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VEGETATION UNDER THE ... ANTHROPOGENIC IMPACT...
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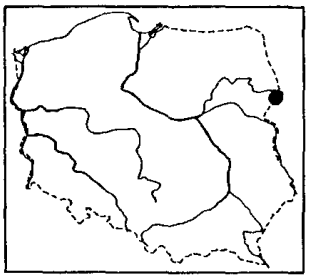
ed. by J.B. FALIŃSKI



VEGETATION UNDER THE DIVERSE ANTHROPOGENIC IMPACT AS OBJECT OF BASIC PHYTOSOCIOLOGICAL MAP

Results of the international cartographical experiment organized in the Białowieża Forest edited by Janusz B. FALIŃSKI

Part Two

CONCEPTIONS AND METHODS OF THE INDIVIDUAL VEGETATION MAPS

Philip JULVE & François GILLET

III. EXPERIENCES OF FRENCH AUTHORS (Map 3)

Summary: This work is the first attempt to use integrated synusial approach for the mapmaking of forests. After recalling the used concepts the authors define the cartographical unit, discuss the used techniques at each stage of mapmaking, also the choices for graphic representation of the actual vegetation colour map at 1:10.000.

Key words: Vegetation mapping; Cartographical experiment; Real vegetation; Forest vegetation; Temperate forests; Man impact on vegetation; Białowieża Forest; Application to integrated synusial approach mapping.

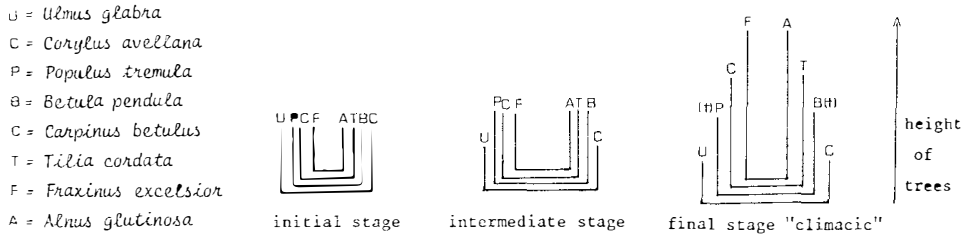
III.1. Conception of the cartographical units

III.1.1. Basic concepts

The main originality of our map is that it is the first application of the integrated synusial approach to mapmaking. As a matter of fact, this new phytosociological method is, according to us, the most suitable because it allows to adjust the choice of the vegetation units to the choice of the map scale, without any loss of information about the phytosociological contents.

According to these conceptions (developed in GILLET 1986), the fundamental functional concrete unit of vegetation is the phytocoenose, which is itself made up of a spatial and temporal organization of different isotropic ecological and structural units called synusiae. A forest phytocoenose, for instance, is composed by different layer (tree, shrub, herb and moss communities) and intralayer (epigeic, epilitic and epiphytic moss communities, mosaics of herbaceous communities determined by soil and light differential factors, etc.) synusiae, bound together by close ecological and dynamical interrelations.

In our conceptual, grounded on the parallelism between the degree of complexity of the studied concrete objects and the integration level of the related abstract units, synusiae are considered as "individus d'association". The association defined



by an original combination of species becomes the basic unit of the classification of the synusiae; the coenassociation defined by an original combination of elementary syntaxa, represents the basic unit of the classification of the phytocoenoses.

The relatively little scale chosen for the present mapmaking work is not appropriate to synusiae mapping, but it is particularly suitable for forest phytocoenoses mapping, the latter being the main purpose of this work. It is the reason why most of our cartographical units are phytocoenoses types (coenassociations), and not associations. Herbaceous coenassociations have been gathered into "phytocoenoses complexes" units, because of theoretical and practical reasons: a precise definition and cartography of these coenassociations should require further investigations in a larger scale. The little clearings (the most of anthropogenic wood cuttings and all natural windfallen woods) are naturally integrated into forest phytocoenoses. However, the greatest of them shall be considered as independant phytocoenoses and separate cartographical units.

A short description of each cartographical vegetation unit is necessary to explain the contents of these new coenotaxa and syntaxa. As far as possible, the correspondence with classicial "forest associations" is given. In a short paragraph are stated the stationary characters. Then, the different main synusiae types occurring in the phytocoenose type are shortly described. A general table, including all our relevés, is given for forest coenassociations, so as to make easier the comparisons of their synusial composition; each elementary syntaxon (or synusiae-type) is illustrated by a floristic "type-relevé" in the text.

III.1.2. Description of the vegetation units*

For each coenassociation is given an example of all types of synusiae (association in our sense) commonly occurring. These types of synusiae are structural sets pointed out by a letter:

T: for tree layer
S: for shrub layer
H: for herb layer
M: for moss communities when they are distinct from herb layer

The abbreviations are used for higher and lower units respectively; as an example:

T sup.: means an arborescent structural set commonly occurring at around 35 meters in this kind of forest
T inf.: means an arborescent structural set occurring around 18 meters high possibly under the precedent one
S sup.: means a shrubby structural set around 6 m high
S inf.: means a scrub structural set around 1.5 m high
H sup.: a megaforb structural set around 0.8 m high
H inf.: a lower herbaceous structural set around 0.1 m high
M sup.: a moss community around 0.03 m high
M inf.: a moss community apllied on the substrate (some millimetres)

in fact structural sets only concern the "set of the present" (see HALLE et al. 1978); we joined them with the "set of the future" (settled by non mature plants of juveniles) resulting in the classical layer concept.

C.U. 1: ***Cirsio oleracei - Fraxinocoenetum excelsioris*** coenass. nov.
Hygrophilous alluvial alder-ash forest (*"Circaeo-Alnetum"*)

Localization - Physiognomy - Ecology:

These hygrophilous forests are settled on wet mineral loam soils on the edges of the rivers, especially in the Orłówka and Łutownia valleys. These exuberant phytocoenoses are generally surrounded by the *Ranunculo cassubici-Fraxinocoenetum*, and can be replaced by the *Carici elongatae-Alnocoenetum* in the peaty depressions where water flows very slowly.

Synusial composition:

The vegetation of these alluvial forests is composed of three ligneous and two herbaceous layer synusiae. Contrary to the *Ranunculo cassubi-*

* In this publication, we keep the Authors' original nomenclature of syntaxa, symbols and text structure. Names of species were revised according to EHRENDORFER (1973).

ci-Fraxinocoenetum, the horizontal variations are here very small and gradual. Only one of the syntaxa which compose this coenassociation can be considered as a good differential: the *Lamio maculati-Impatientetum noli-tangeris*.

T sup.: *Fraxino excelsioris-Alnetum glutinosae* ass. nov. prov.

Among the four constant species of this association (see relevé), *Alnus glutinosa* and *Fraxinus excelsior* are always codominant. The height can reach 40 meters.

Relevé 33c (cov. 70%, height 30 m):
Fraxinus excelsior 33, *Alnus glutinosa* 22, *Quercus robur* 12, *Picea abies* 11.

S. sup.: *Ulmo glabrae-Coryletum avellanae* ass. nov. prov. cf. C.U. 3

S. inf.: *Ribetum rubro-nigri* ass. nov. prov.

This hygrophilous, nitrophilous and hemisciaphilous community is well developed in these alluvial alder-ash forests. Constant and codominant species are *Ribes nigrum, R. rubrum, Viburnum opulus, Euonymus europaea, Corylus avellana* and *Prunus padus*.

Relevé 64 (cov. 40%. height 1.5 m):
Ribes nigrum 22, *Ribes rubrum* 12, *Frangula alnus* 11, *Viburnum opulus* 12, *Euonymus europaea* +, *Fraxinus excelsior* (juv.) 22, *Carpinus betulus* (juv.) +, *Acer platanoides* (juv.) +.

H sup.: *Lamio maculati-Impatientetum noli-tangeris* ass. nov. prov.

Physiognomically very close to the *Stachyo sylvatici-Impatientetum* (cf. C.U. 3), this megaforb community is covering here all the area of the field layer. The dominant species are *Impatiens noli-tangere* and *Urtica dioica*. The positive differential species of this syntaxon towards the latter are *Lamium maculatum* (constant), *Filipendula ulmaria* ssp. *denudata, Galium aparine, Cirsium oleraceum, Chaerophyllum hirsutum* ssp. *cicutaria* and the negative differential species are very numerous (*Stachys sylvatica, Dryopteris filix-mas, Rubus idaeus, Festuca gigantea*, etc.).

Relevé 16b (cov. 100%, height 1 m):
Impatiens noli-tangere 34, *Urtica dioica* 33, *Lamium maculatum* 11, *Galium aparine* +, *Aegopodium podagraria* +; *Galium elongatum* +.

H inf.: *Cardamino amarae-Chrysosplenietum alternifolii* MAAS 1959

This microforb layer synusia is developed underneath the *Lamio maculati-Impatientetum* megaforb synusia. Its development is also more precocious (architectural and phenological shift). Constant and codominant species are *Stellaria nemorum, Chrysosplenium alternifolium, Cardamine amara*.

Relevé 55c (cov. 80%, height 0.1 m):
Chrysosplenium alternifolium 33, *Geranium robertianum* 33, *Stellaria nemorum* 23, *Cardamine amara* 12, *Circaea alpina* +.

C.U. 2: ***Ranunculo cassubici-Fraxinocoenetum excelsioris*** coenass. nov.
Hygrophilous neutrophilous linden-ash forest (*"Tilio-Carpinetum"* p.p.)

Localization - Physiognomy - Ecology.

In the primeval part of the Forest (National Park), these phytocoenoses are generally limited to a narrow fringe between the alluvial forests of the *Cirsio oleracei-Fraxinocoenetum* and the hygroclinous forests of the *Carici remotae-Piceocoenetum*. In the exploited part of the Forest, they are more largely distributed and often in mosaic with the latter, probably because of anthropogenic disturbances. In the two cases, the horizontal heterogeneity is relatively important, especially in the inferior layers, because of microtopographic and edaphic variations.

Synusial composition:

Even if variable, the synusial composition of the *Ranunculo cassubici-Fraxinocoenetum* is well characterized by the coexistence of two arborescent synusiae-types (the *Carpino-Tilietum cordatae* being in position of structural subordination to the *Fraxino-Alnetum glutinosae*), and by two differential field syntaxa (the *Hepatico-Ranunculetum ranunculetosum cassubici* and the *Cardamino flexuosae-Rumicetum sanguinei*).

T sup.: *Fraxino excelsioris-Alnetum glutinosae* ass. nov. prov. cf. C.U. 1

T inf.: *Carpino-betuli-Tilietum cordatae* ass. nov. prov. cf. C.U. 3

S sup.: *Ulmo glabrae-Coryletum avellanae* ass. nov. prov.

This heliophilous syntaxon often contains here *Ulmus minor* (cf. C.U. 3)

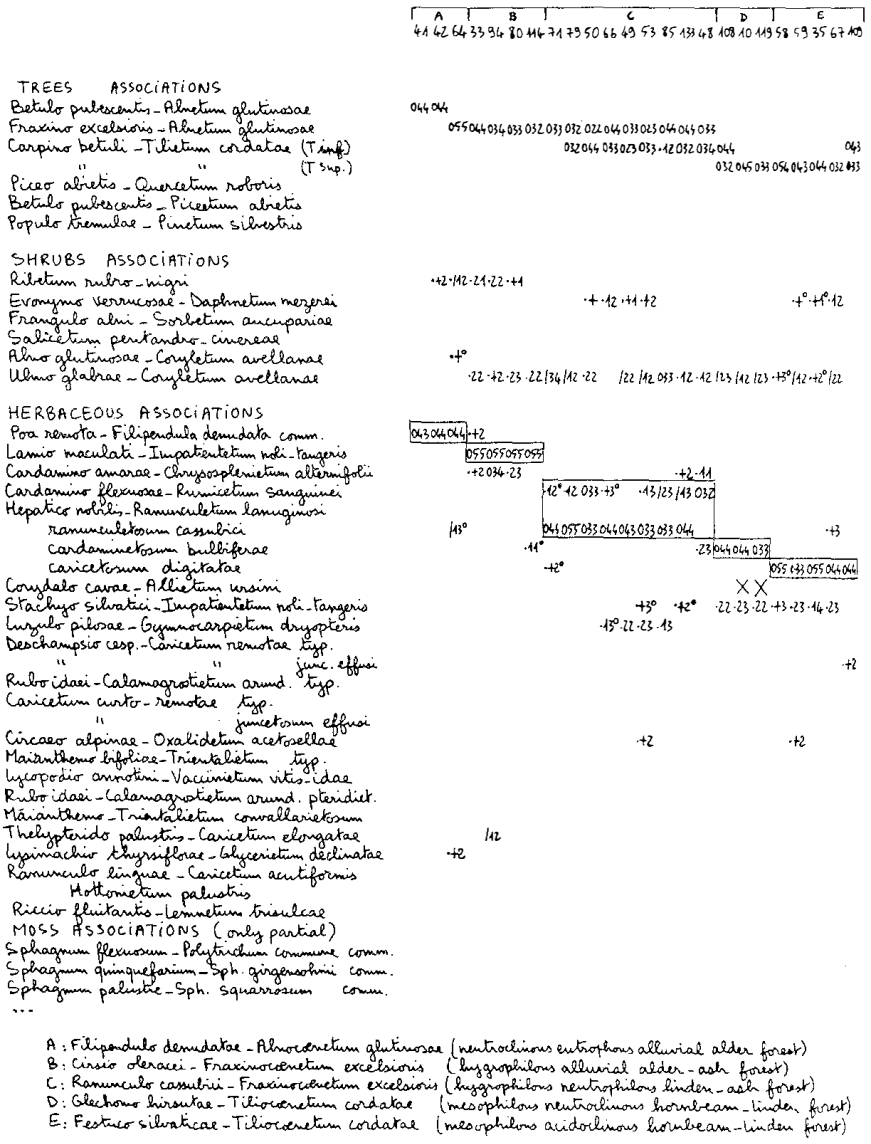
H inf.: *Hepatico trilobae-Ranunculetum lanuginosi ranunculetosum cassubici* subass. nov. prov.

