

# **Stand structure assessments within forest monitoring under ICP Forests and EU**

- 1. Stand structure in general**
- 2. Level II**
- 3. Level I**
- 4. ForestBIOTA**

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# 1. Stand structure in general

Key factors for assessing European forest biodiversity  
(BEAR project – Larsson, T.-B., 2001)

Scale	Structural key factors	Compositional key factors	Functional key factors
<b>National regional</b>	Total area of forest with respect to: <ul style="list-style-type: none"> <li>- Legal status/utilisation or protection</li> <li>- Forest ownership</li> <li>- Tree species and age</li> <li>- Old growth/Forest left for free development</li> <li>- Afforestation/deforestation</li> </ul>	<ul style="list-style-type: none"> <li>- Native species</li> <li>- Non-native or not "site original" tree species</li> </ul>	FOR ALL SCALES: NATURAL DISTURBANCE: <ul style="list-style-type: none"> <li>- Fire</li> <li>- Wind and snow</li> <li>- Biological disturbance</li> </ul> HUMAN INFLUENCE: <ul style="list-style-type: none"> <li>- Forestry</li> <li>- Agriculture and grazing</li> <li>- Other land-use</li> <li>- Pollution</li> </ul>
<b>Land-scape</b>	<ul style="list-style-type: none"> <li>- Number and type of habitats (incl. water courses)</li> <li>- Continuity and connectivity of important habitats</li> <li>- Fragmentation</li> <li>- History of landscape use</li> </ul>		
<b>Stand</b>	<ul style="list-style-type: none"> <li>- Tree species</li> <li>- Stand size</li> <li>- Stand edge/shape</li> <li>- Forest history</li> <li>- Habitat type(s)</li> <li>- Tree stand structural complexity</li> <li>- Dead wood</li> <li>- Litter</li> </ul>	<ul style="list-style-type: none"> <li>- Species with specific landscape-scale requirements</li> <li>- Non-native or not "site original" tree species</li> <li>- Species with specific stand type and scale requirements</li> <li>- Biological soil condition</li> </ul>	



# 1. Stand structure in general

Def: Stand structure: distribution and spatial arrangement of forest specific elements, e. g. tree individuals, species, diameters or heights.

Is it really a value *per se*?

