Acta Botanica Hungarica 44(3–4), pp. 335–346, 2002

TRANSITORY VEGETATION TYPES: A CASE STUDY FROM RIVERINE FORESTS

A. ORTMANN-AJKAI

H-7635 Pécs, Báránytető 2, Hungary
E-mail: aadrienn@dravanet.hu

(Received 25 February 2002)

More vegetation mappers recognise the importance of vegetation types not determinable with classical coenotaxa. Vegetation map and relevés in Vajszló forest (Dráva lowlands) were made in 1994–98. Dominant vegetation types are *Fraxino pannonicae-Carpinetum*, *Scillo vindobonensi-Ulmetum* and transitory stands between the two, which occupy remarkable area, because of continually changing water supply, manifold transitory situation (between zones of hardwood riverine and hornbeam-oak forests with strong montane and Illyrian effects), anthropogenic activity (water control for the last 200 years, forestry for the last 100 years). Vegetation types, recognisable in the field, were determined as "oak-ash-elm riverine", "hornbeam-oak" or "transitory" according to 22 points of view, regarding species composition, ecological indicator values, site characteristics and multifactorial evaluation. Statistical analyses did not separate the two communities, but proved the existence of a some hundred metres wide transitory zone, whose surface is 30% of the whole study area.

Key words: continuity or discontinuity of vegetation, transitory vegetation types, GIS, hardwood (oak-ash-elm) grove (*Scillo vindobonensi-Ulmetum*), lowland hornbeam-oak forests (*Fraxino pannonicae-Carpinetum*), vegetation mapping

INTRODUCTION

One of the core questions of vegetation science is, whether the vegetation is continuous or discontinuous. Do separable, independent plant communities exist, or they go through into each other continually? Depending on the given situation, examples can be mentioned for both.

Well-separable plant communities can be found where site characteristics (soil, bedrock, climate) have well determined differences. This site heterogeneity is characteristic mostly on hilly areas; lowlands – on a landscape scale – show homogeneous site characteristics, here vegetation is discontinuous mostly as a result of human activity.

Classical Braun-Blanquet (or Zürich–Montpellier) coenology school was born in the densely populated, cultivated landscapes of western Europe, where the natural vegetation existed in forms of well-separable associations. Characterisation and following hierarchical classification was possible by

0236–6495/02/$ 5.00 © 2002 Akadémiai Kiadó, Budapest

studying "typical" – natural, old, undisturbed – stands. Transitory stands were neglected.

Hungarian coenology – following this route – dealt first with well separable communities of hilly areas, and with loess-, sand- and sodic soil vegetation – separable by soil characteristics – of the Hungarian lowland (Fekete 1998).

Serious problems regarding the applicability of community-categories of classical communities were recognised first by Juhász-Nagy (1957), studying meadow and pasture communities in Bereg lowlands, in a coenologically poblematic area: lowland landscape, border zone of two climatic belts, near-natural area but influenced for centuries by human activities. For solving these problems he developed a new model family built on strict mathematical-information theoretical base for studying the structure of vegetation.

Landscape-scale treatment of forest communities of the Hungarian Plain was accomplished using methods of classical coenology (Zólyomi (1934, 1937), Simon (1957), Kárpáti (1958), Járai-Komlódi (1958a, b), Kevey (1993, 1998).

This working method is appropiate when we are interested in the plant community: we want to describe its species composition, geographical distribution or other characteristics. But if we want to characterise the whole vegetation of a given area, we have to face the annoying fact that some observable plant "assemblages" – sometimes: most of them – cannot be classified into classical coenological categories: they are "non-typical" stands. If our study area is a small geographical area, and the homogeneity of site characteristic make possible the occurrence of only small numbers of plant communities, we have to give more attention to sub-community units and to the fact that communities are not separated by sharp border lines but going into each other thorough wide border zones.

Thank to the renaissance of vegetation mapping in the last years, more and more authors show the inadequacies of Zürich–Montpellier methods, e. g. Seregélyes and S. Csomós (1995), Standovár (1995), Bagi (1997a, b, 1998), Jusztin and Körmöczi (2000). I have reached similar consequences during my studies in riverine forests.

Methods of the Zürich–Montpellier coenological school – building on the hypothesis that vegetation is basically discontinuous – can be applied where "indicator-indicandum correspondence is strong, bedrock and subsoil are varied even in small dimensions, where transitional climate of the region brings into existence varied microclimate areas, where both zonality of plant communities and extrazonalities are well expressed, where there were interesting vegetation movements in the past, but place changes were not complete" (Fekete 1995).

