

Impact of weather parameters, atmospheric deposition and foliar nutrients in the Romanian intensive monitoring system



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Introduction

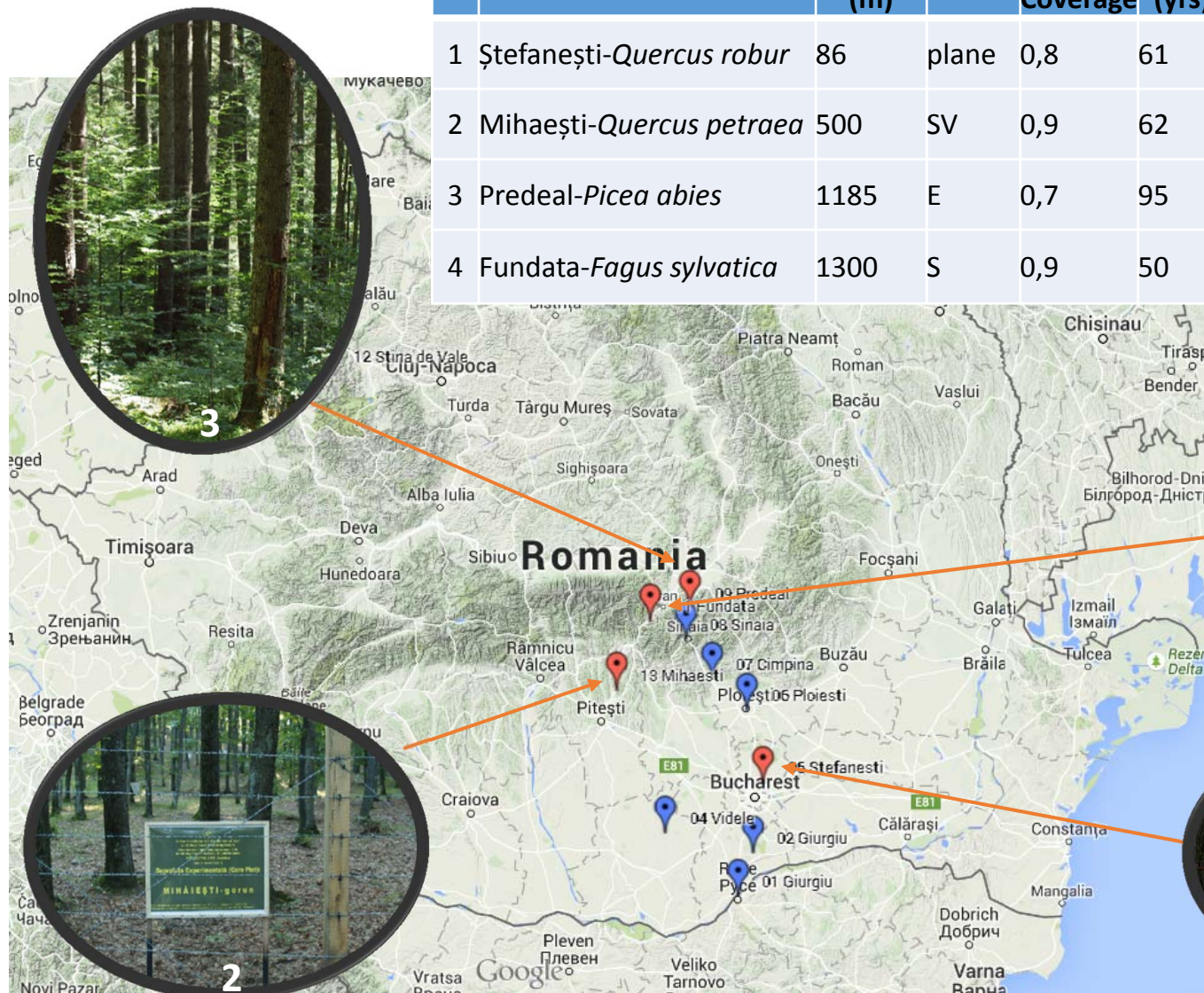
The research on the patterns, causes and effects on forest health status in the selected ecosystems of the Romanian monitoring network is intended to outline the impact of the explanatory indicators (e.g. climate, depositions and nutrients) and their relevance, in an attempt to describe the subsequent consequences of the missing leaves/needles and on forest growth in relation to non-segregated natural and anthropogenic disturbances