This syntaxon is the more hygrophilous of the three subassociations of the *Hepatico-Ranunculetum*. Its differential species are *Ranunculus cassubicus, Brachypodium sylvaticum, Paris quadrifolia, Carex remota, Crepis paludosa, Ajuga reptans*. It appears a little bit less nitrophilous than the subassociation *cardaminetosum bulbiferae*. It is dominated by *Lamiastrum galeobdolon ssp. galeobdolon, Asarum europaeum* (optimum here), *Ranunculus lanuginosus, Ranunculus cassubicus, Carex sylvatica, Hepatica nobilis, Pulmonaria obscura, etc.*

Relevé 71a (cov. 80%, height 0.2 m):
Ranunculus cassubicus 22, *Ranunculus lanuginosus* 22, *Pulmonaria obscura* 22, *Lamiastrum gale-*

Tab. 1

Some coenassociations of the Białowieża Forest (north-east Poland)

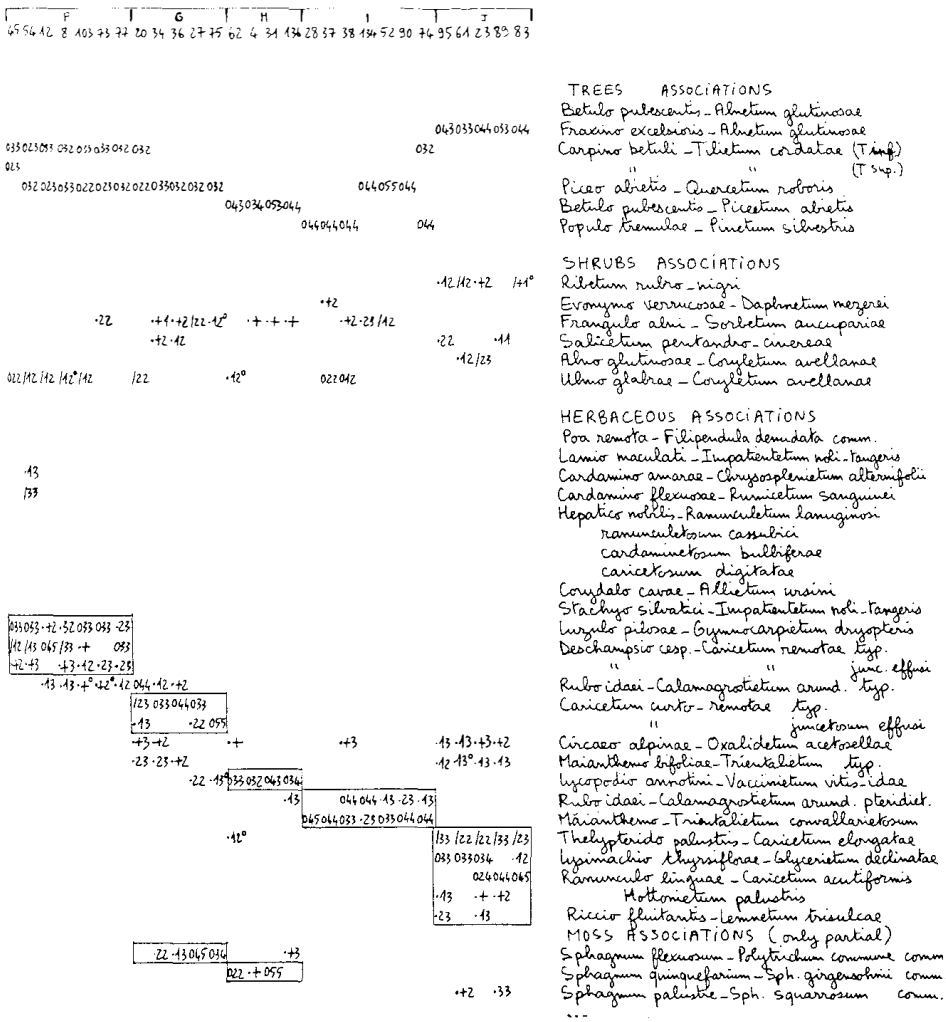


A: Filipendulo denudatae - Alnocarnetum glutinosae (neutrocline eutrophous alluvial alder forest)
B: Cirsio oleracei - Fraxinocarnetum excelsioris (hygrophilous alluvial alder - ash forest)
C: Ranunculo cassubici - Fraxinocarnetum excelsioris (hygrophilous neutrophilous linden - ash forest)
D: Glechomo hirsutae - Tiliocarnetum cordatae (mesophilous neutrocline hornbeam - linden forest)
E: Festuco silvaticae - Tiliocarnetum cordatae (mesophilous acidocline hornbeam - linden forest)

obdolon ssp. *galeobdolon* 22, *Asarum europaeum* 13, *Aegopodium podagraria* 12, *Carex sylvatica* 12, *Festuca gigantea* 12, *Crepis paludosa* 11, *Carex remota* +2, *Stellaria holostea* +2, *Ajuga reptans* +2, *Impatiens noli-tangere* +2, *Hepatica nobilis* +, *Dryopteris filix-mas* +, *Glechoma hirsuta* +, *Equisetum palustre* +, *Stellaria nemorum* +, *Anemone nemorosa* +, *Lathyrus vernus* +, *Viola reichenbachiana* +, *Chaerophyllum hirsutum* ssp. *cicutaria* +, *Paris quadrifolia* +, *Filipendula ulmaria* ssp. *denudata* +.

H inf.: *Cardamino flexuosae-Rumicetum sanguinei* ass. nov. prov.

This pioneer association occurs in the muddy depressions, often trodden and turned up by wild



F: Carici remotae - Piceocoenetum abietis (acidocliнous spruce-oak forest)
G: Carici curtae - Querco-coenetum roboris (hygrophilous acidophilous spruce-oak forest)
H: Sphagno girgensohnii - Piceocoenetum abietis (peaty spruce forest)
I: Trientalio europaei - Pinocoenetum silvestris (xerocliнous acidophilous pine-forest)
J: Carici elongatae - Alnocoenetum glutinosae (neutrocliнous peaty alder forest)

boars. The proportion of bare soil is always important. The more significant species are *Rumex sanguineus*, *Cardamine flexuosa*, *Ranunculus repens* and *Caltha palustris*.

Relevé 88a (cov. 20%, height 0.15 m):

Ranunculus repens 12, *Caltha palustris* 12, *Rumex sanguineus* 11, *Poa trivialis* 11°, *Cardamine flexuosa* +2, *Mentha arvensis* +2, *Veronica beccabunga* +2, *Ajuga reptans* +, *Moehringia trinervia* +, *Carex remota* +, *Galium palustre* +, *Chrysosplenium alternifolium* +, *Cardamine amara* +, *Ranunculus lanuginosus* +, *Ranunculus cassubicus* +.

C.U. 3: ***Glechomo hirsutae-Tiliocoenetum cordatae*** coenass. nov.
Mesophilous neutroclinous hornbeam--linden-forest (*"Tilio-Carpinetum"* p.p.)

Localization - Physiognomy - Ecology:

These forest phytocoenoses cover a large part of the studied area. The arborescent layer is relatively close and the saltation windfallen woods are very rare, so that the pedestrian exploration is here very easy! These beautiful forests are settled on fresh clay soils. The main contacts occur with the *Carici remotae-Piceocoenetum* and with the *Festuco sylvaticae-Tiliocoenetum.*

Synusial composition:

Statistically homogeneous, the synusial composition, very close to the *Festuco sylvaticae-Tiliocoenetum*, is differentiated by the constancy of the subassociation *cardaminetosum bulbiferae* of the *Hepatico trilobae-Ranunculetum lanuginosi*, and probably also by the individualization of a spring herbaceous synusia with *Corydalis cava, Allium ursinum, Isopyrum thalictroides*, etc. (these species have almost completely disappeared when we did our relevés).

T sup.: *Carpino betuli-Tilietum cordatae* ass. nov. prov.

This association is here at its optimal development. The mean height of the synusia often exceeds 30 metres. *Carpinus betulus* and *Tilia cordata* are constant and codominant. Other constant species are *Acer platanoides* and *Picea abies, Quercus robur* and *Fraxinus excelsior* have a lower frequency.

Relevé 1b (cov. 80%, height 30 m):
Tilia cordata 23, *Acer platanoides* 23, *Fraxinus excelsior* 23, *Picea abies* 22, *Carpinus betulus* 21.

S sup.: *Ulmo glabrae-Coryletum avellanae* ass. nov. prov.

This community appears round the clearings of the forest, where in ensures the healing of the canopy. The constant and codominant species are *Corylus avellana, Carpinus betulus* and *Ulmus glabra.*

Relevé 1 c (cov. 30%, height 6 m):
Corylus avellana 22, *Ulmus glabra* 22, *Tilia cordata* 12, *Carpinus betulus* +2.

H sup.: *Stachyo sylvatici-Impatientetum noli-tangeris* PASSARGE 1967.

This megaforb syntaxon occurs in the clearings. The flora shows a neutrophilous, nitrophilous, hygroclinous and heliophilous character. The main constant species are *Impatiens noli-tangere, Urtica dioica, Athyrium filix-femina, Stachys sylvatica* and *Dryopteris filix-mas.* Frequently, this megaforb covers a microforb dominated by *Cardamine amara* and *Chrysosplenium alternifolium* (*Cardamino amarae-Chrysosplenietum alternifolii*, cf. C.U. 1).

Relevé 39a (cov. 100%, height 1 m):
Impatiens noli-tangere 44, *Urtica dioica* 32, *Athyrium filix-femina* 12, *Stachys sylvatica* 12, *Actaea spicata* 11, *Aegopodium podagraria* 11, *Dryopteris filix-mas* +, *Rubus idaeus* +, *Festuca gigantea* +, *Geum urbanum* +, *Equisetum pratense* +.

H inf.: *Hepatico trilobae-Ranunculetum lanuginosi cardaminetosum bulbiferae* subass. nov. prov.

This hemisciaphilous, mesophilous and neutronitrophilous community covers the greatest area of the field layer of the phytocoenose. Its floristic composition is very rich. The main constant and codominant species are *Lamiastrum galeobdolon* ssp. *galeobdolon, Impatiens noli-tangere* (°), *Stellaria nemorum, Ranunculus lanuginosus, Stellaria holostea, Dentaria bulbifera, Glechoma hirsuta, Hepatica nobilis, Oxalis acetosella, Geranium robertianum, Galium odoratum, Milium effusum.* The differential species of the subassociation *cardaminetosum bulbiferae* are *Dentaria bulbifera, Glechoma hirsuta, Allium ursinum, Mercurialis perennis, Geranium robertianum, Impatiens noli-tangere* and *Stellaria nemorum.*

Relevé 60a (cov. 90%, height 0.2 m):
Impatiens noli-tangere 33.°, *Allium ursinum* 33, *Mercurialis perennis* 23., *Glechoma hirsuta* 22, *Stellaria holostea* 22, *Stellaria nemorum* 22, *Asarum europaeum* 12, *Ranunculus lanuginosus* 12, *Hepatica nobilis* 12, *Lamiastrum galeobdolon* ssp. *galeobdolon* 12, *Dentaria bulbifera* 11, *Polygonatum multiflorum* 11, *Dryopteris filix-mas* +2, *Geranium robertianum* +2, *Urtica dioica* +, *Aegopodium podagraria* +, *Stachys sylvatica* +, *Lathyrus vernus* +, *Geum urbanum* +, *Moehringia trinervia* +, *Milium effusum* +, *Equisetum pratense* +.