The areas, whose vegetation map we want to prepare, are often not like this. If we made classical quadrate-relevés – which are excellent tool for describing vegetation – it is not surprising that they cannot correspond to standards, cannot be ordered into the hierarchical coenological system of communities.

The problem is more acute in areas under strong human impact, or in areas where a key environmental factor – water availability – is changing continuously: in floodplains.

STUDY AREA AND METHODS

The object of this study is a 600 ha forest stand (Vajszló forest) in the Dráva lowland, whose vegetation was mapped and characterised by 82 coenological relevés between 1996 and 1998 (Ortmann-né Ajkai 1998a). Dominant plant communities are: lowland hornbeam-oak forests (*Fraxino pannonicae-Carpinetum*) with two types: *Stellaria holostea* and *Carex sylvatica* types, and hardwood (oak-ash-elm) groves (*Scillo vindobonensi-Ulmetum*) with five types: *Galium odoratum*, *Carex sylvatica*, *Galeobdolon luteum*, *Circaea lutetiana* and *Carex remota*)

This area is very suitable for studying vegetation transitions just because that same causes, which make its coenological study difficult: its vegetation gives an excellent example for both "transitory characterlessness" (1,2) and "impoverished characterlessness" (3) (Fekete 1995).

1. Long ecocline: moving away from river Dráva area is slightly elevating, so water availability – most important ecological factor in respect of distinguishing the two communities – changes continuously, so the two communities join each other through a wide – sometimes kilometre-wide – transitory zone.

2. Border zones:

a. Border line between lowland hornbeam-oak and closed oak forests runs near Barcs, about 40 km E of our study area; hornbeam-oak forests here developed because of a very slight effect of subsoil water, so they are almost zonal.

b. Titelicum floral district penetrates into Praeillyricum, so this lowland area has some mountainous character traits. Praeillyricum itself is a transitory zone between Pannonicum and Illyricum.

3. Human impact

a. Water availability in the area – key factor of separating the two communities – worsens continually because of water regulation of the last 200 years. We do not have exact data about the drying out process, nor about how vegetation indicates this process, but it may be assumed that hardwood groves change slowly into hornbeam-oak stands (Kevey in Fekete *et al*. 1997).

b. Today's "best" forests are cultivated by forestry methods for more than 100 years: old stands are regularly cut down and renewed (Papp 1975, Turós 1995). Since the end of the last century widespread method of renewing is artifical planting by sowing oaks then pursuing agricultural cultivation between the rows for some years – it means total destruction of original herb layer. Today's oldest stands – classified as "typical" – were created in that way. In 80–100 years time it was possible for species to recolonise from neighbouring stands – but nobody can say, how complete it was, which species disappeared or became rare because of it. Nowadays the natural renewing of forests gains space, which provides better possibilities for natural regeneration, but it lasts for decades. Connection between the herb layer types and the age of stands has not been studied yet in floodplain areas – all literature data is on the "typical" old stands.

An attempt was made to identify vegetation types – recognisable in the field and made relevés of – with coenotaxa in literature, but it was sometimes problematical because of the above-mentioned reasons. So the data were analysed with several different methods in the hope that some analyses will join observable types to coenotaxa in the literature.

Types of hornbeam-oak forests and oak-ash-elm groves were evaluated from 22 different points of view, and in all cases a decision was made, whether – from this point of view – a type can be regarded as hornbeam-oak or oak-ash-elm forest (Table 1). Categorisation is coded as follows: 1 = strong hornbeam-oak character; 0 = strong oak-ash-elm character; 0.5 = transitory between the two.

RESULTS AND DISCUSSION

Species composition

1. Dominant tree species (Fig. 1): *Fraxinus angustifolia* in canopy of hornbeam-oak forests is represented by 5%, in oak-ash-elm forests by 15–25%.

2. Accompanying tree species I (Fig. 2): *Ulmus laevis* appears only in canopy of oak-ash-elm forests.

3. Accompanying tree species II (Fig. 2): canopy of hornbeam-oak forests is less diverse: there are 0–4 accompanying species with a coverage of max. 10%.

4. Shrub layer: total coverage of grove shrubs (*Acer tataricum*, *Cornus sanguinea*, *Fraxinus angustifolia*, *Sambucus nigra*, *Ulmus laevis*) is under 5% in hornbeam-oak forests, above 10% in hardwood groves.

