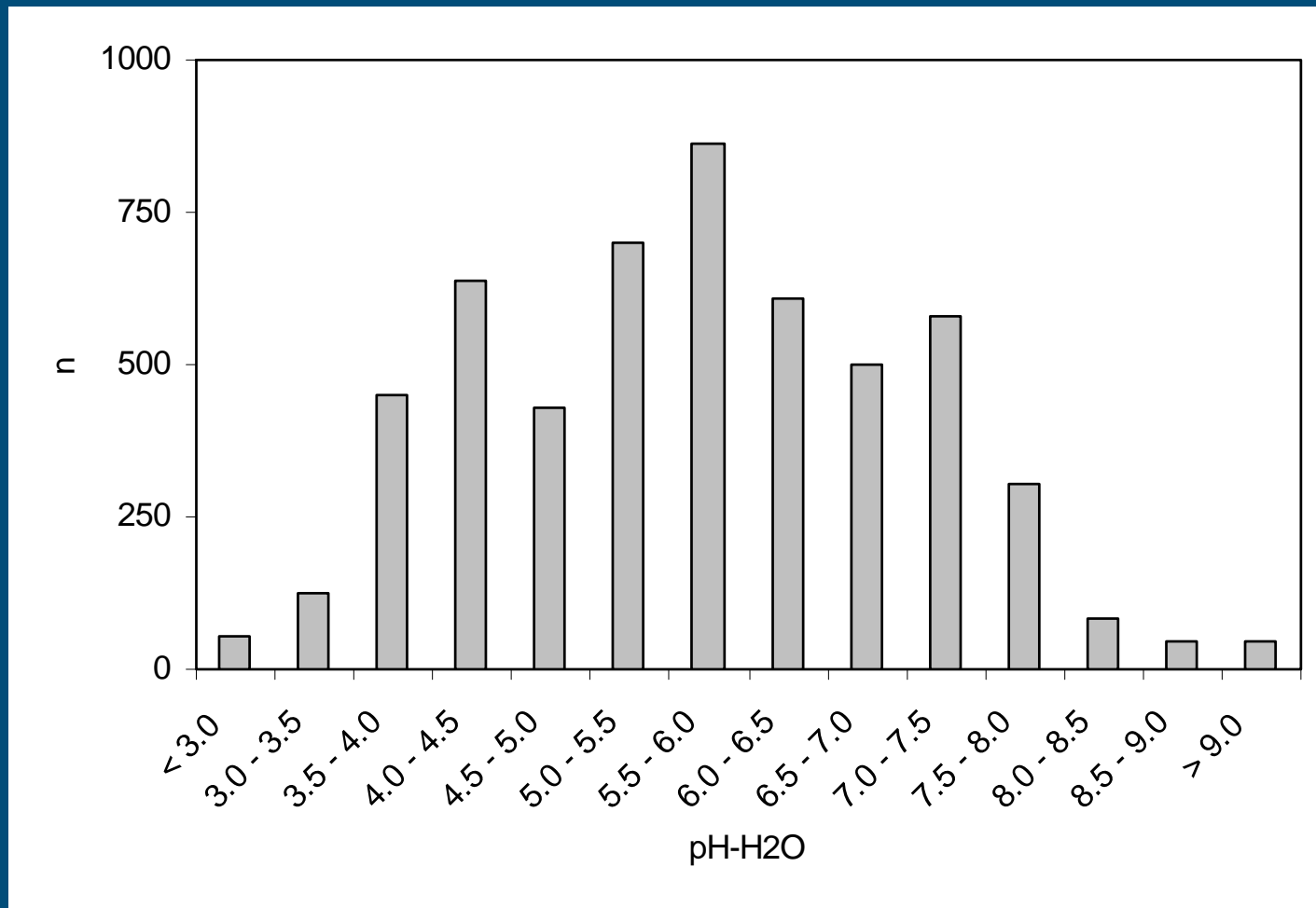
Wamelink et al. 2002

Method

- 1 Fill a database with vegetation relevés and measured soil pH
- 2 Estimate the response per species
- 3 Use the responses per species to estimate the pH for a new relevée