1.1 Surrogate for compositional factors, e.g. birds (after Ellenberg)

1.2 Directly related to forest management

N bird species



## 2. Stand structure on Level II plots

### Level II

### Tree growth data

\* species

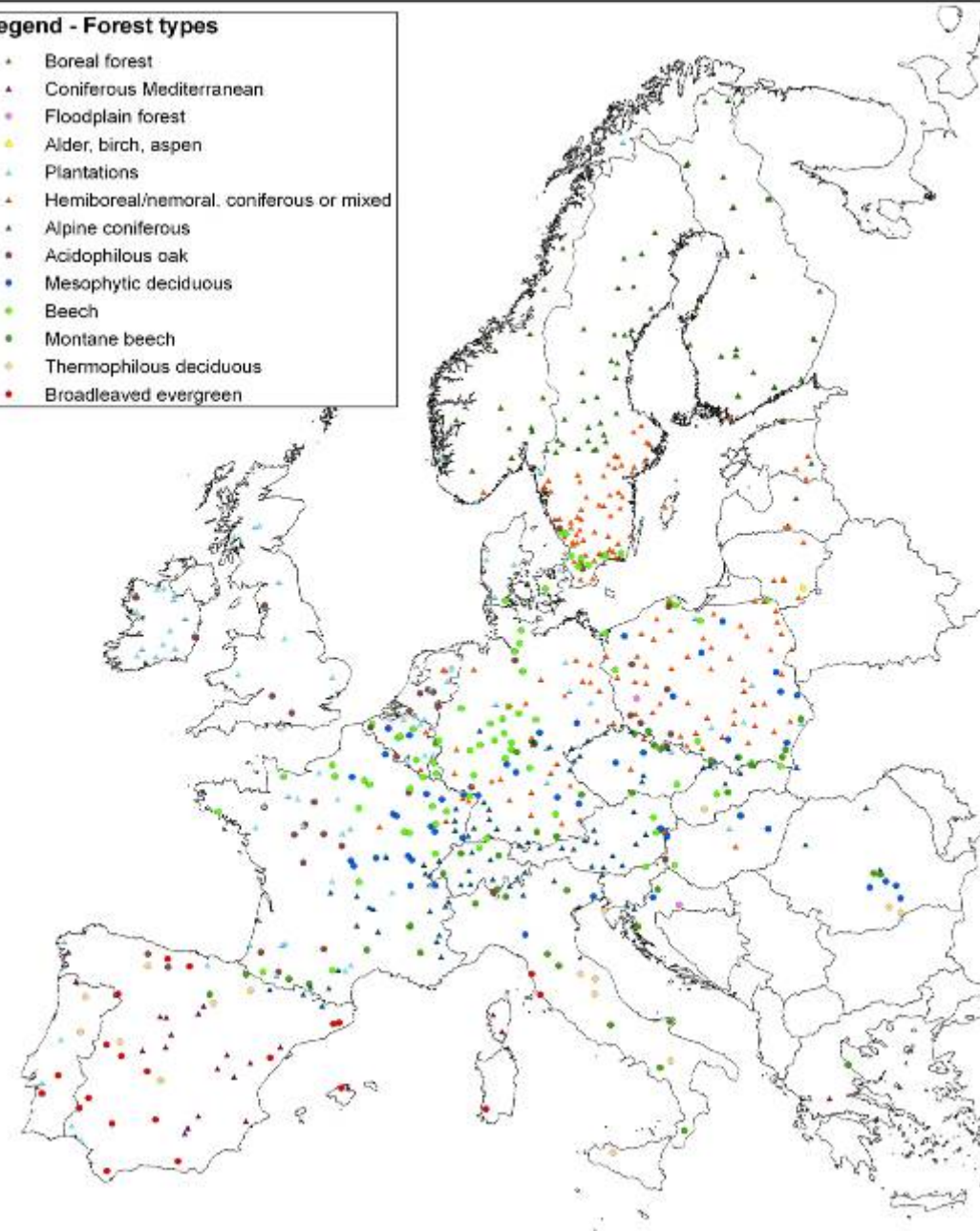
\* dbh

\* some heights

available for 769 plots (0.25 ha)

#### Legend - Forest types

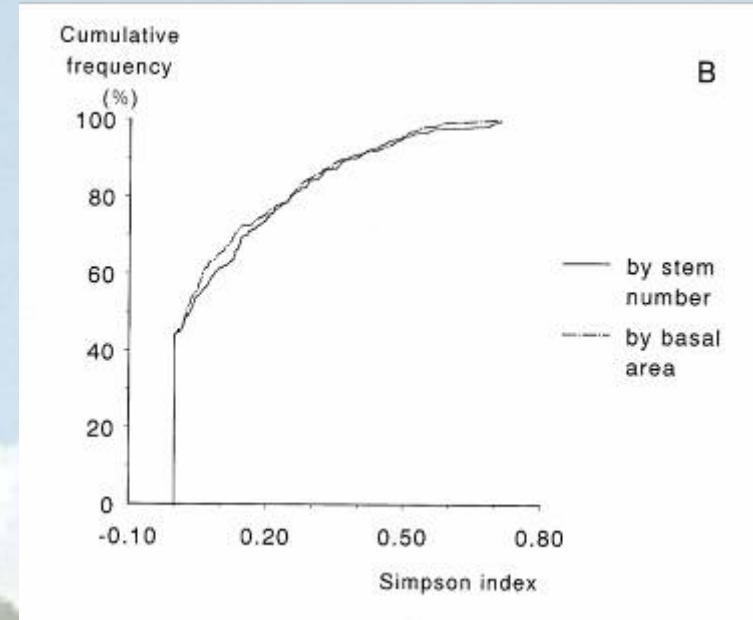
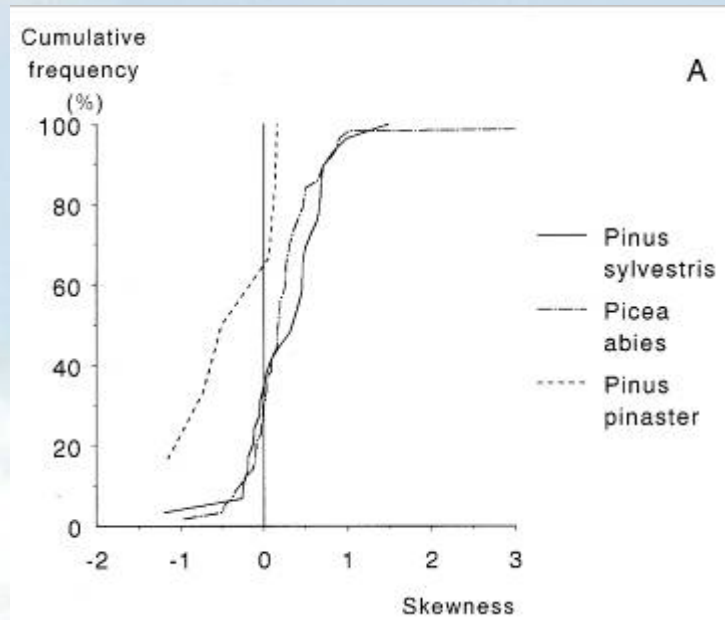
- Boreal forest
- ▲ Coniferous Mediterranean
- Floodplain forest
- ▲ Alder, birch, aspen
- Plantations
- ▲ Hemiboreal/nemoral. coniferous or mixed
- ▲ Alpine coniferous
- Acidophilous oak
- Mesophytic deciduous
- Beech
- Montane beech
- Thermophilous deciduous
- Broadleaved evergreen