Table 1
Comparison of hornbeam-oak and hardwood grove forests from 22 points of view

	Hornbeam-oak forests		Hardwood grove forests				
	Stellaria holostea	*Carex sylvatica*	*Carex sylvatica*	*Galium odoratum*	*Galeobdolon luteum*	*Circaea lutetiana*	*Carex remota*
1	1	1	0	0	0	0	0
2	1	1	0	0	0	0	0
3	1	1	1	1	0	0	0
4	1	1	0.5	0.5	0	0	0
5	1	1	0.5	0.5	0	0	0
6	1	0.5	0.5	0.5	1	0.5	0
7	1	0.5	0	1	0.5	0	0
8	1	1	0	1	0	0	1
9	1	1	1	1	0	0	0
10	1	1	0	1	1	0	0
11	1	1	1	1	0	0	0
12	1	0.5	0.5	1	0	0.5	0
13	1	1	0.5	1	0	0	0
14	1	1	0.5	0.5	0	0	0
15	1	1	1	0	0.5	0	0
16	0.5	1	0	1	0	0	0
17	1	1	0.5	1	1	0	0
18	0.5	1	0	0	0	0	0
19	1	1	0.5	0.5	0	0	0
20	1	1	0.5	0.5	0.5	0.5	0
21	1	1	0.5	0.5	0	0.5	0
22	1	1	0	1	0	0	0
Total	21	20.5	9	14.5	4.5	2	1

5. Characteristic species in herb layer (Fig. 3). Some character species, known from literature (e.g. Simon 1957, Kevey 1993) are too rare here for using characterisation (e.g. *Ulmus laevis*, *Vinca minor*), some of them (e.g. *Carpinus betulus*, *Fraxinus angustifolia*) occur in this region in both communities. Local character and differential species was sorted from local relevés, which characterises well the two communities in this area.

6. Facies-building species. According to the literature, *Stellaria holostea* (Majer 1968) is type-building species in half-dry, *Galeobdolon luteum* (Simon 1957) in mesophilous lowland hornbeam-oak forests (Majer 1968), *Carex sylvatica*, *Galium odoratum* and *Circaea lutetiana* are mentioned from both communities (Kevey 1993, 1998, Borhidi 1965), *Carex remota* only from oak-ash-elm groves (Kevey 1993).

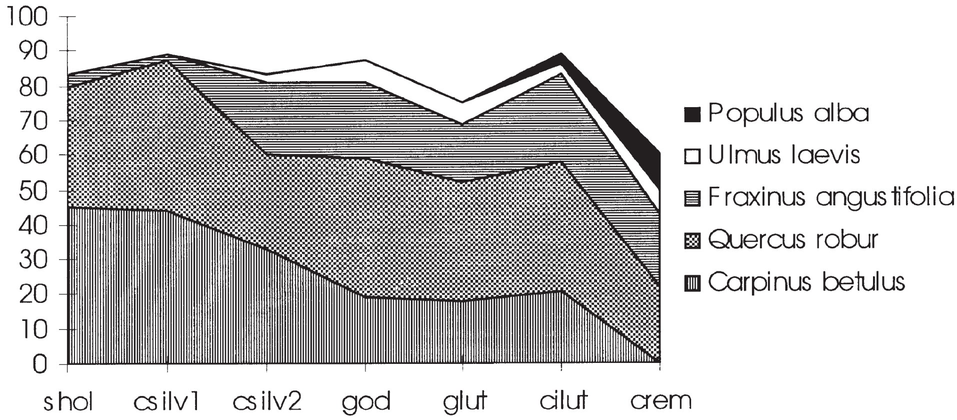

Fig. 1. Dominant species in canopy (shol = *Fraxino pannonicae-Carpinetum Stellaria holostea* type, csilv1 = *Fraxino pannonicae-Carpinetum Carex sylvatica* type, csilv2 = *Scillo vindobonensi-Ulmetum Carex sylvatica* type, god = *Scillo vindobonensi-Ulmetum Galium odoratum* type, cilut = *Scillo vindobonensi-Ulmetum Circaea lutetiana* type, glut = *Scillo vindobonensi-Ulmetum Galeobdolon luteum* type, crem = *Scillo vindobonensi-Ulmetum Carex remota* type)

Ecological indicator values

7. Water (Fig. 4): hornbeam-oak forests are characterised with narrow (W5–W7) spectra (Fig. 4a), where W5 peak represents significally higher coverage than all more wet categories together. Hardwood groves are characterised with wide (W4–W8) spectra (Fig. 4b), without a distinct peak. Transitory types: narrow spectra with W6 peak (Fig. 4c).

