LANDSCAPE PREFERENCE STUDY OF AGRICULTURAL LANDSCAPES IN GERMANY

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Summary: This paper reports the results of a landscape preference study using photographs of agricultural landscapes from Germany as stimuli. At present, agricultural landscapes are subject to innovations in agricultural management as well as climate change. Hence, large-scale changes of landscapes with regard to their structure, appearance or diversity are likely in the future. A survey was carried out among inhabitants of different parts of Germany, with questions regarding demographic factors (e.g. sex, age, school and professional qualification, importance of nature and environment, frequency of outdoor trips) as well as different scenic qualities such as variety, uniqueness and beauty of landscape. The study explores various factors to account for variability in preference judgements for particular agricultural landscape scenes, including mainly different types of meadows, pastures and arable land. Variance is examined and discussed in relation to the level of preference/ scenic quality, in relation to possible group differences, and in relation to phytosociological typology. Finally, potential topics for further research are discussed.

Introduction

Scenic values, especially variety, beauty and uniqueness of landscapes, are a basis for both human recreation in nature or landscape and the leisure industry as an economic branch that has become more and more important in recent decades (TIPS and SAVASDISARA 1986, PURCELL et al. 1994, NOHL 2001). Many regions in Europe and even worldwide are competing for tourists by attracting them with a more or less distinctive landscape scenery.

There is a consensus that visual landscape assessment is an indispensable component of landscape and environmental planning, which aim at both ensuring and enhancing landscape beauty, variety and uniqueness and providing guidelines and recommendations for infrastructure and urban development projects within the framework of impact assessment instruments such as environmental impact assessment (EIA) or strategic environmental assessment (SEA), either according to European law or to impact regulations as part of national legal systems (KRAUSE 2001, NOHL 2001, TURNER 2004, LEWIS 2008). The main idea of those impact assessment instruments is to avoid and to mitigate impairments to landscape scenery and even to compensate for inevitable impairments to landscape scenery by specific measures.

In order to achieve the above-mentioned aims, special assessment methods that also ensure common scientific standards are needed (HERZOG 1985, ARRIAZA et al. 2004, LAFORTEZZA et al. 2008, BULUT and YILMAZ 2009, ODE et al. 2009, SEVENANT and ANTROP 2009). In Germany, more than 150 visual landscape assessment methods have been developed and described (KENNEWEG and GRUEHN 2001), most of them based on single expert ratings. As pointed out in figure 1, according to a landscape survey carried out

by Gruehn et al. (2007) in the German federal state of Saxony, single expert ratings are extremely debatable, because the maximum difference of two single expert ratings may reach 10 ranks on a scale from 0 to 10. Figure 1 reveals similar results for single layman ratings as well as for single layman ratings compared to single expert ratings.

In contrast to this, mean differences between expert and layman landscape preferences based on a random sample (n = 600) are less than 1 rank and mostly even not significant (p ≤ 0.05, Mann-Whitney U test).

Our conclusions from the above-mentioned survey are as follows:
• Single case studies or single (expert) judgements are scientifically inadequate
• More empirical surveys are needed to better understand, to assess and to model landscape scenery of specific landscape types reflecting perception by different social groups.
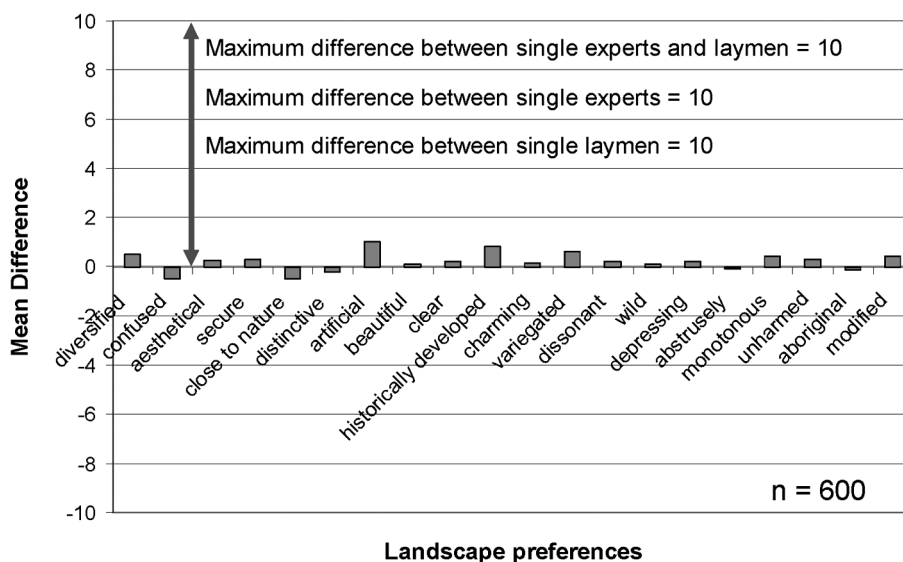