Dataset; vegetation relevés with measured pH



Total number of relevés: 5428

Species response and estimation of the pH

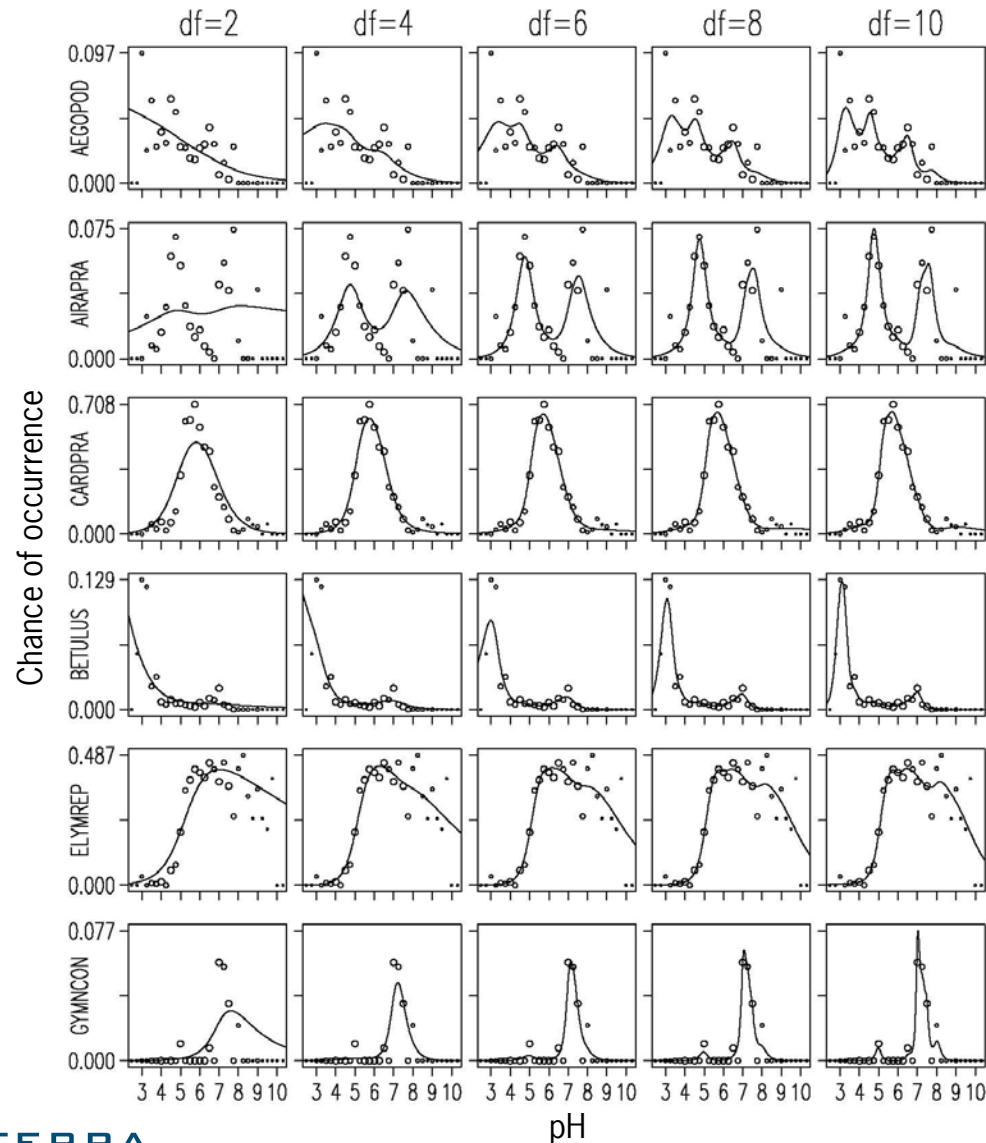
Species responses are estimated using splines