## 2. Stand structure on Level II plots

**No specific stand structural evaluations since 1999!**

(FIMCI 1999 based on 253 plots)

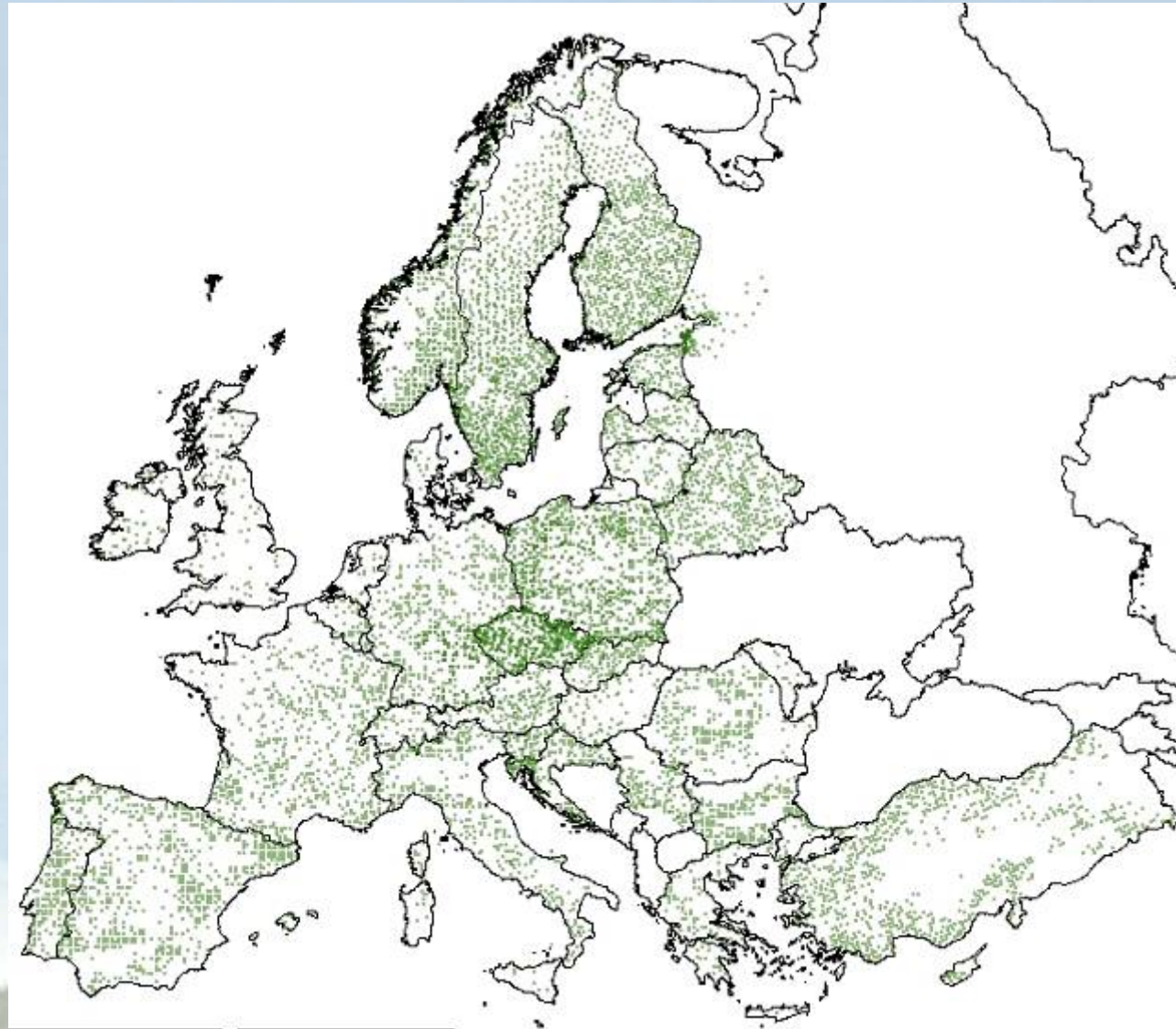
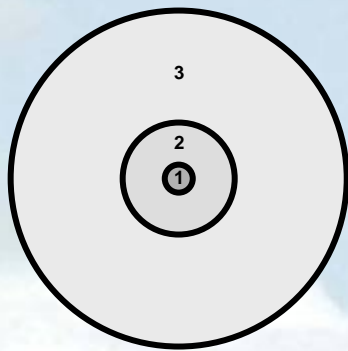


