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HABITAT DIVERSITY AND SPONTANEOUS SUCCESSION OF FOREST WETLANDS IN BIAŁOWIEŻA PRIMEVAL FOREST

Orłówka river

Study aim

Evaluation of the direction and nature of the changes ongoing in a phytocoenosis of forest wetland sites

Ribeso nigri-Alnetum – alder swamp forest in winter

Study scope

- ✓ Types of plant communities:
  Ledo-Sphagnetum magellanici Sukopp 1929
  Vaccinio uliginosi-Pinetum Kleist 1929
  Sphagno-Betuletum pubescentis Sokoł. 1985
  Sphagno girgensohnii-Piceetum Polak. 1962
  Thelypterido-Betuletum pubescentis Czerw. 1972
  Ribeso nigri-Alnetum Sol.-Górn. 1975
  Circaeo-Alnetum Oberd. 1953
- ✓ Resampling of relevés recorded in the 1960s-1970s
- ✓ In *Ledo-Sphagnetum magellanici and Sphagno girgensohnii-Piceetum* community the breast high diameter of tree species were measured
- ✓ Climatic conditions analysis; mean annual precipitation and temperature
- ✓ Ground water table measurement (1985-2004)
- ✓ Soil characteristics: pH, C, N, Al, Ca, Fe, K, Cu,Mg, Mn,Na,Ni,P,Pb,S, Zn content, base saturation, soil texture, peat thickness

Sphagno-Betuletum pubescentis – sphagno-pine bog forest on transitional moor

Study area

Basic data about Białowieża Forest (Faliński, 1986)

- Location: 52º 43´N, 23º50´E

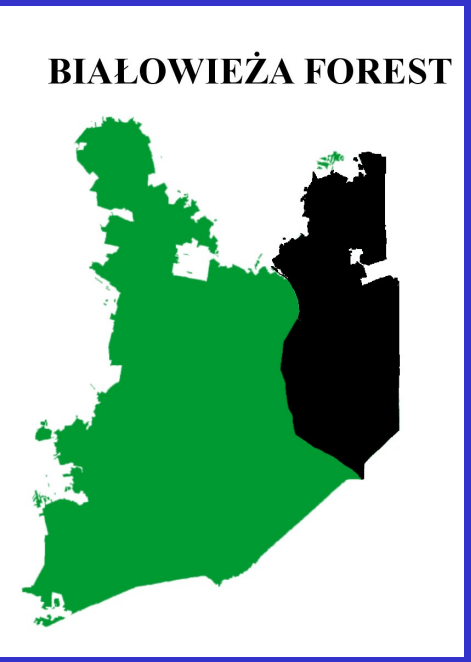
- Area
  Total surface of Białowieża Forest: 1300 km^2
  In Poland: 580 km^2
  Strict Reserve of BNP: 47 km^2

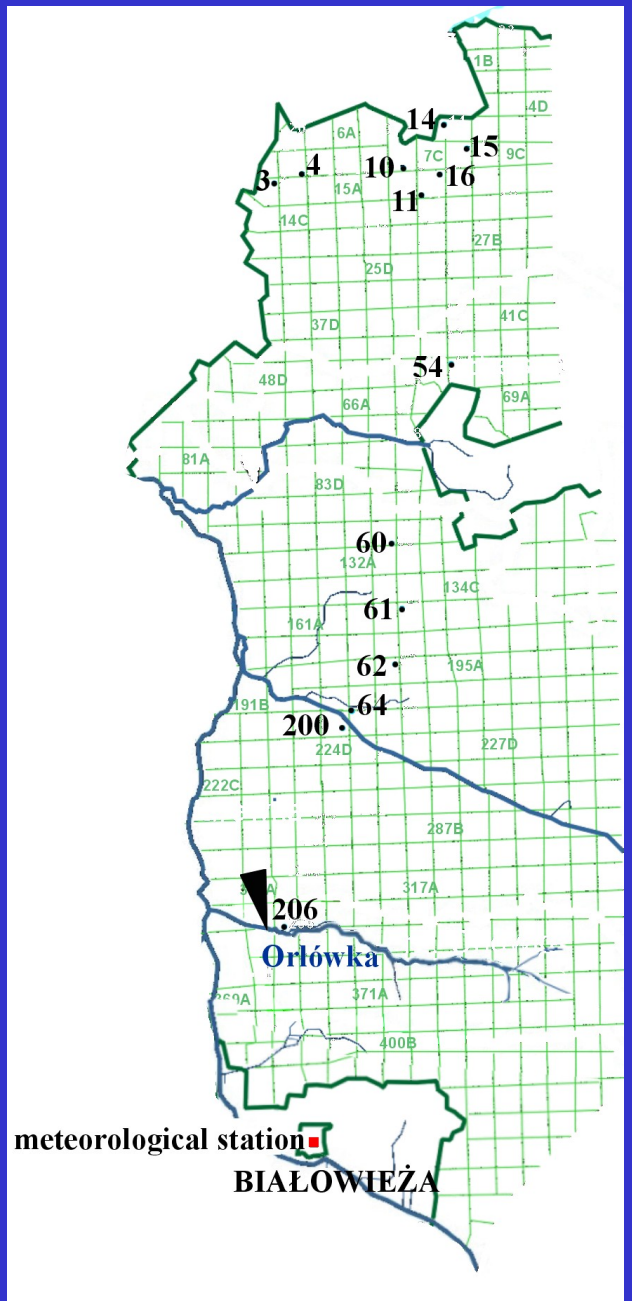
- Climate
  Yearly rainfall: 641 mm
  Mean temperature: year 6.8 ºC
  January -4.7 ºC
  July 17.8 ºC
  Vegetation season: 210 days

- Habitats
  Total broadleaved forests: 52,2 %
  Fresh forests: 53,8 %
  Wet forests : 28,5 %,
  Swamp forests: 17,7 %
  Forest and scrub associations: 16

