Biodiversity Monitoring Programme of
Russian Academy of Science
Center for Forest Ecology and Productivity of RAS

Assessment of vegetation diversity of the North-Eastern forests in Kostroma region. Upscaling vegetation data from forest-stand to regional level

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Structure of the computer information-analytical system

Flowchart of vegetation diversity assessment

Обозначения: Д - деревья, К - кустарники, Т - травы

Steps of vegetation sample plots data proceeding to assess vegetation diversity at forest-stand level

1) расчет показателей разнообразия для каждого отдельного описания:
   - число видов по основным ярусам растительности,
   - число видов по жизненным формам (деревья, кустарники, травы),
   - общее число видов на площадке без повторов по ярусам,
   - число видов разных эколого-ценотических групп;

2) расчет экологических оценок описания по экологическим шкалам (Д.Цыганова, Г. Элленберга);

3) предварительная типизация описаний (по доминантам древостоя и доминирующей группе видов напочвенного покрова);

4) ординация описаний для выявления основных градиентов варьирования растительности;

5) уточнение типизации описаний;

6) расчет показателей разнообразия выделенных типов растительных сообществ:
   - общее число видов в целом в сообществе и в среднем на площадке,
   - число деревьев, кустарников и трав в целом в сообществе и в среднем на площадке,
   - число видов разных эколого-ценотических групп в целом в сообществе и в среднем на площадке,
   - коэффициенты флористического сходства между сообществами,
   - коэффициенты гетерогенности,
   - диапазоны и средние экологических факторов для сообществ;

7) оценка сукцессионного статуса выделенных типов сообществ

Number of vegetation sample plots in different forest types at the North-East of Kostroma region

	2003	2004	Всего
ельники, пихто-ельники			
PcBN	39	24	63
PcBr	15	35	50
PcGm	5	15	20
PcH	52	8	60
PcNB	30	29	59
PcS	5		5
PcVm	20	22	42
березняки			
BBN	3	8	11
BBr		12	12
BH	11		11
BNB	2	8	10
BVm	1	2	3

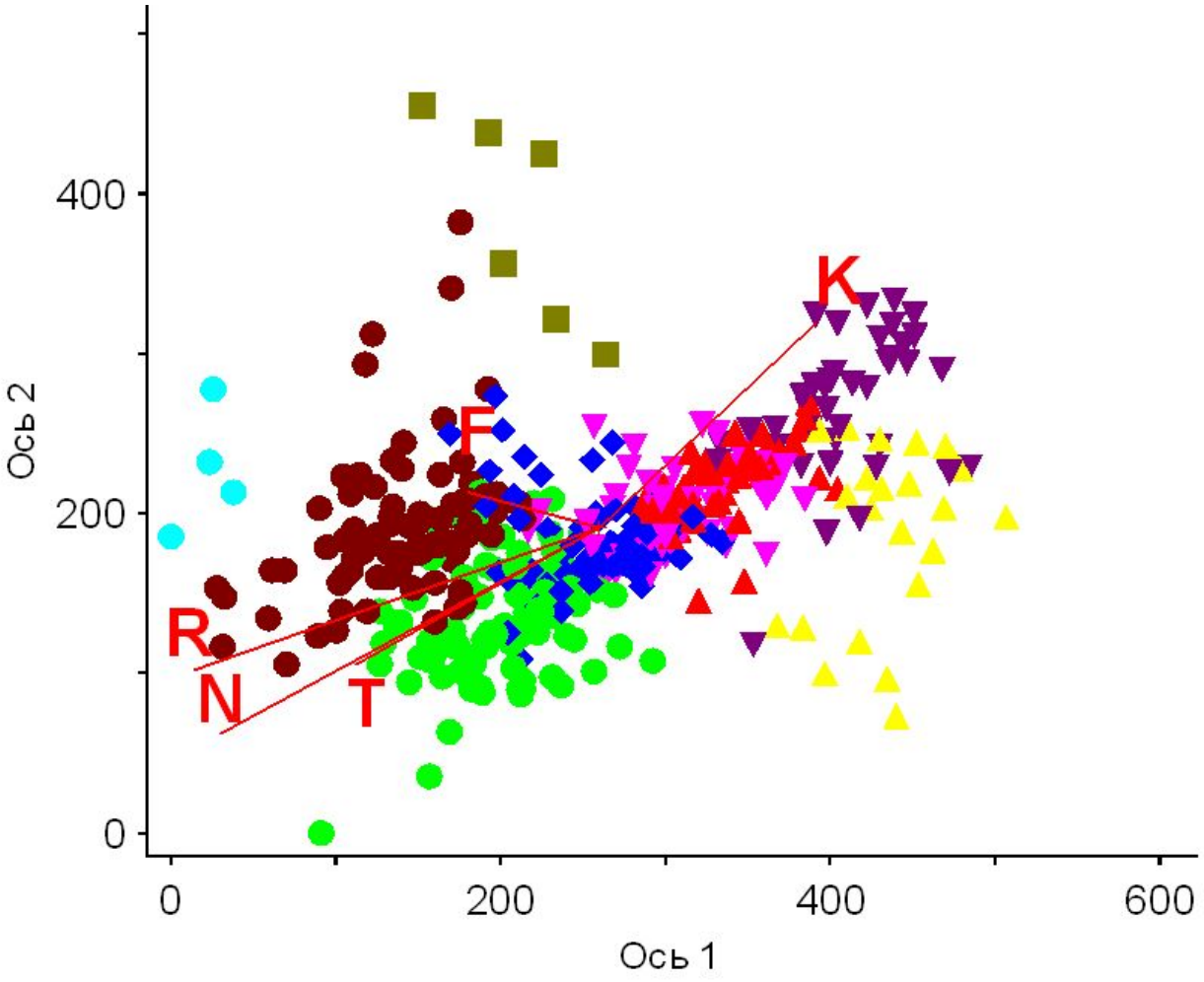
	2003	2004	Всего
сосняки			
PnBr	5		5
PnF		22	22
PnGm	8	13	21
PnNB	3		3
PnS	1		1
PnVm	8	2	10
осинники			
PpBN		18	18
PpBr		2	2
PpNB		3	3
липняки			
TBN		3	3
TH	6		6
ольшаники			
A	4		4

24 типа леса
444 описания

Number of phytosociological releves per forest type groups and per year

	F	Gm	Vm	Br	NB	BN	TH	Nt	S
2003		13	29	20	35	42	69	4	6
2004	22	28	26	49	40	53	8		
Bcero	22	41	55	69	75	95	77	4	6

DCA ordination of the Kostroma vegetation sample plots



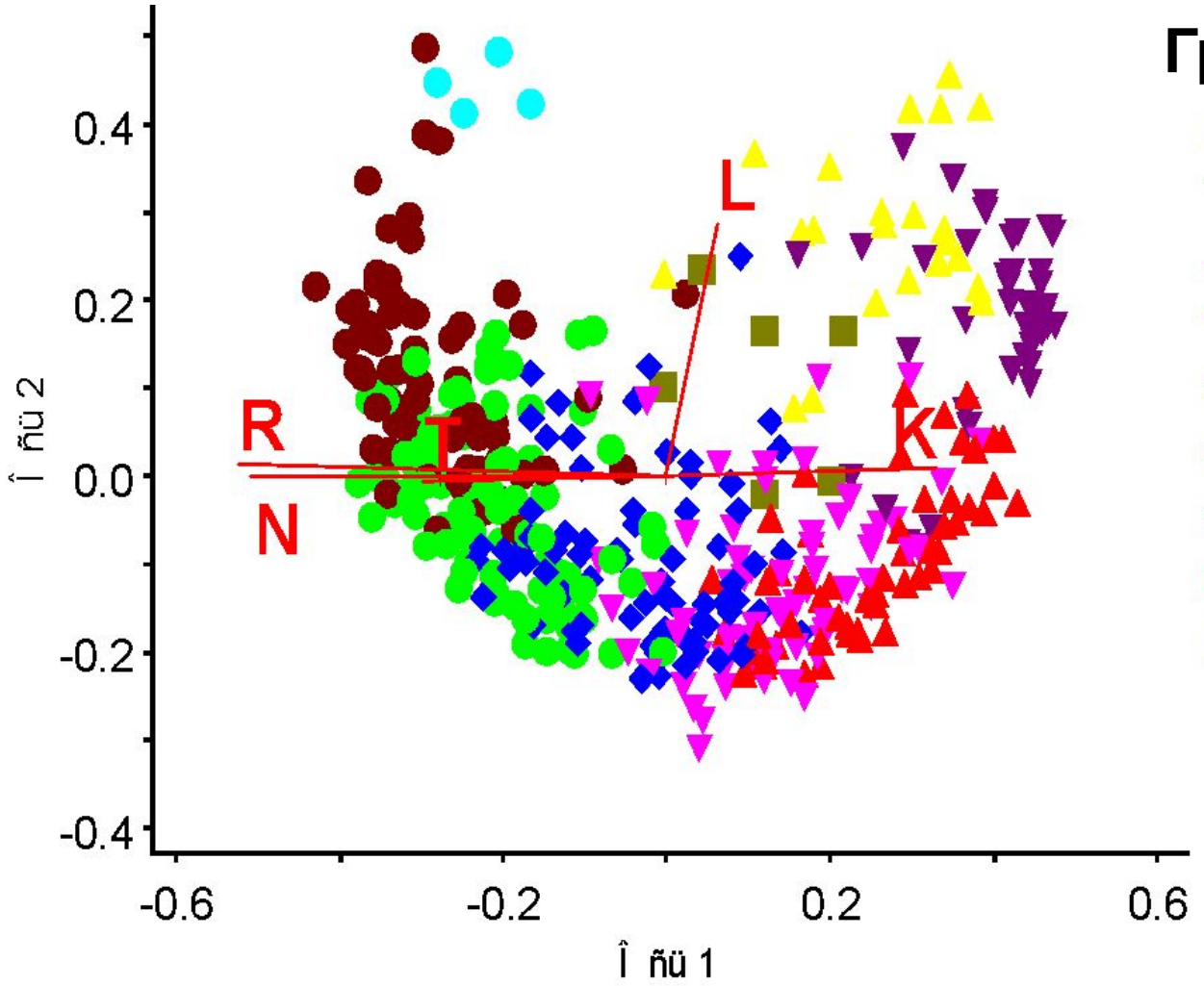
Группы типов леса

- боровая
- зеленомошная
- черничная
- бореальная
- неморал.-бореал.
- бореал.-неморал.
- высокотравная
- нитрофил. (ольшан.)
- сфагновая

Ellenberg's indicator values:

R – soil reaction
N – soil nutrient
T – temperature
F – soil moisture
K – climate continentality

PCoA ordination of the Kostroma vegetation sample plots



Группы типов леса

- áî ðî âàÿ
- çåëåí î ì î ø í àÿ
- ÷åðí è÷í àÿ
- áî ðåàëüí àÿ
- í åì î ðàë.-áî ðåàë.
- áî ðåàë.-í åì î ðàë.
- âû ñî êî òðàâí àÿ
- í èòðî ô èë.(î ëüø àí .)
- ñô àãí î âàÿ

Ellenberg's indicator values:

R – soil reaction
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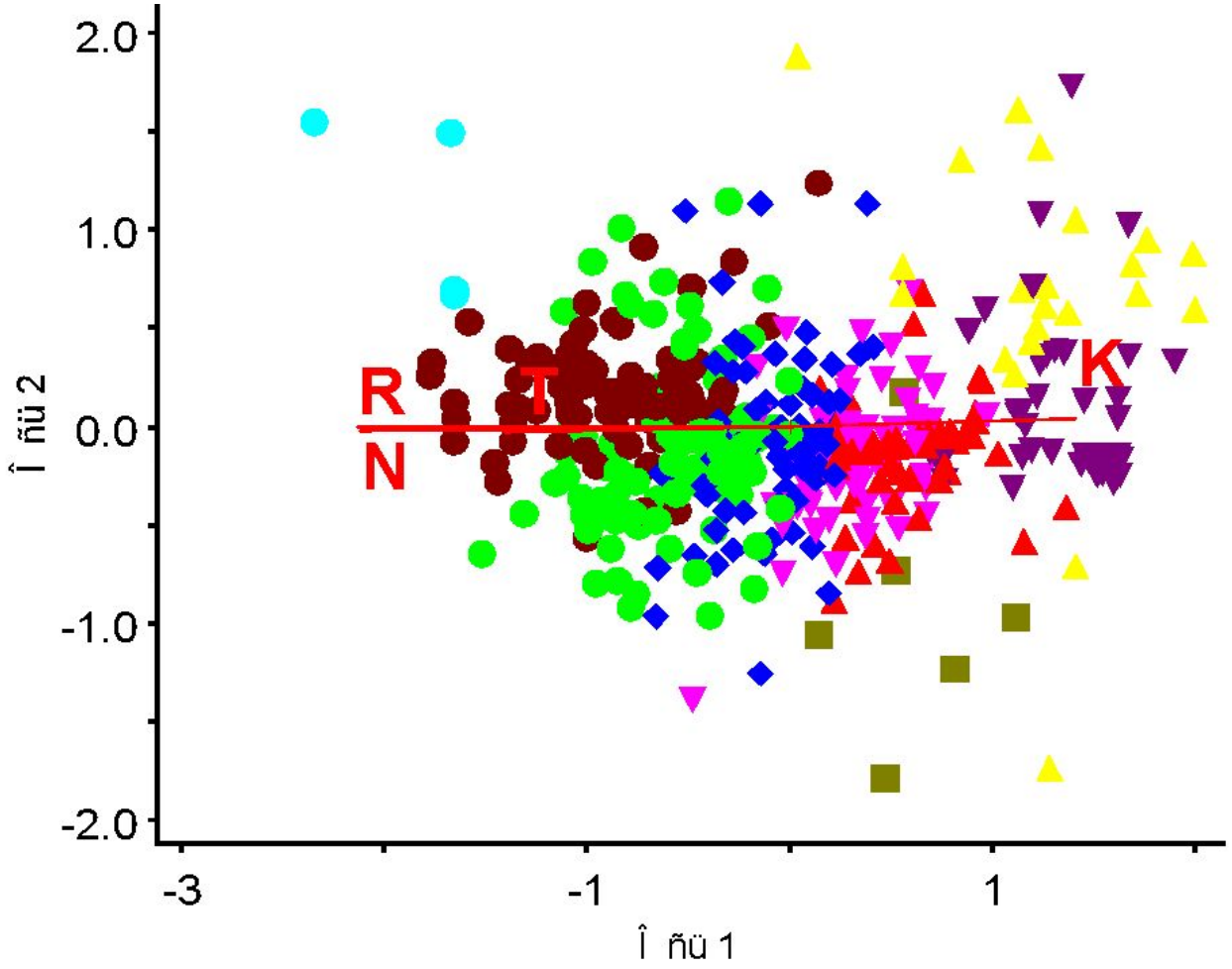
K – climate continentality

NMS ordination of the Kostroma vegetation sample plots



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- áî ðåàë.-í åì î ðàë.
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- í èòðî ô èë.(î ëüø àí .)
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Ellenberg's indicator values:

R – soil reaction
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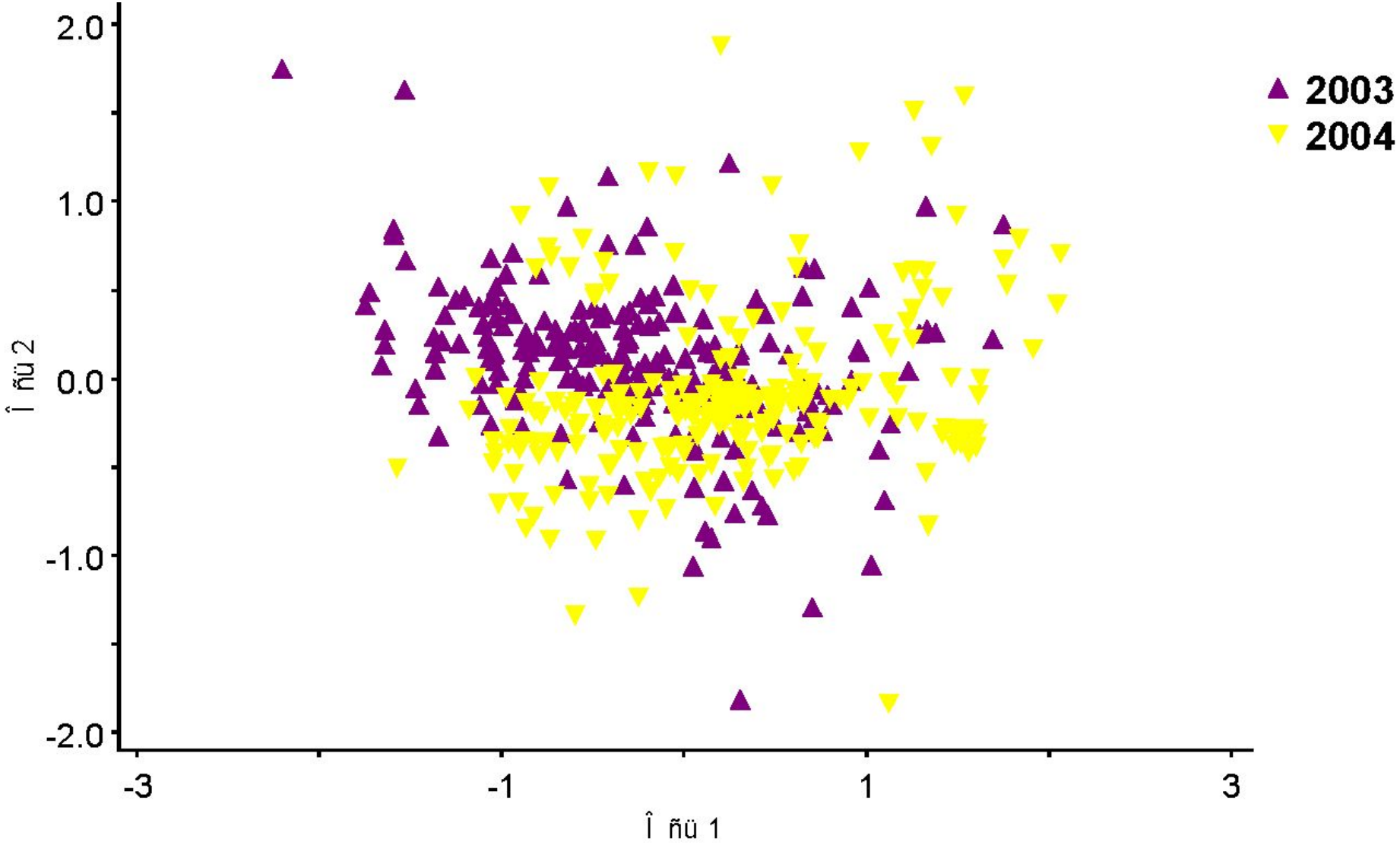
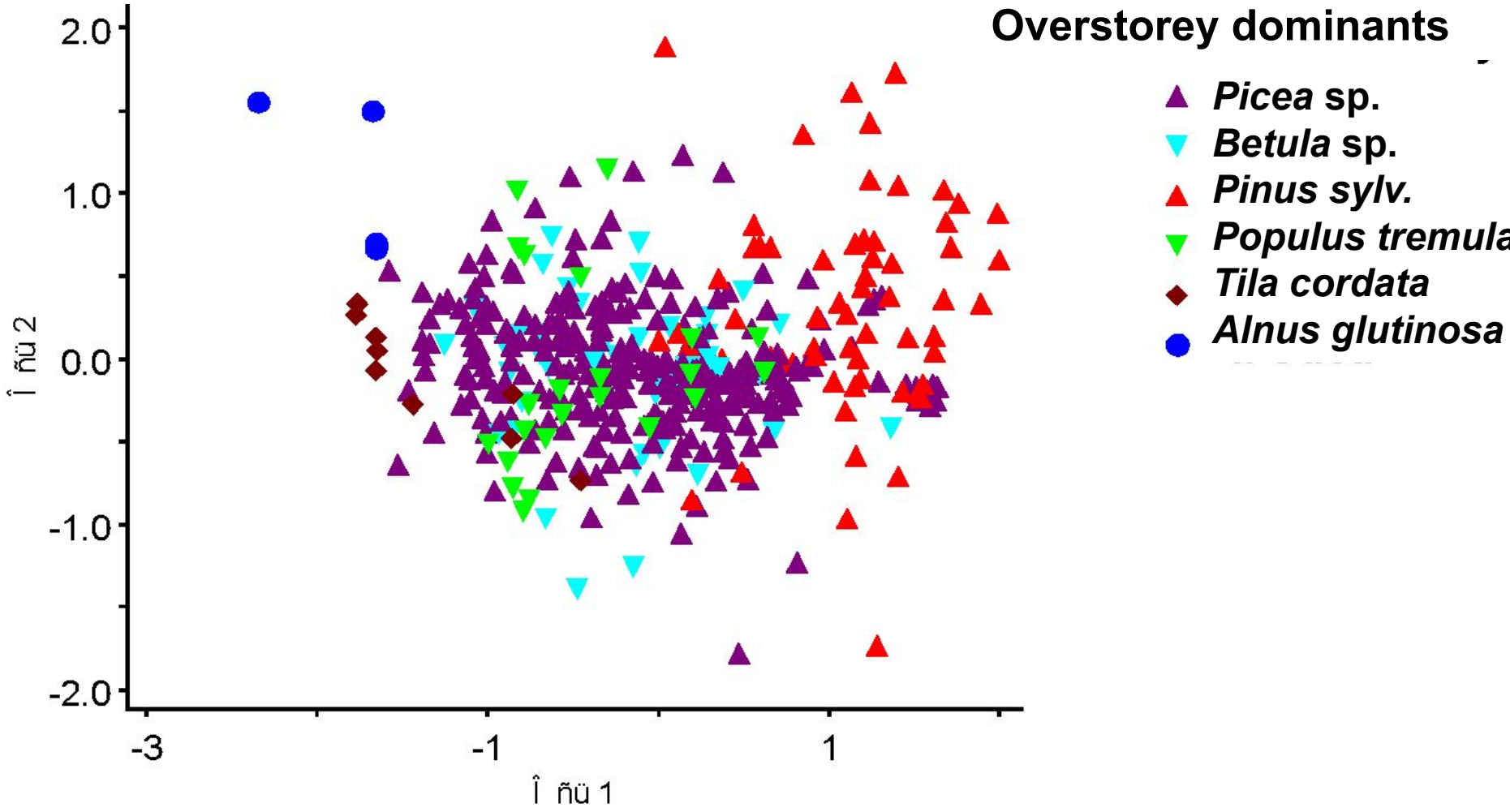
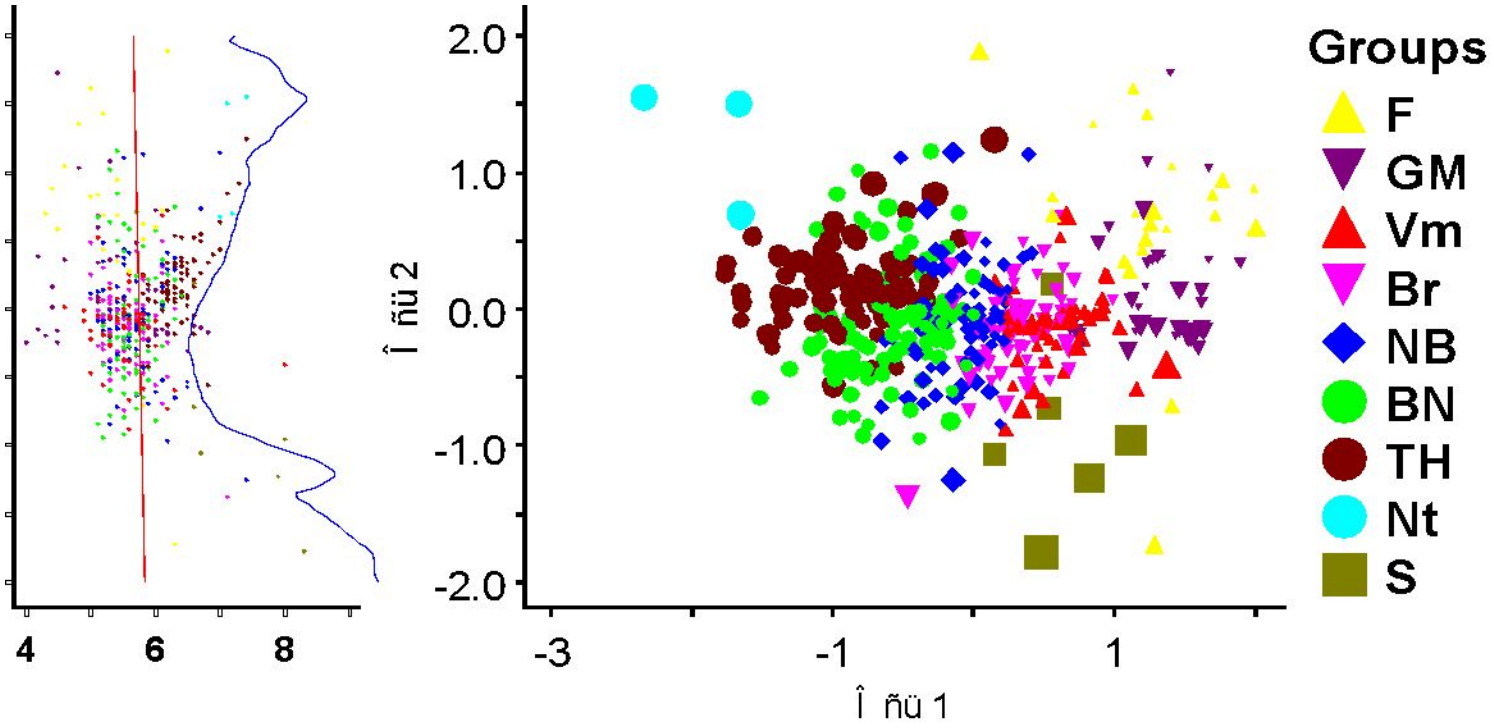
NMS ordination of the Kostroma vegetation sample plots



NMS ordination of the Kostroma vegetation sample plots

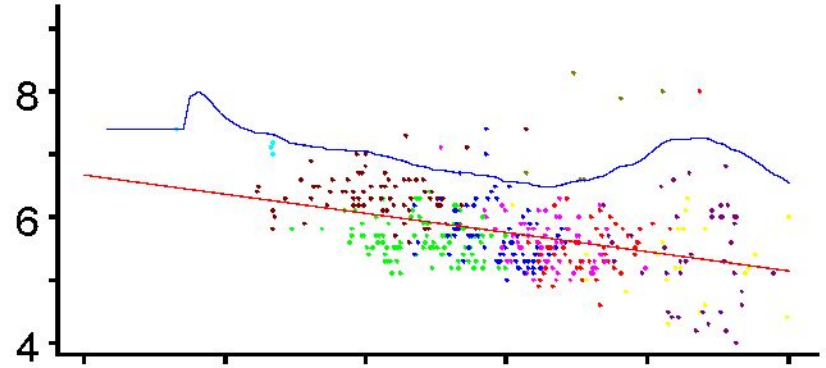


NMS ordination of the Kostroma vegetation sample plots with values F (soil moisture) overlay

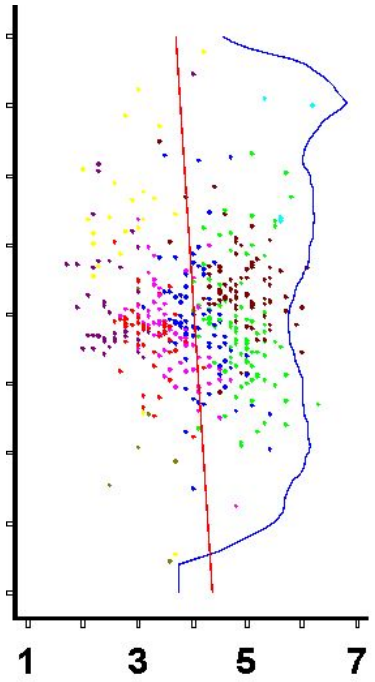


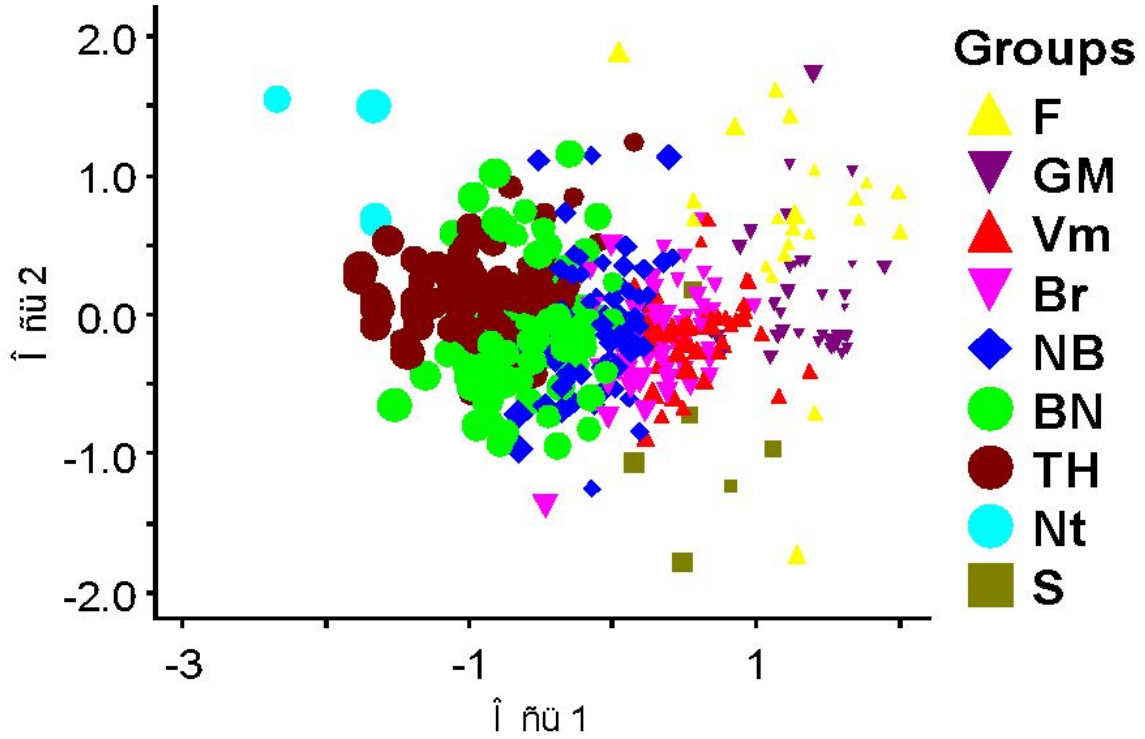
F

Î ñü 1
r = -.413 tau = -.323
Î ñü 2
r = -.040 tau = .057



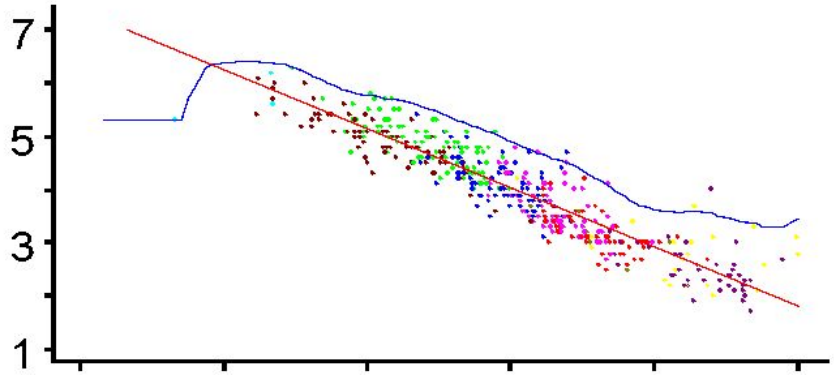
NMS ordination of the Kostroma vegetation sample plots with values N (soil nutrient) overlay