Figure 1. Mean differences between landscape preferences of experts and laymen
1. ábra A szakemberek és átlagemberek tájpreferenciáiban rejlő átlagos különbségek

Our current research aims at extending knowledge on landscape perception as a scientific basis for visual landscape assessment in landscape and environmental planning practice. On the one hand, it is intended to acquire accurate information concerning landscape perception in different landscape types with a main focus in Europe, but in future also including ratings from people with non-European background (cross-cultural-studies). A further attempt is dedicated to the connection between scale and data resolution, especially the resolution of land-use and habitat data as a basis for large-scale assessments. A severe scientific problem is connected to the transfer of correlations derived from highly aggregated data level to less aggregated levels (Bahrenberg et al. 1985). Robinson (1950) discovered and defined this problem as 'ecological fallacy'. To avoid false conclusions, especially in planning practice, more detailed and scale-related knowledge about landscape perception of different landscape types on different aggregation levels is needed.

Recent landscape preference studies reveal that scenic quality to a considerable extent depends on the proportion of agricultural landscapes (ROTH and GRUEHN 2005; GRUEHN et al. 2007). In most Central European countries about 60% of total area is covered by agricultural landscapes, e.g. in Germany. At present, agricultural landscapes are subject to innovations in cultivation management as well as climate change. Hence, large-scale changes of agricultural landscapes with regard to their structure, appearance or diversity are likely in the future.

The core question in this context is whether landscape perception is only dependent on the proportion of agricultural land within a certain landscape, or whether landscape perception depends on the mixture of different vegetation types within a landscape as well.

A survey was carried out among inhabitants of different parts of Germany as well as from Asia, with questions concerning different scenic qualities such as variety, uniqueness and beauty of agricultural landscapes as well as demographic or sociological factors (e.g. sex, age, education, importance of nature and environment, frequency of outdoor trips).

The goal of the study was to test the following research hypotheses:

- Landscape perception of agricultural landscapes is affected by composition and appearance of vegetation (=types of meadows, pastures, arable land etc. determined by ecological as well as land use factors);
- Landscape perception of agricultural landscapes is affected by spatial resolution of vegetation data;
- Landscape perception of agricultural landscapes is more or less independent from demographic factors.

Materials and methods

The methods used in our research are theoretically based on the psychological-phenomenological approach (NOHL 2001). This approach comprises the real landscape (on an objective level), the viewer (on a subjective level) as well as the scenic landscape quality as an interface between real landscape and viewer (image level). According to NOHL (2001), scenic quality can be described as aesthetically-symbolically interpreted appearance of landscape. Since ratings of single viewers to a large extend reflect subjective experiences, expectations, visions etc. we use large random samples ($n \geq 100$) to avoid biases. For practical and economical reasons we replace ratings in real landscapes by ratings of photographs (of real landscapes). According to ROTH and GRUEHN (2005) and ROTH (2006) this approach is justified by a strong correlation between people's ratings of real landscapes and their photograph- based ratings. Data acquisition was carried out by traditional questionnaires, but will be replaced more and more by validated Internet surveys (ROTH 2006).