Objectives

- The main objective is to highlight the influence of climate and atmospheric deposition on selected forest ecosystems of the Romanian intensive monitoring network.
 - Forest growth & Crown condition as main response indicators
 - Meteo & Deposition as explanatory indicators
 - Meteo (precipitation: annual, seasonal)
 - Atmospheric deposition (open field N-NH₄, S-SO₄, total N)
 - Soil solution & Foliar chemistry as intermediary indicators
 - Soil solution (N-NH₄, N-NO₃, total N, S-SO₄)
 - Foliar chemistry (N, S, K, Ca, Mg, P, N/K, N/P, N/Ca)

Location

No	Plot	Altitude (m)	Aspect	Crown Coverage	Age (yrs)	No. of trees	Soil type
1	Ștefanești- <i>Quercus robur</i>	86	plane	0,8	61	148	Luvisol mollic
2	Mihaești- <i>Quercus petraea</i>	500	SV	0,9	62	140	Cambisol eutric
3	Predeal- <i>Picea abies</i>	1185	E	0,7	95	102	Cambisol dystic
4	Fundata- <i>Fagus sylvatica</i>	1300	S	0,9	50	206	Cambisol eutric somerirendzic

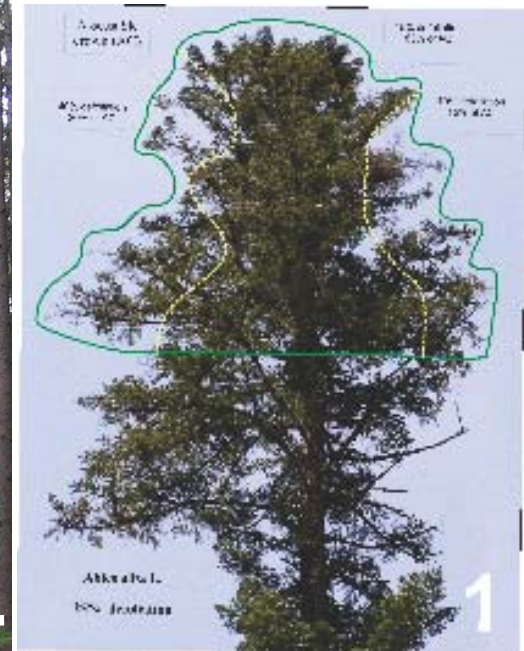


Methodology

- Manual ICP-F
- Stepwise regression

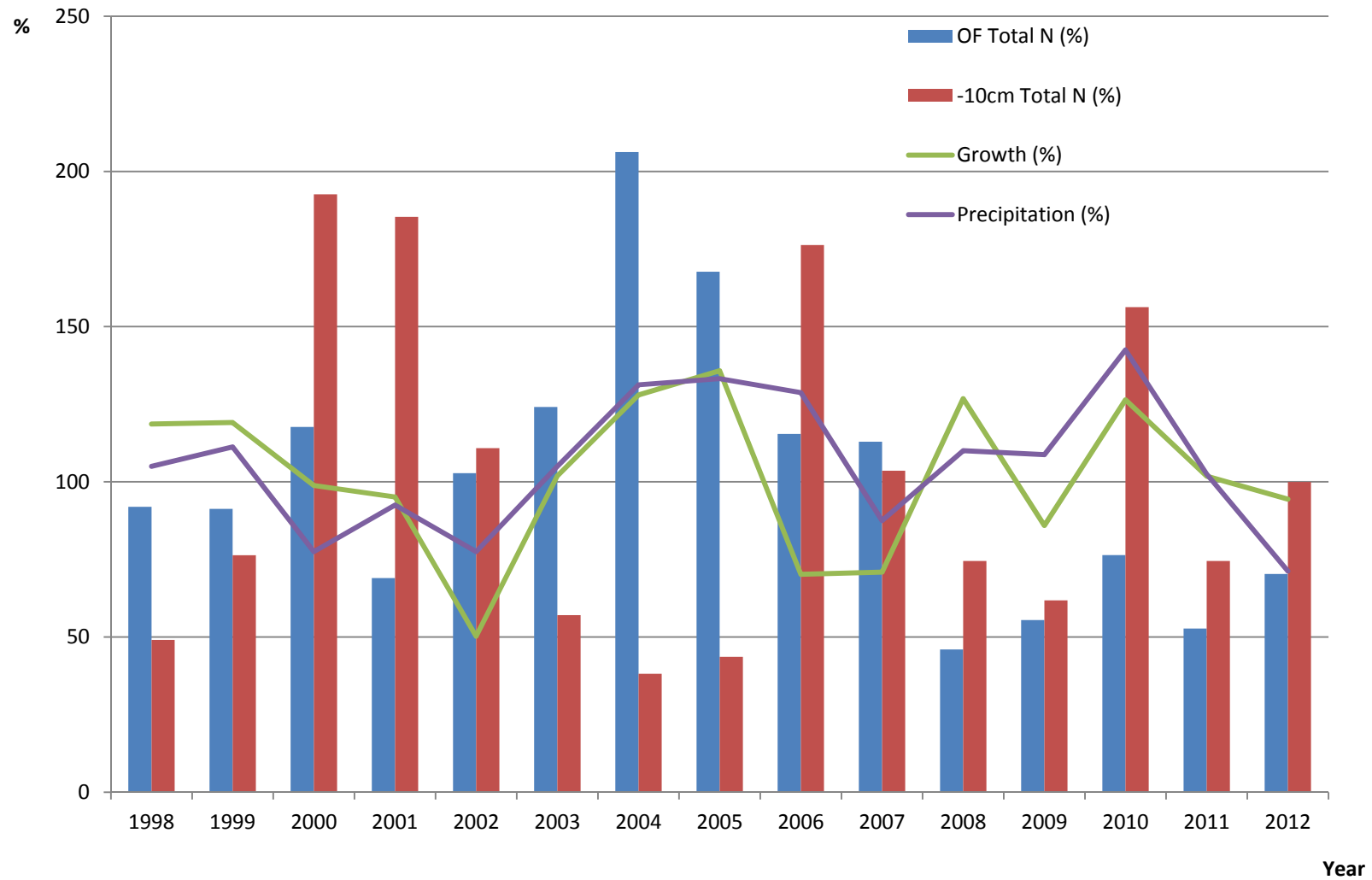
Methods:

- (1) Crown condition;**
- (2) Forest growth and yield;**
- (3) Ground vegetation;
- (4) Foliar analysis;**
- (5) Soil;
- (6) Soil solution;**
- (7) Wet and dry deposition;**
- (8) Air quality (O_3 , NO_2 , NH_3)
- (9) Meteorology;**