C.U. 4: ***Festuco sylvaticae-Tiliocoenetum cordatae*** coenass. nov.
Mesophilous acidoclinous hornbeam-linden-forest (*"Tilio-Carpinetum"* p.p.)

Localization - Physiognomy - Ecology:

More localized than the previous one, this forest-type is developed in a higher topographical position, so that the soil, though partially clayey, is relatively dry and acid. These forests could be adjacent to the *Glechomo hirsutae-Tiliocoenetum cordatae*, the physiognomy of which is very similar, or to the *Carici remotae-Piceocenetum.*

Synusial composition:

Two syntaxa could be considered as differential towards the *Glechomo hirsutae-Tiliocoenetum*; the

subassociation *caricetosum digitatae* of the *Hepatico-Ranunculetum*, which replaces here the subassociation *cardaminetosum bulbiferae* in the field layer, and a shrub community, the *Euonymo verrucosae-Daphnetum mezerei*.

T sup.: *Carpino betuli-Tilietum cordatae* ass. nov. prov. cf. C.U.3.

S sup.: *Ulmo glabrae-Coryletum avellanae* ass. nov. prov. cf. C.U. 3.

S inf.: *Euonymo verrucosae-Daphnetum mezerei* ass. nov. prov.

This sciaphilous shrub community is very scattered in these phytocoenoses. However it is well characterised by the presence of *Euonymus verrucosa, E. europaea* and *Daphne mezereum*.

Relevé 35c: (cov. 20%, height 0.5 m):
Corylus avellana 12, *Tilia cordata* 12°, *Carpinus betulus* 12°, *Euonymus verrucosa* +, *Daphne mezereum* +, *Euonymus europaea* +, *Fraxinus excelsior* +.

H sup.: *Stachyo sylvatici-Impatientetum noli-tangeris* PASSARGE 1967 cf. C.U.3.

H inf.: *Hepatico trilobae-Ranunculetum lanuginosi caricetosum digitatae* subass. nov. prov.

This subassociation can be distinguished from the others by the fidelity of several differential species like *Carex digitata, Dryopteris carthusiana, Maianthemum bifolium, Rubus saxatilis, Melica nutans, Festuca sylvatica*, and by the dominance of *Oxalis acetosella* or sometimes *Carex pilosa*. These species bring this acidoclinous and xeroclinous syntaxon near the *Maianthemo-Trientalietum europaei*, but the constancy of many differential species of the *Hepatico trilobae-Ranunculetum lanuginosi* (*Hepatica nobilis* (= *H. triloba*), *Equisetum pratense, Aegopodium podagraria, Lamiastrum galeobdolon*, etc.) impose the fastening to this association.

Relevé 59a (cov. 80%, height 0.2 m):
Oxalis acetosella 23, *Gymnocarpium dryopteris* 23, *Maianthemum bifolium* 22, *Lamiastrum galeobdolon* ssp. *galeobdolon* 22, *Stellaria holostea* 22, *Festuca altissima* 12, *Carex pilosa* 12, *Equisetum pratense* 12, *Equisetum sylvaticum* 12, *Anemone nemorosa* 12, *Rubus saxatilis* 11, *Hepatica nobilis* 11, *Milium effusum* 11, *Impatiens noli-tangere* +2°, *Galium odoratum* +2, *Carex digitata* +, *Dryopteris carthusiana* +, *Ranunculus lanuginosus* +, *Carex remota* +, *Galeopsis tetrahit* +, *Aegopodium podagraria* +, *Athyrium filix-femina* +, *Viola reichenbachiana* +, *Deschampsia cespitosa* +, *Polygonatum multiflorum* +, *Lilium martagon* (+), *Lathyrus vernus* (+).

C.U. 5. ***Carici remotae-Piceocoenetum abietis*** coenass. nov.
Acidoclinous spruce-oak forest (*"Tilio-Carpinetum"* p.p.)

Localization - Physiognomy - Ecology:

These forests phytocoenoses, well represented upon the considered territory, specially on the east border of themapped area, are characterized firstly by the cooccurrence of two arborescent synusiae, and secondly by the abundance of uprooted trees (chablis). These ones are essentially the fact of the spruce, and are favoured by a special layout of soil substrate (clay soil covered by a superficial sand layer). These forests occur in many topographical situations, the most often in intermediate position. Contacts are offered with numerous forests phytocoenoses types, but mostly with *Carici curtae-Quercocoenetum roboris* and *Glechomo hirsutae-Tiliocoenetum cordatae*.

Synusial composition:

Two arborescent syntaxa, one shrubby syntaxon, and four herbaceous syntaxa, are regularly present in these phytocoenoses, the most faithful being the *Luzulo pilosae-Gymnocarpietum dryopteris* and the two subassociations of the *Deschampsio cespitosae-Caricetum remotae*.

T sup.: *Piceo abietis-Quercetum roboris* ass. nov. prov.

Two trees are represented in the superior arborescent layer, their level frequently reaching 40 m.: *Quercus robur* and *Picea abies*. While the former is deeply rooted in the clay soil, the latter develops its root-plate in the superficial sandy layer; this promotes the "saltation" for the oldest of these conifers.

Relevé 12a (cov. 30%, height 35 m):
Quercus robur 23, *Picea abies* 22.

T inf.: *Carpino betuli-Tilietum cordatae* ass. nov. prov.

Compared to the precedent one, this association is structurally subordinated. It is clearly less exuberant here as in the *Glechomo hirsutae-Tiliocoenetum cordatae*. *Carpinus betulus, Acer platanoides* and *Tilia cordata* are constant and codominant. The height does rarely reach more than 25 m.

S sup.: *Ulmo glabrae-Coryletum avellanae* ass. nov. prov.

This community of "Scar Mantle" does appear along the uprooted trees clearing borders (cf. C.U. 3).

H sup.: *Deschampsio cespitosae-Caricetum remotae typicum* subass. nov. prov.

This syntaxon develops abundantly in primary situations in the clay hollows of uprooted trees. The flora does reveal a mesohygrophilous, acidoc-

linous, mesotrophic and hemisciaphilous character. It is dominated by *Carex remota*, constantly accompanied by *Carex elongata, Deschampsia cespitosa, Festuca gigantea, Galium elongatum, Stellaria nemorum, Polygonum minus*, etc. The fundamentaly pioneer behaviour of this community makes it easy to invade artificial hollows (Ruts...) frequently encountered in the exploited part of our work area.

Relevé 8b (cov. 90%, height 0.5 m):
Carex remota 54, *Stellaria nemorum* 22, *Polygonum minus* 13, *Carex elongata* 12, *Deschampsia cespitosa* 12, *Stellaria holostea* 12, *Athyrium filix-femina* 12, *Calamagrostis arundinacea* 12, *Glyceria declinata* 11, *Festuca gigantea* +, *Galium elongatum* +, *Lamiastrum galeobdolon* ssp. *galeobdolon* +, *Maianthemum bifolium* +, *Milium effusum* +, *Equisetum pratense* +, *Oxalis acetosella* +, *Carex sylvatica* +, *Anemone nemorosa* +, *Ranunculus repens* +, *Equisetum sylvaticum* +.

H sup.: *Deschampsio cespitosae-Caricetum remotae juncetosum effusi* subass. nov. prov.

More localized this community takes the place of the precedent one in the clay hollows of the largest uprooted trees. The differential species of this syntaxon which has a mesohygrophilous, acidoclinous and clearly heliophilous character, are *Juncus effusus* and *Carex leporina*.

Relevé 77a (cov. 100%, height 1 m):
Carex remota 44, *Juncus effusus* 22, *Deschampsia cespitosa* 22, *Carex leporina* 12, *Festuca gigantea* 12, *Ranunculus repens* 12, *Galium palustre* +2, *Carex elongata* +2, *Equisetum sylvaticum* +.

H sup.: *Rubo idaei-Calamagrostietum arundinaceae typicum* subass. nov. prov.

This heliophilous, acidophilous and xeroclinous community colonizes the sandy soil, on slightly elevated position, in the clearings of uprooted trees (or clearings cut in the exploited part of the forest). It occurs generally in a mosaic with *Deschampsio cespitosae-Caricetum remotae juncetosum effusi*. *Calamagrostis arundinacea* is largely dominant, ever accompanied by *Rubus idaeus* and *Dryopteris carthusiana*, at times by *Epilobium angustifolium*.

Relevé 8e (cov. 95%, height 1 m):
Calamagrostis arundinacea 54, *Stellaria holostea* 33, *Dryopteris carthusiana* 12, *Oxalis acetosella* 12, *Maianthemum bifolium* 12, *Stellaria nemorum* 11, *Equisetum sylvaticum* 11, *Rubus idaeus* +2, *Athyrium filix-femina* +2, *Milium effusum* +, *Lamiastrum galeobdolon* ssp. *galeobdolon* +.

H. inf.: *Luzulo pilosae-Gymnocarpietum dryopteris* ass. nov. prov.

This sciaphilous, acidophilous and xeroclinous syntaxon develops on sandy soil of shadowed places of this phytocoenose. Among constant species, which are often dominant, we noticed *Oxalis acetosella, Maianthemum bifolium, Gymnocarpium dryopteris, Carex pilosa* (optimal in this community), *Carex digitata, Luzula pilosa, Anemone nemorosa, Stellaria holostea*. The association is distinguished from the *Hepatico trilobae-Ranunculetum lanuginosi caricetosum digitatae* by the absence of neutronitroclinous taxa as *Ranunculus lanuginosus, Lathyrus vernus, Aegopodium podagraria, Viola reichenbachiana, Dryopteris filix-mas* and so on.

Relevé 103a (cov. 50%, height 0.15 m):
Oxalis acetosella 33, *Stellaria holostea* 23, *Maianthemum bifolium* 22, *Gymnocarpium dryopteris* 12, *Carex digitata* 12, *Luzula pilosa* 11, *Dryopteris carthusiana* 11, *Anemone nemorosa* 11, *Milium effusum* 11, *Equisetum pratense* 11, *Equisetum sylvaticum* +, *Rubus idaeus* +°, *Carex remota* +°, *Calamagrostis arundinacea* +°.

C.U. 6: ***Carici curtae-Quercocoenetum roboris*** coenass. nov.
Hygrophilous acidophilous spruce-oak-forest ("*Carici elongatae-Quercetum*" p.p.)

Localization - Physiognomy - Ecology:

The physiognomy of these light forests looks like the *Carici remotae-Piceocoenetum abietis* one, the saltation windfallen woods of *Picea* are here extremely numerous. This phytocoenoses type, relatively localized, forms generally a narrow halo around the climax pine-forests phytocoenoses (*Trientalio europaei-Pinocoenetum sylvestris* or *Ledo palustris-Pinocoenetum sylvestris*). The moist-wet clay soil is covered by a very superficial sand horizon.

Synusial composition:

The ligneous vegetation is poorly developed in these forests (only two constant syntaxa). The herbaceous synusiae are represented by three constant syntaxa, two of them being considered as differential (*Caricetum curto-remotae typicum* and *Maianthemo-Trientalietum europaei typicum*).

T sup.: *Piceo abietis-Quercetum roboris* ass. nov. prov.

This arborescent synusia is very scattered here. The oaks, strongly deep-rooted, are significantly more abundant than spruces, most of the latter being uprooted! (cf. C.U. 5).

S sup.: *Frangulo-Sorbetum aucupariae* ass. nov. prov.

These punctual or linear shrub synusiae occur regularly in this forest-type. They succeed dynamically to the heliophilous high herbs communities described below. The codominant constant species are *Sorbus aucuparia, Corylus avellana, Carpinus betulus, Populus tremula, Frangula alnus, Betula pendula.*

Relevé 104a (cov. 20%, height 2 m):
Frangula alnus 22, *Sorbus aucuparia* 11, *Populus tremula* 11, *Carpinus betulus* 1.1, *Corylus avellana* +, *Betula pendula* +,

H sup.: *Rubo idaei-Calamagrostietum arundinaceae typicum* subass. nov. prov.