The questionnaires contain a broad range of different landscape preferences as listed in figure 1. The data base comprises the ratings of 171 interviewees from 2 different regions of Germany (Northern Germany and Southern Germany) as well as from Asia. Those regions differ from each other in terms of climate and soil conditions and with regard to their potential natural vegetation as well as their agricultural land use. The definition of vegetation types equates to the systematic approach of MERTZ (2000), reflecting results from OBERDORFER (1994) as well as POTT (1995). 35 photos of different agricultural vegetation types were investigated as listed in Table 1.

Agricultural Vegetation Types	Phytosociological Nomenclature (Association-level)
Dog Rose - Juniper Coppice	Roso-Juniperetum
Hairy Greenweed Heath	Genisto-Pilosae-Callunetum
Senecio sylvaticus - Fireweed Association	Senecio sylvatici-Epilobietum angustifolii
Wood Small-reed Association	Calamagrostietum epigeji
Hemp Agrimony Association	Eupatorietum cannabini
Root Chervil - Common Butterbur Association	Chaerophyllo-Petasitetum hybridii
Parsley Piert - German Chamomile Association	Alchemillo arvensis-Matricarietum
Echium-Melilot Scrub	Echio-Meliloletum
Tall Oat Grass Meadow	Arrhenatheretum elatioris
Mountainous Tall Oat Grass Meadow	Alchemillo-Arrhenatheretum elatioris
Bulbuous Buttercup -Tall Oat Grass Meadow	Ranunculo bulbosi-Arrhenatheretum
Meadow Sage - Tall Oat Grass Meadow	Salvio-Arrhenatheretum
Meadow Foxtail Association	Alopecuretum pratensis
Yellow Oat Grass Meadow	Trisetetum flavescentis
North Alpine Yellow Oat Grass Meadow	Astrantio-Trisetetum
Baldmoney Meadow	Meo-Trisetetum flavescentis
Perennial Ryegrass Pasture	Lolio-Cynosuretum
Alpine Eutrophic Pasture	Crepido aureae-Festucetum rubrae
Red Fescue - Bentgrass Pasture	Festuco commutatae-Cynosuretum
Subalpine Crested Dog's Tail Pasture	Crepido-Cynosuretum
Perennial Ryegrass - Greater Plantain-Association	Lolio-Plantaginetum majoris
Erect Brome - Mesoxerophytic Grassland	Mesobrometum erecti
Oligotrophic Calcareous Pasture	Gentiano-Koelerietum pyramidatae
Oligotrophic Calcareous Mesoxerophytic Grassland	Onobrychido viciifoliae-Brometum
Erect Brome - Xerophytic Grassland	Xerobrometum erecti
Alsatia Xerophytic Grassland	Artemisio albae-Koelerietum vallesianae

Table 1. Agricultural vegetation types investigated according to Mertz (2000).
1. táblázat Mezőgazdasági vegetáció típusok Mertz (2000) szerint

In order to analyse effects of demographic factors on landscape perception the questionnaires also contain demographic variables, e.g. sex, age, education etc. We use inference statistics to test effects of certain factor variables on their significance. For statistical analyses parametric and non-parametric methods are used according to mathematical prerequisites with SPSS 17.0.

Results

Figure 2 points out visual landscape quality assessment of 35 photos of different agricultural vegetation types by four groups of different origin (Northern Germany, Southern Germany, Asia and unknown origin). The results reveal that there are no significant differences in landscape perception among the groups mentioned (Kruskal-Wallis one-way analysis of variance) or the effect is of no relevance (ANOVA), because of a very low eta-squared.