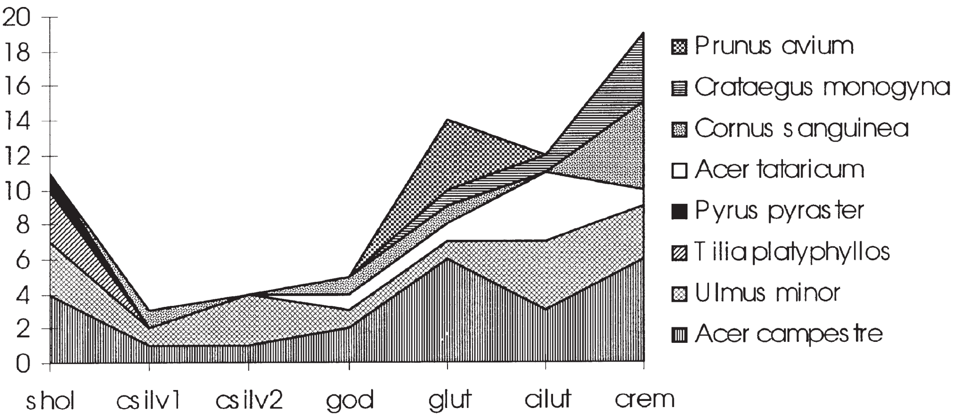

Fig. 2. Accompanying species in canopy

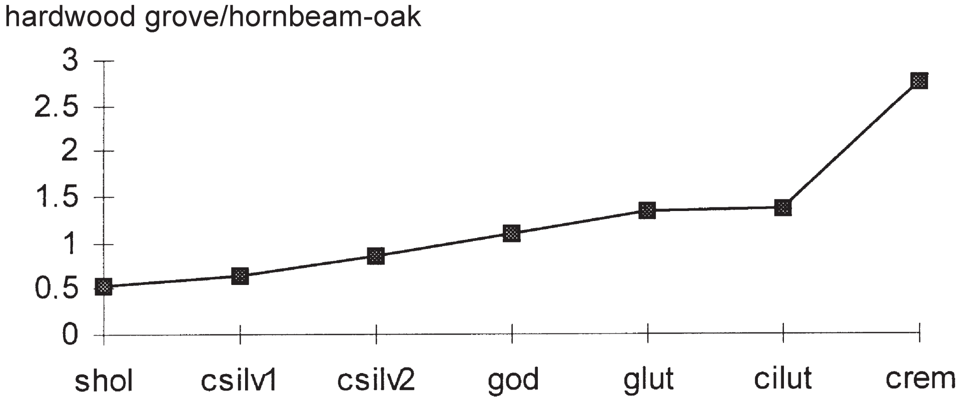

Fig. 3. Ratio of characterising species of hardwood groves versus hornbeam-oak forests in herb layer of types

8. Soil reaction: hornbeam-oak forests dominated by R6, hardwood groves by R7 species.

9. Nitrogen: hornbeam-oak forests: distinct peak at N5; hardwood groves: similar peaks at N5, N7 and N9 (Ortmann-né Ajkai 1998b).

10. Light: both types of hornbeam-oak forests are characterised by medium light conditions (L4 or L5 peaks, more light-demanding categories are under 20%). Between hardwood grove types there are ones demanding medium, weak (L2, L3 peaks) and good (L4, L5, L6 peaks) light conditions. Three of fives types is well-lighted, so this can be taken as characteristic for the community (Ortmann-né Ajkai 1998b).