## 2. Stand structure on Level I plots

Level I  
Tree growth data

\* none

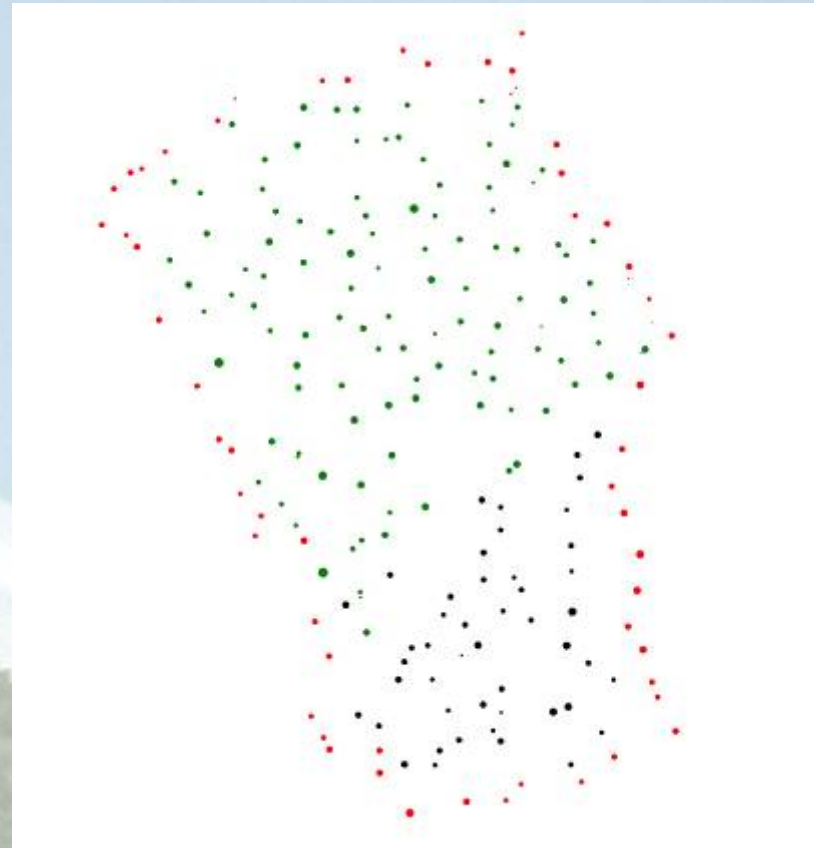
but **BioSoil** ongoing  
\* dbh, species  
on approx. 5000 plots



**ForestBIOTA:** „Forest Biodiversity Test-phase Assessments“  
on approx. 100 selected Level II plots 2005/2006

- Stand structure
- Deadwood
- Epiphytic lichens
- Ground vegetation
- Forest type classification

ForestBIOTA: tree coordinates  
(Peter MEYER, Göttingen)