Figure 3 represents visual landscape quality assessment results of a Tall Oat Grass Meadow (*Arrhenatheretum elatioris*) by the above-mentioned groups from Northern and Southern Germany, Asia and unknown origin. The results clearly indicate that there are no significant differences in the ratings of the four groups (Kruskal-Wallis one-way analysis of variance). A similar approach was followed using photos from four different tall oat grass meadows. Again, statistical analysis reveals no significant differences in landscape perception for the different groups mentioned above.
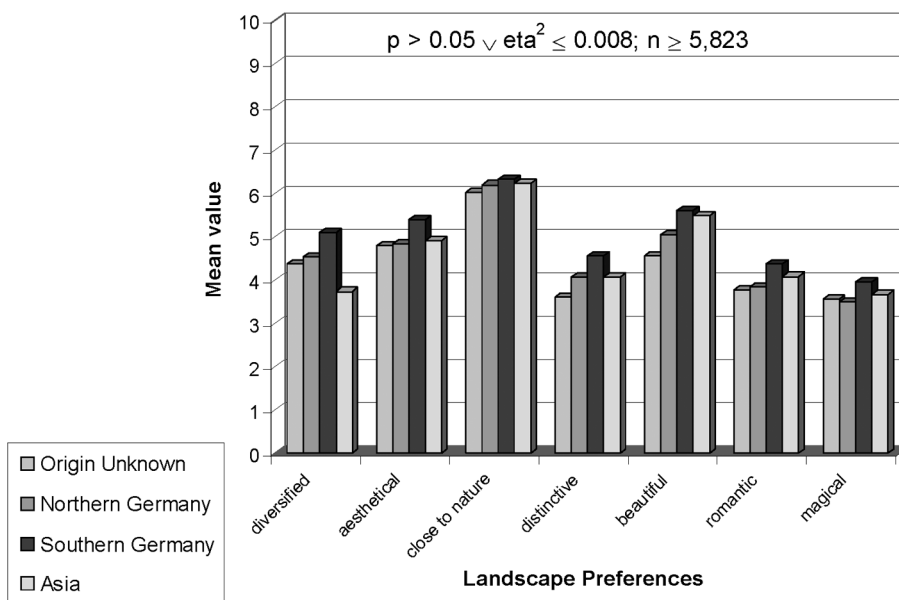

Figure 2. Visual landscape quality assessment of 35 photos of different agricultural vegetation types by 4 groups of different origin
2. ábra 35 mezőgazdasági vegetációtípus fotójának vizuális tájminőség értékelése
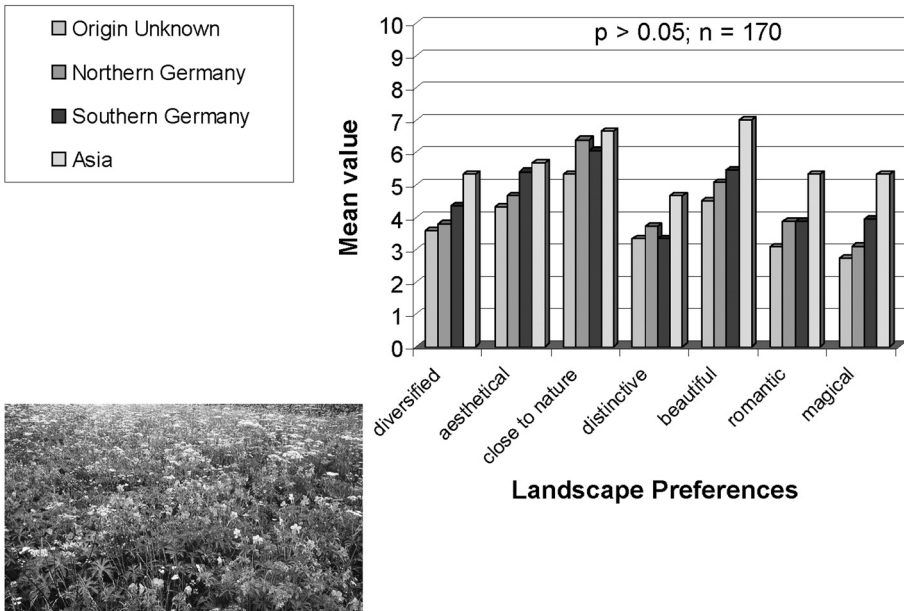4 különböző eredetű csoporttól