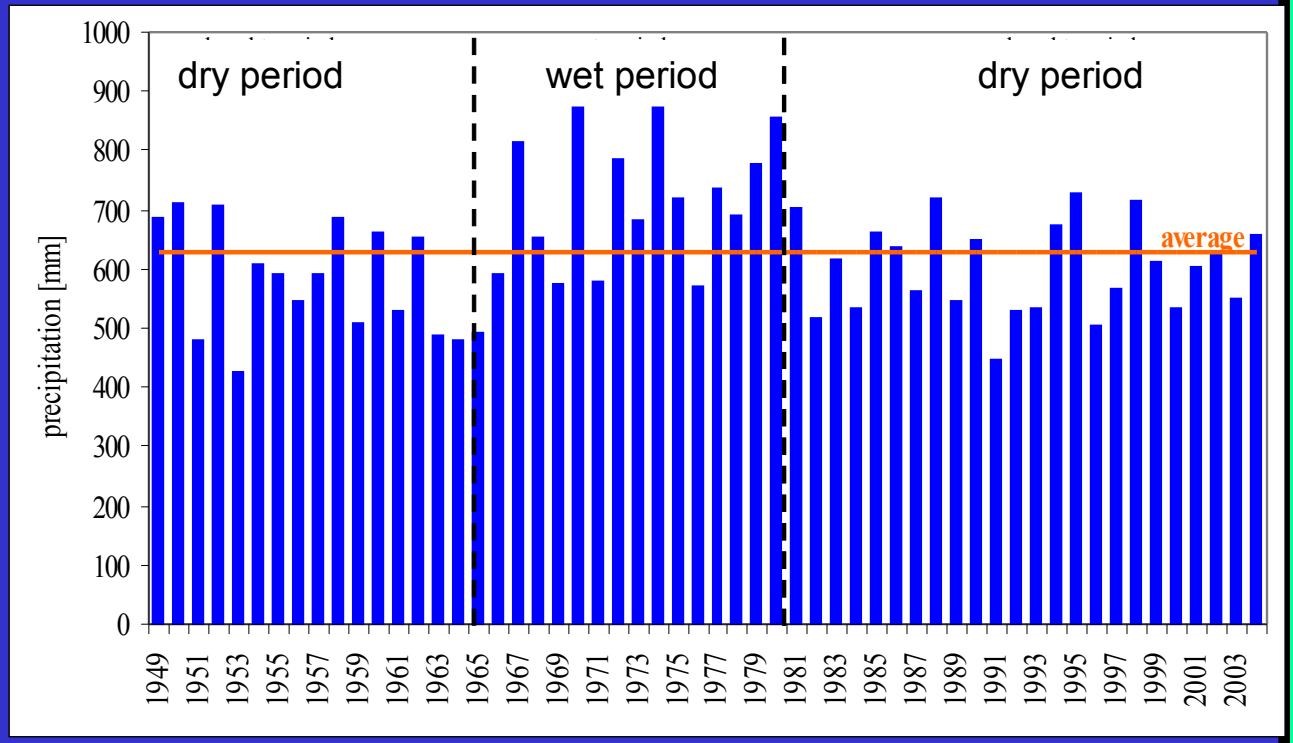
Thelypterido-Betuletum pubescentis - pine swamp forest

Distribution of groundwater measuring points in swamp forest site



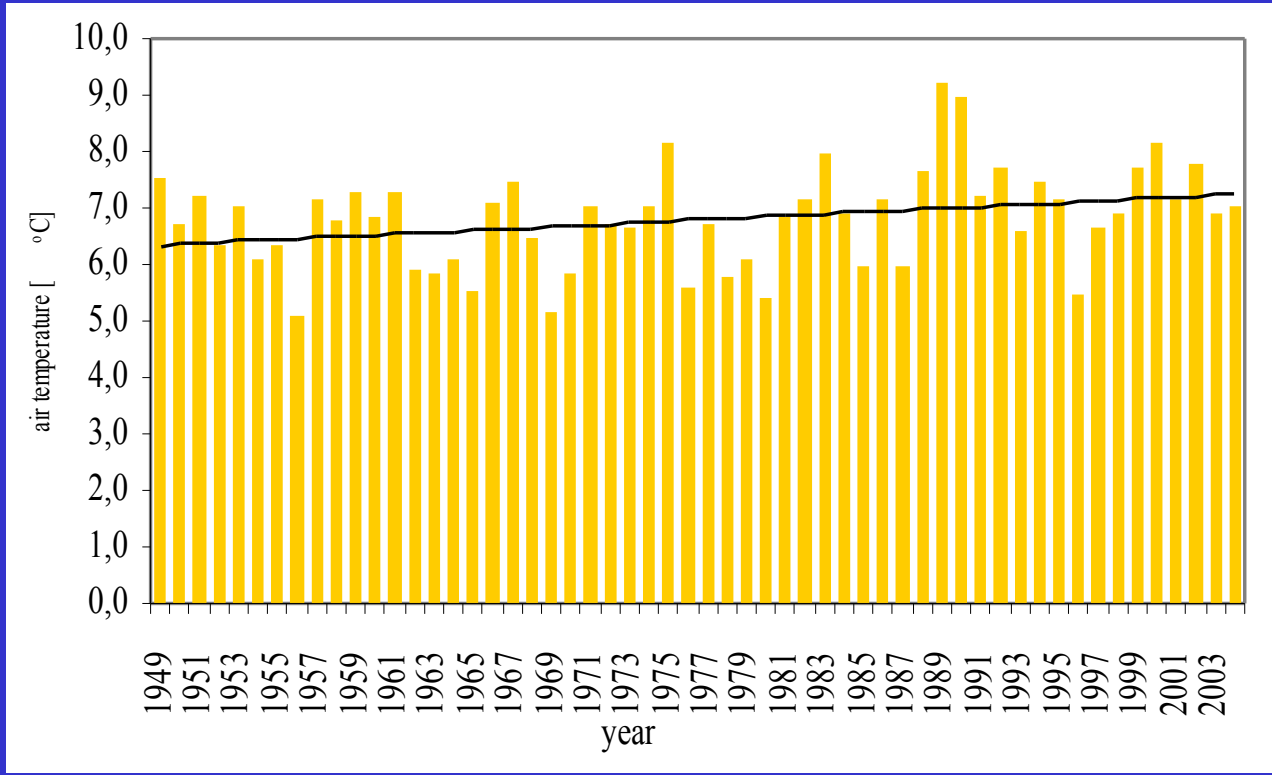


Precipitation measured in Białowieża meteorological station in the period 1949-2004