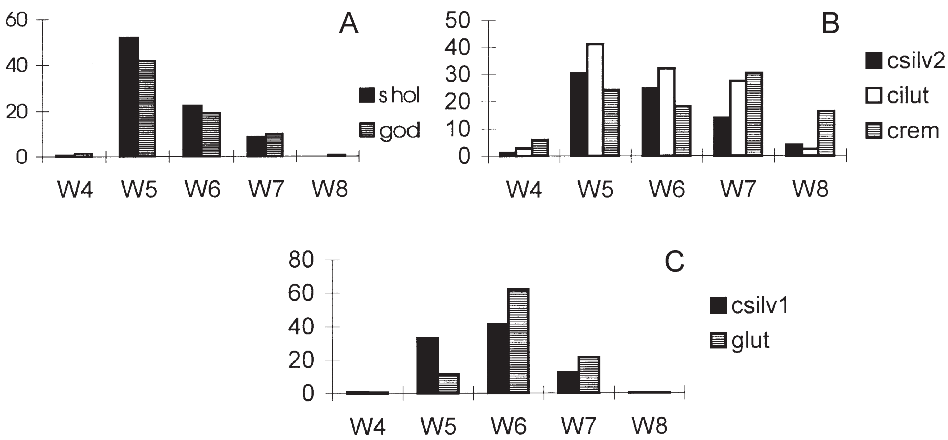

Fig. 4. Water spectra (A = narrow spectra, B = wide spectra, C = transitory spectra)

11. Continentality: K3 dominance by hornbeam-oak, K4 dominance by hardwood groves (Ortmann-né Ajkai 1998b).

Vegetation types compared according to pairs of most important ecological indicator

12. Water and light: *Galium odoratum* type looks like a hornbeam-oak forest; both *Carex sylvatica* types are transitory (Fig. 5a).

13. Water and nitrogen: *Galium odoratum* type again is close to hornbeam-oak ones; *Carex sylvatica* types of hardwood groves is transitory (Fig. 5b).

14. Light and nitrogen: *Galium odoratum* and *Carex sylvatica* types of hardwood groves are proved to be transitory (Fig. 5c).

Site characteristics

15. Elevation above sea level: hornbeam-oak forests lie mostly on 97, hardwood groves on 96 m a.s.l. (Ortmann-né Ajkai 1998b).

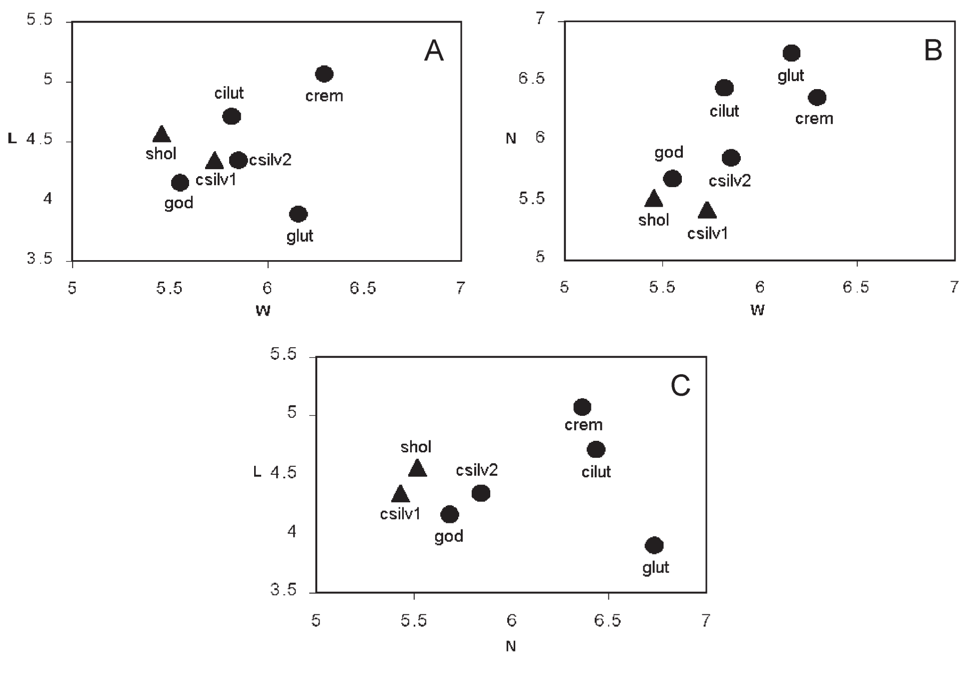

Fig. 5. Distribution of vegetation types by pairs of most important ecological indicators (A = water and light, B = water and nitrogen, C = light and nitrogen)

16. Genetic soil type: hornbeam-oak forests occur mostly on rust-brown forest soil, hardwood groves on alluvial forest soil (Ortmann-né Ajkai 1998b).

17. Water availability: balanced water availability (rust-brown forest soil or alluvial forest soil on loam) characterises hornbeam-oak forests (Ortmann-né Ajkai 1998b).