## 4. Stand structure on ForestBIOTA plots

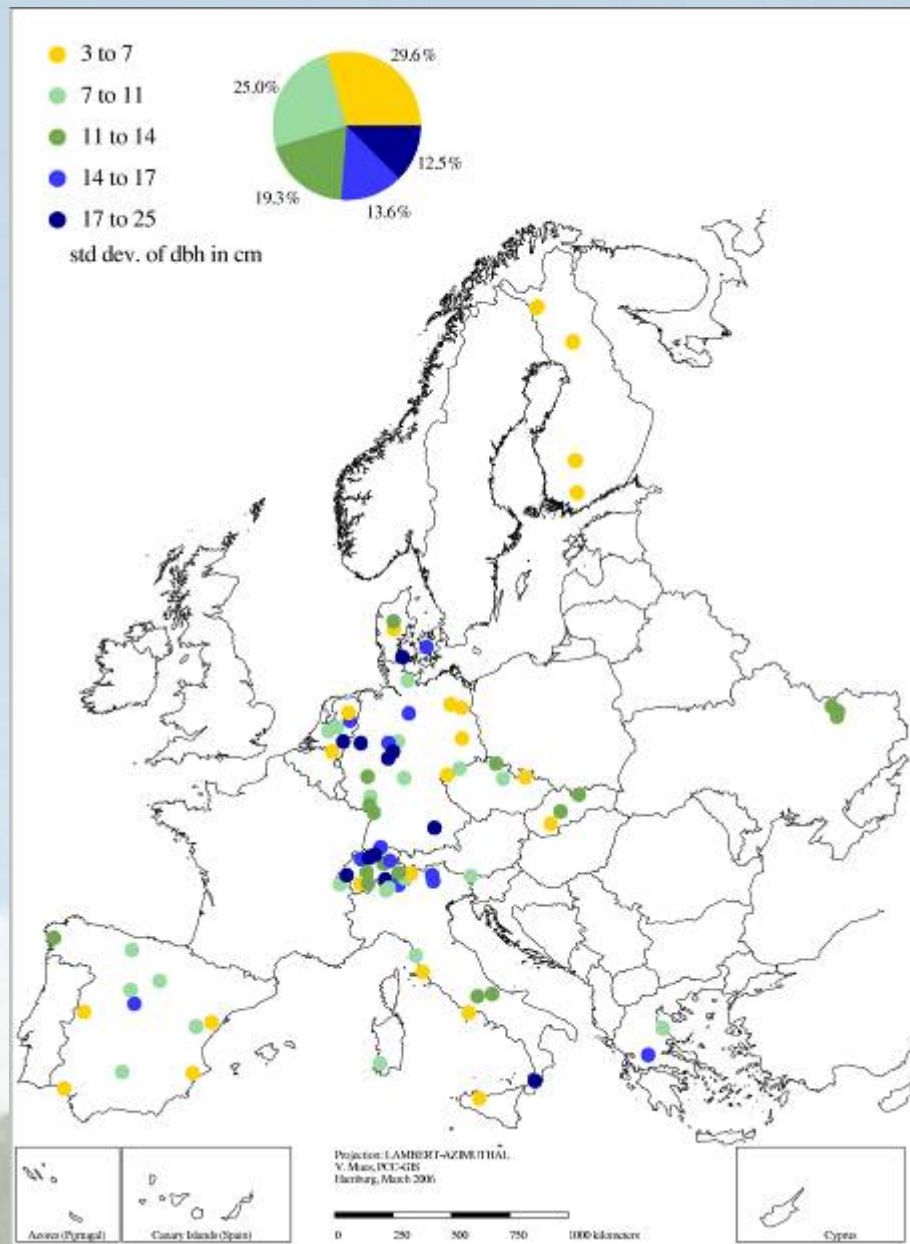
ForestBIOTA new:  
distant dependant indicators