Circaeo-Alnetum – ash-alder riparian forest close by Orłówka river in spring

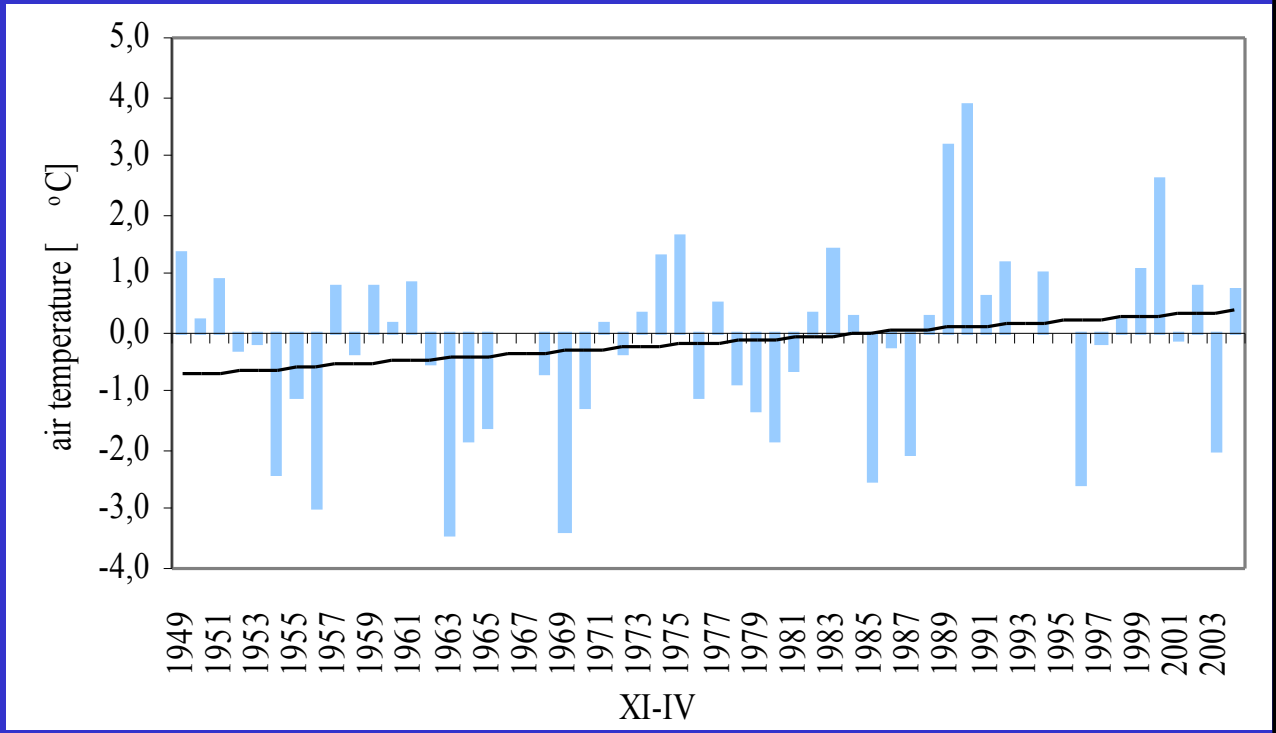
Mean annual air temperature in the period 1949 - 2004



Gagea lutea – riparian forest species

Plagiomnium undulatum - riparian forest moss

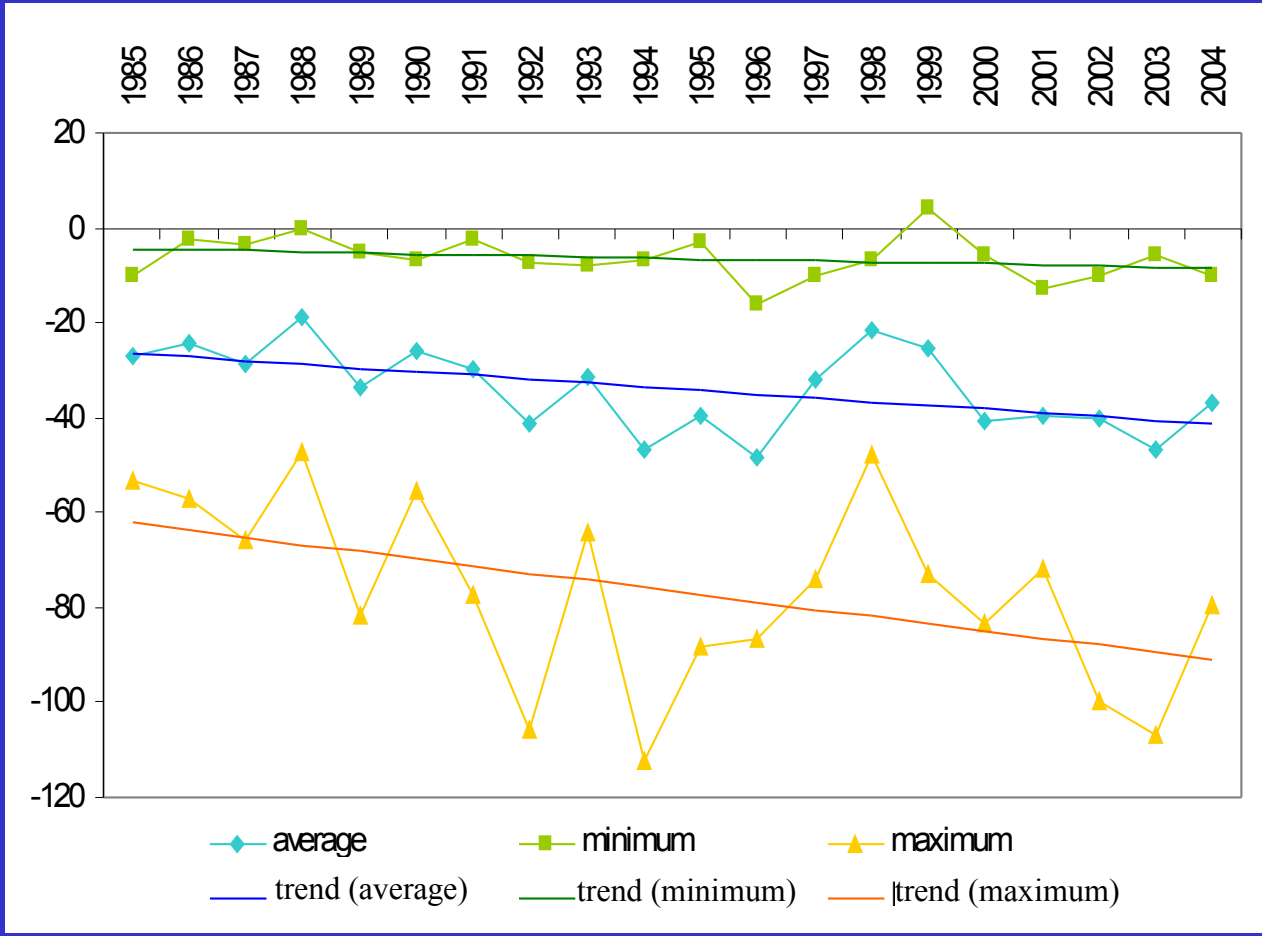
Mean air temperature in the winter season (1949 – 2004)