And by calculating the mean of the observations

Using the means of the observations for the estimation of the pH
gave better results than using the splines

The pH for a new relevé is estimated by calculating the average of
the means of the species present in the relevé

Response curves (splines) for some species for different degrees of freedom for the spline



Aegopodium podagraria

Aira praecox

Cardamine pratensis

Carpinus betulus

Elymus repens

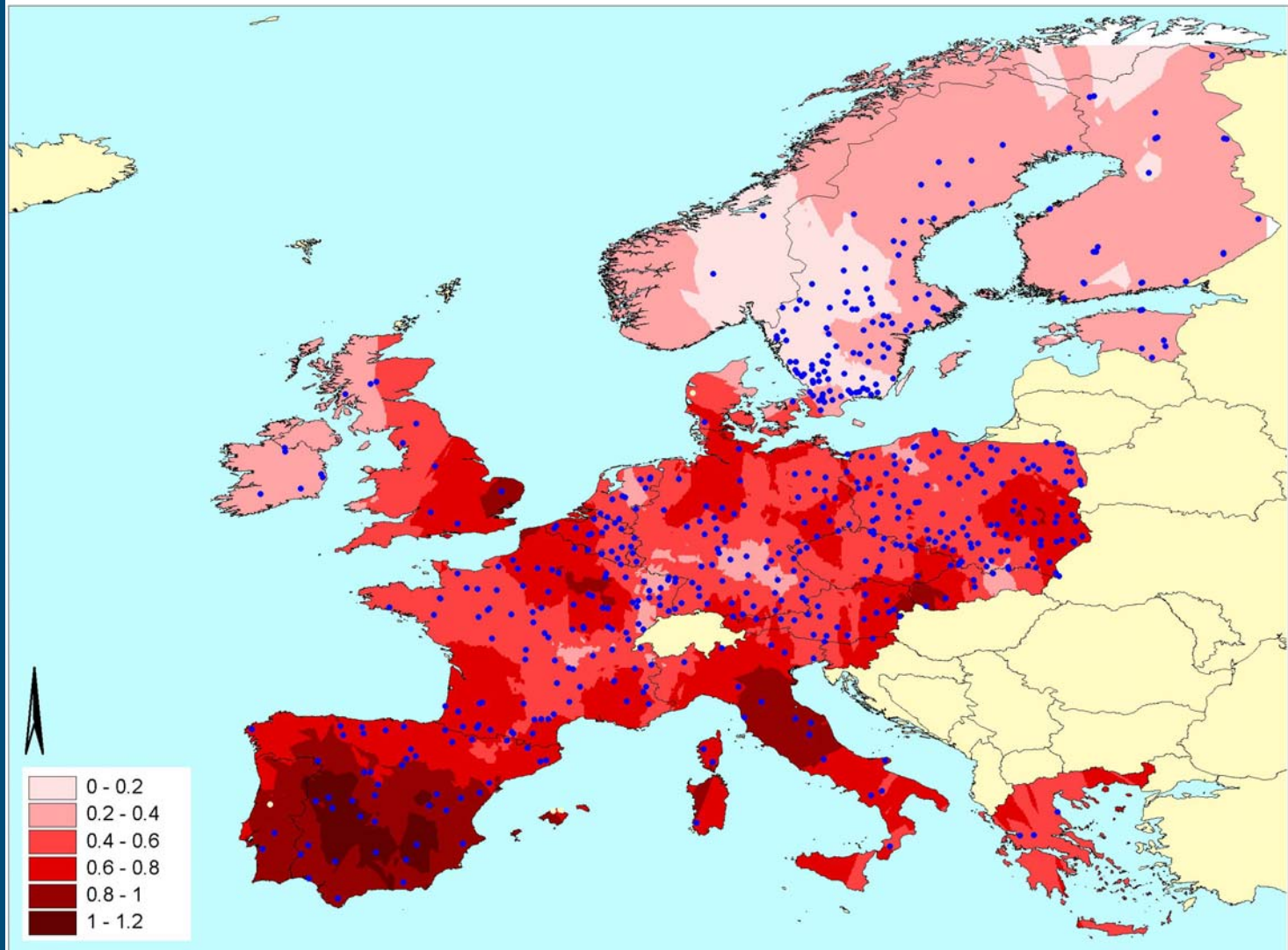
Gymnadenia conopsea

Average root mean squared error of prediction (RMSEP) for the validation sets

Set	n relevés	n species	Species common with training set	RMSEP
Training set	5428	556	556	0.86
Dunes	66	211	145	0.80
Dunes (old)	48	166	119	0.65
Grassland	84	166	115	0.93
Forest NL	395	339	214	0.68
Grassland Poland	144	137	93	0.99
UK	1648	426	246	0.95