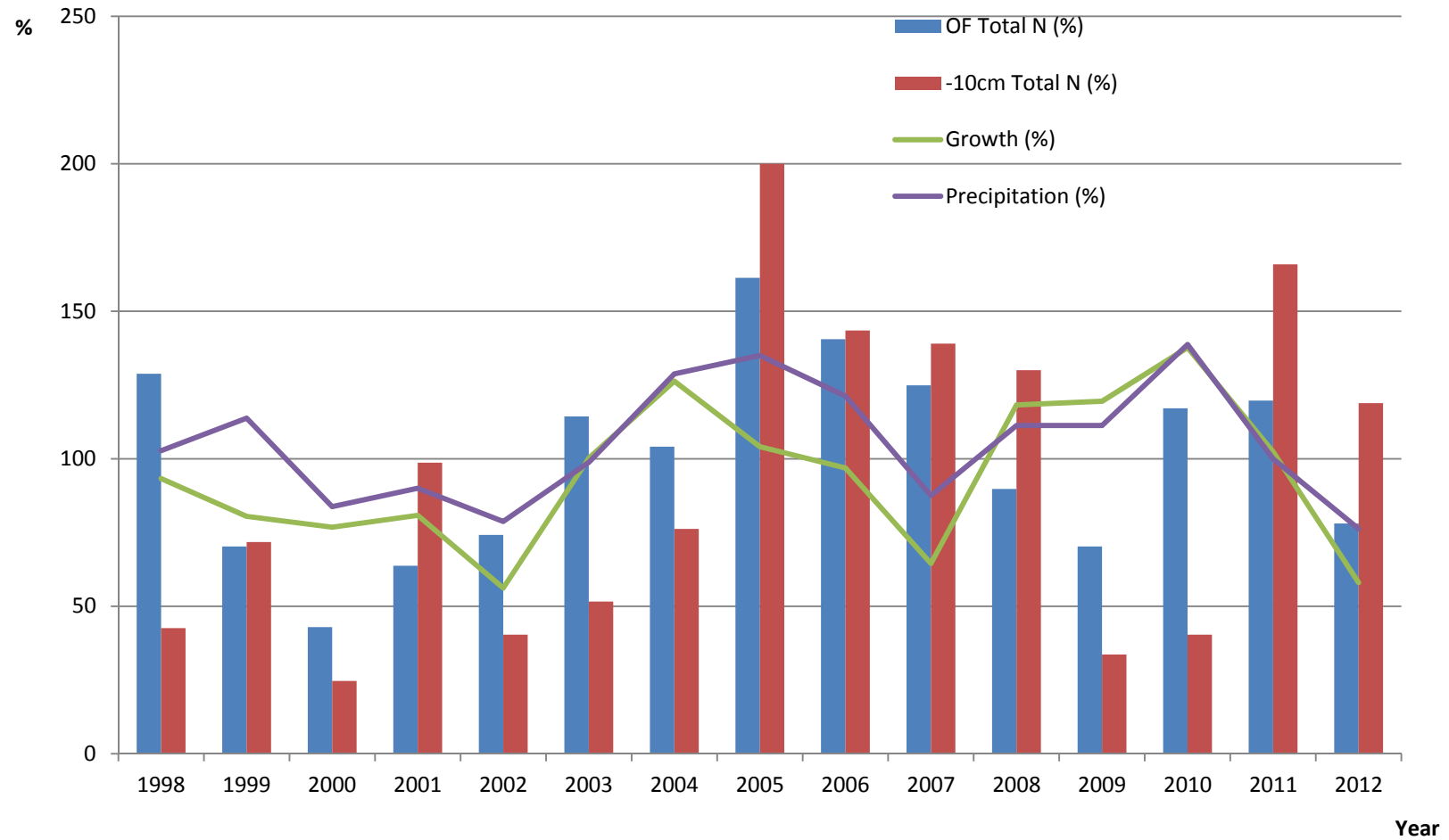
Results

Stefanesti – *Quercus robur*



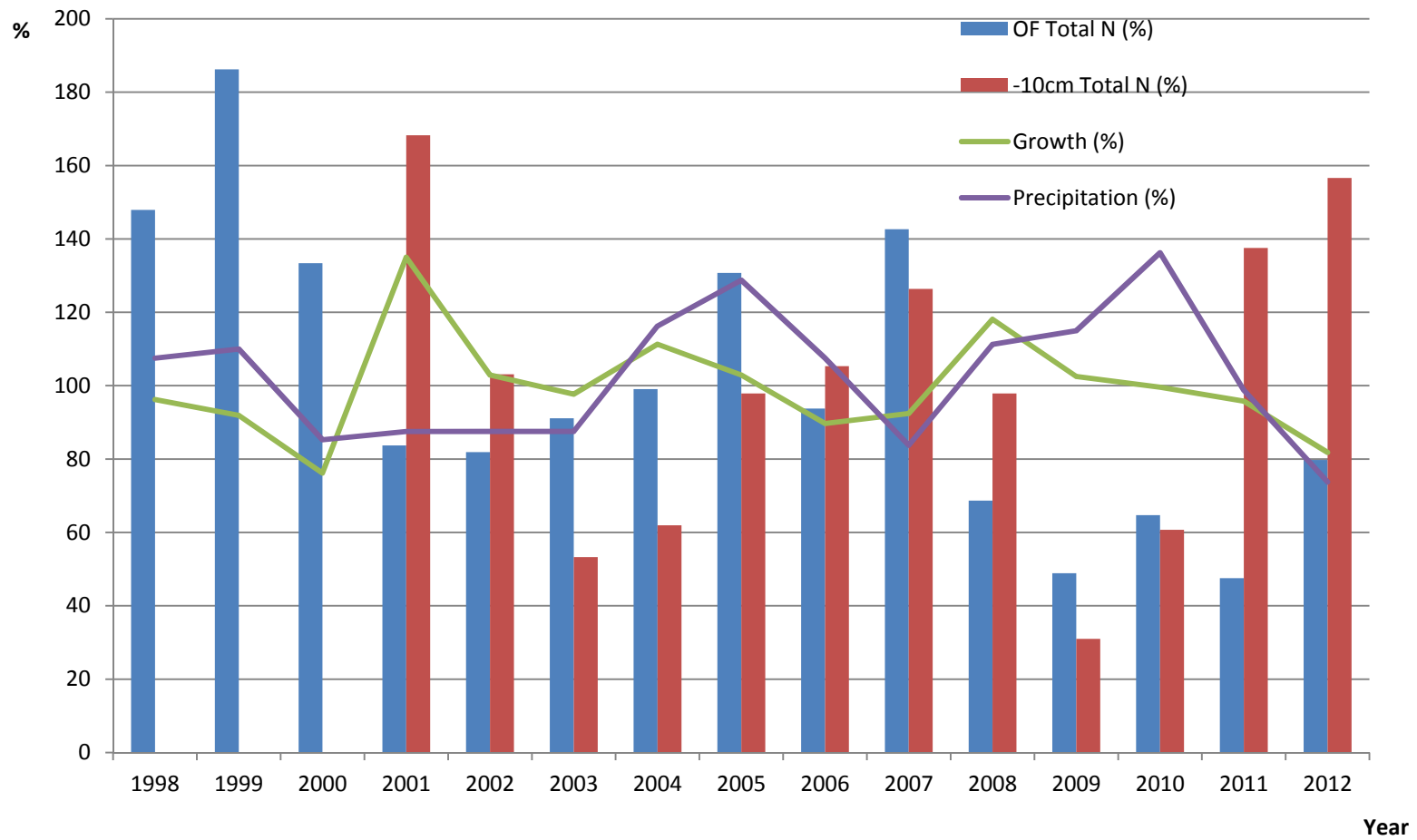
Results

Mihaesti – *Quercus petraea*



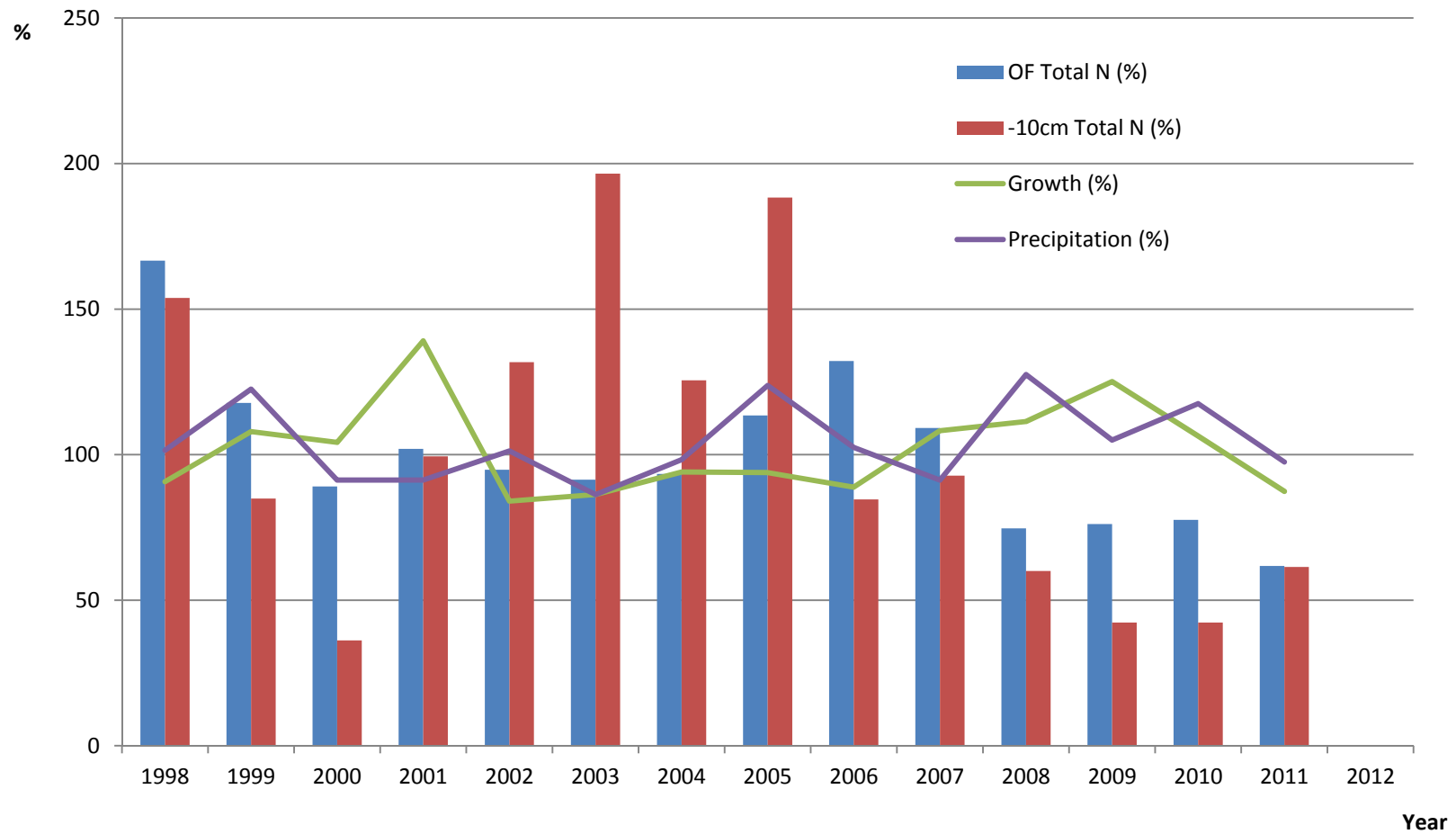
Results

Fundata – *Fagus sylvatica*



Results

Predeal – *Picea abies*



Results

Mihaesti – *Quercus petraea* (tree growth = f(meteo, deposition, soil solution))

Model Summary^{a, g}

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.844 ^a	.713	.687	14.3603	.713	27.279	1	11	.000
2	.923 ^b	.852	.823	10.7990	.140	9.452	1	10	.012
3	.962 ^c	.925	.899	8.1320	.072	8.635	1	9	.017
4	.989 ^d	.978	.966	4.7074	.053	18.858	1	8	.002
5	.994 ^e	.988	.980	3.6105	.011	6.600	1	7	.037

a. Predictors: (Constant), Precipitation (mm)

b. Predictors: (Constant), Precipitation (mm), -10cmN-NO3 (kg ha-1 yr-1)

c. Predictors: (Constant), Precipitation (mm), -10cmN-NO3 (kg ha-1 yr-1), Defoliation (%)

d. Predictors: (Constant), Precipitation (mm), -10cmN-NO3 (kg ha-1 yr-1), Defoliation (%), Winter (mm)

e. Predictors: (Constant), Precipitation (mm), -10cmN-NO3 (kg ha-1 yr-1), Defoliation (%), Winter (mm), Spring (mm)