Sphagnum squarrosum – characteristic peat moss of alder swamp forest

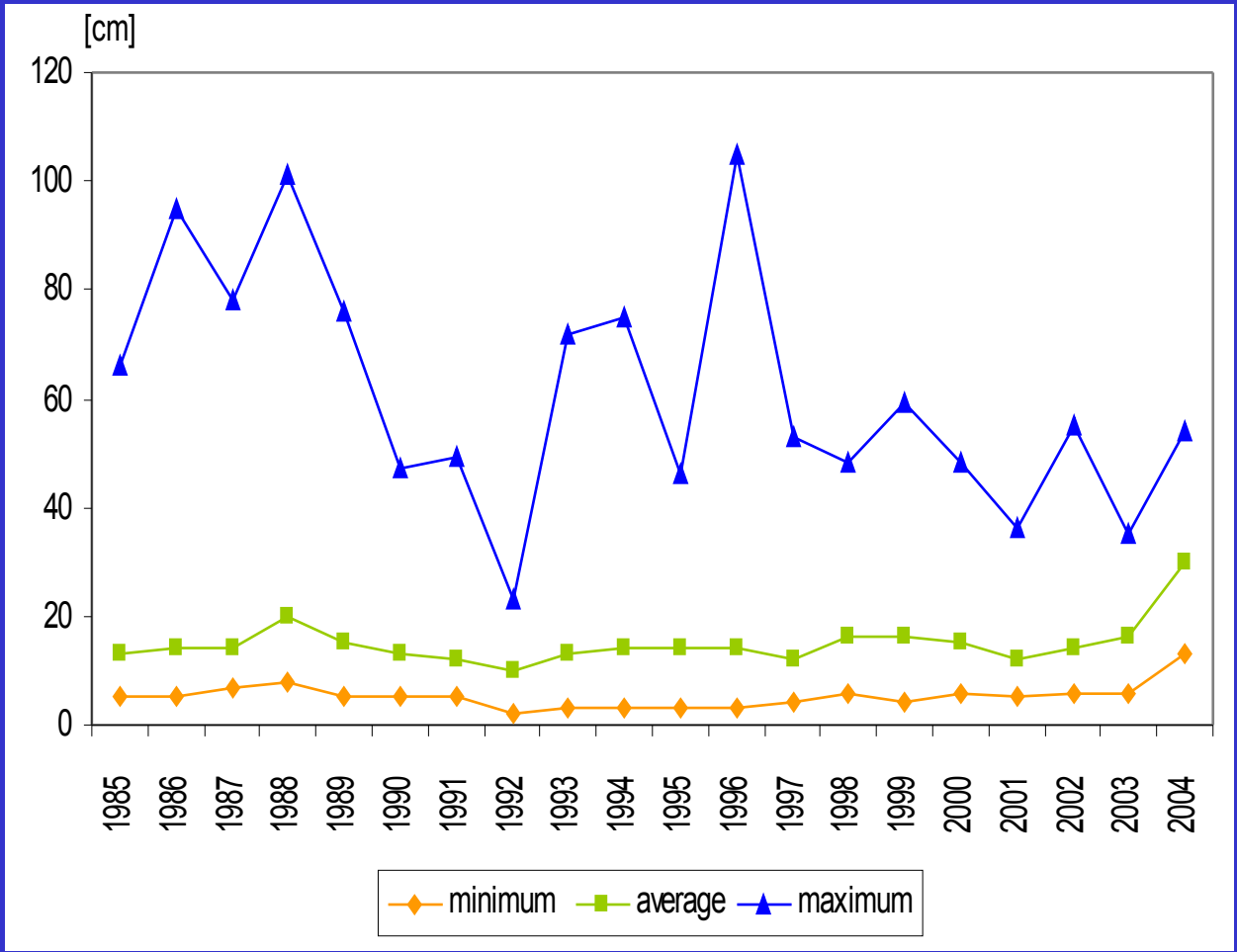
Climacium dendroides –alder swamp forest moss

Ground water table changes in *Ribeso nigri-Alnetum* and *Circaeo-Alnetum* site



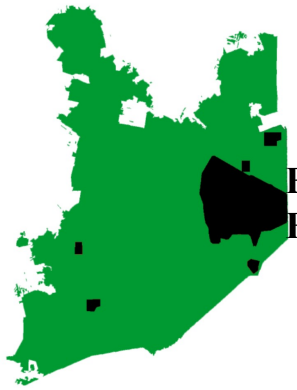
Ribeso-nigri Alnetum - alder swamp forest

Characteristic of water level in Orłówka river

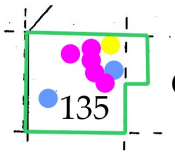


Riparian forest and Orłówka river

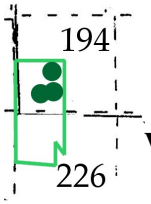
Distribution of relevés in Białowieża Forest