Figure 3. Visual landscape quality assessment of tall oat grass meadow *(Arrhenatheretum elatioris)*
by 4 groups of different origin
3. ábra A franciaperjés kaszálórét *(Arrhenatheretum elatioris)* vizuális tájminőség értékelése
4 különböző eredetű csoporttól

Figure 4 illustrates a comparison of two different agricultural vegetation types, a Bulbous Buttercup – Tall Oat Grass-Meadow (Ranunculo bulbosi-Arrhenatheretum) compared to Perennial Ryegrass-Greater Plantain-Association (Lolio-Plantaginetum). These entities represent the most extreme differences concerning the landscape preferences of all agricultural vegetation types investigated. The assessment was done by an overall sample, comprising the above-mentioned groups from different origin, mainly Germany and Asia. The results indicate not only considerable, but also significant differences (Mann-Whitney U) between both agricultural vegetation types concerning all variables. The interviewees significantly prefer Bulbous Buttercup – Tall Oat Grass-Meadows compared to Perennial Ryegrass – Greater Plantain-Association. The Bulbous Buttercup – Tall Oat Grass-Meadow is perceived as more diversified, more aesthetical, closer to nature, more beautiful, romantic and magical. Eta-squared values – as indicator for the ratio of variance explained in the dependent variable by a predictor (factor variable) – range from 0.104 ("close to nature") to 0.722 ("beautiful").
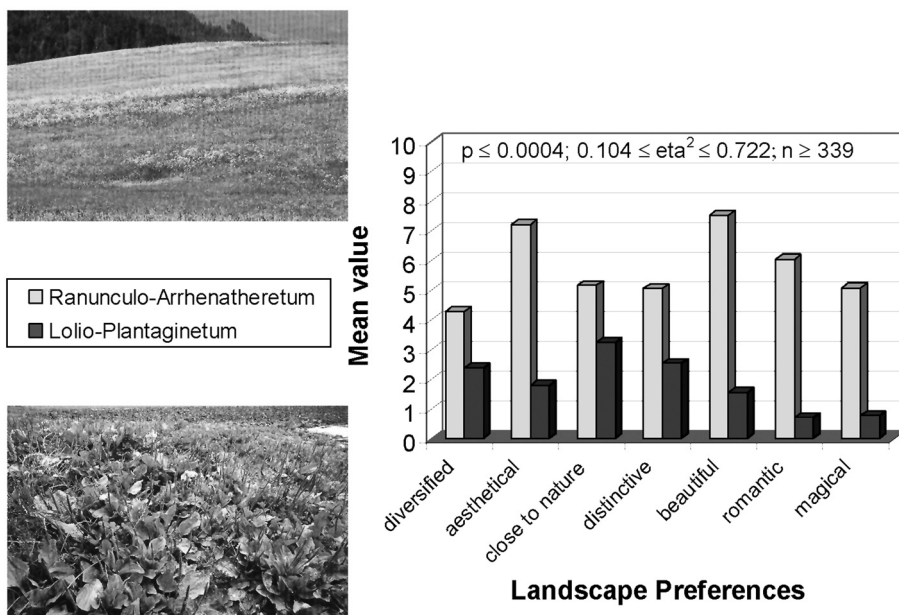
Figure 4. Visual landscape quality assessment of bulbous buttercup – tall oat grass-meadow
(Ranunculo bulbosi-Arrhenatheretum) compared to perennial ryegrass – greater plantain-association
(Lolio-Plantaginetum)
4. ábra A borjúpázsisos pusztai csenkeszrét társulás dombvidéki, vikariáns asszociációjának
(Ranunculo bulbosi-Arrhenatheretum) és a nagy útifű társulásnak *(Lolio-Plantaginetum)*
az összehasonlító vizuális tájminőség értékelése