f. Plot = Mihaesti-Quercus petraea

g. Dependent Variable: Growth index

Coefficients^{a, b}

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-15.362	21.233		-.724	.484					
	Precipitation (mm)	1.029	.197	.844	5.223	.000	.844	.844	.844	1.000	1.000
2	(Constant)	-11.567	16.015		-.722	.487					
	Precipitation (mm)	1.087	.149	.892	7.280	.000	.844	.917	.885	.984	1.016
	-10cmN-NO3 (kg ha-1 yr-1)	-.123	.040	-.377	-3.074	.012	-.263	-.697	-.374	.984	1.016
3	(Constant)	-47.459	17.165		-2.765	.022					
	Precipitation (mm)	1.030	.114	.846	9.032	.000	.844	.949	.827	.956	1.046
	-10cmN-NO3 (kg ha-1 yr-1)	-.114	.030	-.348	-3.753	.005	-.263	-.781	-.344	.973	1.028
	Defoliation (%)	1.771	.603	.274	2.938	.017	.435	.700	.269	.965	1.036
4	(Constant)	-57.788	10.217		-5.656	.000					
	Precipitation (mm)	.840	.079	.689	10.602	.000	.844	.966	.562	.664	1.507
	-10cmN-NO3 (kg ha-1 yr-1)	-.088	.018	-.271	-4.780	.001	-.263	-.861	-.253	.876	1.141
	Defoliation (%)	1.988	.352	.307	5.641	.000	.435	.894	.299	.945	1.058
	Winter (mm)	.222	.051	.282	4.343	.002	.677	.838	.230	.668	1.498
5	(Constant)	-51.958	8.158		-6.369	.000					
	Precipitation (mm)	.918	.068	.753	13.523	.000	.844	.981	.550	.532	1.879
	-10cmN-NO3 (kg ha-1 yr-1)	-.076	.015	-.234	-5.120	.001	-.263	-.888	-.208	.791	1.265
	Defoliation (%)	1.718	.290	.266	5.925	.001	.435	.913	.241	.822	1.217
	Winter (mm)	.270	.043	.343	6.216	.000	.677	.920	.253	.544	1.839
	Spring (mm)	-.147	.057	-.158	-2.569	.037	.357	-.697	-.104	.439	2.278

a. Plot = Mihaesti-Quercus petraea

b. Dependent Variable: Growth index

Variables Entered/Removed^{a, b}

Model	Variables Entered	Variables Removed	Method
1	Precipitation (mm)		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	-10cmN-NO3 (kg ha-1 yr-1)		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Defoliation (%)		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Winter (mm)		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	Spring (mm)		Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Plot = Mihaesti-Quercus petraea

b. Dependent Variable: Growth index

Results

Main predictors of forest vitality indicator - tree growth, defoliation and mortality

Plot / Dependent Variables	Growth	Defoliation	Mortality
Mihaesti – <i>Quercus petraea</i>	P(mm) -10cm N-NO3 Defoliation (%) WinterP(mm) SpringP(mm)		Mg (foliar) Ca (foliar)
Stefanesti – <i>Quercus robur</i>	P(mm) -10 cm S-SO4 Defoliation(%)		P (foliar) N/Ca (foliar)
Fundata – <i>Fagus sylvatica</i>	PreviousFall P(mm)	SummerP(mm)) OF N-NO3 N foliar	P(mm)
Predeal – <i>Picea abies</i>	WinterP (mm)	-10cm N-NO3	Ca (foliar) N/Ca (foliar) P(mm)

Results – foliar chemistry (mg/g)