BIAŁOWIEŻA FOREST



GŁUSZEC



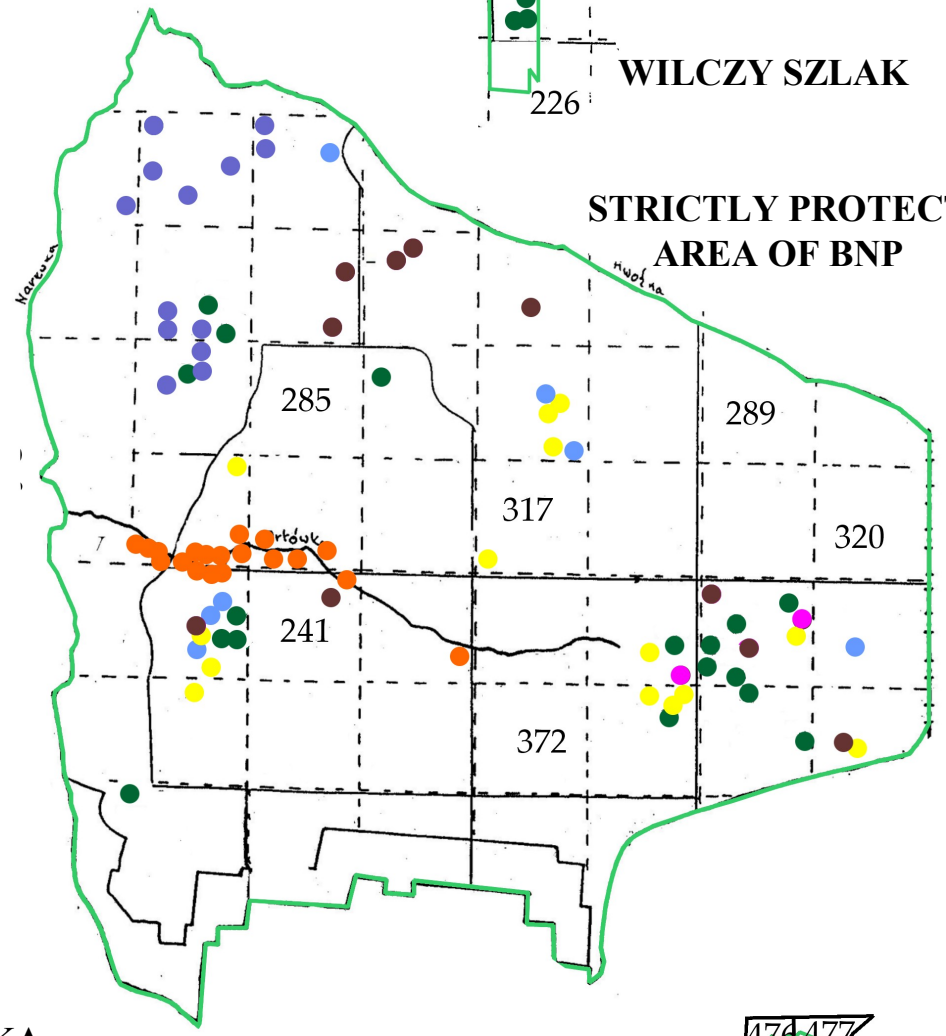
WILCZY SZLAK

Types of forest plant communities

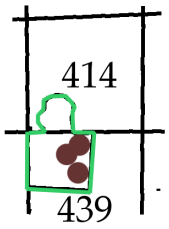
- Ribeso nigri - Alnetum
- Thelypterido - Betuletum pubescentis
- Ledo-Sphagnetum magellanici
- Sphagno - Betuletum pubescentis
- Sphagno girgensohnii - Piceetum
- Vaccinio uliginosi - Pinetum
- Circaeo - Alnetum

reserve border

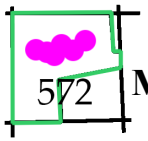
340 compartment number



STRICTLY PROTECTED AREA OF BNP



GŁĘBOKI KĄT



MICHNÓWKA

WYSOKIE BAGNO

Changes of moisture and nitrogen indicator value

plant community	number of relevés	study year/ change	moisture indicator value	nitrogen indicator value
Ledo-Sphagnetum magellanici	13	1960	4.69	1.82
		2004	4.64	1.86
		2004-1960	-0.05	-0.04
Vaccinio uliginosi-Pinetum	9	1960	4.31	1.87
		2004	4.30	1.97
		2004-1960	-0.01	0.10*
Sphagno girgensohnii-Piceetum	18	1960	3.65	2.84
		2004	3.65	3.08
		2004-1960	0.00	0.24*
Sphagno-Betuletum pubescentis	15	1960	4.41	2.76
		2004	4.21	2.88
		2004-1960	-0.20*	0.12*
Thelypterido-Betuletum pubescentis	13	1960	4.47	3.18
		2004	4.37	3.32
		2004-1960	-0.10*	0.14*

* significant differences refer to Wilcoxon signed rank test with $P < 0.05$

Hottonia palustris (water) - declining species in alder swamp forest

Maianthemum bifolium - (fresh soil) increasing species

Changes of moisture and nitrogen indicator value cont.

plant community	number of relevés	study year/ change	moisture indicator value	nitrogen indicator value
Ribeso nigri-Alnetum	20	1960	4.50	3.45
		2004	4.41	3.47
		2004-1960	-0.09*	0.02
Circaeo-Alnetum	19	1960	3.81	3.84
		2004	3.81	3.83
		2004-1960	0.00	0.01

* significant differences refer to Wilcoxon signed rank test with $P < 0.05$

Comarum palustre - common species of swamp forest

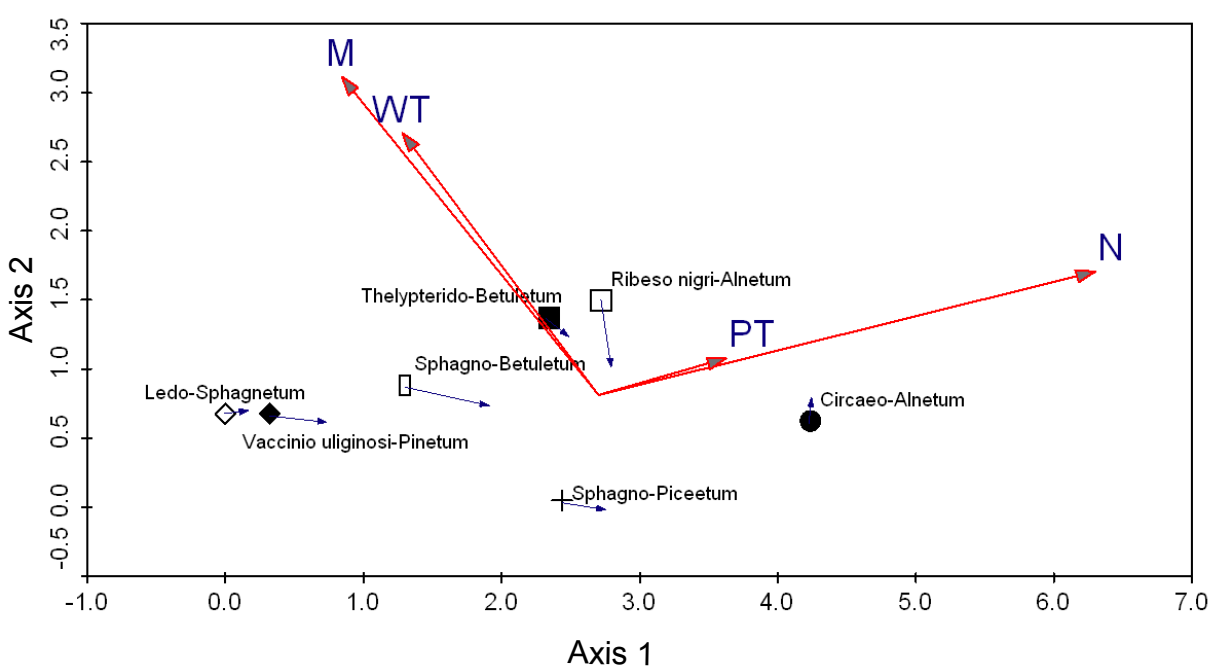
Trichocolea tomentella – rare moos of forest wetlands

Mean value of some soil characteristics

Plant community	depth of peat (cm)	ground water table (cm)	pH-KCL	C/N	base saturation (%)
Vaccnio uliginosi – Pinetum	71	-24	3,56	34,45	28,07
Ledo-Sphagnetum magellanici	80	-15	3,50	29,62	34,42
Sphagno girgensohnii-Piceetum	101	-25	4,58	19,07	85,59
Sphagno - Betuletum pubescentis	61	-19	4,31	19,58	77,74
Thrlypterido.-Betuletum pubescentis	182	5	5,37	16,52	95,46
Ribeso nigri – Alnetum	54	9	5,43	16,39	94,34
Circaeo – Alnetum	124	-40	5,92	17,78	97,91