18. Complex site type: hornbeam-oak forests grow mostly on complex site type characterised by deep rust-brown forest soil on sand and temporary water surplus) (Ortmann-né Ajkai 1998b).

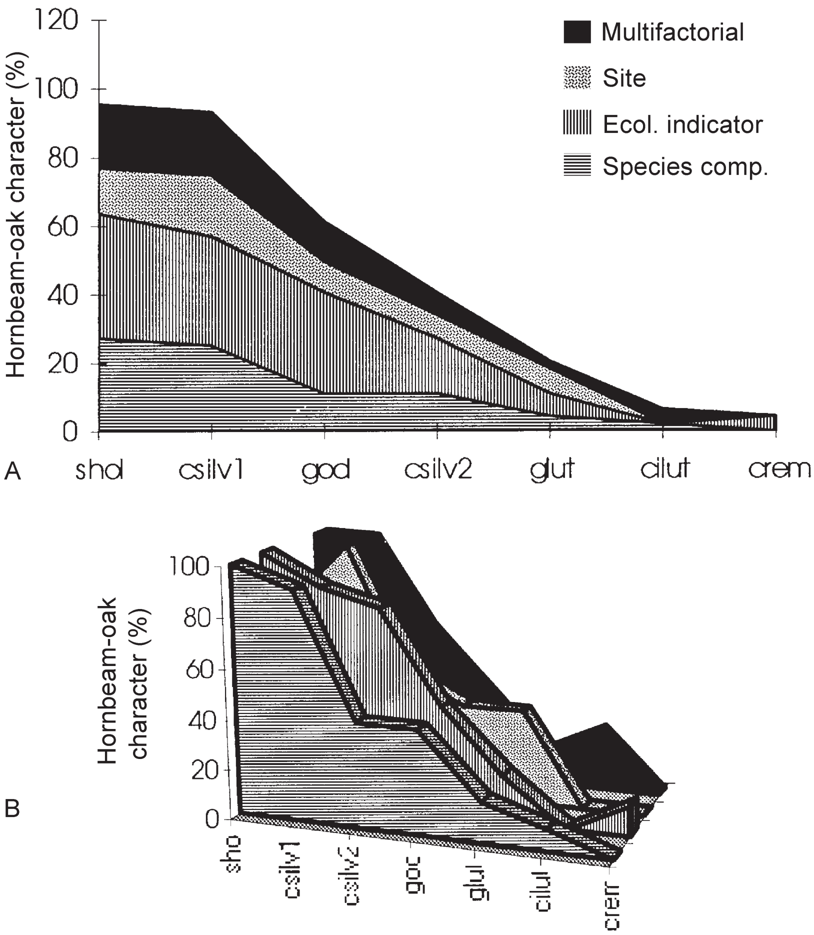

Fig. 6. Percentage hornbeam-oak characteristic of different types of hornbeam-oak forests and hardwood groves by 22 different points of view. – A = Change of characteristics in transition between hornbeam-oak forests and hardwood groves. – B = Transition between hornbeam-oak forests and hardwood groves by different methods of analysis

Multifactorial analyses

19. Cluster analysis: hornbeam-oak forests separate from "typical" hardwood groves and *Galeobdolon luteum* type.

20. PCoA (all relevés): there are zones of "only hornbeam-oak forests" and "only hardwood groves"; between them is a transitory zone, where relevés of all types – except *Carex remota* type – can be found.

21. PCoA (relevés except some very degraded ones): hornbeam-oak forests are separated well from most hardwood grove relevés. In transitory zone there are relevés of *Galium odoratum*, *Carex sylvatica* and *Circaea lutetiana* types.

22. Multifactorial analyses of type averages of ecological indicator values: *Galium odoratum* type of hardwood groves is joined in all cases, *Carex sylvatica* type of hardwood groves is joined twice out of three to hornbeam-oak forests.

CONCLUSIONS

Summarising data of Table 1 (Fig. 6a) supports that besides "typical" hornbeam-oak forests or hardwood groves stands "transitory" types also exist; it cannot be determined unambiguously, which community they belong to. According to their species composition – this is the base of classical coenological classification – they stand closer to hardwood groves, so they have been regarded as those. Existence of a "transitory" category is most obvious looking at site data, in lesser extent (at 2 types) at the results of multifactorial analyses. Ecological indicator values stress continuity (Fig. 6b).