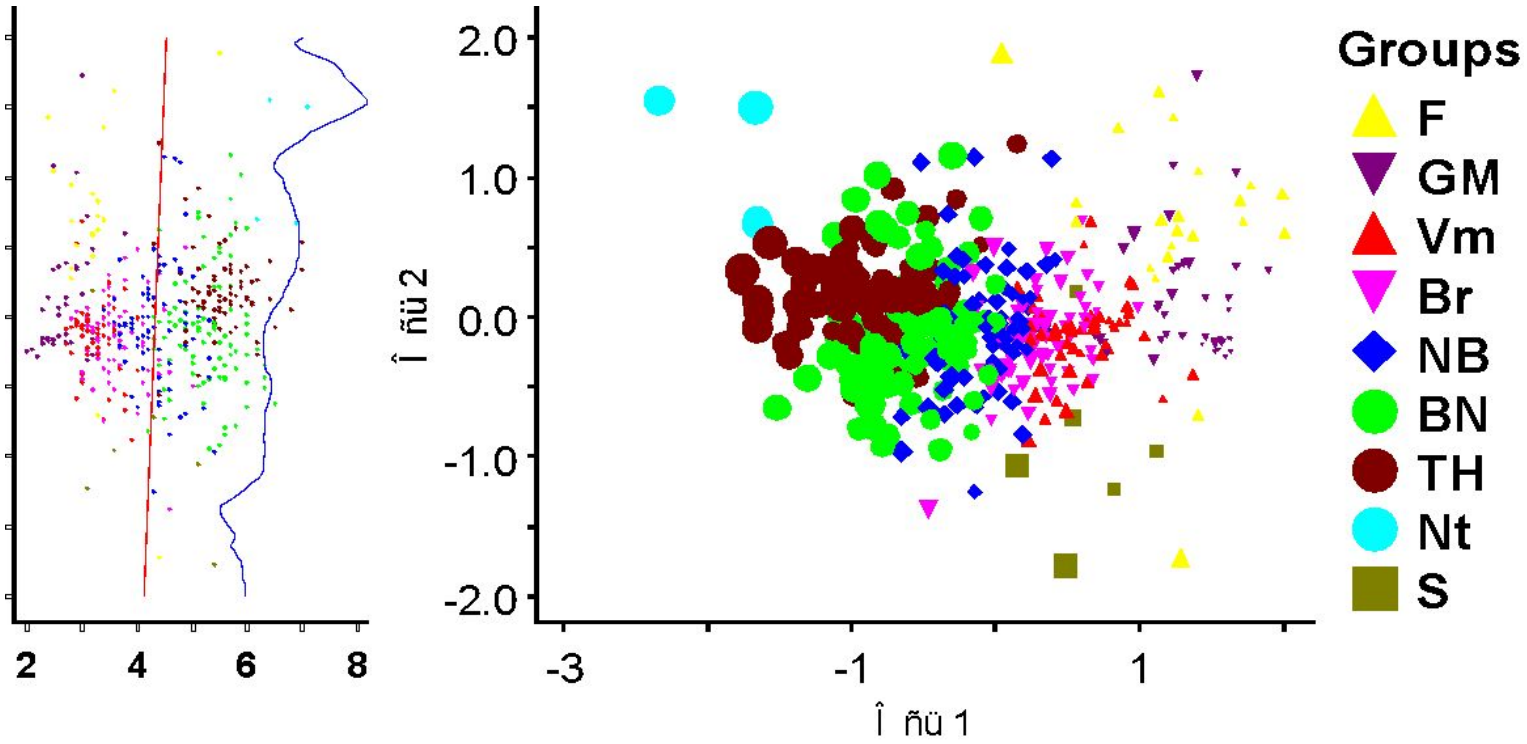


N

Î ñü 1
r = -.923 tau = -.792
Î ñü 2
r = -.085 tau = -.057

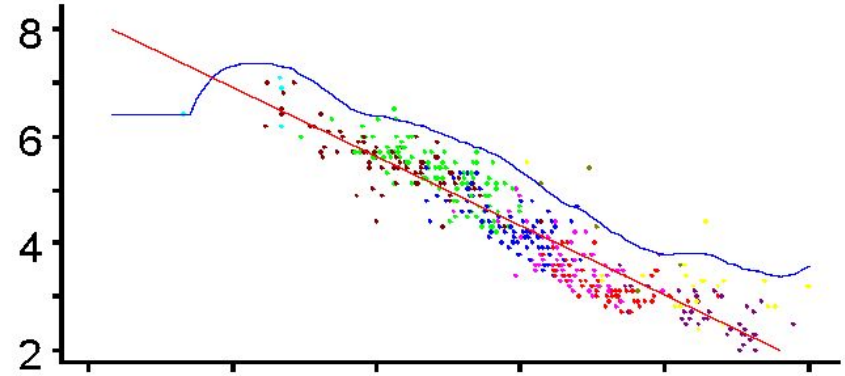


NMS ordination of the Kostroma vegetation sample plots with values R (soil reaction) overlay

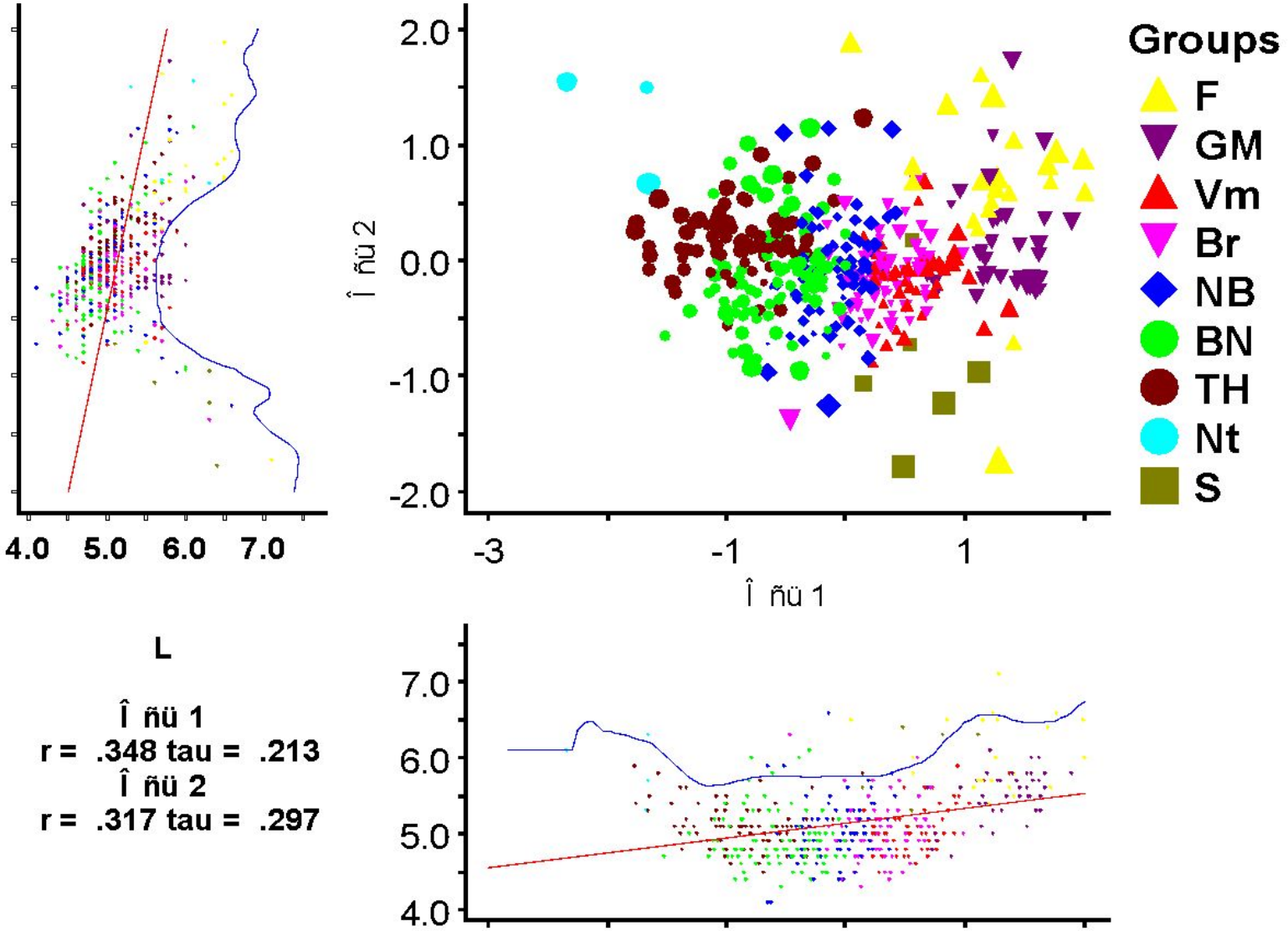


R

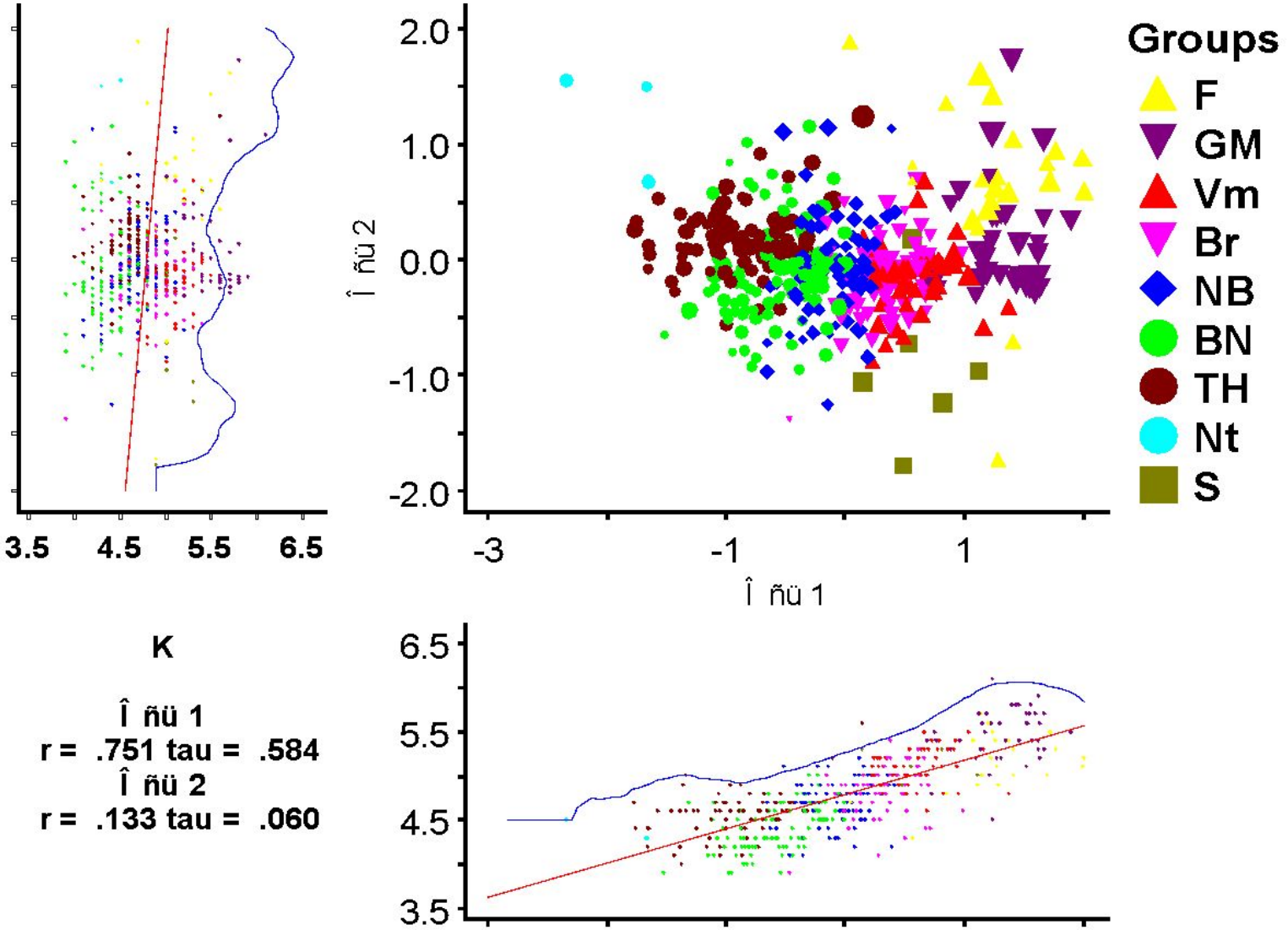
Î ñü 1
r = -.924 tau = -.802
Î ñü 2
r = .040 tau = .049