Generally more scattered than in the *Carici remotae-Piceocoenetum*, this xeroclinous syntaxon overgrows the clearings on raised sand soil (cf. C.U. 5).

H sup.: *Caricetum curto-remotae typicum* subass. nov. prov.

The physiognomy and the physiography of this community and of the *Deschampsio cespitosae-Caricetum remotae* (cf. C.U. 5) are comparable: they both occur in uprooted tree moist hollows, which are here very developed, and are dominated by different *Carex* species, particularly *C. remota* and *C. elongata*. The differential taxa of the *Caricetum curto-remotae* are here *Calamagrostis canescens* not constant but often dominant), *Carex canescens* (*C. curta*), *Lysimachia vulgaris*. The subassociation *typicum*, differentied by *Carex nigra, Carex echinata* and *Molinia caerulea*, is the more constant. The flora shows a pronounced hygrophilous and acidophilous character.

Relevé 27c (cov. 50%, height 0.3 m):
Carex elongata 32, *Carex canescens* 32, *Lysimachia vulgaris* 21, *Carex nigra* 13, *Carex remota* +2, *Carex echinata* +2, *Polygonum minus* +2, *Juncus effusus* +.

H sup.: *Caricetum curto-remotae juncetosum effusi* subass. nov. prov.

This subassociation can be distinguished from the latter subassociation *typicum* by the dominance of *Juncus effusus* and the presence of *Carex leporina* and *Carex pallescens*. It seems to be a little bit less hygrophilous and perhaps more heliophilous.

Relevé 20b (cov. 100%, height 0.8 m):
Juncus effusus 44, *Carex remota* 23, *Carex canescens* 22, *Carex leporina* 12, *Carex pallescens* 12, *Juncus conglomeratus* 12, *Lysimachia vulgaris* 11, *Carex elongata* +2.

H inf.: *Maianthemo-Trientalietum europaei typicum* subass. nov. prov.

This syntaxon represents the mesophilous trend of this acidophilous and sciaphilous association (cf. C.U. 7). Constant species are *Oxalis acetosella, Maianthemum bifolium, Vaccinium myrtillus* (always scattered here), *Trientalis europaea, Dryopteris carthusiana.* It occurs on the sandy soil of the shaded and dry places of the phytocoenose.

Relevé 24b (cov. 70%, height 0.1 m):
Oxalis acetosella 33, *Maianthemum bifolium* 32, *Trientalis europaea* 12, *Dryopteris carthusiana* 12, *Calamagrostis arundinacea* 12°, *Vaccinium myrtillus* +2, *Luzula pilosa* +2, *Moehringia trinervia* +2.

C.U. 7: ***Trientalio europaei-Pinocoenetum sylvestris*** coenass nov.
Xeroclinous acidophilous pine-forest
("*Pino-Quercetum*" p.p.)

Localization - Physiognomy - Ecology:

This coenassociation is relatively localized in the map area. It occurs in sommital position on deep fresh sand. These high but often very scattered and light pine forests offer frequent contacts with *Festuco sylvaticae-Tiliocoenetum cordatae* and *Carici curtae-Quercocoenetum roboris* phytocoenoses.

Synusial composition:

The synusial composition contains four constant synusiae-types, with three differential syntaxa: *Populo tremulae-Pinetum sylvestris, Maianthemo-Trientalietum convallarietosum* and *Rubo idaei-Calamagrostietum pteridietosum.*

T sup.: *Populo tremulae-Pinetum sylvestris* ass. nov. prov.

Generally dominated by *Pinus sylvestris* and *Picea abies*, these arborescent synusiae are often penetrated by heliophilous "nomads" like *Populus tremula, Betula pubescens, B. pendula. Quercus robur* is constant, but scattered.

Relevé 21c (cov. 50%, height 35 m):
Pinus sylvestris 22, *Populus tremula* 22, *Picea abies* 22, *Quercus robur* 12.

S inf.: *Frangulo-Sorbetum aucupariae* ass. nov. prov.

This heliophilous cicatricial shrub community occurs in the clearings (cf. C.U. 6).

H sup.: *Rubo idaei-Calamagrostietum arundinaceae pteridietosum* subass. nov. prov.

This acidophilous subassociation of the *Rubo-Calamagrostietum* replaces the subassociation *typicum* (cf. C.U. 5) - in the large clearings of these pine-forests. *Calamagrostis arundinacea* and *Pteridium aquilinum* are codominant. The number of

species is appreciably more important in the cuttings of the exploited part of the forest (anthropic enrichment).

Relevé 21a (cov. 100%, height 1 m):
Pteridium aquilinum 33, *Calamagrostis arundinacea* 33, *Rubus idaeus* 22, *Urtica dioica* 12, *Galeopsis tetrahit* 11, *Populus tremula* 11°, *Mycelis muralis* +.

H inf.: *Maianthemo-Trientalietum europaei convallarietosum* subass. nov. prov.

The main constant species of this acidophilous, thermoxerophilous and hemisciaphilous syntaxon are: *Trientalis europaea, Mainathemum bifolium, Vaccinium myrtillus, Rubus saxatilis, Oxalis acetosella, Convallaria majalis, Viola riviniana.* The differential species of the subassociation *convallarietosum* are: *Convallaria majalis, Solidago virgaurea, Veronica officinalis, Melampyrum pratense, Melittis melissophyllum, Scorzonera humilis.*

Relevé 38c (cov. 70%, height 0.15 m):
Oxalis acetosella 33, *Vaccinium myrtillus* 33, *Trientalis europaea* 23, *Calamagrostis arundinacea* 23°, *Maianthemum bifolium* 12, *Vaccinium vitis-idaea* 12, *Convallaria majalis* 11, *Rubus saxatilis* 11, *Dryopteris carthusiana* 11, *Veronica officinalis* +2, *Viola reichenbachiana* +2, *Viola riviniana* +, *Luzula pilosa* +, *Melampyrum pratense* +, *Scorzonera humilis* +, *Solidago virgaurea* +, *Lilium martagon* +, *Moehringia trinervia* +.

C.U. 8: ***Sphagno girgensohnii-Piceocoenetum abietis*** coenass. nov.
Peaty spruce forest (*"Sphagno girgensohnii-Piceetum"*)

Localization - Physiognomy - Ecology:

These phytocoenoses are sparsely represented on the mapped area, in the National Park. The *Sphagnum* peat is here superficial compared to *Ledo palustris-Pinocoenetum sylvestris*, and so the trees are rooted in mineral or sedge peat substrates contrary to the pine forest.

As described by FALIŃSKI (1986), this type of phytocoenose can come from a sedge-peat forest (see C.U. 11), and so there is often a mosaic structure with mounds and depressions.

Synusial composition:

T sup.: *Betulo pubescentis-Piceetum abietis* ass. nov. prov.

In this association *Picea abies* always dominates, other less constant and never dominating species are *Betula pubescens, Alnus glutinosa, Pinus sylvestris.* Contrary to *Piceo-Quercetum roboris, Quercus robur* never occurs here. The height is around 15-20 metres and the cover mostly around 75%.

Relevé 4: (cov. 40%, height 15 m):
Picea abies 31, *Betula pubescens* 11.

S. inf.: *Frangulo-Sorbetum aucupariae* ass. nov. prov.

This community is always scarce and poorly developed here (see C.U. 7).

H inf.: *Lycopodio annotini-Vaccinietum vitis-idaeae* ass. nov. prov.

This is an acidophilous sciaphilous community. Compared with *Maianthemo-Trientalietum*, the association described here lacks the mesotrophous species like *Anemone nemorosa, Maianthemum bifolium, Calamagrostis arundinacea* and so on. *Lycopodium annotinum* and *Vaccinium vitis-idaea* are constant and faithful here, other species are *Vaccinium myrtillus* (often dominating), *Dryopteris carthusiana, Orthilia secunda, Trientalis europaea*, and some other scattered species. It occupies the top of the mounds at the base of tree trunks.

Relevé 62A (cov. 30%, height 0.10 m):
Vaccinium vitis-idaea 22, *Vaccinium myrtillus* 11, *Orthilia secunda* 11, *Lycopodium annotinum* +, *Oxalis acetosella* 22, *Circaea alpina* +, *Dryopteris carthusiana* +, *Vaccinium oxycoccos* +.

The bryophytes synusiae are important in this phytocoenose though we did not study them very well, we present some examples more or less regularly seen and typical of the coenassociation.

1) Community with *Bazzania trilobata* and *Ptilium crista-castrensis* on the top of the mound, mesoxerophilous.
Relevé 62 (cov. 100%):
Bazzania trilobata 12, *Ptilium crista-castrensis* 22, *Pleurozium schreberi* 33, *Dicranum* sp. 12, *Plagiochila asplenioides* 23, *Rhytidiadelphus triquetrus* +.
2) Community with *Sphagnum quinquefarium*: mesophilous, sciaphilous.
Relevé 4 (cov. 70%):
Sphagnum quinquefarium 33, *Pleurozium schreberi* 23, *Dicranum scoparium* 12, *Polytrichum strictum* +2.
3) Community with *Sphagnum girgensohnii*, hygrophilous, sciaphilous.
Relevé 31 (cov. 100%):
Sphagnum girgensohnii 55, *Sphagnum flexuosum* +, *Sphagnum palustre* +, *Polytrichum commune* +.

Two other communities, relics of previous hydrophilous dynamic stages are also sometimes sparsely present: one with *Sphagnum squarrosum* often at the base of mounds, the other with *Trichocolea tomentella, Marchantia polymorpha* var. *aquatica, Mnium gr. seligeri*, etc. on the side of water holes.

C.U. 9. ***Ledo palustris-Pinocoenetum sylvestris*** coenass. nov.
Oligotrophic acidophilous peaty scotch pine forest (*"Vaccinio uliginosi-Pinetum"*) (*"Sphagnetum magellanici pinetosum"*)

Localization - Physiognomy - Ecology:

These phytocoenoses are punctual, east of the mapped area in acidophilous sandy depressions where organic matter develops in peat due to water stagnation.

The community has a subboreal character, the tree layer being more or less scattered.

Synusial composition:

T inf.: *Betulo carpaticae-Pinetum sylvestris* ass. nov. prov.

The determination difficulties of the birch and the few points sampled obscure our understanding of this association. The cover is always weak and the height reaches 15 m. *Pinus sylvestris* is constant and dominant with some scarce *Picea abies*. The percentage of *Betula* cf. *carpatica* (maybe also some true *Betula pubescens* ?)* depends on the dynamic stage but the species seems always constant.

Relevé 5, (cov. 30%, height 15 m):
Pinus sylvestris 22, *Picea abies* 11, *Betula pubescens* cf. ssp. *carpatica* 32.

H. inf .: *Ledo palustris-Sphagnetum magellanici* SUKOPP 1959.

Relevé 105, (cov. 70% for herbaceous, 100% for bryophytes):
Eriophorum vaginatum 23, *Vaccinium oxycoccos* 22, *Andromeda polifolia* 13, *Vaccinium uliginosum* +3, *Ledum palustre* 22, *Vaccinium myrtillus* 22, *Sphagnum magellanicum* 33, *Sphagnum apiculatum* 44.

The association has a subboreal character and an ombrotrophic nutrition.

C.U. 10: ***Carici elongatae-Alnocoenetum glutinosae*** coenass nov.
Neutroclinous peaty alder forest (*"Carici elongatae-Alnetum"* p.p.) (*"Ribo nigri-Alnetum"* p.p.)

Localization - Physiognomy - Ecology:

These phytocoenoses occur in peaty depressions where stagnant water promotes organic matter accumulation. This phenomenon is seen in the alluvial plain of the Narewka behind alluvial ridge, but also in the inner part of the forest (east of the mapped area) in the upper valley of the little rivers. In one point of Orłówka alluvial plain, the building of a little way did separate a little square of stagnant water which did permit the development of peaty soils.

This coenassociation is one of the best example of the utility of the synusial integrated approach: one can see a complex mosaic of hollows more of less deep, and a mound where trees are rooted. The cover degree of the arborescent layer is never continuous but greater than that of the built surface, so this phytocoenose, taken as a whole, does present a "forest atmosphere".

Synusial composition:

In spite of the structural analysis which evidently demonstrates a mosaic feature the classical workers (DÖRING 1987 as an example) come persistently to the astonishing conclusion that this type of forest does represent one association! Despite not having paid too much attention to the numerous bryophyte synusiae, because of lack of time, we recognized in the herbs layer as an example, as many as seven type of herbaceous synusiae which occurmore of less constantly in this kind of phytocoenose.