Existing Level II data:  
distant independant indicators

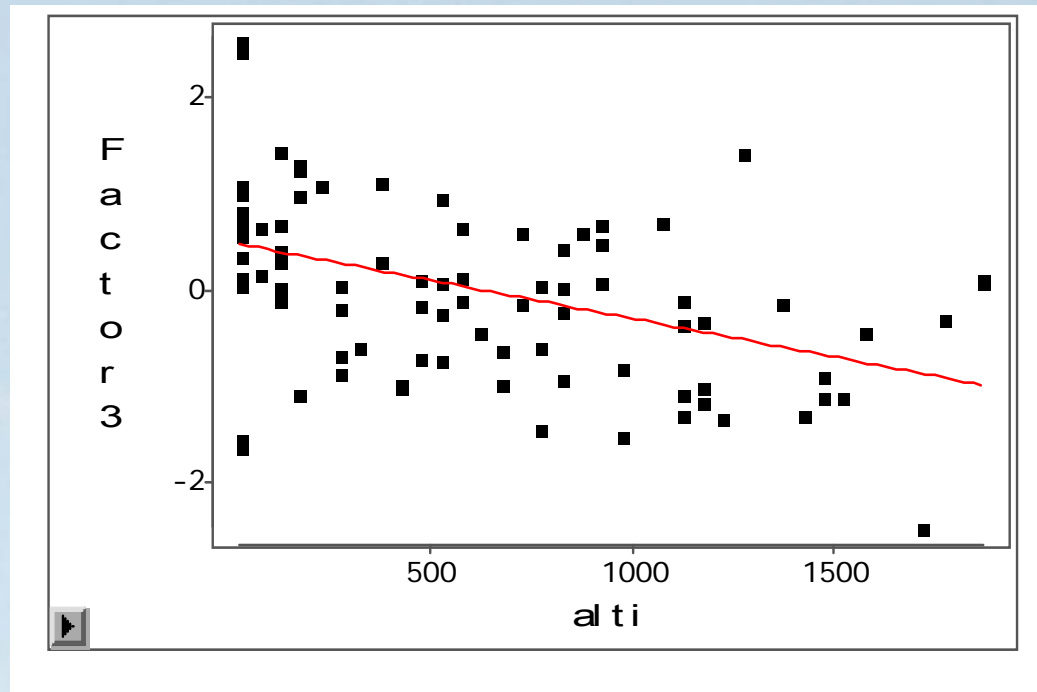
Spatially explicit indices	
Clark Evans Index	$CE = \frac{\frac{1}{n} \sum_{i=1}^n r_i}{0,5\sqrt{10000 / N}}$ <p>with  <math>r_i</math> = distance of tree <math>i</math> to next neighbour  <math>N</math> = number of trees per ha  <math>n</math> = number of sample trees</p>
Contagion Index	$W_i = \frac{1}{4} \sum_{j=1}^4 w_j$ <p>with  <math>w_j = 1</math> if <math>\alpha</math> angle <math>j &lt; 90^\circ</math>  <math>w_j = 0</math> otherwise</p>
Mingling Index	$MI_i = \frac{1}{4} \sum_{j=1}^4 v_{ij}$ <p>with  <math>v_{ij} = 0</math> in case that neighbour <math>j</math> belongs to same species and  <math>v_{ij} = 1</math> in case that neighbour <math>j</math> belongs to same species</p>
Diameter differentiation	$T = \frac{1}{n} \sum_{i=1}^n (1 - r_i)$ <p>with  <math>r_i</math> = (thinner dbh)/(thicker dbh) of tree pair <math>i</math>  <math>n</math> = number of measured tree pairs</p>
Indices without spatial relation	
Shannon Index of diversity	$H' = - \sum_i^N \log p_i \cdot p_i$ <p>with  <math>p_i</math> = relative abundance of the <math>i</math>th species  <math>N</math> = number of species (log = natural logarithm (base = e))</p>
Evenness	$E = \frac{H'}{H'_{Max.}}$ <p>with  <math>H'</math> = Shannon-Index  <math>H'_{Max.}</math> = Potential maximum value (= log N [species number])</p>



# 4. Stand structure on ForestBIOTA plots



## 4. Stand structure on ForestBIOTA plots



Relationship between PCA axis 3 (mainly Clark Evans and contagion) and altitude  $R^2 = 0.20$ ,  $(p > F) = 0.001$ .

## 4. Stand structure on ForestBIOTA plots

Correlations between species diversity  
and different environmental and stand structural parameters

		Moss layer		Herb vegetation		Epiphyt. lichens	
		Species number	Eveness	Species number	Eveness	Species number	Eveness
Geographic location	North/South gradient (°latitude)	++		--		--	--
	East/West gradient (°longitude)						
	Altitude (m a.s.l.)			++		++	++
Site	Soil acidity (pH organic layer)	--		++		++	++
Stand structure	Number of tree layers			++			
	Number of trees per ha.					++	
	Area covered by tree stems (basal area)			--			
	Regularity of horizontal tree distribution (mean contagion)					++	++
	stand age						
	Density of tree crowns (canopy closure)						
Atmosph. deposition	Ammonium (NH <sub>4</sub> -N)			--			--
	Nitrate (NO <sub>3</sub> -N)						
	Sulphur (SO <sub>4</sub> -S)			--			--





[www.icp-forests.org](http://www.icp-forests.org) ..... thanks