Plot	Year	N	S	K	Ca	Mg	P	N/K	N/P	N/Ca
Mihaesti	1993	12.2	3.0	9.8	9.3	1.9	1.7	1.2	7.2	1.3
Mihaesti	1996	12.2	3.0	9.8	9.3	1.9	1.7	1.2	7.2	1.3
Mihaesti	1999	12.0	1.1	7.9	9.0	1.8	2.6	1.5	4.6	1.3
Mihaesti	2002	12.8	2.3	3.0	9.8	2.3	1.4	4.3	9.1	1.3
Mihaesti	2006	17.2	1.4	1.1	7.4	1.6	1.7	15.0	10.1	2.3
Mihaesti	2009	10.6	2.0	1.4	3.0	3.9	1.8	7.8	6.1	3.5
Mihaesti	2011	19.8	2.0	1.8	2.9	2.9	2.2	10.9	9.1	6.8
Mihaesti	2013	11.2	1.9	1.3	2.9	2.3	1.7	8.9	6.7	3.9
Stefanesti	1993	13.9	2.4	0.9	12.4	2.3	0.9	16.0	15.4	1.1
Stefanesti	1996	17.3	2.8	0.8	9.7	3.4	0.8	20.8	21.6	1.8
Stefanesti	1999	13.8	1.4	1.0	9.7	2.6	1.0	13.9	13.8	1.4
Stefanesti	2000	12.6		1.2	6.0	1.5	0.7	10.5	18.0	2.1
Stefanesti	2002	12.3		1.3	5.0	1.6	0.8	9.5	15.4	2.5
Stefanesti	2006	13.3	1.3	0.9	7.9	2.1	1.0	14.8	13.3	1.7
Stefanesti	2009	13.3	1.4	2.0	5.4	5.4	2.2	6.6	5.9	2.4
Stefanesti	2011	13.4	1.4	2.0	5.4	5.4	2.2	6.6	6.0	2.5
Stefanesti	2013	10.1	1.0	1.7	5.1	1.7	1.7	5.9	6.1	2.0
Fundata	1993	13.7	2.0	9.1	14.7	1.7	1.6	1.5	8.6	0.9
Fundata	1996	20.0	2.1	7.5	7.9	1.2	2.0	2.7	10.0	2.5
Fundata	1999	16.7	1.2	5.2	9.0	1.2	2.1	3.2	8.0	1.9
Fundata	2002	12.7	2.3	2.5	9.8	2.3	1.3	5.1	9.8	1.3
Fundata	2006	18.9	1.5	2.7	9.3	1.3	1.2	7.0	10.6	2.0
Fundata	2009	14.4	2.2	2.9	2.3	3.2	1.9	4.9	7.8	6.3
Fundata	2011	14.5	2.4	1.8	2.3	2.9	2.2	8.0	6.7	6.3
Fundata	2013	12.7	2.1	2.8	2.6	2.2	1.6	4.6	7.9	4.8
Predeal	1996	9.7	1.0	4.7	5.0	0.8	2.0	2.1	4.9	1.9
Predeal	1999	12.0	1.1	4.8	6.1	0.7	2.8	2.5	4.3	2.0
Predeal	2002	13.1	1.1	5.0	6.5	0.6	3.1	2.6	4.2	2.0
Predeal	2006	11.6	0.9	5.0	6.5	1.4	0.9	2.3	12.3	1.8
Predeal	2009	12.0	1.0	5.0	6.5	1.2	1.2	2.4	10.0	1.8
Predeal	2011	13.0	1.0	5.7	8.0	1.0	1.3	2.3	9.8	1.6
Predeal	2013	11.8	1.0	3.9	6.1	1.0	1.2	3.0	10.1	1.9

low
normal
high

Stefan (1997)

Conclusions

The main highlighted predictors:

- Rainfall as the common denominator at all locations
- Crown defoliation (Stefanesti-*Quercus robur*, Mihaesti – *Quercus petraea*)
- Sulphur in soil solution at 10 cm depth (Stefanesti-*Quercus robur*)
- Nitrogen in soil solution at 10 cm depth (Mihaesti – *Quercus petraea*)
 - nutrition imbalances triggered by relative high ionic rates (N/K) accompanied by inadequate supply of these elements
- limiting nutritive factors represented by a low ratio of N/P (Fundata-*Fagus sylvatica*) and low ratio of N/Ca (Predeal-*Picea abies*)

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Thank you!

Introduction

- Graphical conceptual model on photo