Profile of raised bog soil

DCA ordination diagram of forest wetlands according to main habitat gradients

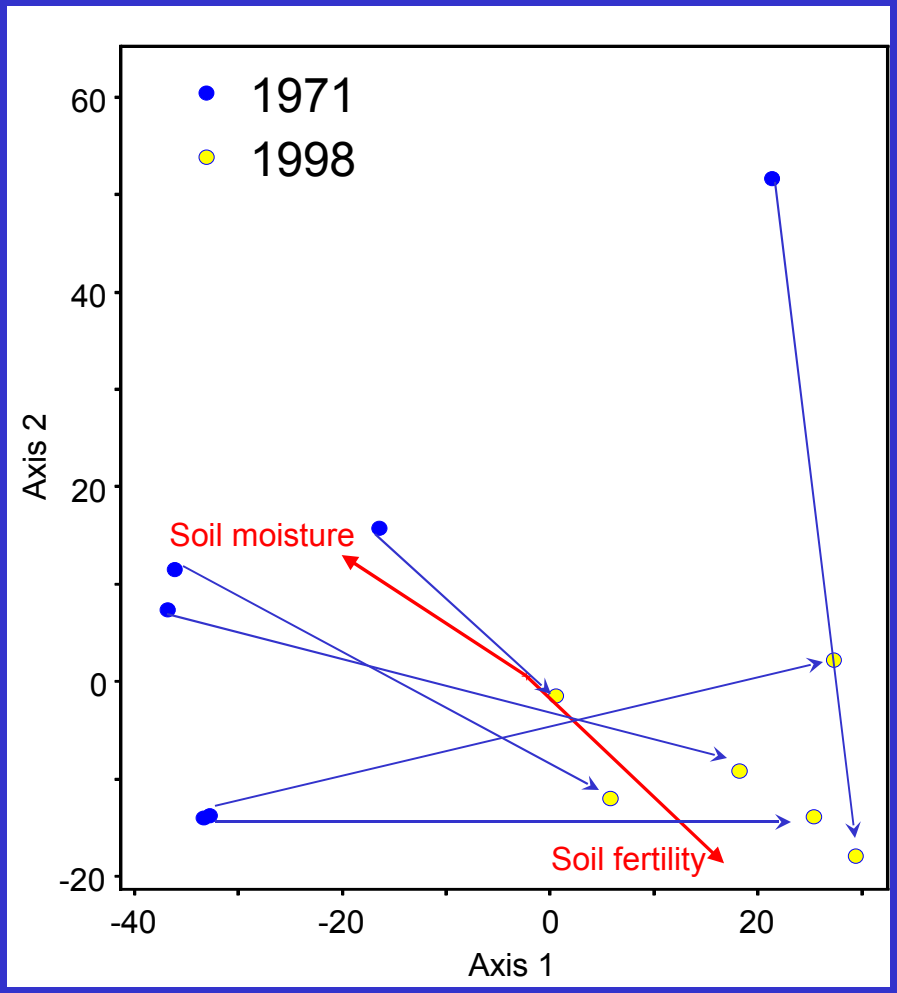


M- soil moisture
N – soil fertility
WT – water table level
PT - peat thickness

Lycopus europaeus - characteristic species of alder swamp forest

Trichocolea tomentella - characteristic liverworts of natural alder swamp forest

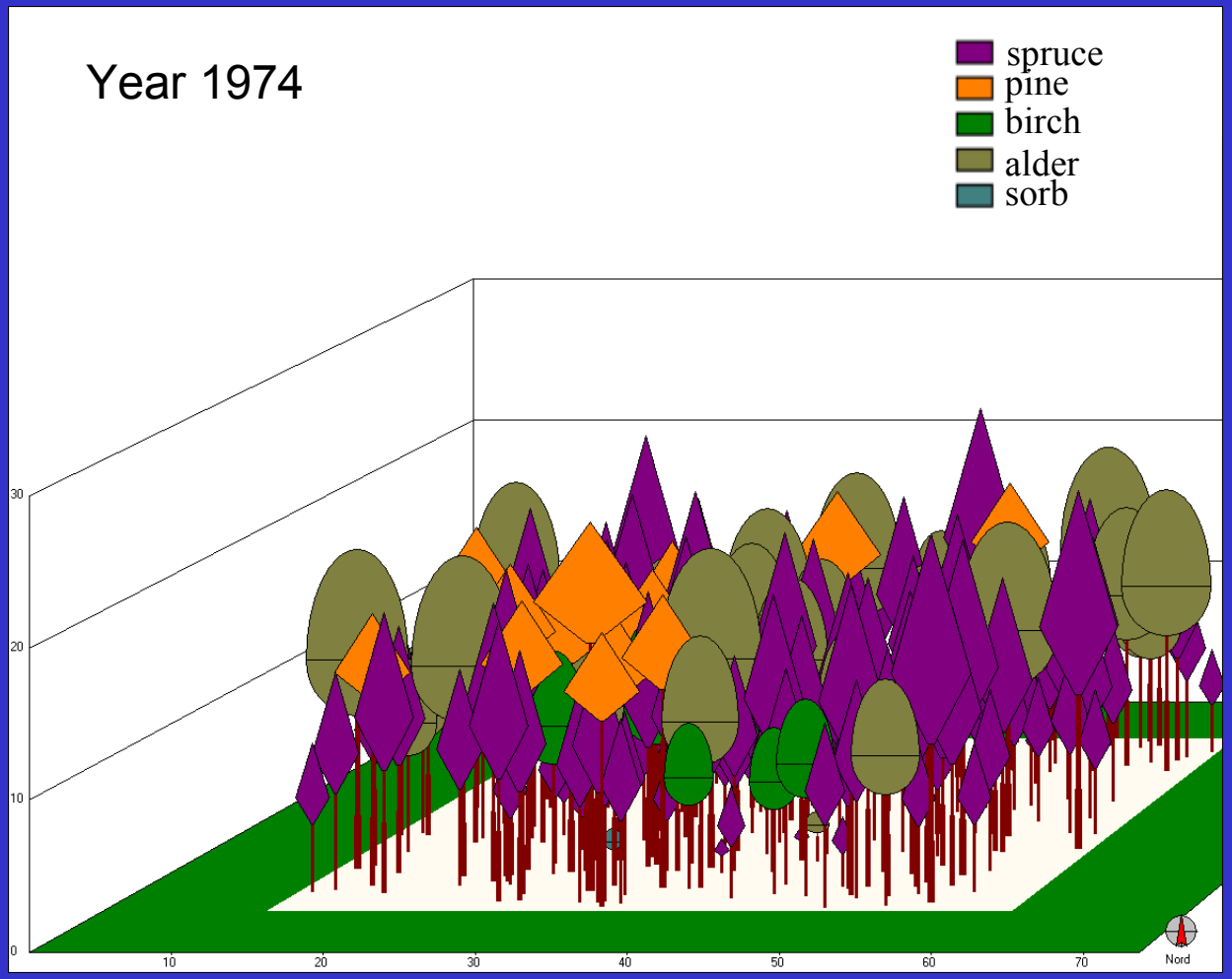
Example diagram (DCA) of 6 relevés in *Ledo-Sphagnetum magellanici* according to main habitat gradients