T sup.: *Fraxino excelsioris-Alnetum glutinosae* ass. nov. prov.

This association is dominated here by *Alnus glutinosa* which coexist with *Fraxinus excelsior* and more scarce *Picea abies*. *Quercus robur* never seems to occur. We are not sure that this is the same syntaxon as for the trees of *Cirsio oleracei-Fraxinocoenetum* (see C.U. 1) but due to our lack of observation we prefer to ascribe the communities to the same association. The cover is never continuous, the height around 20 metres, a little bit lower than in the typical *Fraxino-Alnetum* (cf. C.U. 1).

S sup.: *Alno glutinosae-Coryletum avellanae* ass. nov. prov.

This shrubby community reaches a six metre height but a relatively scarce cover mostly under 25% of the phytocoenose. It has a relatively diffuse spatial distribution. *Alnus glutinosa* and *Corylus avellana* are constant, other shrubs (juveniles essentially) being irregular.

Releve. 23: (cov. 20%, height 6 m):
Alnus glutinosa (juv.) 22, *Corylus avellana* 12, *Fraxinus excelsior* (juv.) 12, *Picea abies* (juv.) 11, *Carpinus betulus* (juv.) +, *Tilia cordata* (juv.) +, *Ulmus glabra* (juv.) +.

S inf.: *Ribetum rubro-nigri* ass. nov. prov.

This community of little shrubs reaching 1.50 m to 2 m is always very scattered. It combines *Ribes nigrum* and *Ribes rubrum* constant and occasional-

* The Editor share the opinion of the Authors that the occurrence of *Betula carpatica* in the Białowieża Forest uncertain.

ly *Euonymus europaea, Viburnum opulus, Frangula alnus* (cf. C.U. 1).

H inf.: *Maianthemo bifoliae-Trientalietum europaeae typicum*

This community is the same as the one described in *Carici curtae-Quercocoenetum* (see C.U. 6).

It occupies the top of the mound where the soil is more acid and xeroclinous. It is often poorly developed due to the surface inferior to the minimum area so the releves must often include many mounds.

H inf.: *Circaeo alpinae-Oxalidetum acetosellae* ass. nov. prov.

This association is punctual on rooted trunks of all types of phytocoenoses but often frequent here due to the numerous fallen trunks.

Relevé 118, (cov. 80%, height 0.05 m):
Oxalis acetosella 44, *Circaea alpina* 33, *Gymnocarpium dryopteris* 22, *Dryopteris carthusiana* +2.

H sup.: *Thelypterido palustris-Caricetum elongatae* ass. nov. prov.

This association develops stripes as the base of the mounds between constantly stagnant water and more mesophilous conditions. The plants are always rooted in organic matter and even on dead fallen branches can penetrate the more hygrophilous hollows. Constant are *Carex elongata, Thelypteris palustris, Peucedanum palustre, Lycopus europaeus, Athyrium filix-femina* and *Dryopteris carthusiana* often present differentiate the community towards a more hygrophilous one. The combination also contains less constantly *Solanum dulcamara, Galium palustre* ssp. *elongatum*, and others; the number of species is around ten.

Relevé 61B (cov. 70%, height 0.4 m):
Carex elongata 44, *Thelypteris palustris* 23, *Athyrium filix-femina* 23, *Solanum dulcamara* 11, *Lycopus europaeus* +, *Lysimachia vulgaris* +, *Galium elongatum* +, *Dryopteris carthusiana* +, *Urtica dioica* +, *Oxalis acetosella* 12, *Cardamine pratensis* +.

H sup.: *Ranunculo linguae-Caricetum acutiformis* ass. nov. prov.

This association is typical of the hollows of the phytocoenose. It is a neutrophilous mesotrophic, hemisciaphilous and hydrophilous one developed on peaty soil.

Carex acutiformis is dominant, other constant species are *Ranunculus lingua, Galium elongatum, Lycopus europaeus, Solanum dulcamara, Iris pseudacorus, Lythrum salicaria, Myosotis scorpioides* coll., *Peucedanum palustre*. Other species are less constant but one could come to dominance: *Phragmites australis*. The association like the former one takes place in *Caricion rostratae*.

Relevé 23E (cov. 99%, height 1.5 m):
Carex acutiformis 55, *Galium elongatum* 32, *Ranunculus lingua* 22, *Peucedanum palustre* 11, *Lycopus europaeus* 11, *Solanum dulcamara* 11, *Iris pseudacorus* 12, *Myosotis scorpioides* coll. 12, *Lythrum salicaria* +, *Filipendula ulmaria* ssp. *denudata* +, *Ribes nigrum* +.

H sup.: *Lysimachio thyrsiflorae-Glycerietum declinatae* ass. nov. prov.

This association is close to the former one but is found on more disturbed soils (by *Sus scrofa* essentially) with a pH a little bit lower and also a lower mean water level.

Constant are *Galium elongatum, Solanum dulcamara, Lycopus europaeus, Carex elongata, Caltha palustris, Myosotis scorpioides* coll., *Mentha aquatica, Glyceria declinata*. Less constant but typical are *Lysimachia thyrsiflora, Alisma plantago-aquatica, Calla palustris, Scutellaria galericulata, Scirpus sylvaticus, Carex pseudocyperus, Alopecurus aequalis*.

Relevé 61A (cov. 60%, height 0.4 m):
Glyceria declinata 22, *Alopecurus aequalis* 23, *Mentha aquatica* +, *Myosotis scorpioides* coll. +, *Caltha palustris* +.
Galium elongatum 22, *Lysimachia thyrsiflora* 12, *Carex pseudocyperus* 11, *Iris pseudacorus* 12, *Solanum dulcamara* 11, *Carex elongata* +, *Thelypteris palustris* +, *Scutellaria galericulata* +, *Calla palustris* +, *Cicuta virosa* +, *Lycopus europaeus* +, *Lysimachia vulgaris* +, *Oenanthe aquatica* +, *Alisma plantago-aquatica* +, *Cardamine pratensis* coll. 11, *Ranunculus repens* 11.

H inf.: *Hottonietum palustris* TÜXEN 1937 and *Riccietum fluitantis* SLAVNIC 1956 em TX. 1974.

These aquatic associations are found in the little ponds included in this forest phytocoenose (comp. *Hottonio-Alnetum* auct. !!!), the latter can also be found in temporary superposition with associations of helophytes. Both of them are mesotrophic hemisciaphilous, rich in organic matter conditions.

C.U. 11: ***Potentillo palustris-Betulocoenetum pubescentis*** coenass. nov.
Mesotrophic acidophilous peaty birch forest (*"Carici elongatae-Alnetum"* p.p.) (*"Sphagno squarrosi-Alnetum"* p.p.)

Localization - Physiognomy - Ecology:

This coenassociation is a vicariant close to the *Carici elongatae-Alnocoenetum* but acidophilous. It is not clear whether this is a natural character or if there is a "paludification phenomenon" as indicated by the continuous *Sphagna* carpet. However that may be the autogenous primary dynamics leads towards *Sphagno girgensohnii-Piceocoenetum* (see FALIŃSKI 1986).

Synusial composition:

T sup.: *Betulo pubescentis-Alnetum glutinosae* ass. nov. prov. facies to *Alnus glutinosa.*

Contrary to the tree layer of *Carici elongatae-Alnocoenetum, Fraxinus excelsior* never occurs here, in comparison with facies to *Betula pubescens* (C.U. 13) *Salix pentandra* never occurs here and the level is higher: the height is here around twenty metres. More researches are needed to confirm or not the distinction of the two facies.

Relevé 4 bis, (cov. 40%, height 20 m):
Alnus glutinosa 32, *Betula pubescens* 12.

H sup.: *Potentillo palustris-Scirpetum sylvatici* ass. nov. prov.

Relevé 4 bis, (cov. 100%, height 1 m):
Potentilla palustris 12, *Carex canescens* 12, *Carex lasiocarpa* +, *Carex lasiocarpa x riparia* 33, *Carex vesicaria* 12, *Lysimachia vulgaris* 12, *Calamagrostis canescens* +, *Carex elongata* +, *Peucedanum palustre* +, *Galium elongatum* +, *Iris pseudacorus* +, *Phragmites australis* +, *Scirpus sylvaticus* 13, *Lythrum salicaria* +, *Juncus effusus* 12.
Bryophytes: (cover 100%):
Sphagnum apiculatum 55, *Sphagnum palustre* +2, *Polytrichum commune* 13, *Calliergon giganteum* +2, *Calliergon stramineum* +.

As in all forests on peaty soil the bryophytes communities, while numerous, were not studied because of the lack of time so though the description of these kinds of phytocoenose is partial, we think, by experience, that the typification would not change too much by including bryophyte synusiae.

C.U. 12: ***Filipendulo denudatae-Alnocoenetum glutinosae*** coenass. nov.
Neutroclinous eutrophic alluvial alder forest

Localization - Physiognomy - Ecology:

This coenassociation is largely spread in the Narewka valley where it occupies sites of abandoned meadow. It belongs to a dynamical series of *Cirsio oleracei-Fraxinocoenetum,* being a "pre-forest" stage. So it occurs in secondary progressive dynamics when trees invade the *Filipendulo niveae-Caricetum cespitosae.*

Synusial composition:

T sup.: *Betulo pubescentis-Alnetum glutinosae* ass. nov. prov.

This pioneer community is always covering (around 80%) with a height between ten and eighteen metres. It is here mostly dominated by *Alnus glutinosa* (comp. C.U. 13 and C.U. 11) but due to irregularities in the dominance relations between alder and birch it is possible that the decisive fact, in the pioneer stage, is only of historical significance: the former becomes more dominant; in the mature forests the dominance has more meaning, alder preferring neutroclinous substrates and birch acidophilous.

S sup.: *Alno glutinosae-Coryletum avellanae* ass. nov. prov.

Very rare and scattered due to the important cover and homogeneous structure of the tree layer (numerous young trees and no windfallen trees see C.U. 10).

This community is hemisciaphilous and best developed around windfallen trees or clearings.

S inf.: *Ribetum rubro-nigri* ass. nov. prov.

This sciaphilous community is always poorly developed. It includes special species and juveniles of trees of the arborescent associations (see C.U.1).

H sup.: Community with *Poa remota* and *Filipendula ulmaria* ssp. *denudata.*

This is a sciaphilous eutrophic community of secondary forest in alluvial plain. It follows dynamically the heliophilous *Filipendulo niveae-Caricetum cespitosae* and will transform inside the mature forest (*Cirsio oleracei-Fraxinocoenetum*) into *Lamio maculati-Impatientetum noli-tangeris.* We have transitional relevés which show this gradual transformation.

Relevé 41 (cov. 100%, height 0.80 m):
Filipendula ulmaria ssp. *denudata* 22, *Geum rivale* 22, *Crepis paludosa* 11, *Geranium palustre* +, *Cirsium rivulare* +.
Angelica sylvestris 11, *Valeriana* gr. *officinalis* +, *Cirsium oleraceum* +, *Stachys palustris* +, *Eupatorium cannabinum* +.
Phragmites australis 23, *Solanum dulcamara* 22, *Carex riparia* 12, *Lycopus europaeus* 11, *Lysimachia vulgaris* 11, *Equisetum fluviatile* +, *Galium elongatum* +, *Carex paniculata* +.
Thelypteris palustris 12, *Carex elongata* +, *Viola palustris* 11.
Poa remota 12, *Humulus lupulus* +, *Agropyron caninum* 12, *Urtica dioica* 11, *Impatiens noli-tangere* +, *Circaea lutetiana* +, *Geranium robertianum* +.
Myosotis scorpioides +, *Poa trivialis* +, *Ranunculus repens* 11, *Lychnis flos-cuculi* +, *Dryopteris carthusiana* +, *Cardamine amara* +, *Milium effusum* +.

C.U. 13: ***Betulo humilis-Betulocoenetum pubescentis*** coenass. nov.
Mesotrophic peaty alluvial depression birch forest (*"Betulo humilis-Salicetum rosmarinifoliae"*)

Localization - Physiognomy - Ecology:

These phytocoenoses found on peaty alluvial depression of the Narewka valley are typical secondary recolonization forests which come by progressive autogenous dynamics when mown has ceased. Due to the few observations it is not quite clear which dynamical series they belong to. We think that their origin is in *Caricetum elatae* and their future in *Carici elongatae-Alnocoenetum* from which they could represent a "pre-forest" stage.