How consequent are the results obtained by these different analysis methods?

The shapes of the four graphs are similar (Fig. 6b), there are inside a 25% wide zone. The only exception is the *Galium odoratum* type: regarding its ecological indicator values (calculated on the basis of herb layer data) it looks very hornbeam-oak like.

This deviation can be explained by the fact that herb layer of this type with masses of *Galium odoratum*, *Hedera helix*, *Pulmonaria officinalis* – which species determine in great extent the results of analyses based on cover data – is very similar to that of hornbeam-oak forests; hardwood grove character of this type is realised in accompanying species of canopy and in shrub layer; in herb layer species characteristic of hardwood grove appear, but their cover is not significant.

Based on the results above we can conclude that categories of classical coenology are not always sufficient for preparing a vegetation map, not even in near-natural areas. On the one hand we need "anthropogenic" categories (Seregélyes 1995), on the other hand – if study area lies at the border zone of

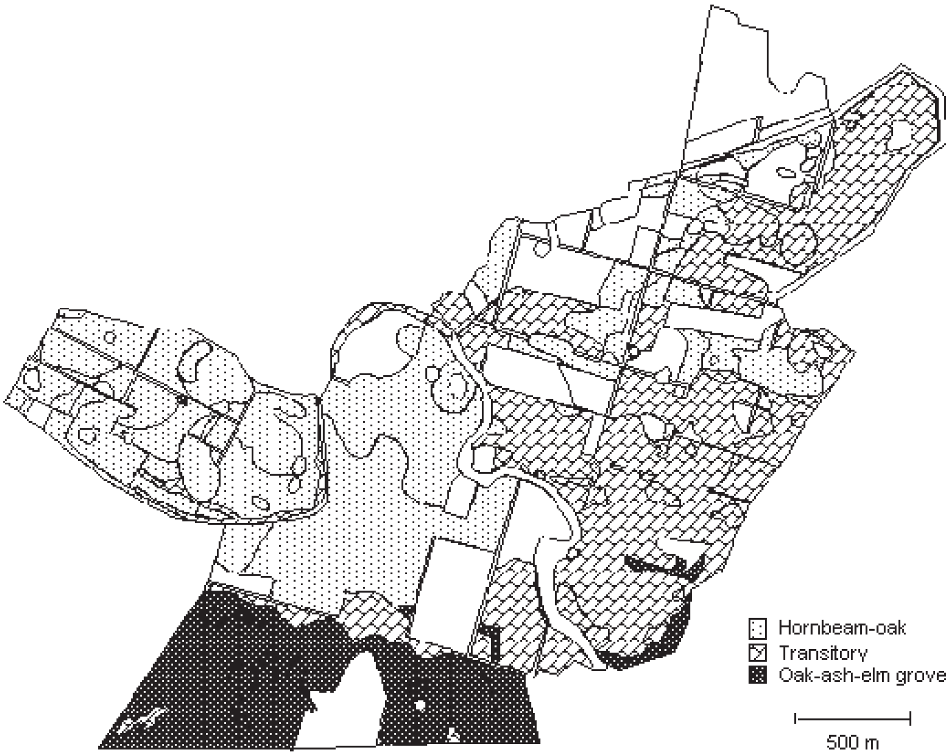

Fig. 7. Vegetation map with "typical" and "transitory" categories

two widespread communities – in this case the almost zonal hornbeam-oak forests and hardwood groves; – and one environmental factor, which plays major role in separating these two communities – in this case water availability – changes continuously, importance of "transitory" categories can be of equal importance to classical coenological ones (Fig. 7).

*

Acknowledgement – Our research was supported by the PhD School of Botany JPTE, Pécs.

REFERENCES

Bagi, I. (1997a): Átalakuló homoki vegetáció a Duna–Tisza közén. – *Kitaibelia* **2**(2): 253–264.
Bagi, I. (1997b): *A vegetációtérképezés elméleti kérdései.* – Kand. diss. thes., JATE, Szeged, 17 pp. (mscr.)
Bagi, I. (1998): A Zürich-Montpellier fitocönológiai iskola lehetőségei és korlátai a vegetáció dokumentálásában. – *Tilia* **6**: 239–252.

Borhidi, A. (1961): Klimadiagramme und klimazonale Karten Ungarns. – *Ann. Univ. Budapest., Ser. Biol.* **4**: 21–50.