Andromeda polifolia – raised bog indicator species

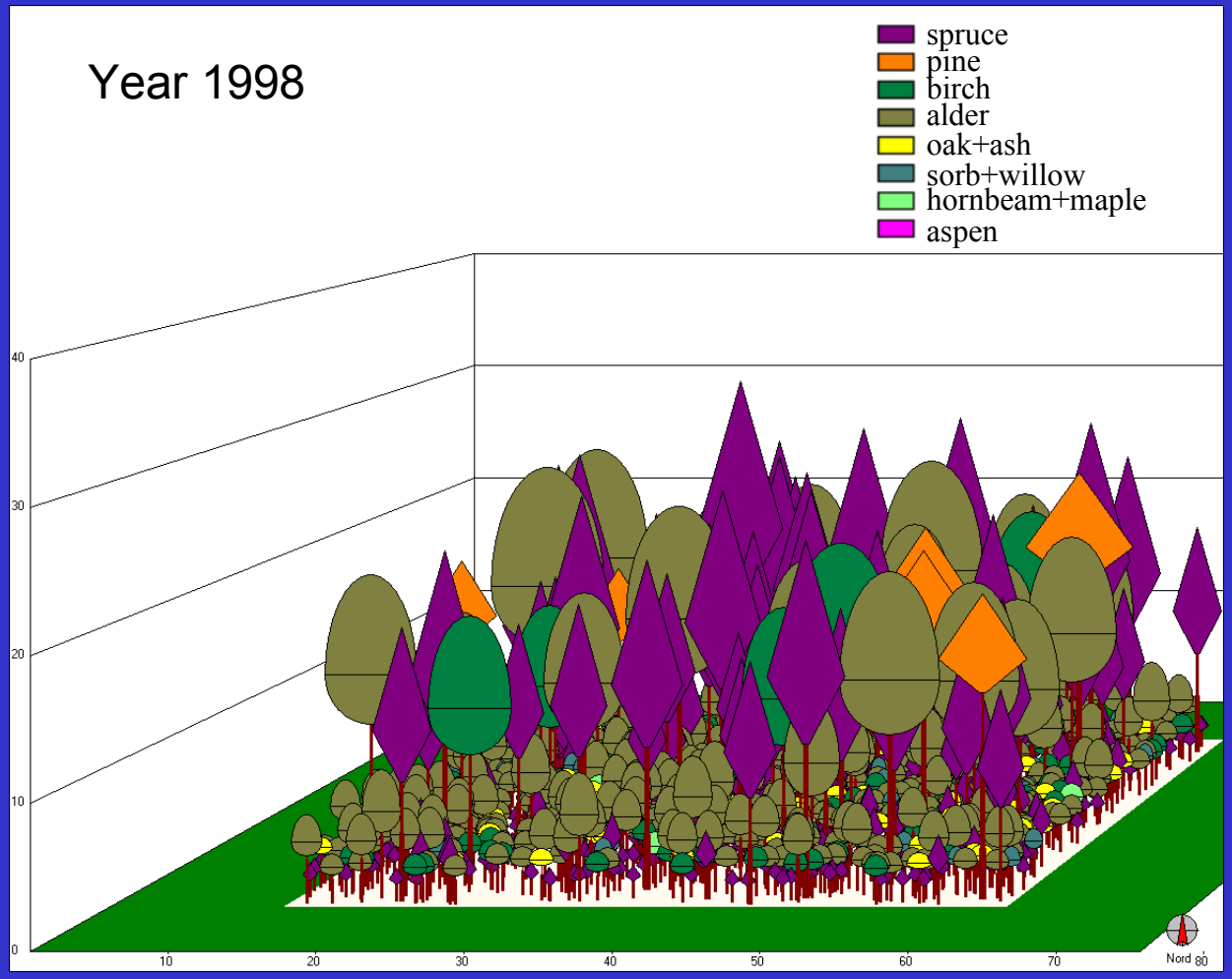
Ledum palustre – declining species in bog forest

Changes of stand in *Sphagno girgensohnii-Piceetum* community
Sample area: 0.25 ha



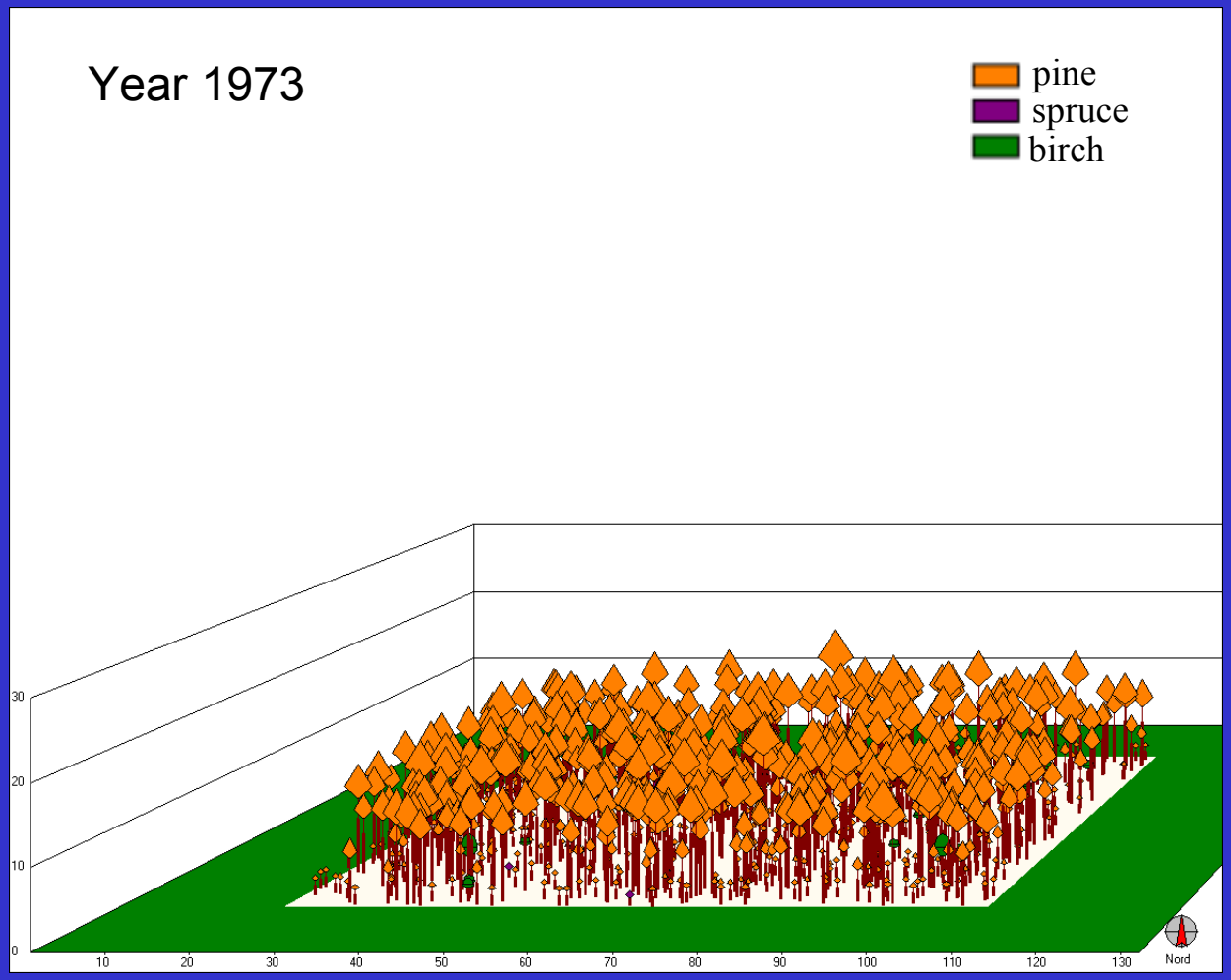
Sphagnum girgensohnii – characteristic species of boreal spruce forest