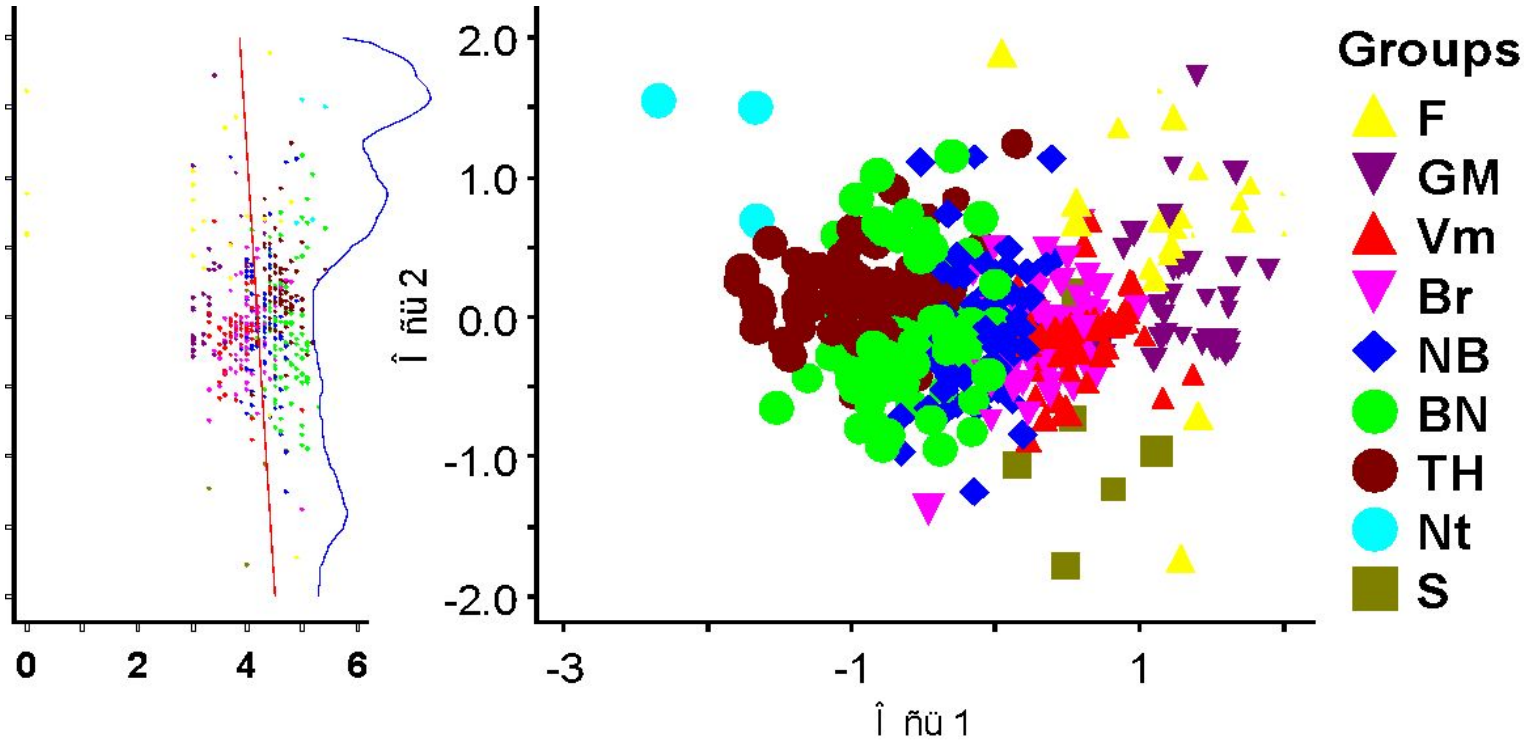
NMS ordination of the Kostroma vegetation sample plots with values L (light regime) overlay



NMS ordination of the Kostroma vegetation sample plots with values K (climate continentality) overlay

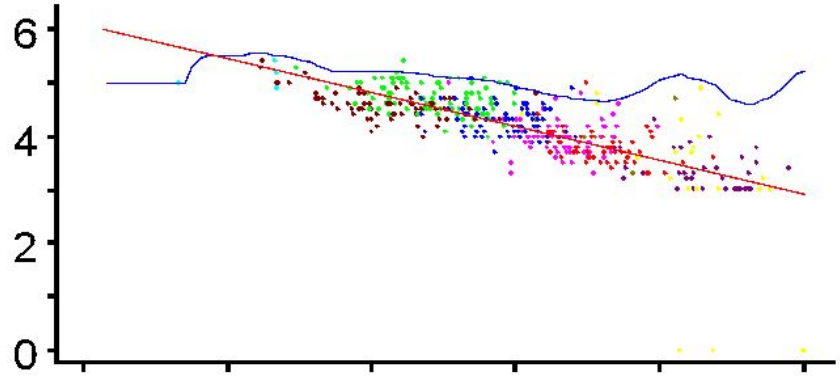


NMS ordination of the Kostroma vegetation sample plots with values T (temperature regime) overlay



T

Î ñü 1
r = -.751 tau = -.633
Î ñü 2
r = -.110 tau = .024



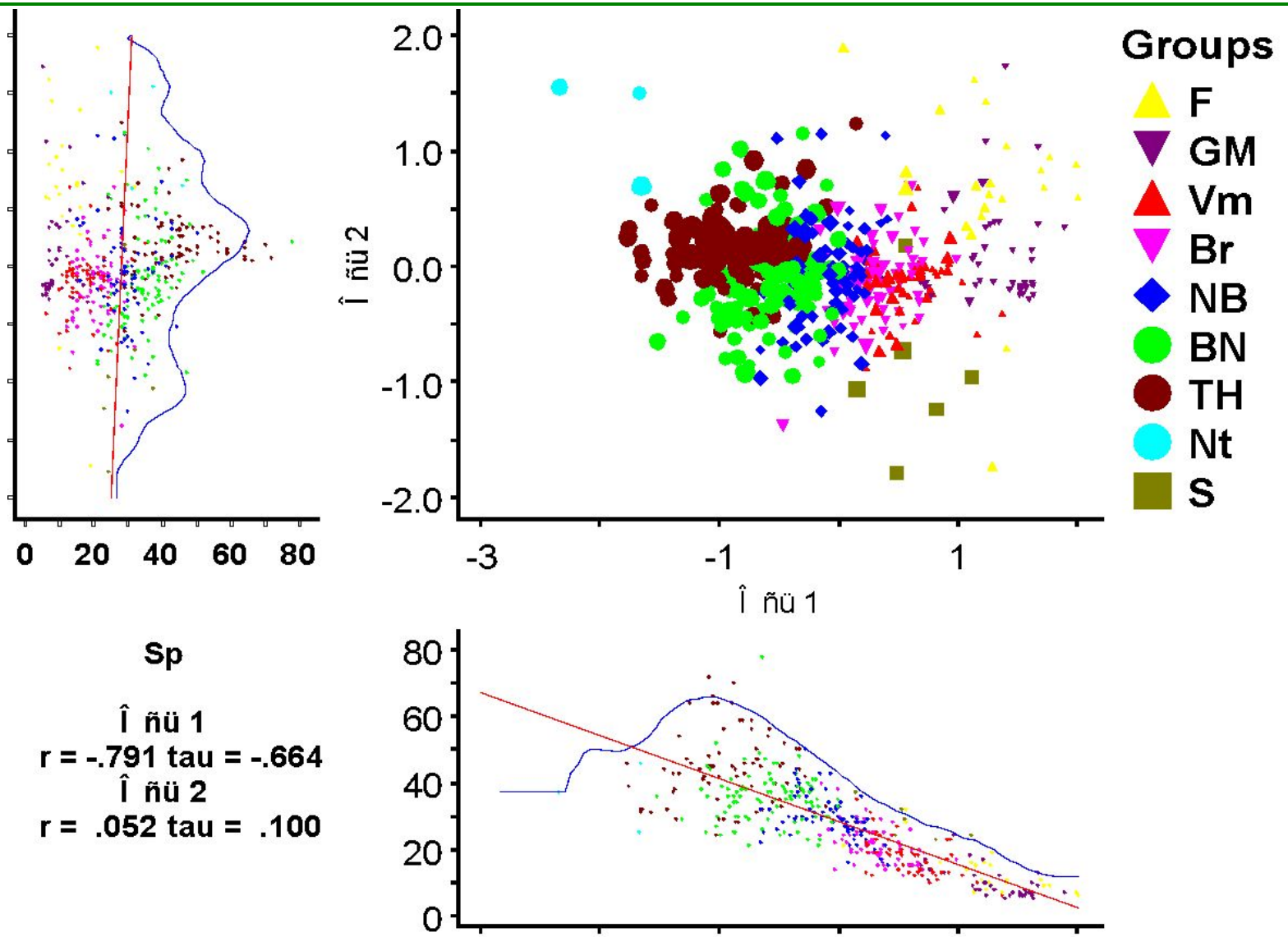
Reliability of a difference between the forest types upon the species number at the plots

	BN	Br	F	Gm	NB	Nt	S	TH	Vm
BN		1	1	1	1	0	0	1	1
Br	1		1	1	1	0	0	1	0
F	1	1		0	1	1	1	1	0
Gm	1	1	0		1	1	1	1	1
NB	1	1	1	1		0	0	1	1
Nt	0	0	1	1	0		0	0	1
S	0	0	1	1	0	0		1	0
TH	1	1	1	1	1	0	1		1
Vm	1	0	0	1	1	1	0	1	

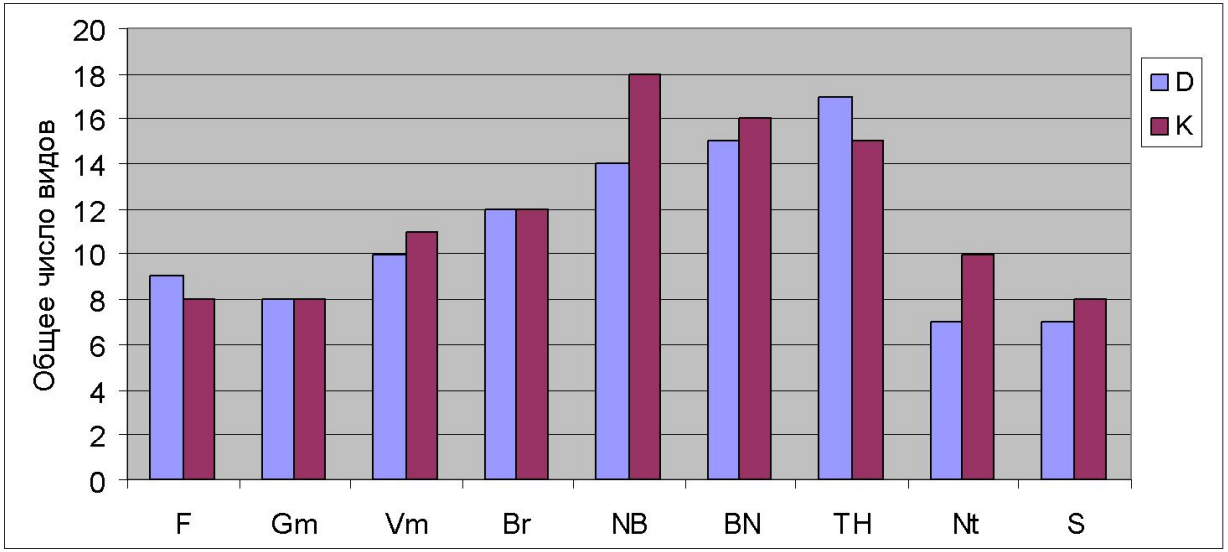
1 - различия между группами достоверны при $p<0.05$

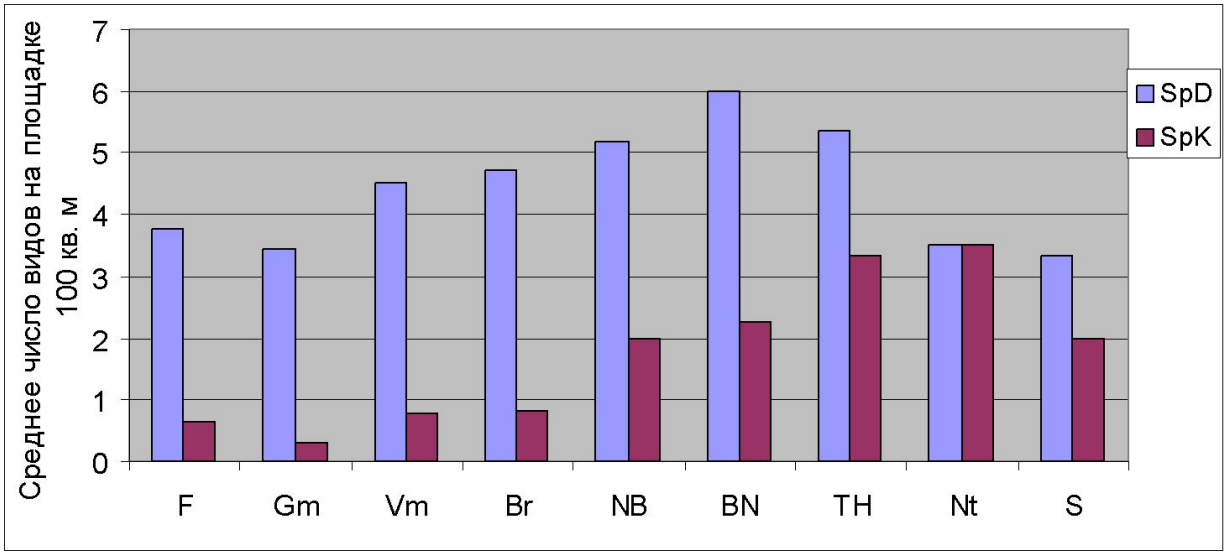
0 - различия между группами недостоверны

NMS ordination of the Kostroma vegetation sample plots with the number of vascular plants overlay

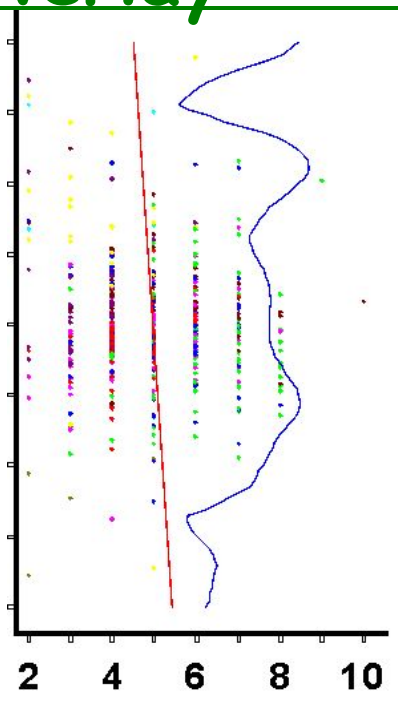


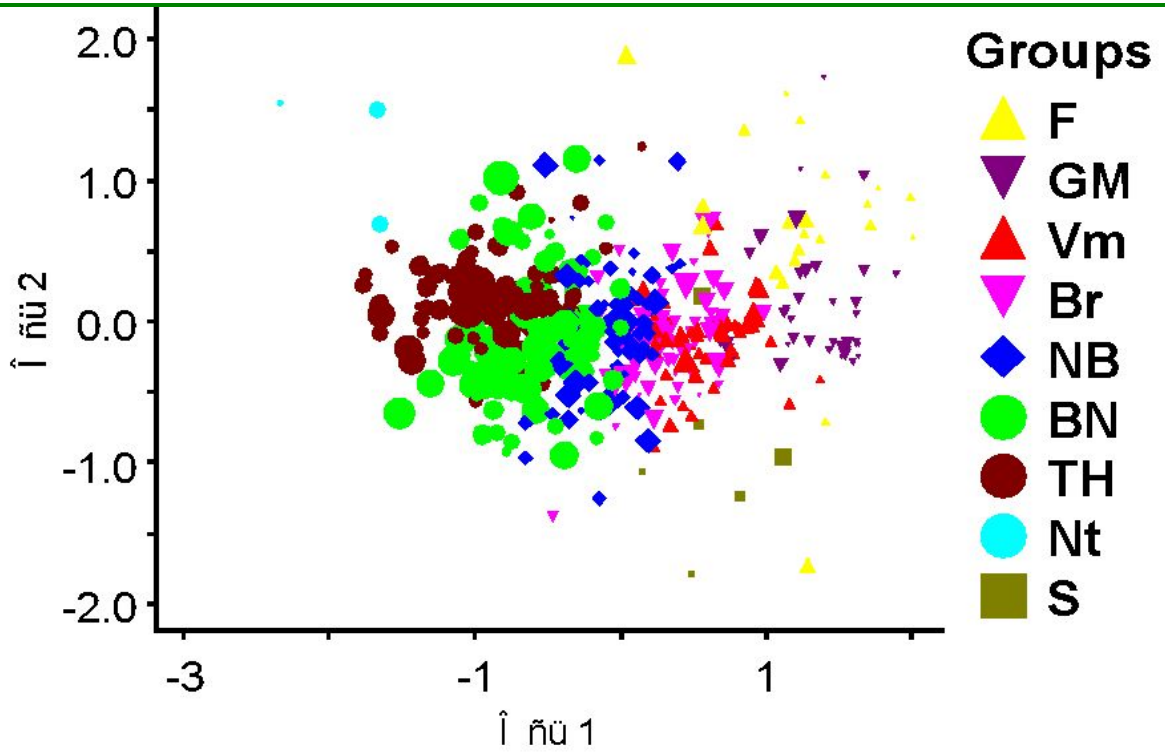
Tree and shrub species diversity of the forest types