T inf.: *Betulo pubescentis-Alnetum glutinosae* ass. nov. prov., facies to *Betula pubescens.*

This community, always dominated by *Betula pubescens,* is about ten metres high.

The other species are *Alnus glutinosa* and more scarce *Picea abies, Pinus sylvestris* even *Salix pentandra.*

S sup.: *Salicetum pentandro-cinereae* (PASSARGE 1961) ass. nov. prov.

This community, exclusive on secondary recolonization, is better developed outside the forest phytocoenose as external mantle. Here it is only relict.

Bot species are typical but *Salix pentandra* in its juvenile form, there are also juveniles of trees in this forest form of the association.

S inf: *Betulo humilis-Salicetum rosmarinifoliae* (OBERDORFER 1964) ass. nov. prov.

A very interesting association of boreal character.

Relevé 125 (cov. 70%, height 1.5 m):
Betula humilis 44, *Salix rosmarinifolia* 11, *Ribes nigrum* 11.

H sup.: Community with *Menyanthes trifoliata* and *Phragmites australis*

Due to the lack of documentation, we cannot define more precisely this community which has close affinities with some subassociations of the *Peucedano-Calamagrostietosum canescentis* WEBER 78 and with the *Phragmitetum calamagrostietosum* of the same author (see WEBER 1978).

Relevé 63 (cov. 80%, height 1.5 m):
Phragmites australis 33, *Equisetum fluviatile* 23, *Calamagrostis canescens* 23, *Peucedanum palustre* 11, *Carex appropinquata* 12, *Galium elongatum* +, *Lycopus europaeus* +.
Menyanthes trifoliata 22, *Viola palustris* 11, *Carex nigra* +.
Caltha palustris 12, *Lythrum salicaria* 11, *Scirpus sylvaticus* +, *Filipendula ulmaria* ssp. *denudata* +, *Cirsium palustre* +, *Lychnis flos-cuculi* +, *Galium aparine* +, *Poa trivialis* 11, *Myosotis scorpioides* +.

C.U. 14. **The phytocoenoses complex unit of the former expoited river valley**

In this unit, mapped in golden yellow, each phytocoenose is monosynusial. So the types of synusiae (= association in our sense) are similar to the classical phytosociological unit. We did not try to map each association because of the lack of repairs point and beacuse of the correspondence with photo interpretation.

5 associations are present in this unit.

1) The most frequent is the *Filipendulo niveae-Caricetum cespitosae* ass. nov. It is not equivalent to the "*Caricetum cespitosae* STEFFEN 1931" which is an hygrophilous meadow of medium level and could be classified in *Alopecurion pratensis* (PASSARGE 1964) de FOUCAULT 1984, nor to the *Cnidio-Caricetum cespitosae* CELIŃSKI 1978(1976) belonging to *Cnidion venosi* BÁL.-TUL. 1965 as an hygrophilous meadow of lower level. It is also different from *Comaro-Caricetum cespitosae* (PAŁCZYŃSKI 1975) BÁL.-TUL. in CELIŃSKI 1978 (1976) which occupies more peaty soils. Our association is dynamically bound to an unknown meadow: when it is no more exploited (mown), themeadow species decrease like the megaforb species of *Filipendulo-Calystegietea* and *Phragmiti-Magnocaricetea* (specially *Caricetalia elatae*) come to dominance and exclusive. The relation between these two last classes, which can be seen in our community, have already suggested a possible union (compare JULVE 1985(1984).

The association combines a constant group of megaforb species: *Filipendula ulmaria* ssp. *ulmaria* (seems more heliophilous than ssp. *denudata* in the region), *Veronica longifolia, Lythrum salicaria, Polygonum bistorta,* less frequent *Geum rivale, Valeriana* gr. *officinalis, Polemonium caeruleum, Stachys palustris* and so on; associated with a constant group of *Phragmiti-Magnocaricetea* species: *Carex cespitosa, Lysimachia vulgaris, Phragmites australis, Calamagrostis canescens* and so on. Among the accompanying species *Galium aparine, Urtica dioica* are sometimes present. The association grows on eutrophic neutrophilous soils of subcontinental alluvial plains. This vegetation between 1.5 and 2 metres high covers always nearly 100%. The average number of species is fifteen. The community comes from abandoned mown meadows, and has a natural evolution towards the forests of *Cirsio oleracei-Fraxinocoenetum,* through an intermediate stage of *Filipendulo denudatae-Alnocoenetum.* The soil is not so peaty and wet as in "*Caricetum elatae*" due to the position topographically higher and more distant from the river. The association is generally heliophilous.

While attempting a synthesis we prefer yet to ascribe this association to the *Filipendulo-Calystegietea* (PREISING in HÜLBUSCH 1973) J.-M. & J. GÉHU 1987(1985) which combines the hygrophilous megaforb from the plains on more or less eutrophic soils; the *Lythro salicariae-Filipenduleta-*

lia (PASSARGE 1988 in press) stat nov. for the meso-eutrophic planarian-collinean associations (1), the *Stachyo palustris-Cirsion oleracei* all. nov. for the neutrophilous one (2), the *Veronico longifoliae-Lysimachenion* PASSARGE 77 (subcontinental and more thermophilous in summer) (3).

Relevé 124A (cov. 100%, height 1.70 m):

Filipendula ulmaria ssp. *ulmaria* 22, *Veronica longifolia* 11, *Lythrum salicaria* 11, *Polygonum bistorta* +, *Geum rivale* +, *Polemonium caeruleum* +, *Cirsium palustre* +, *Carex cespitosa* 44, *Phragmites australis* 33, *Lysimachia vulgaris* 11, *Calamagrostis canescens* 11, *Equisetum fluviatile* 11, *Carex elata* +, *Carex appropinquata* +, *Peucedanum palustre* +, *Galium aparine* +, *Poa trivialis* +.

This is the heliophilous typical subassociation tending towards *Caricion rostratae*.

Relevé 65 (cov. 100%, height 1.70 m):

Filipendula ulmaria ssp. ulmaria 22, *Veronica longifolia* 22, *Geranium palustre* 11, *Polygonum bistorta* +, *Geum rivale* +, *Cirsium rivulare* +, *Valeriana* gr. *officinalis* +, *Cirsium oleraceum* +, *Stachys palustris* +, *Scrophularia umbrosa* +, *Senecio paludosus* 12, *Lythrum salicaria* +, *Carex cespitosa* 33, *Phragmites australis* 33, *Calamagrostis canescens* 12, *Lysimachia vulgaris* +, *Lathyrus palustris* +, *Galium aparine* 11, *Scrophularia nodosa* 11, *Impatiens noli-tangere* +°.

This releve represents a subassociation tending towards the community with *Poa remota* and *Filipendula ulmaria* ssp. *denudata*, more sciaphilous (see C.U. 12) in the region, as shown by *Scrophularia nodosa, Impatiens noli-tangere, Geranium palustre*. It could be named after the last species.

2) In the Narewka valley the cessation of mowing determines progressive secondary recolonization. After a "megaforb stage" of *Filipendulo niveae-Caricetum cespitosae* the vegetation evolues towards *Filipendulo denudatae-Alnocoenetum glutinosae* (and after *Cirsio oleracei-Fraxinocoenetum*) through an intermediate stage, where a shrubby community takes place, scattered, in the megaforb community. This shrubby community: the *Salicetum pentandro-cinereae* seems to facilitate the evolution towards forests phytocoenoses though it has nothing to do with the inner and outer mantle of the forests coenassociations (see C.U. 1 and 12). We must remark it is the same phenomenon as for Junipers scrub in xerophilous biotopes, which are mostly different from the stabilized outer mantle of the forest they prepare.

Relevé 43a (cov. 30%, height 4 m):

Salix cinerea 44, *Salix pentandra* +.

It seems that the *Salicetum pentandro-cinereae* (PASSARGE 1961) can have the same role in secondary succession in many dynamical series.

3) Another rarer herbaceous community, found only once, is one with the dominance of *Carex acuta* (? = *C. acutiformis*) which could be placed in the very complex *"Caricetum gracilis"* of the authors (*Caricion gracilis* (GÉHU 1961) BÁL.-TUL. 1961, *Caricetalia elatae* PIGNATTI 1953 ap. 54, *Phragmiti-Magnocaricetea* KLIKA in KLIKA & NOWAK 1941). This community could develop in a more emineral soil than the former. We have not enough observation in the region to have a better understanding of its ecology and dynamical relationship.

Relevé 51B (cov. 99%, height 1.50 m):

Carex acutiformis 55, *Carex vesicaria* 22, *Carex cespitosa* +2, *Senecio paludosus* +, *Iris pseudacorus* +, *Lythrum salicaria* +, *Rumex hydrolapathum* +, *Symphytum officinale* 11.

Note that this community differs from those described by FALIŃSKI 1966 as *Caricetum gracilis* TX. 1937 (Tab. 46, p. 127.).

4) A community with the dominance of *Carex elata* which should be, placed in the too classical (and complex!) *Caricetum elatae* KOCH 1926 as used by authors, but certainly belonging to *Caricion rostratae* BÁL.-TUL. 1963, *Caricetalia elatae* PIGNATTI 1953 ap. 1954; it has been found near the Narewka in the north of the mapped zone. It occupied moister soils than the *Filipendulo-Caricetum cespitosae* which exists farther from the river, and above all is found on peaty soils. In some releves we found *Calamagrostis stricta*, a typical species of these peaty mires of boreal origin. The dynamics of the community should go to *Carici elongatae-Alnocoenetum* but this is not proved.

The community has a height of 1 to 1.6 m and a great covering 100%. It combines *Carex elata* constant and dominant, and constantly *Carex vesicaria, Lysimachia vulgaris* and *Lythrum salicaria*. The other species are less common: *Equisetum fluviatile, Iris pseudacorus, Calamagrostris stricta, Phalaris arundinacea* and so on.

Relevé 138, (cov. 99%, height 1.6 m):

Caricion rostratae:

Carex elata 55, *Calamagrostis canescens* 22, *Carex vesicaria* +, *Equisetum fluviatile* +, *Carex appropinquata* +, *Potentilla palustris* (diff.) 22.

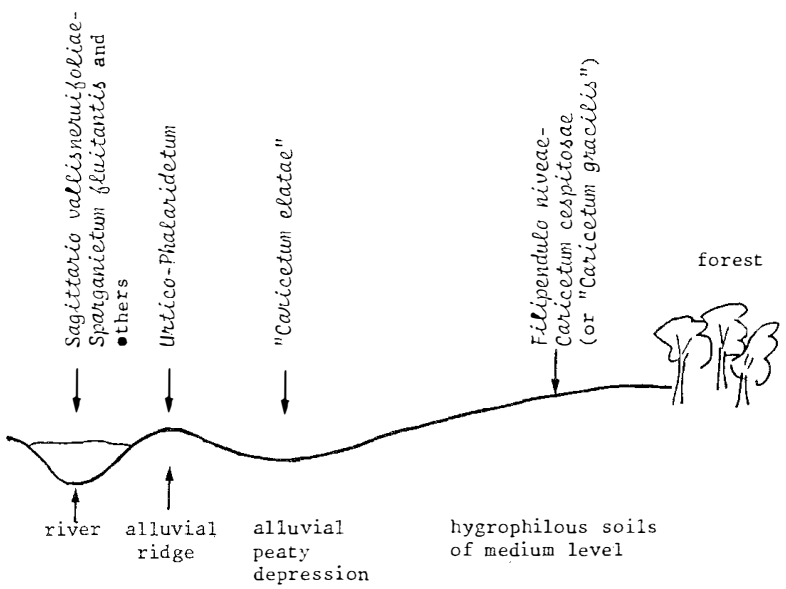
Order and class:

Lysimachia vulgaris 22, *Lythrum salicaria* 22, *Iris pseudacorus* 11, *Rumex aquaticus* +.

(1) Opposed to *Calystegietalia sepium* on more eutrophic nitratophilous soils which also occupies generally higher topographic level.

(2) Opposed to *Achilleo ptarmicae-Cirsion palustris* all. nov. for acidophilous one.

(3) Opposed to *Angelico sylvestri-Filipendulenion* PASSARGE 1977 (oceanic and more psychrophilous in summer).