Borhidi, A. (1963): Die Zönologie des Verbandes Fagion illyricum I. Allgemeiner Teil. – *Acta Bot. Hung.* **9**: 259–297.

Borhidi, A. (1965): Die Zönologie des Verbandes Fagion illyricum II. Systematischer Teil. – *Acta Bot. Hung.* **11**: 53–102.

Borhidi, A. (1995): Social behaviour types, the naturalness and relative ecological indicator values of the higher plants in the Hungarian flora. – *Acta Bot. Hung.* **39**(1–2): 97–181.

Fekete, G. (1995): Fitocönológia és vegetációtan: hazai aspektusok. – *Bot. Közlem.* **82**(1–2): 107–127.

Fekete, G. (1998): Vegetációtérképezés: Visszatekintés és hazai körkép. – *Bot. Közlem.* **85**(1–2): 17–29.

Fekete, G., Molnár, Zs. and Horváth, F. (1997): A magyarországi élőhelyek leírása, határozója és a Nemzeti hely-osztályozási Rendszer. – MTA ÖBKI–MTM, Vácrátót–Budapest.

Járai-Komlódi, M. (1958a): Die Pflanzengesellschaften in dem Turjángebiet von Ócsa-Dabas. – *Acta Bot. Hung.* **4**: 63–92.

Járai-Komlódi, M. (1958b): Sukzessionsstudien in Eschen-Erlenbruchwäldern des Donau-Theiss-Zwischenstromgebietes. – *Ann. Univ. Budapest., Sect. Biol.* **2**: 113–122.

Juhász-Nagy, P. (1957): A Beregi-sík rét-legelőtársulásai. – *Acta Univ. Debrecen.* pp. 195–228.

Jusztin, I. and Körmöczi, L. (2000): Homoki gyepközösségek határzónájának szezonális változása. – *Acta Biologica Debrecina*, Suppl., **1161**: 2000.

Kárpáti, I. (1958): *A Duna-ártér erdei.* – Diss. thes., Budapest.

Kárpáti, I. (1985): *Az ártéri szintek geomorfológiai- és vegetáció-szukcessziójának kapcsolata.* – In: Fekete, G. (ed.): A cönológiai szukcesszió kérdései. Akadémiai Kiadó, Budapest, pp. 73–82.

Kárpáti, I. and Kárpáti, V. (1958): A hazai Duna-ártér erdőtípusai. – *Az Erdő* **7**: 307–318.

Kevey, B. (1993): *A Szigetköz ligeterdeinek összehasonlító cönológiai vizsgálata.* – Kand. diss., JPTE, Pécs. (mscr.)

Kevey, B. (1998): A Szigetköz erdeinek szukcessziós viszonyai. – *Kitaibelia* **3**(1): 47–63.

Majer, A. (1968): *Magyarország erdőtársulásai.* – Akadémiai Kiadó, Budapest.

Ortmann-né Ajkai, A. (1998a): Vegetation mapping as a base of botanical GIS applications II. Vegetation map of the Vajszló forest (SW Hungary). – *Acta Bot. Hung.* **41**(1–4): 193–227.

Ortmann-né Ajkai, A. (1998b): *Vegetációtérképezés a Drávamenti-síkság erdőiben: Cönológiai és térinformatikai elemzések.* – PhD diss., JPTE, Pécs, 84 pp. (mscr.)

Papp, T. (1975): *A természetes felújítás lehetőségei és módszerei a Dráva menti tölgyesekben.* – Doktori ért., Pécs. (mscr.)

Seregélyes, T. and S. Csomós, Á. (1995): Hogyan készítsünk vegetációtérképet? – *Tilia* **1**: 158–169.

Simon, T. (1957): *Die Wälder des nördlichen Alföld.* (Az Észak-Alföld erdői). – Akadémiai Kiadó, Budapest, 172 pp.

Standovár, T. (1995): "Növényzeti minták" klasszifikációja. – *Tilia* **1**: 145–157.

Turós, L. (1995): *Az Ormányság erdő- és vadgazdálkodása.* Tanulmány a FAO számára. – Vajszló. (mscr.)

Zólyomi, B. (1934): A Hanság növényszövetkezetei. (Die Pflanzengesellschaften des Hanság). – *Vasi Szemle* **1**: 146–174.

Zólyomi, B. (1937): A Szigetköz növénytani kutatásának eredményei. – *Bot. Közlem.* **34**: 169–192.