Forest EU	589	806	299	0.66

The RMSEP of the training set for Ellenberg R is 1.04
(derived from Wamelink et al. 2002)

Smoothed difference between measured and calculated soil pH for European forest (ICP forest level2 plots)



CD/website with results

Species Respons

File Edit View

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pH (H₂O) (5189 relevés; 547 species present at 25 or more relevés; 1000 bootstraps)

[Home](#) [1 species](#) [1 species 4 df](#) [4 species](#)

Species Translator: ANTXODO Anthoxanthum odoratum Gewoon reukgras

Select a species to display its response curve.

Species ANTXODO Df Best

Yscale: ☒ One ☐ Max

Species Information

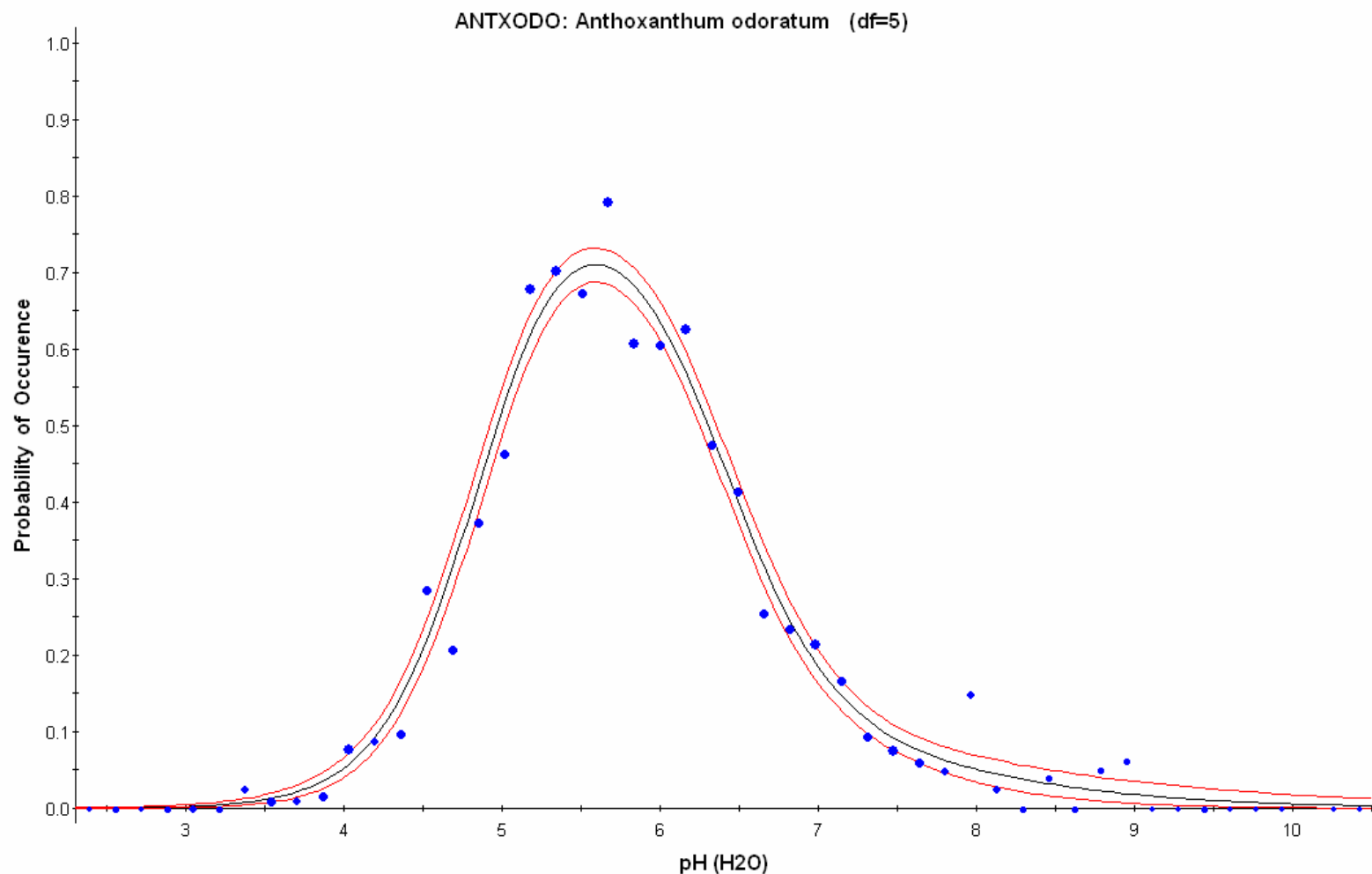
Short name: ANTXODO
Npresent: 1751
Mean: 5.746
Best df: 5
Latin name: Anthoxanthum odoratum
Dutch name: Gewoon reukgras