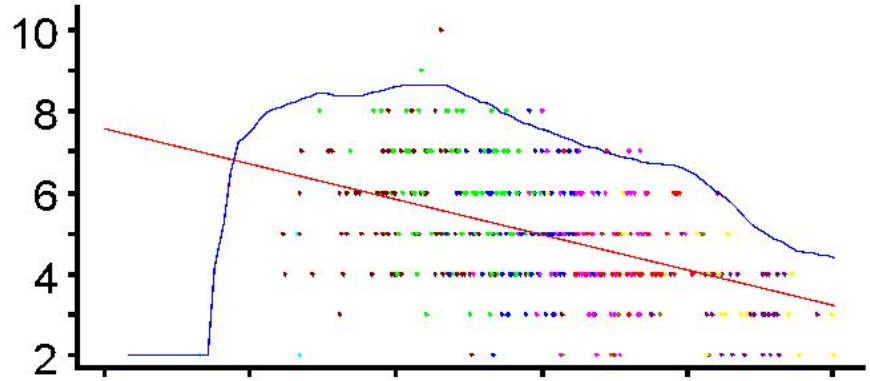
NMS ordination of the Kostroma vegetation sample plots with the number of tree species overlay



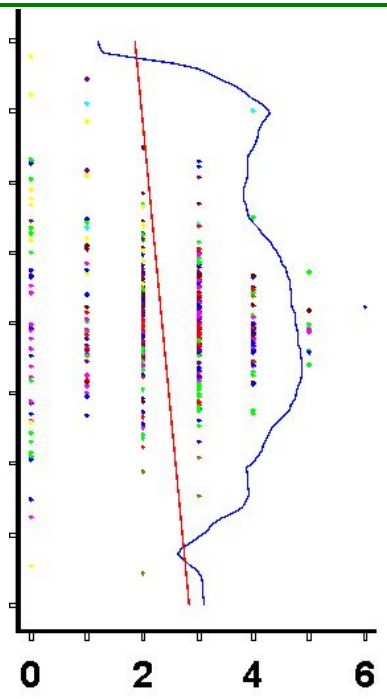


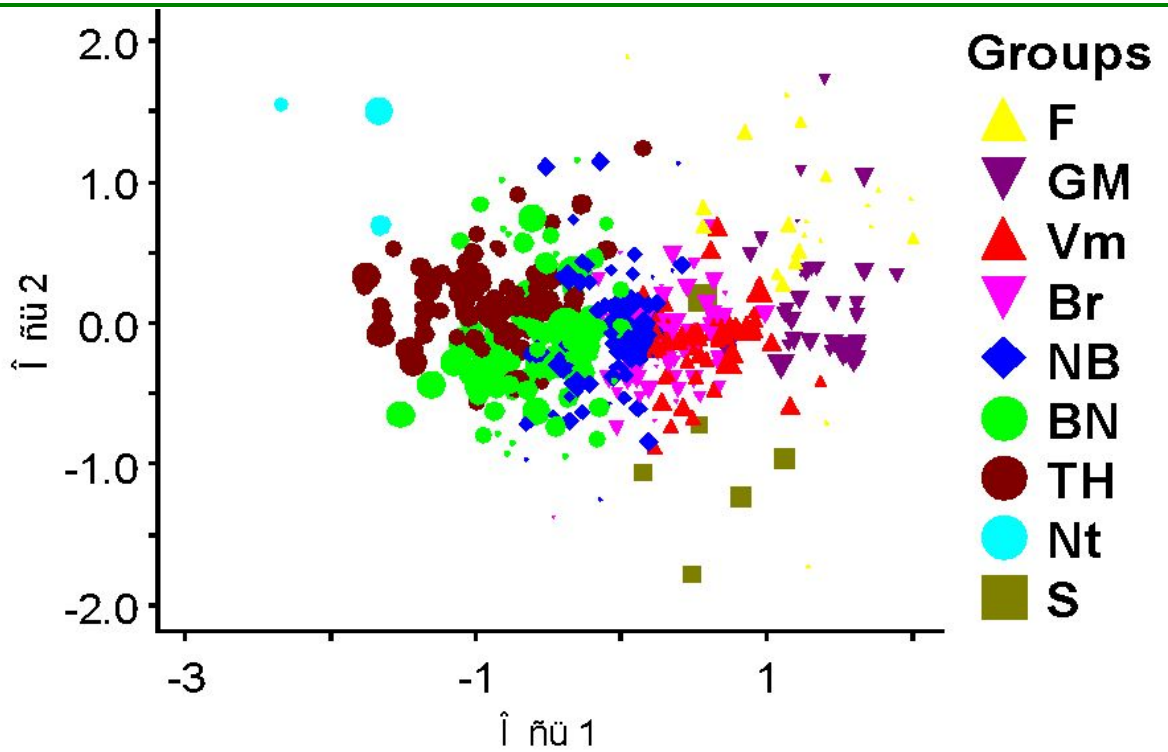
SpD

Î ñü 1
r = -.475 tau = -.368
Î ñü 2
r = -.072 tau = -.028



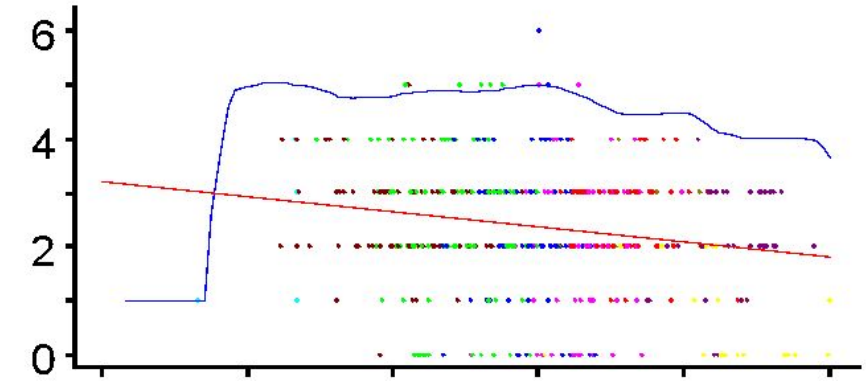
NMS ordination of the Kostroma vegetation sample plots with the number of tree species in overstorey overlay



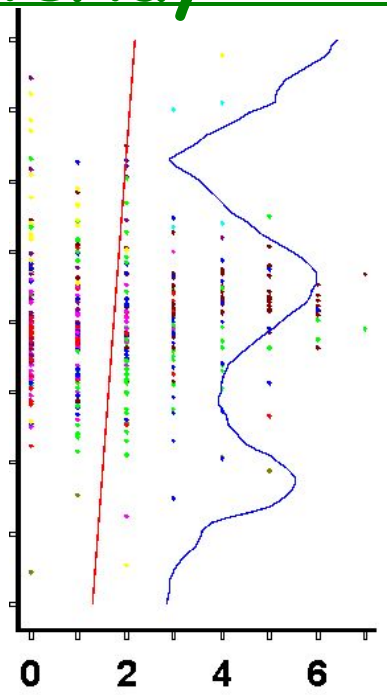


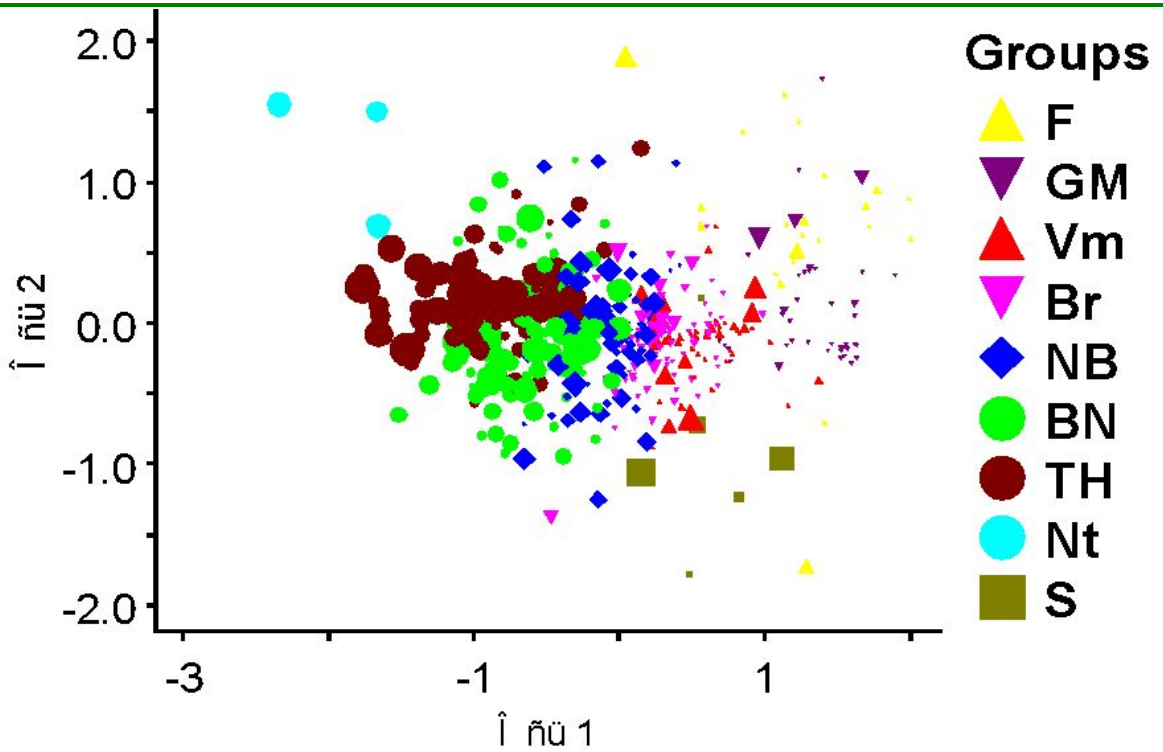
DA

Î ñü 1
r = -.189 tau = -.132
Î ñü 2
r = -.093 tau = -.059



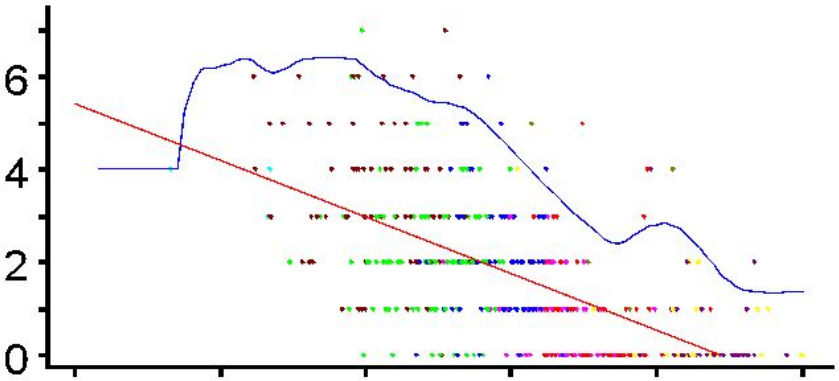
NMS ordination of the Kostroma vegetation sample plots with the number of shrub species overlay



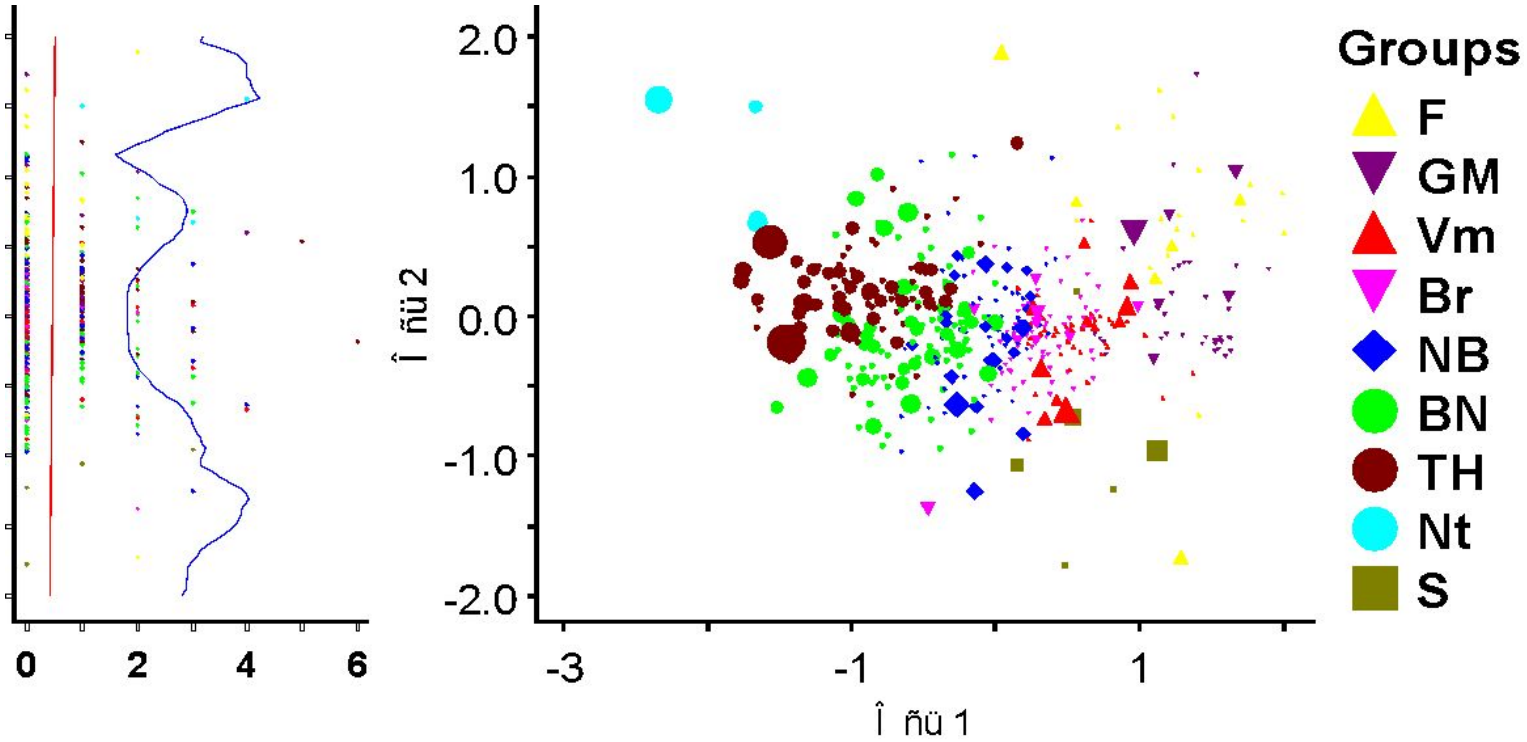


SpK

Î ñü 1
r = -.601 tau = -.500
Î ñü 2
r = .063 tau = .099

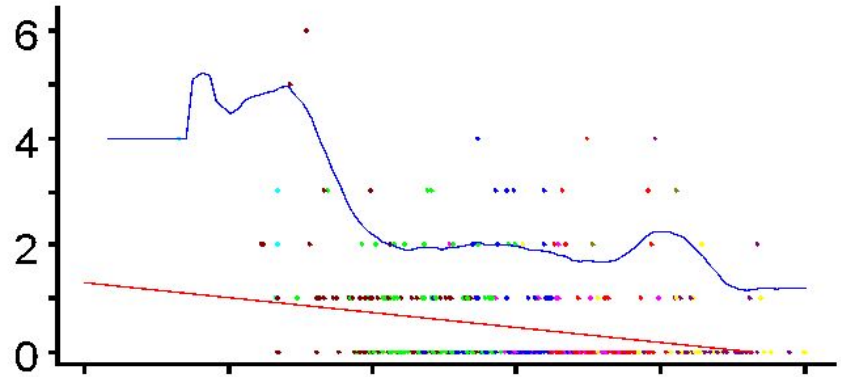


NMS ordination of the Kostroma vegetation sample plots with the number of shrub species in the upper understorey overlay