5) A community typical of alluvial ridge has been observed in the Łutownia valley and near the Narewka, on mineral soils put down by the hibernal waters. It is a eutrophic one dominated by *Phalaris arundinacea,* sometimes *Phragmites australis*, with typical nitrophytes like *Urtica dioica* and *Galium aparine*. We did not see the original publication of *Phalaridetum arundinaceae* LIBBERT 1931 but as usual we think that these old names are based upon the dominance of one species and not upon the total floristic composition of the community which we use as the basis of modern phytosociology. The community in question could be named *Urtico dioicae-Phalaridetum arundinaceae* (LIBBERT 1931) SCHMIDT 1981 in a subcontinental race with *Veronica longifolia*. This association belongs to *Calystegietalia* which we ascribed to *Filipendulo-Calystegietea* (and not *Galio-Urticetea* which are more mesophilous). The existence of a *Phalaridion arundinaceae* KOPECKY 1960 is insufficiently proved as there are no synthetic comparative tables for the moment, the association group seems enough for the taxonomical purpose. The progressive dynamical relationships of this community are not clear as it is not obvious that any young tree could germinate on these periodically rejuvenated soils. More observations seem necessary.

Relevé 138 (cov. 99%, height 1.60 m):
Phalaris arundinacea 44, *Lythrum salicaria* 11, *Lysimachia vulgaris* +, *Urtica dioica* 22, *Galium aparine* 23, *Veronica longifolia* 22, *Filipendula ulmaria ssp. ulmaria* 11, *Filipendula ulmaria ssp. denudata* +, *Scirpus sylvaticus* 12, *Symphytum officinale* +, *Myosotis scorpioides* +.

A transect in Łutownia valley could represent the topographical relationship of the communities described in this cartographical unit. When an alluvial peaty depression is farther from the river, as in Narewka valley, a *Filipendulo nivea-Caricetum cespitosae* (with *F. ulmaria* ssp. *ulmaria* = *F. ulmaria* ssp. *nivea)* community can intercalate between alluvial ridge and alluvial peaty depression.

The aquatic communities of the rivers were not studied for this work, we recognized: *Potamogeton natantis-Nupharetum luteae* (deep calm water), *Sagittario vallisnerifoliae-Sparganietum fluitantis* (flowing water), *Myriophyllum* sp. community (under water), *Rorippo amphibiae-Oenanthetum aquaticae* (slightly deep and calm water), *Lemno-Spirodeletum polyrhizae* (little pleustophytes in calm water), and a fragmentary community with *Schoenoplectus lacustris*.

C.U. 15, 16, 17, 18, 19 : **The exploited meadows**

Three other communities have been separately mapped in bright yellow with surcharge. They correspond to mowed meadows yet still exploited in the Łutownia valley.

C.U. 15. The black points surcharge shows the *Succiso pratensis-Festucetum nigrescentis* BÁL.-TUL. 1965. This community belongs to *Alopecurion pratensis* (PASSARGE 1964) de FOUCAULT

1984, *Agrostietalia stoloniferae* OBERD. et al. 1967 em. de FOUCAULT 1984, *Agrostio-Arrhenatheretea* de FOUCAULT 1984, this class means the old *"Molinio-Arrhenatheretea"* excluded, megaforb (*Filipendulo-Calystegietea*), *Molinion* and *Juncion acutiflori* mires meadows (*Caricetea nigrae*), and including some mediterranean communities.

Though this is not surely clear, because of only one observation, we think that this mown meadow belongs to a dynamical series of *Cirsio oleracei-Fraxinocoenetum*, through megaforb (= abandoned meadow) of *Filipendulo niveae-Caricetum cespitosae*, a not yet defined shrub community (maybe *Salicetum pentandro-cinereae*), the young "pre-forest" (compare JULVE 1988(1985) in press) of *Filipendulo denudatae-Alnocoenetum* towards a climax phytocoenose of *Cirsio oleracei-Fraxinocoenetum*.

Relevé 140, (cov. 99%, height 0.80 m):
Agrostio-Arrhenatheretea:
Trifolium repens 11, *Ranunculus acris* 11, *Plantago lanceolata* +, *Phleum pratense* +, *Poa pratensis* +, *Stellaria graminea* +, *Leontodon autumnalis* +, *Rumex acetosa* +, *Vicia cracca* +, *Myosotis arvensis* (diff.) 11.
Agrostietalia stoloniferae:
Juncus effusus 23, *Ranunculus repens* 22, *Potentilla anserina* 22, *Carex hirta* 11, *Myosotis scorpioides* 11, *Alopecurus pratensis* 11, *Lychnis flos-cuculi* +, *Equisetum palustre* +, *Galium palustre ssp. palustre* (diff.) +, *Poa trivialis* +, *Cardamine pratensis* +, *Mentha arvensis* +.
Oligotrophic hygrophilous companions from *Caricetea nigrae* class:
Succisa pratensis 33, *Epilobium palustre* 11, *Galium uliginosum* 21, *Festuca nigrescens* (diff.) +, *Carex panicea* +.
Mesotrophic pioneer of megaforb and magnosedges communities:
Deschampsia cespitosa 33, *Filipendula ulmaria ssp. denudata* +, *Veronica longifolia* +, *Carex gracilis* +, *Calamagrostis canescens* +, *Lythrum salicaria* +, *Lysimachia vulgaris* +, *Scutellaria galericulata* +, *Carex vesicaria* +, *Iris pseudacorus* +.

C.U. 16. The black circle surcharge represents an acidophilous, mesotrophic, mesohygrophilous grassland. This is a very interesting community belonging to the ass-group of *Junceta effusi* as described by PASSARGE 1964. Though we have only one releve the combination of species is so clear that we can give a new name: *Hyperico maculati-Juncetum effusi* ass. nov. It belongs to *Ranunculo-Cynosurion cristati* PASSARGE 1969, *Agrostietalia stoloniferae* OBERD. et al. 1967 em. de FOUCAULT 1984, *Agrostio-Arrhenatheretea* de FOUCAULT 1984. We think that the potential forest of this plot should be the *Carici remotae-Piceocoenetum*, though we do not know intermediate stages. Though it is nearer the river than the former one, this community occurs on a higher topographical plot: a little isolated bump in alluvial plain. It is also mown regularly. When grazing occurs, this association evolves in *Alopecuro-Cynosuretum cristati* PASSARGE 1969 (a vicariant of oceanic *Junco acutiflori-Cynosuretum* SOUGNEZ 1957).

Relevé 143, (cov. 99%, height 0.50 m):
Agrostio-Arrhenatheretea:
Plantago lanceolata 21, *Rumex acetosa* 11, *Achillea millefolium* 11, *Holcus lanatus* 11, *Prunella vulgaris* 11, *Leucanthemum vulgare* +, *Ranunculus acris* +, *Phleum pratense* +, *Cerastium holosteoides* +, *Festuca pratensis* +, *Vicia cracca* +, *Veronica chamaedrys* +, *Juncus tenuis* +,
Agrostietalia stoloniferae:
Juncus effusus 22, *Carex otrubae* +, *Juncus articulatus* +, *Potentilla anserina* +, *Lychnis flos-cuculi* +,
Oligotrophic companions from *Nardetea:*
Agrostis tenuis 33, *Luzula multiflora* 11, *Hypericum maculatum ssp. maculatum* 22, *Carex pallescens* 11, *Stellaria graminea* 22, *Briza media* (diff.) 11, *Anthoxanthum odoratum* +, *Potentilla erecta* +, *Carex leporina* +.
Oligotrophic hygrophilous from *Caricetea nigrae:*
Galium uliginosum 21, *Carex panicea* 11.
Other species:
Polygonum bistorta 11, *Veronica longifolia* +, *Deschampsia cespitosa* +, *Cirsium arvense* +.

C.U. 17. The black vertical lines on bright yellow mean the *Cirsietum rivularis* RALSKI 1931. We do not give any relevé of this community, mown during the study. Relevés 1 & 2 of table 54 p. 140 in FALIŃSKI 1966 give the floristic composition of the community we saw in the Łutownia valley. It is a mown meadow, eutrophic and hygrophilous of medium level. This association belongs to *Alopecurion pratensis* (PASSARGE 1964) dc FOUCAULT 1984. It probably belongs to the dynamic series of *Ranunculo cassubici-Fraxinocoenetum* but this has to be proved by more observations. It is also possible that the dynamically bound megaforb should be the *Filipendulo-Geranietum palustris*.

C.U. 18. The bright yellow with cross surcharge has been employed for a clearing park in the forest. It seems to be an old railways station place, maybe in connection with second world war as shown by the occurrence of *Glyceria striata*, a typical polemochor plant (see JULVE 1988 in press). This place is now used by forestry office to lay down trunks

waiting for a transport. The vegetation is a trampled mesohygrophilous meadow which could be placed in the *Agrostio prorepentis-Ranunculetum repentis* (KNAPP 1946) nom. et def. nov. It means pro parte the *"Ranunculetum repentis"* of authors; the *Ranunculus repens-Agrostis stolonifera* community, sub-comm, of *Dactylis glomerata*, form of *Juncus articulatus* in KNAPP and VOIGTLANDER 1982 (p. 77) as an example. This association takes place in *Lolio-Potentillion anserinae* TÜXEN 1947 (in the strict sense of de FOUCAULT 1984), *Agrostietalia stoloniferae, Agrostio-Arrenatheretea.* It should take place in the dynamical series of *Ranunculo cassubici-Fraxinocoenetum.*

Relevé 130, (cov. 99%, height 0.40 m):
Lolio-Potentillion and *Agrostietalia* species:
Potentilla anserina 22, *Trifolium hybridum* 22, *Carex hirta* 22, *Juncus articulatus* 22, *Juncus effusus* 11, *Poa trivialis* 12, *Odontites verna* (ssp. *serotina* ?) 11, *Rumex crispus* +, *Ranunculus repens* +, *Alopecurus pratensis* +, *Agrostis stolonifera* (ssp. *prorepens* ?) +.
Agrostio-Arrhenatheretea species:
Trifolium repens 33, *Festuca pratensis* 22, *Phleum pratense* 11, *Dactylis glomerata* +, *Trifolium pratense* +, *Lathyrus pratensis* +, *Vicia cracca* +, *Stellaria graminea* +, *Agropyron repens* +, *Prunella vulgaris* +, *Rhinanthus* cf. *angustifolius* +, *Plantago major* +, *Juncus tenuis* +, *Leontodon hispidus* coll. +.
Other species:
Trifolium medium +, *Trifolium campestre* +, *Medicago lupulina* +, *Myosotis arvensis* +, *Equisetum arvense* +, *Epilobium montanum* +.

C.U. 19. The bright yellow colour with a triangle has been used for a community of the same determinism as the former but in a potentiality of *Trientalio europae-Pinocoenetum sylvestris.* This community has a dominance of *Agrostis tenuis* and should take place in *Nardetea*, but unfortunately we have no releve of it. The reader should see *Polygalo-Nardetum* as described by FALIŃSKI (1966, p. 164) though the community in question was less oligotrophic and more thermoxerophilic than FALIŃSKI's.

C.U. 20, 21: **The clearing-cuts**

The grey colours have been used for the clearing-cuts in the exploited part when there were no more trees. At first exists a herbaceous community (bright grey), and the autogenous dynamics leads to shrubby communities followed by "pre-forest" and climactic-forest (see JULVE 1988 (1985) in press as an example).

Each potentiality gives special clearing-cut communities but we did not distinguish them on the map because of lack of enough observations about dynamical connections. Even in some cases we were not sure of the climactic community because there can be some convergence in regressive stages when ecologicall conditions are somewhat different: the water level is higher due to lack of great evapotranspiration of trees, the trophic level is higher due to nitrification acceleration. But when looking at the map it seems obvious which series belong to most types of clearings.

In most cases the herbaceous clearing-cut is occupied by the "windfallen-tree" herbaceous natural community (see part III.1.2) which comes to spatial occurrence, with some more species recruited in eutrophic or hygrophilous clearing-cuts characteristic species, and often also some meadow species. These not stabilized communities are always rich in species, even when some aperture occurs in the vegetal cover, some annual species can come. We would give only one example.

Relevé 52, (cov. 90%, height 0.50 m):
Climactic type of phytocoenose: *Trientalio europaei - Pinocoenetum sylvestris*
Species of *Rubo idaei-Calamagrostietum pteridietosum:*
Calamagrostis arundinacea 33, *Rubus idaeus* 32, *Pteridium aquilinum* 33.
Eutrophic species of clearing-cuts:
Epilobium angustifolium 12, *Galeopsis tetrahit* 22, *Senecio sylvaticus* +, *Mycelis muralis* 11, *Epilobium montanum* +, *Urtica dioica* +.
Companions:
Equisetum sylvaticum +, *Stellaria holostea* 12, *Milium effusum* +, *Impatiens noli-tangere* +, *Athyrium filix-femina* +, *Stachys sylvatica* +, *Scrophularia nodosa* +, *Dactylis glomerata* +.