Analysis of Deviance

Change	Deviance	Prob.
+ P(1)	0.32	0.572
+ P(2)	1523.65	<.001
+ P(3)	259.76	<.001
+ P(4)	34.47	<.001
+ P(5)	9.80	0.002
+ P(6)	4.27	0.039
+ P(7)	2.86	0.091
+ P(8)	2.60	0.107
+ P(9)	2.67	0.102
+ P(10)	2.81	0.094

Symbol Definition Rawdata

Nrelevés	Npoint	Symbol
1 - 10	9	small
11 - 25	9	...
26 - 100	7	...
101 - 200	16	...
> 200	8	big



Print this graph

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Done

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Goals for the Future

- Enlarging the database with:
 - European data (especially from the South of Europe)
 - other abiotic variables (hydrology)
 - combined measurements
- Estimation of interaction effects
- Ecological meaning of the shape of the response curves
- Call for European partners

pH (H₂O) (5189 relevés; 547 species present at 25 or more relevés; 1000 bootstraps)

Home 1 species 1 species 4 df 4 species

Species Translator: ERICTET Erica tetralix Gewone dophei

Select a species to display its response curve for up to 4 df's.

Species

ERICTET

Df selector

Best	Select
1	
2	Set B-1 B+2
3	
4	Set 2 3 4 5
5	
6	Set 4 5 6 7
7	
8	Set 6 7 8 9
9	
10	Set 2 4 6 8

Yscale: ☒ One ☐ Max

Mean: 4.581

Best df: 5

Latin name:

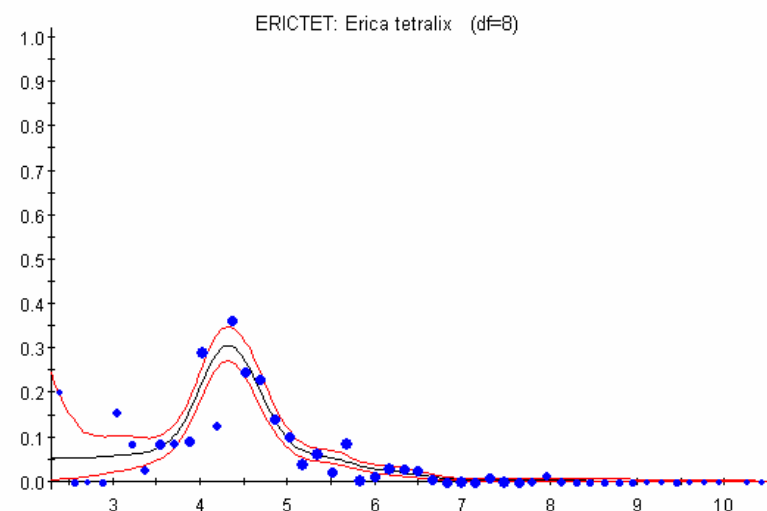
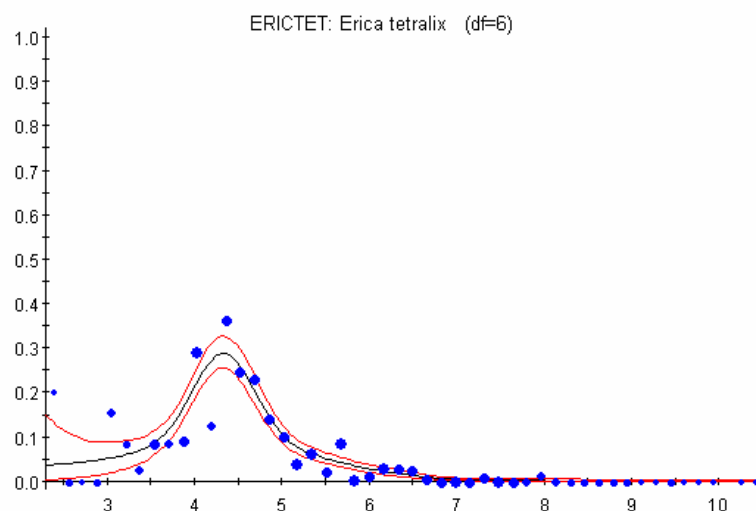
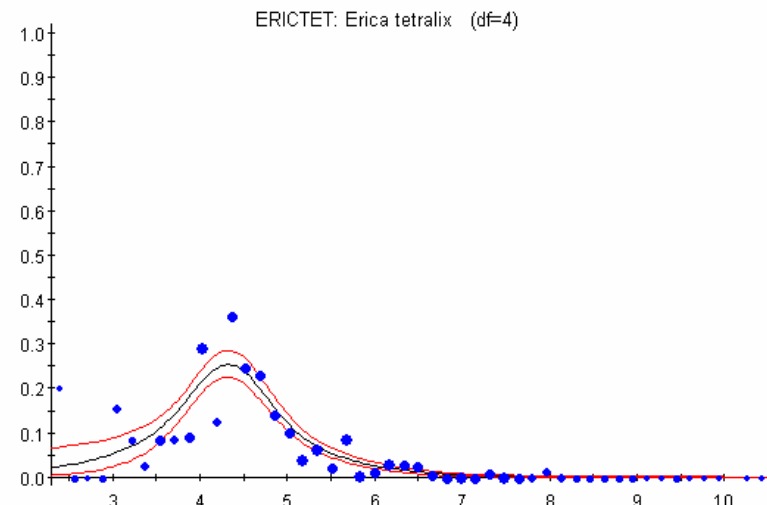
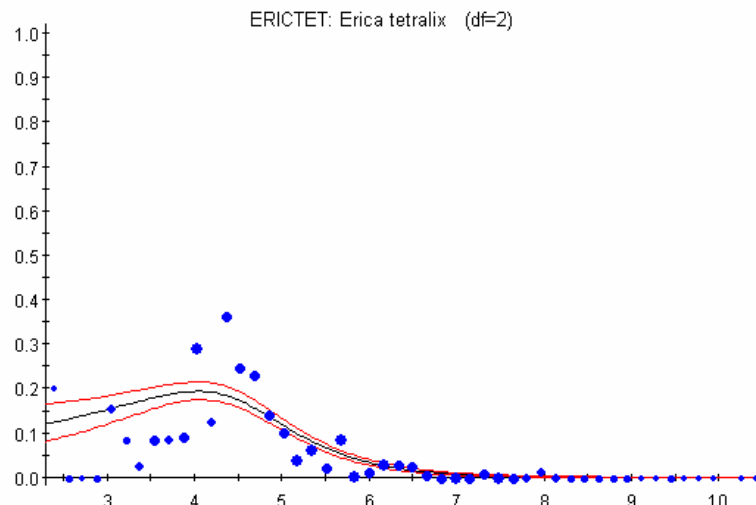
Erica tetralix