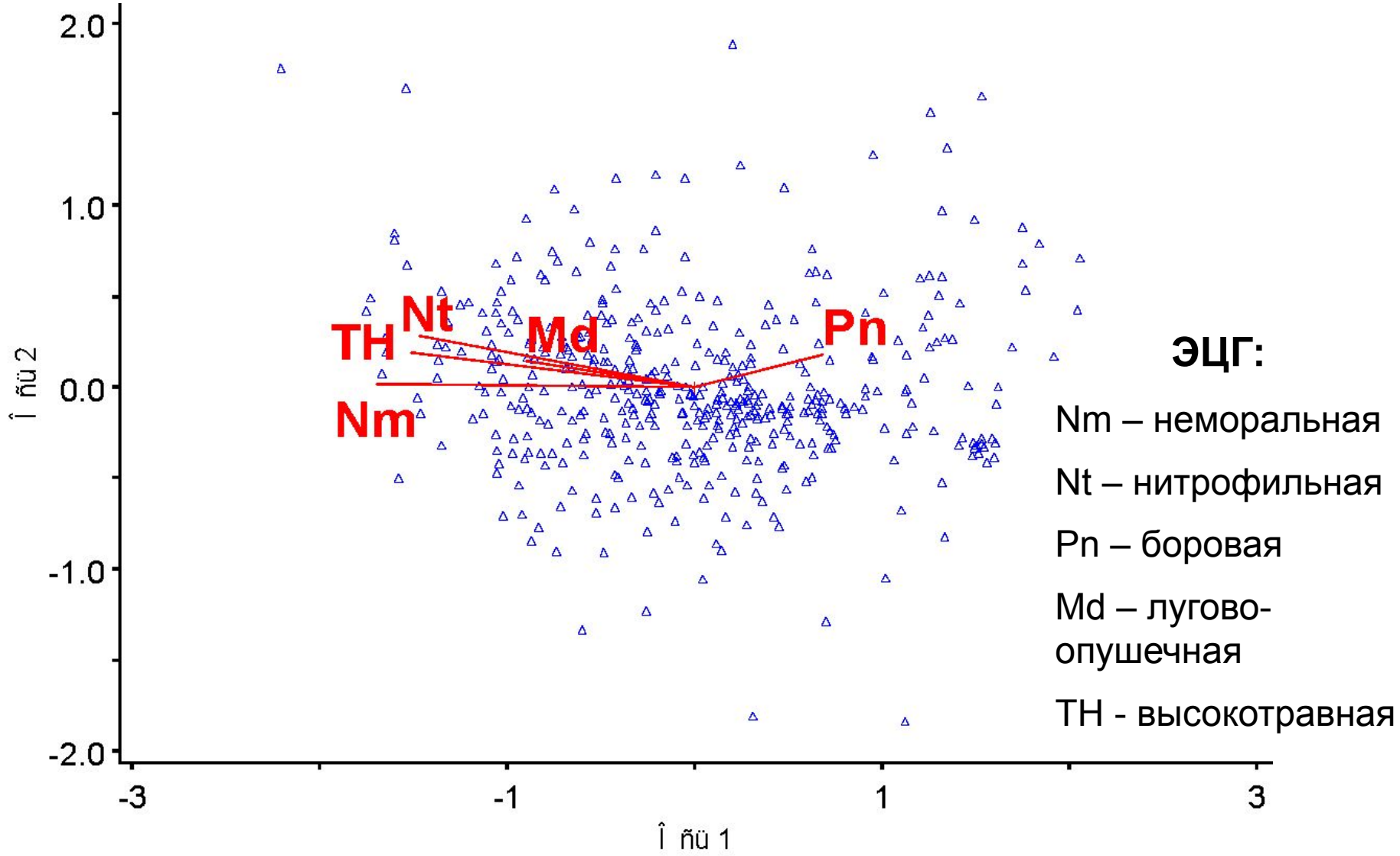


KB

Î ñü 1
r = -.257 tau = -.216
Î ñü 2
r = .014 tau = .065



NMS ordination of the Kostroma vegetation sample plots with the species number of different ecological-coenotic groups overlay



ЭЦГ:

Nm – неморальная

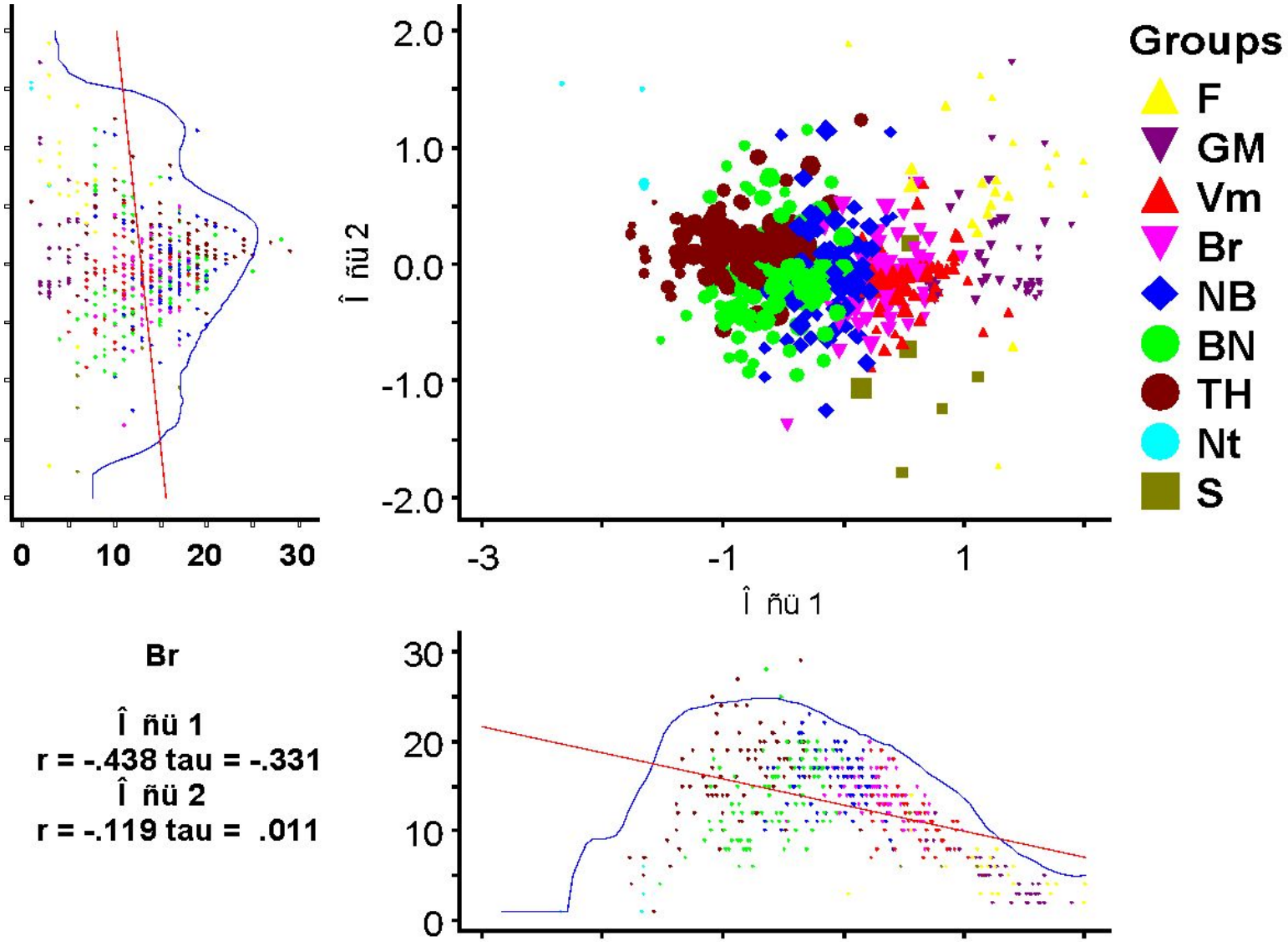
Nt – нитрофильная

Pn – боровая

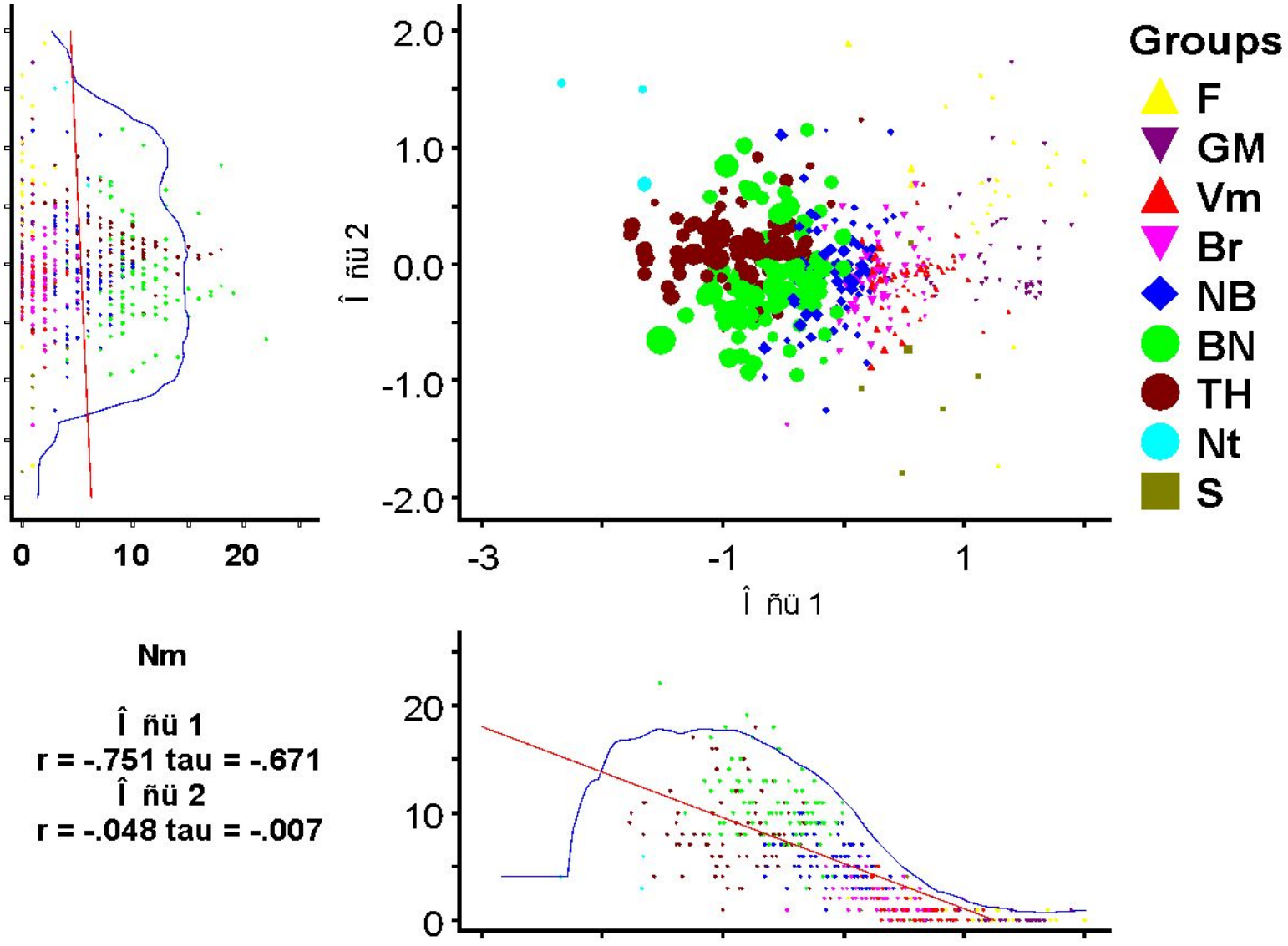
Md – лугово-опушечная

TH - высокотравная

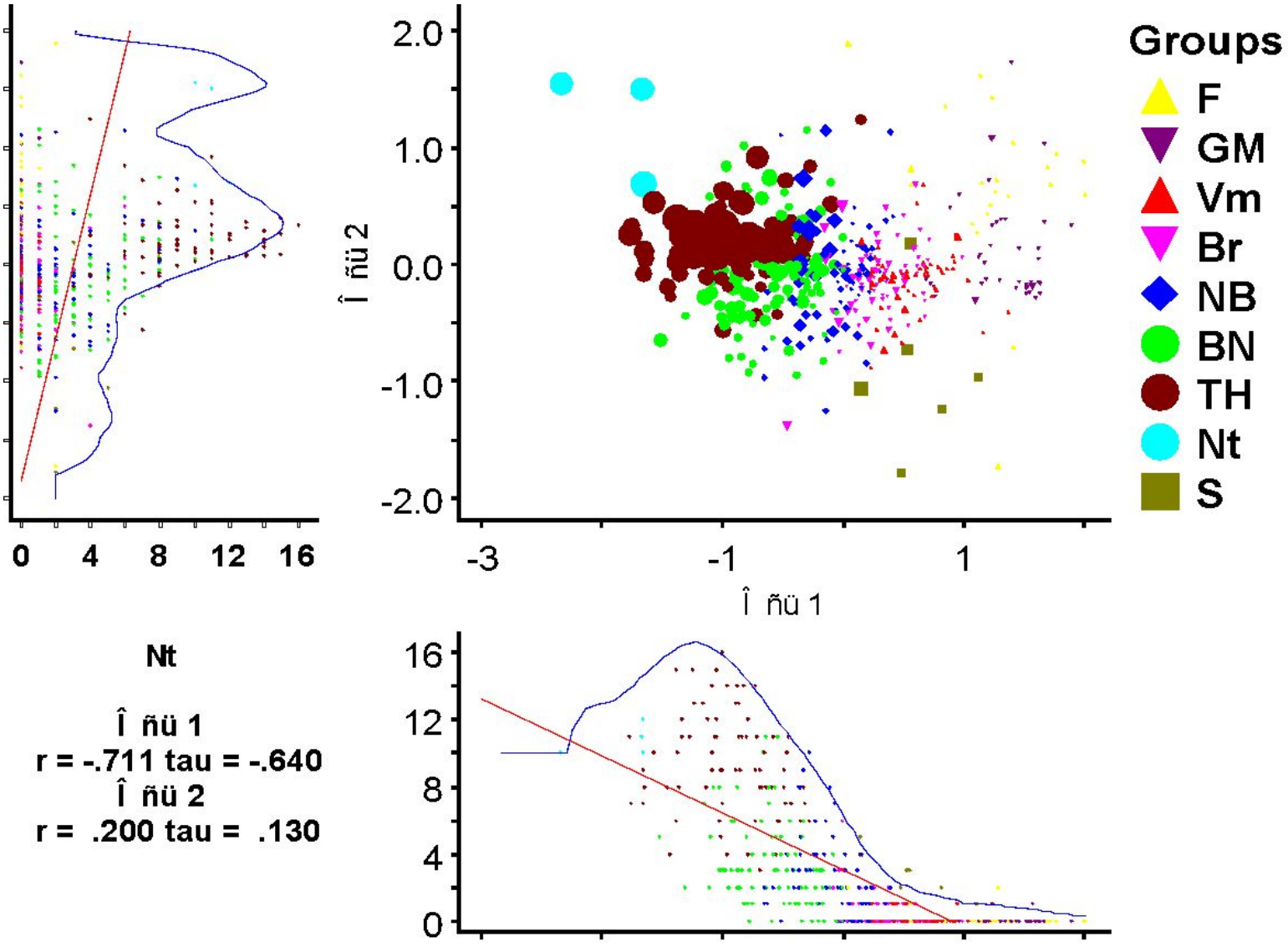
NMS ordination of the Kostroma vegetation sample plots with the number of boreal species overlay