Changes of stand in *Sphagno girgensohnii-Piceetum* community
Sample area: 0.25 ha



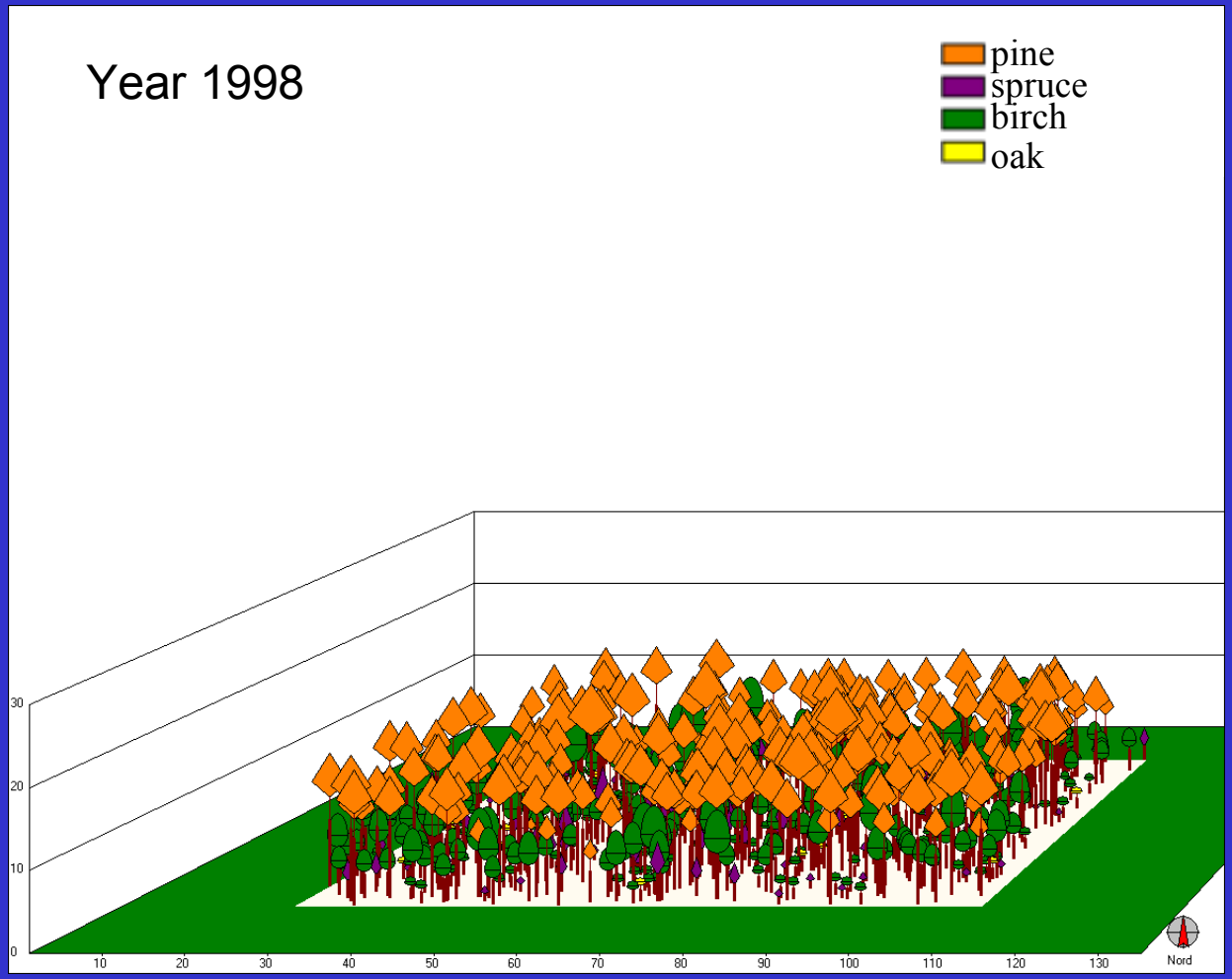
Sphagno girg.–Piceetum – expansion of deciduous species in Głęboki Kąt reserve

Changes of stand in *Ledo-Sphagnetum magellanici* community
Area: 0.75 ha



Ledo-Sphagnetum magellanici - boggy pine forest

Changes of stand in *Ledo-Sphagnetum magellanici* community
Area: 0.75 ha



Sphagnum magellanicum – characteristic species of raised bog

Sphagnum recurvum – dominant species of boggy coniferous forest

Conclusions

The permanent observations (1949-2004) of climatic conditions and groundwater table (1985-2004) in Białowieża Forest show important changes, particularly such as:

- the precipitation, especially in last period, was lower than the many years` average,
- the mean air temperature noted in Białowieża rose by 0.9 °C,
- the ground water table level in forest wetland biotopes became lower 10 cm during 19 years.

These changes had following influence on wetland vegetation and their habitats:

10. The obtained results indicate changes in wetlands vegetation, although those changes were not occurred in every communities in the same level.

Caltha palustris

Conclusions cont.

4. According to the ecological indicator value every sites, besides *Sphagno girgensohnii-Piceetum and Circaeo-Alnetum*, have a lower moisture of soil than they was in the 1960s-1970s.
5. Due to peat oxidation process the soil nitrogen indicator value increased in majority part of habitats,
6. The deciduous species share, especially birch and alder, increased in *Ledo-Sphagnetum magellanici and Sphagno girgensohnii-Piceetum*.

Swamp forest in spring


THANK YOU !