Dutch name:

Gewone dophei

Analysis of Deviance

Change	Deviance	Prob.
+ P(1)	348.49	<.001
+ P(2)	130.11	<.001
+ P(3)	45.97	<.001
+ P(4)	18.16	<.001
+ P(5)	10.74	0.001
+ P(6)	7.12	0.008
+ P(7)	4.92	0.026
+ P(8)	3.93	0.047
+ P(9)	3.71	0.054
+ P(10)	3.83	0.050



CD/website with results (RawMean)

LatinName	C_N	Ca	Cl	ghg	glg	gvg	K	Mg	Na	Ntot	nh4
	-	mg/g	mg/kg	cm	cm	cm	mg/kg	mg/kg	mg/kg	g/kg	mg/kg
Acer campestre				52.42	122.87	70.03					
Acer platanoides				61.70							
Acer pseudoplatanus				55.35	120.47	68.81					
Achillea millefolium	13.12	52.89	904.80	35.50	112.16		25.27	34.18	8.99	1.13	
Achillea ptarmica				19.17	80.67						
Adoxa moschatellina				30.97	92.34	43.46					
Aegopodium podagraria				47.11	107.24	67.56				1.70	
Agrimonia eupatoria							45.47		9.29		
Agrostis species	9.62			27.96	125.49		18.37				0.79
Agrostis canina	20.45	145.67	361.25	9.70	79.55	19.10	10.87	22.56	21.75	2.46	1.25
Agrostis capillaris	16.05	47.35	1516.06	43.87	105.18	47.39	21.01	33.00	9.97	1.40	1.23
Agrostis gigantea							40.66		9.26		
Agrostis stolonifera	17.88		1236.26	22.81	67.49	29.76	27.95		32.81	1.61	1.19

RawMean results for C/N (81), Ca (58), Cl (202), ghg (278), glg (255), gvg (202), K (164), Mg (58), Na (103), Ntotal (122), NH₄ (47), NO₃ (39), PO₄ (163), Ptotal (183), pH_{H2O} (547), pH_{KCl} (280), moisture% (64)

Species response and estimation of the pH for a relevée

Species responses are estimated using splines (except RawMean method)

Four methods to estimate a pH value for a relevée
(with species A and B, and species C absent)

1. 'Full': Use the present as well as the absent species response curves in the relevée to estimate the pH ($p_A \times p_B \times (1 - p_C)$)
2. 'Present': Use the present species response curves in the relevée to estimate the pH ($p_A \times p_B$)
3. 'Meanspline': Calculate the mean of the response curve. Then calculate the average of the means values of the present species
4. 'Rawmean': No spline, calculate the mean of the observations. Then calculate the average of the mean values of the present species

Species response and estimation of the pH for a relevée

Method	RMSEP 50	RMSEP 25	Description, see text for further details
pH-H ₂ O	1.344	1.344	Standard deviation of all observed pH
Full	1.207	1.128	Prediction based on present and absent species
Present	1.340	1.327	Prediction based on present species
Meanspline	0.986	0.973	Prediction based on the mean of the spline curve
Rawmean	0.887	0.857	Prediction based on the raw averages