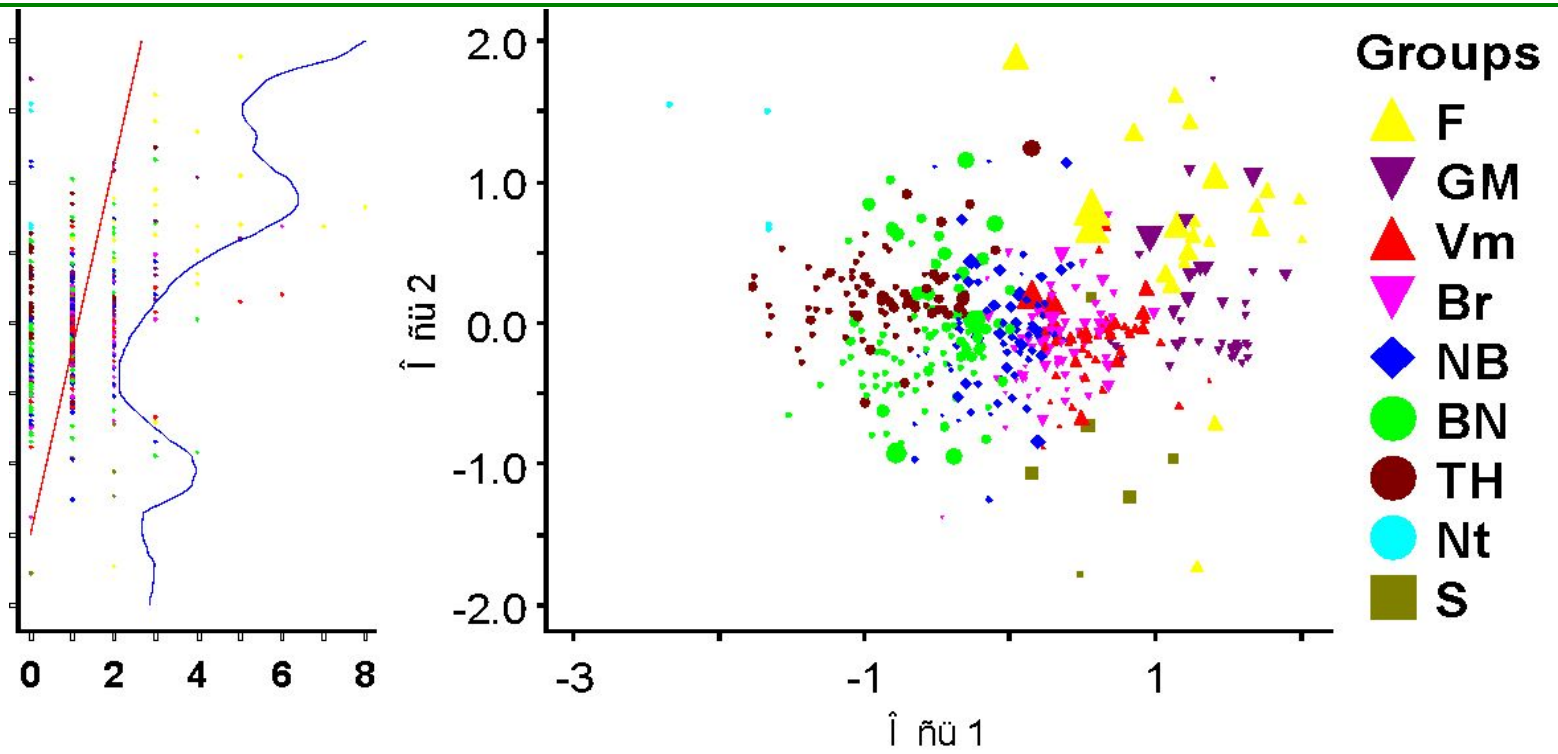
NMS ordination of the Kostroma vegetation sample plots with the number of nemoral species overlay



NMS ordination of the Kostroma vegetation sample plots with the number of nitrophilous species overlay

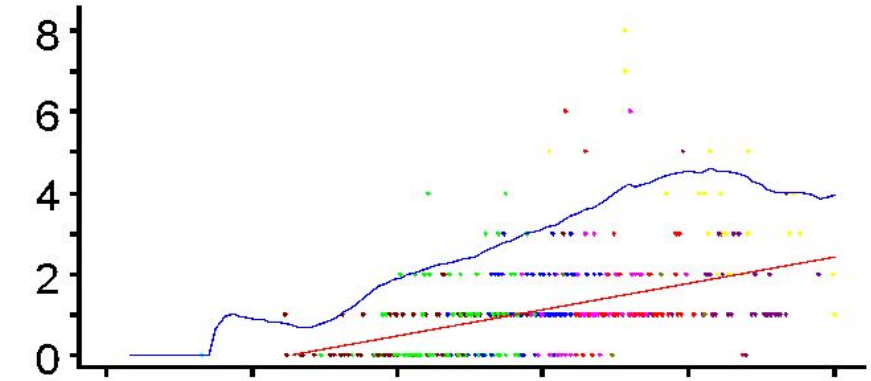


NMS ordination of the Kostroma vegetation sample plots with the number of piny species overlay

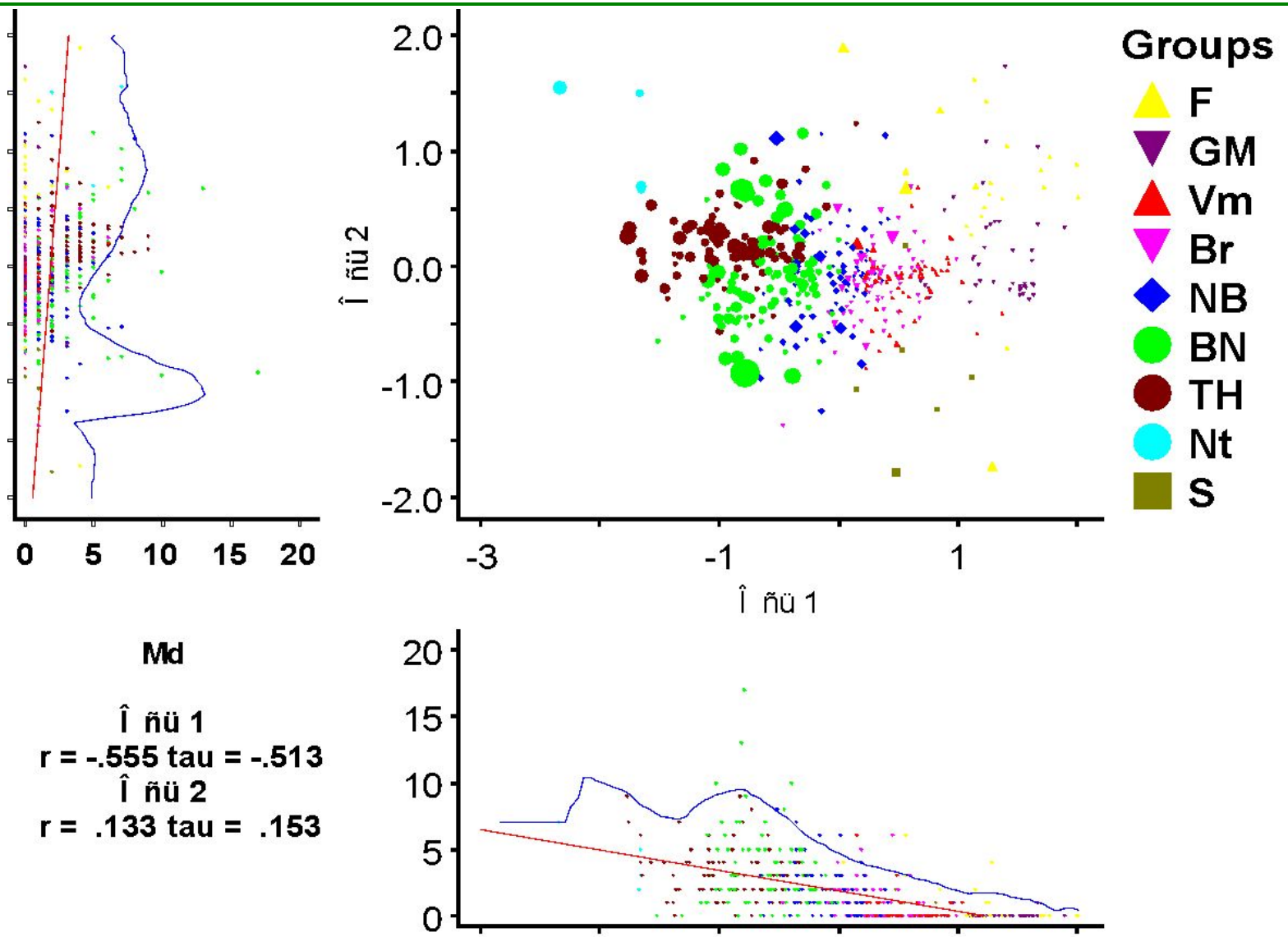


Pn

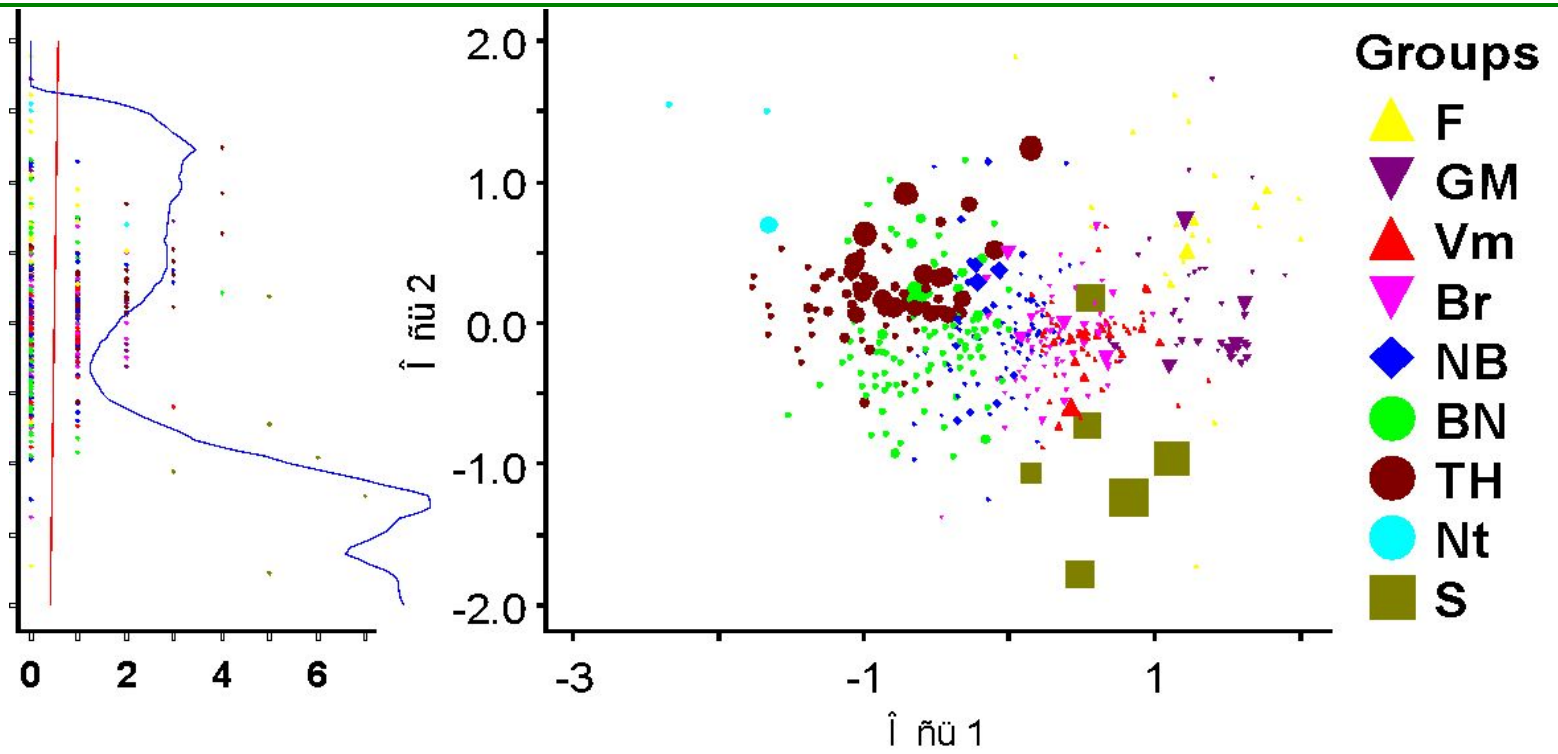
Î ñü 1
r = .465 tau = .429
Î ñü 2
r = .311 tau = .213

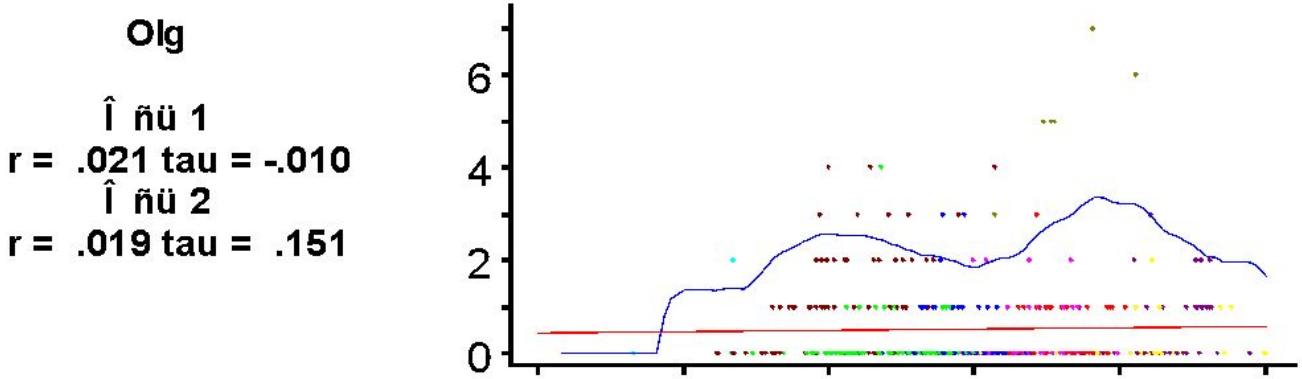


NMS ordination of the Kostroma vegetation sample plots with the number of meadow species overlay