It is possible that the higher level of water content in the soil when clearing-cut occurs brings on topographical migration of herbaceous synusiae as described in part one. This could be one of the reasons of phytocoenoses-complexes such as the one seen in the western part of the study region (see map).

The shrub communities succeeding to herbaceous clearing-cuts have been coloured in dark grey on the map, whatever be the dynamical series, for the same reasons as for herbaceous communities. The location on the map should exhibit the dynamical future of the observed point.

One example:
Relevé 130, (cov. 99%, height 2 m):
Potential coenassociation *Ranunculo cassubici-Fraxinocoenetum :*
Corylus avellana 22, *Ulmus glabra* 22, *Salix caprea* +, *Populus tremula* 11, *Betula pendula* 22, *Carpinus betulus* 22, *Tilia cordata* 11, *Quercus robur* 11, *Picea abies* +, *Alnus glutinosa* 22, *Fraxinus excelsior* +.

These shrubby recolonization synusiae are often very rich in species, as are homologuous herbaceous communities. It seems that diaspores of all types of tree synusiae can germinate and then comes an environmental selection of the best adapted association. Before the final structuring of the forest type a "pre-forest" stage often takes place with nomad heliophilous trees such as *Betula* div. sp., *Populus tremula* but also *Alnus glutinosa*, which grow fast and become dominant before dying and let the dried trees occur. *Alnus glutinosa* seems to possibly dominate in all dynamic series at early stages, and then disappears with the exception of *Cirsio oleracei-Fraxinocoenetum* and *Ranunculo cassubici-Fraxinocoenetum* where in stays in the final stage in the dominating tree-association: *Fraxino-Alnetum glutinosae*. As in the case of the above described releve, it looks like the trees, all present in the initial shrubby community, will develop like a "telescopic stick".

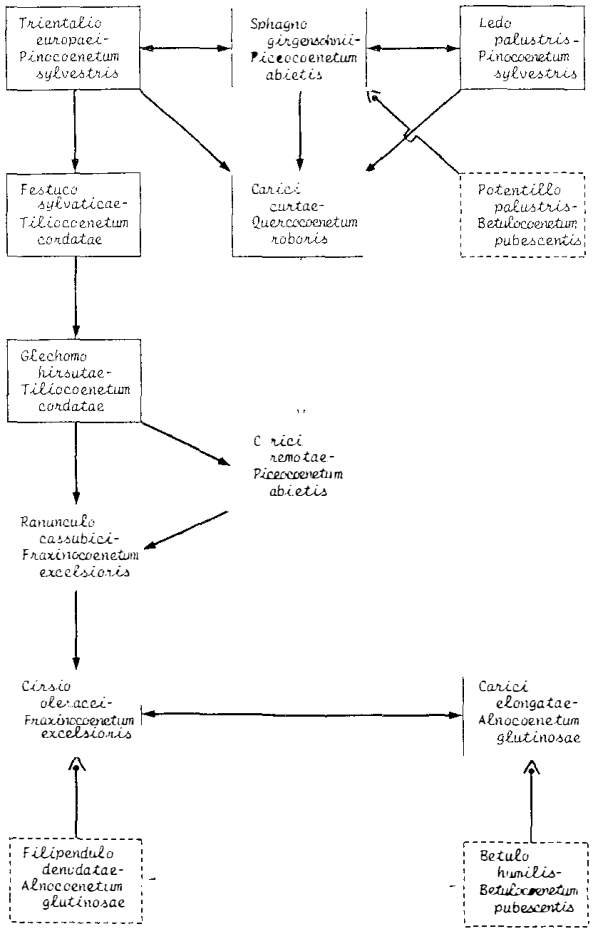
III.1.3. Topographical relationships of the forest phytocoenoses in the studied area

The figures below show the topographical relationships of the forested phytocoenoses we met during our study. The continuous square defining climactic phytocoenoses and dotted-lines square for non climactic phytocoenoses. The symbols between each square have the following signification:

- ◄——► neighbourhood or superposition at the same topographical level
- ◄—— topographical relationship, arrow towards inferior level
- ⇦—— progressive natural dynamics

The various phytocoenoses are arranged along two axes:

- vertical one for the topographical height, which fits partly the trophic level and hygrophily, when excluding mires and bogs. Those can occur at



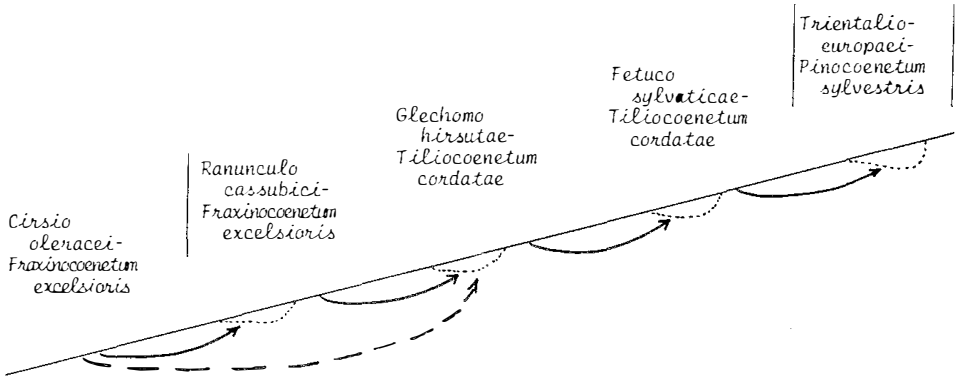


ILLUSTRATION OF THE PRINCIP OF TOPOGRAPHICAL MIGRATION OF HERBACEOUS INTRAFOREST SYNUSIAE

a high level due to topographical peculiarities permitting water accumulation.

- horizontal one for the mineral soil towards peaty soils gradients, which is an important factor of vegetational differentiation in the studied area.

These indications are only valid for climactic phytocoenoses.

The described gradient on mineral soil is also a trophic and hygrophilous gradient which is responsible for the peculiar phenomenon we call "topographical migration of synusiae". It occurs when, due to anthropogenous or great fauna action (wild boar especially), a few hollows are dug out in the soil of a phytocoenose of a given topographical level. So the ecological conditions in these hollows are, for herbaceous synusiae, those of topographically lower units. It brings on a "climb up" of complete synusiae coming from lower spatial units, sometimes only a fragment (some species) making the move, while the rest of the phytocoenose, specially the trees and the shrubs, remain the same. With other scales of space and time the phenomena could also naturally bring about topographical migrations of whole phytocoenoses.

III.2. Vegetation mapping methods used in the field

The use of special concepts described above (namely integrated synusial approach) and the relatively little time allowed (one month) necessited defining our vegetation units in the same time as the map-making. To define the cartographical units while doing the mapmaking in the field seems only possible for persons who are familiar with the method and the kind of phytocoenoses found there. For beginners the definition of phytocoenoses types should obligatorily be done before the cartography work in the field. Though we did not have any experience of lowland primeval forests, and specially of Białowieża Forest, the reading of some classical phytosociological works on Poland allowed us to understand what should be the character of our units in a preliminary phase. Even if we do not pay too much attention to the bryophytes synusiae, it appeared (and it seems to us!) that for a preliminary phase the focusing of attention on vascular communities is sufficient to define correctly the phytocoenoses. As stated by GILLET 1986, the bryophytes synusiae of the mesophilous forests are widespread in many types of phytocoenoses and are only characteristic of higher level coenotaxa; and so they do not have a high information value for the typification of these kinds of phytocoenoses. For the hygrophilous and mire communities, specially those of bogs, the bryophytes synusiae are essential and so we made some relevés to define bryophytes associations. Our experience of these ecosystems allowed us to define our mire phytocoenoses with only few relevés.

During the first 2/3 of the month we worked together to coordinate our understanding of the synusiae and phytocoenoses and during the last part we worked separately so as to improve our "productivity" in mapmaking!

The primary attention was focused on the National Park part to describe the typical natural phytocoenoses and the dynamic and ecological relationship of the synusiae. It allowed us to

recognize the semi-natural and anthropogenic nature of some phytocoenoses of the exploited part of the forest.

Starting from a known mark on the topographical plan, at the beginning of the "principal way", we followed the "black lines" of the grid map. Each time we found a new phytocoenose we made a sample point. This consists in doing a relevé of each synusia: a complete list of species with abundance-dominance and sociability coefficients, and in a second phase in doing a coenorelevé of the synusiae represented in the observed phytocoenose: a "complete" list of synusiae with form symbols (spatial, punctual or linear) cover and "sociability" coefficients (compare JULVE 1986(85) for the employed scales which are the same as for symphytosociology). These relevés allowed us to define our abstract units namely associations (type of synusiae) and coenassociations (=type of phytocoenoses), while comparing them with a classical phytosociological table method, in the evening at the laboratory.

So day after day our units became more precise and clear, and statistically defined! and we did not have to do relevés any more to recognize the coenassociations in the field which could be mapped directly.

The walk along the "black lines" and the crossing-points which occurred when north-south and east-west lines crossed them, allowed us to map the limits of the phytocoenoses encountered along the ways, on the topographical plan. We also made two diagonal lines for each square while only using a compass with aim. It appears that doing it carefully, the mistake of geolocalization does not exceed 50 metres. In this way, we mapped the vegetation found about 100 metres of each side of the ways we walked along. The surfaces not covered by field work were mapped by interpolation, using the topographical correlations recognized in the field, by some typical ecological transects, and the topographical plan. It has proved to have a relatively good correlation between vegetation limits and some topographic isolines, but in some cases the topographical map seemed to be insufficiently precise.

For some complex types of vegetation, specially the bogs, the clearings (in the exploited part) and so on, we did the cartography by following as precisely as possible the vegetational limits while using compass and estimating the distances, and angles.

We did not point the clearings or phytocoenose inferior to circa 2500 m^2. In the laboratory we used photointerpretation only to precise the limits between some different types of vegetation architecture, as an example between herbaceous and ligneous phytocoenoses or between bogs and mesophilous communities. The photos were too old to distinguish some recent clearing-cuts in the exploited part which were for this reason not represented. We also used, a little bit, stereo-watching for the vegetation of river valley, but due to our relative lack of knowledge in this domain, we did not take as much as possible from photo-interpretation. In many cases it seemed to us that photo-units do not correspond well with our phytocoenoses limits taken in the field, specially for mesophilous forests. Maybe many photos taken at different flowering times of the dominant trees in black and white, colour, infrared or false colour could have helped us, but it should require some calibration of the phenology and of the foliage reflectance.

The herbaceous phytocoenoses of the river valleys are mainly monosynusial. In this case our associations are similar to associations of the classical phytosociology. Due to the complexity of the mosaics and to the incoherence of photosunits, tested by verification in the field, and because of the lack of point of location, we described them mainly on the map as phytocoenoses complex unit.

III.3. Cartographical expression

We tried to follow a logic in using kind and intensity of colours:

— the green represents mesophilous forests,

— the blue represents hygrophilous character,

— the red represents organic matter not humified (peat or moor).

A combination of these colours should represent transitional character:

— the golden yellow colour shows phytocoenoses complexes not distinguishable within the chosen scale. This was used for the abandoned herbaceous communities of the alluvial valley (hygrophilous megaforb and sedge vegetation),

— the bright yellow colour has been used for the mown meadows with different kinds of surcharge for different associations (see part III.1),

— the black colour of the river could be interpreted as for the representation of aquatic phytocoenoses which have been poorly investigated (see part III.1).

— The alternation of two vertical colours represents a synusial complex intermediate between two characterized types of phytocoenoses. It has only been found in the exploited part of the forest and could be a consequence of human impact. We did not have enough observation points to sort out this problem, though we think of topographical migration phenomena such as described in the first chapter.

— Another "pyjama-like" representation was used for the dynamic stage of a given potentiality when we were sure of it. It uses alternation of

horizontal white and colour stripes. This representation is used in exploited part of the forest for the cleared woods where there has been some cutting.

— The grey was used for complete cuts of the trees, bright for herbaceous pioneer community and dark for shrubby stages. In this case we were not always sure of the potential vegetation, and we preferred not to be make a choice on the kind of mature phytocoenose which would come.

The key of the map contains the names of phytocoenoses for climactic communities (see part III.1 for explanation), according to GILLET (1986) type of nomenclature, and an ecological periphrasis. For the other types of vegetation we used classical nomenclature. As it is based upon a new method of describing vegetation, the explanatory text is of course essential to the understanding of the map.

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