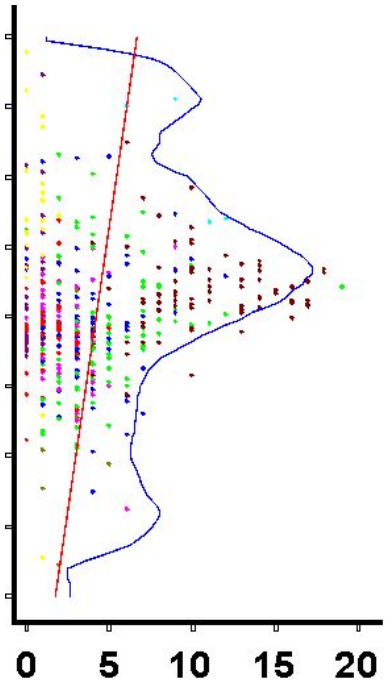


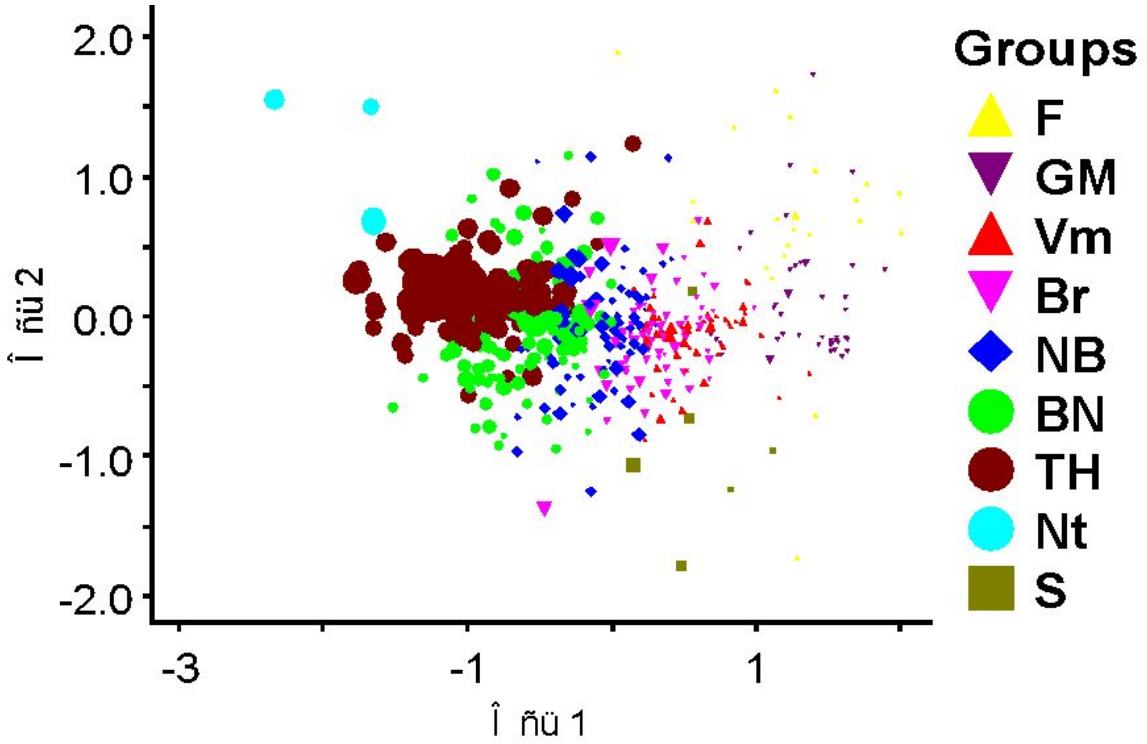
NMS ordination of the Kostroma vegetation sample plots with the number of oligotrophic species overlay





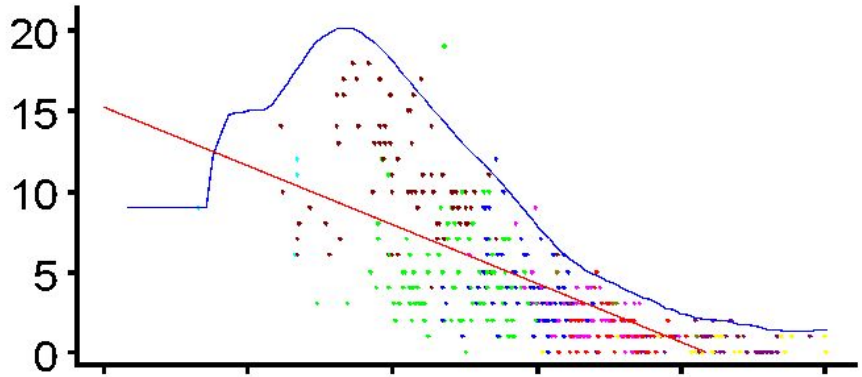
NMS ordination of the Kostroma vegetation sample plots with the number of tall herbaceous species overlay



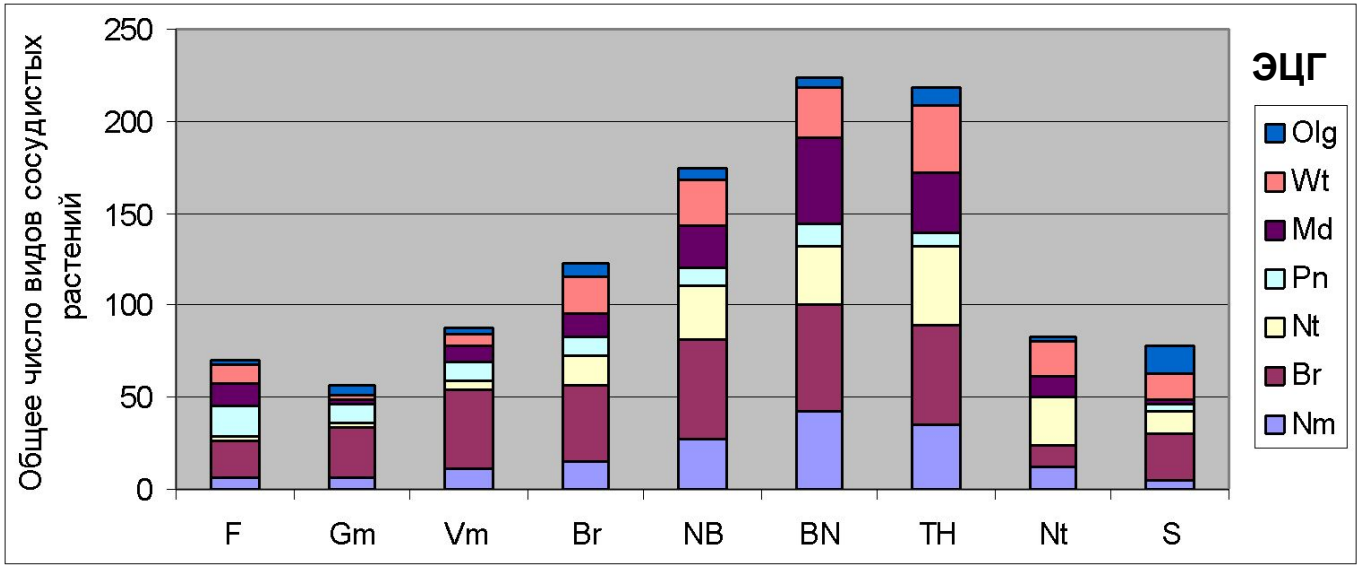


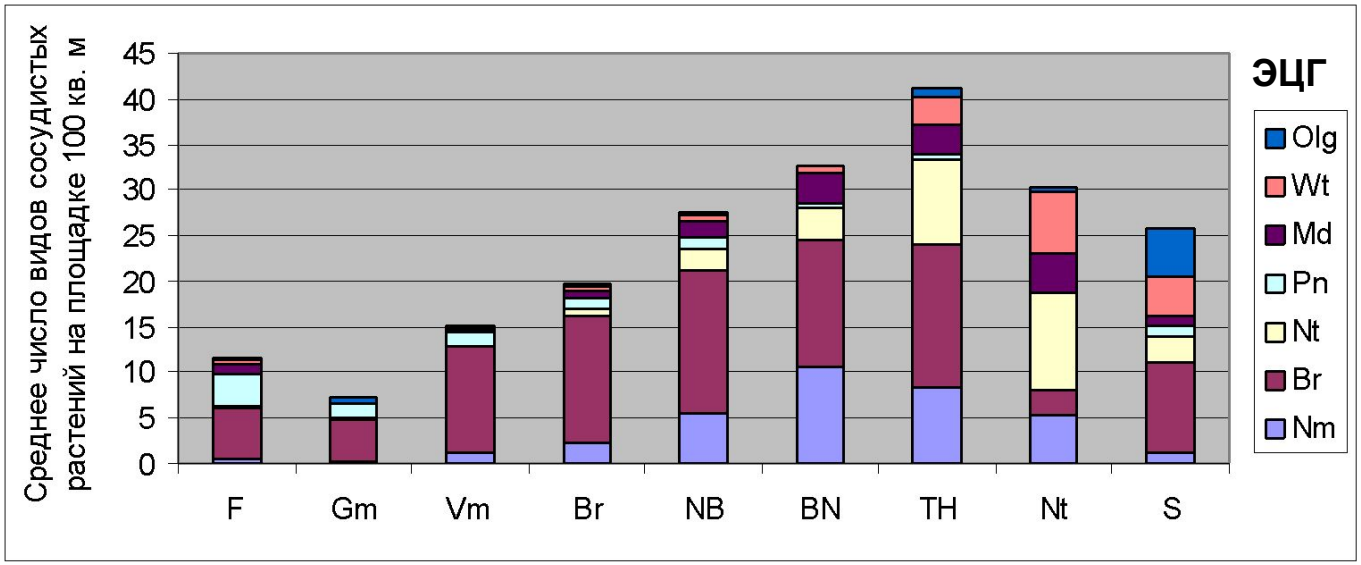
TH

Î ñü 1
r = -.719 tau = -.639
Î ñü 2
r = .143 tau = .100



Ecological-coenotic structure of forest types



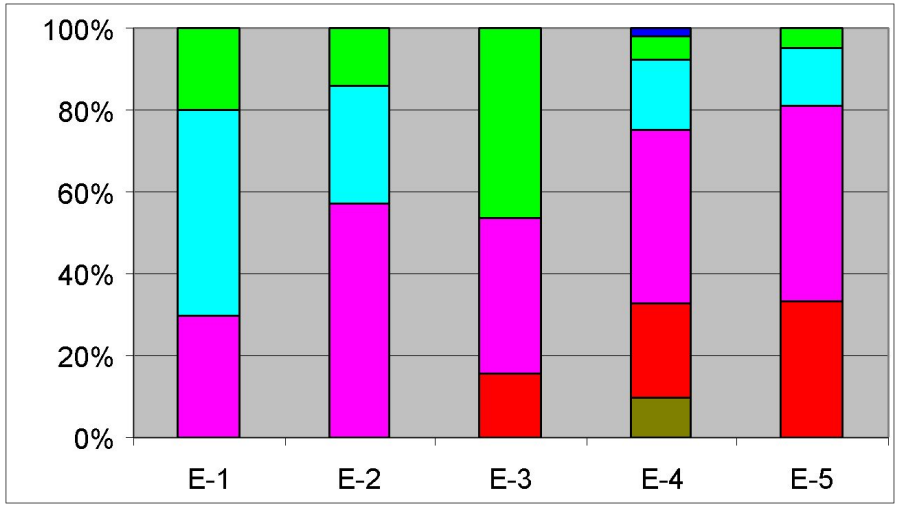


Jaccard's similarity coefficient for forest types

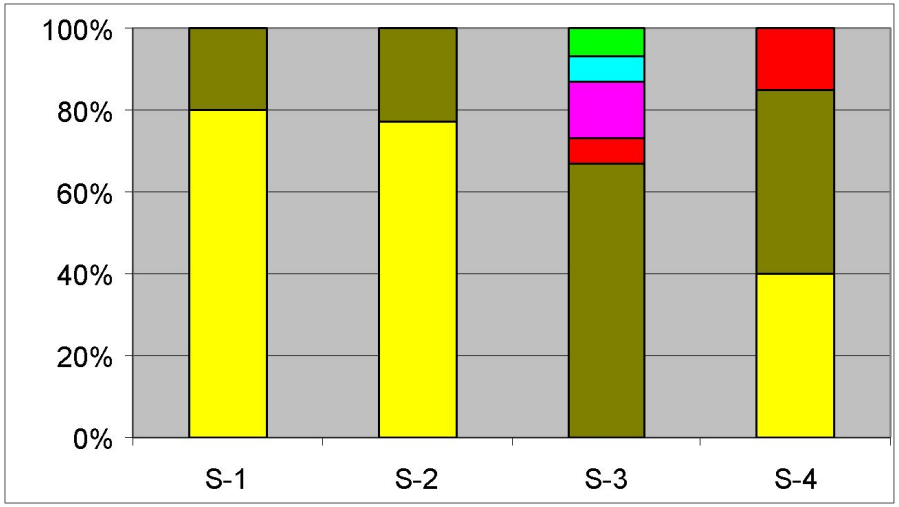
	F	GM	Vm	Br	NB	BN	TH	Nt	S
F	1	0.4	0.3	0.3	0.3	0.2	0.2	0.1	0.2
GM		1	**0.5**	0.3	0.2	0.2	0.2	0.1	0.3
Vm			1	**0.5**	0.4	0.3	0.3	0.1	0.3
Br				1	**0.5**	0.4	0.4	0.2	0.3
NB					1	**0.6**	**0.6**	0.3	0.3
BN						1	**0.6**	0.3	0.3
TH							1	0.3	0.3
Nt								1	0.2
S									1

Forest types and succession variants from the 1st to 5th succession stage

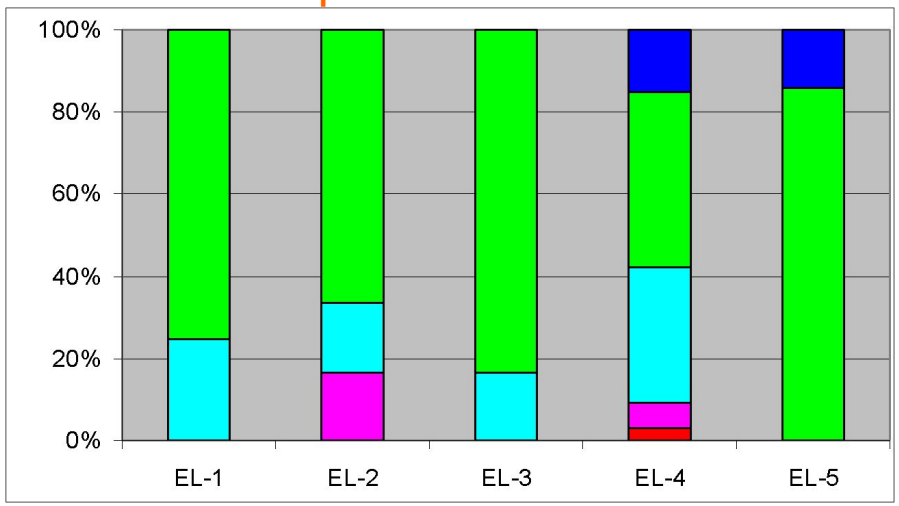
Spruce forest



Pine forest



Mixed spruce and lime forest



Forest types groups:

- H - высокотравная
- BN - бореально-неморальная
- NB - неморально-бореальная
- Br - бореальная
- Vm - черничная
- Gm - зеленомошная
- F - боровая

Generalization of local vegetation diversity indices

- путем непосредственного совмещения локальных точечных данных с картами лесонасаждений при использовании баз данных лесотаксационных описаний
- путем интерполяции локальных точечных значений характеристик разнообразия с использованием данных дистанционного зондирования и цифровой модели рельефа