Figure 5 summarises the landscape preferences of 171 interviewees concerning 35 photos of different agricultural vegetation associations in a two-dimensional diagram (beauty vs. variety). According to this there are some associations which have been regarded as of high beauty and high variety, e.g. Parsley Piert - German Chamomile Association (Alchemillo arvensis - Matricarietum). Additionally figure 5 indicates agricultural vegetation associations which have been regarded as of low beauty and variety, for instance Perennial Ryegrass – Greater Plantain-Association. Other agricultural vegetation associations are characterised by high beauty and low variety (e.g. Bulbous Buttercup – Tall Oat Grass-Meadow (Ranunculo bulbosi-Arrhenatheretum) or minor beauty but medium variety (e.g. Yellow Oat Grass Meadow (*Trisetetum flavescentis*)). The differentiation of agricultural vegetation types on association level explains 22.9 % of the total variation of preferences concerning "beauty" and 15.7 % of the variation of preferences with regard to "variety".
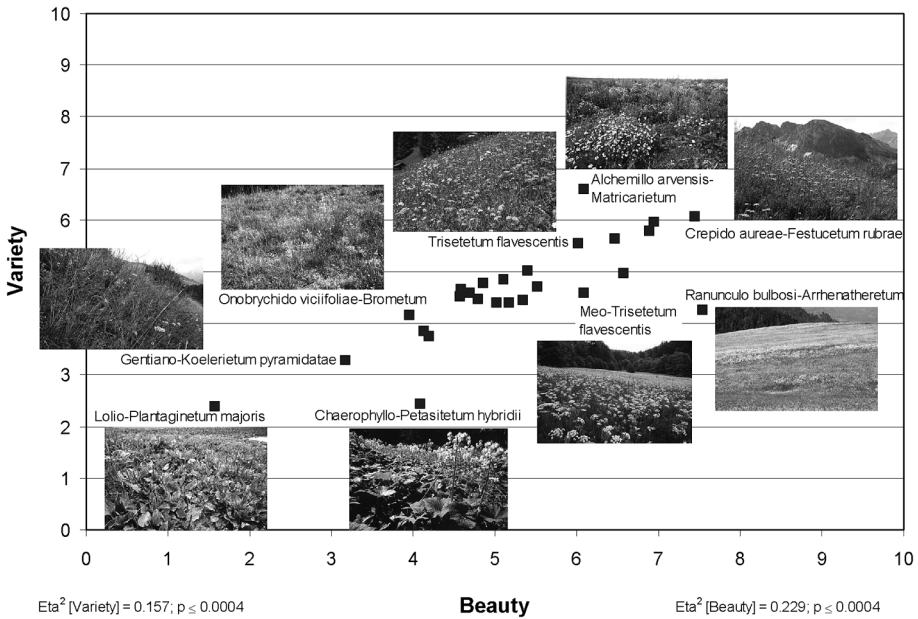
Figure 5. Landscape preferences (beauty vs. variety) in dependence to different agricultural vegetation associations (mean values, 171 interviewees, 35 photos of different)
5. ábra Tájpreferenciák (szépség a sokféleséggel szemben) a különböző mezőgazdasági növényasszociációk függvényében (átlagértékek, 171 megkérdezett, 35 fotó)

Compared to landscape preference assessments on association level, assessments on alliance, formation or class level are more generalised as figures 6 (perceived beauty and 7 (perceived variety) clearly indicate a reduction of variation. The differences between varied or beautiful agricultural vegetation alliances, formations or classes are smaller than those on an association level. Consequently, eta-squared values are lower than discussed with regard to figures 6 and 7. The less aggregated and therefore the higher the spatial resolution is, the higher are the eta-squared-values. This means that differentiated data with high spatial resolution are more appropriate for visual landscape assessment purposes than aggregated data with less spatial resolution.
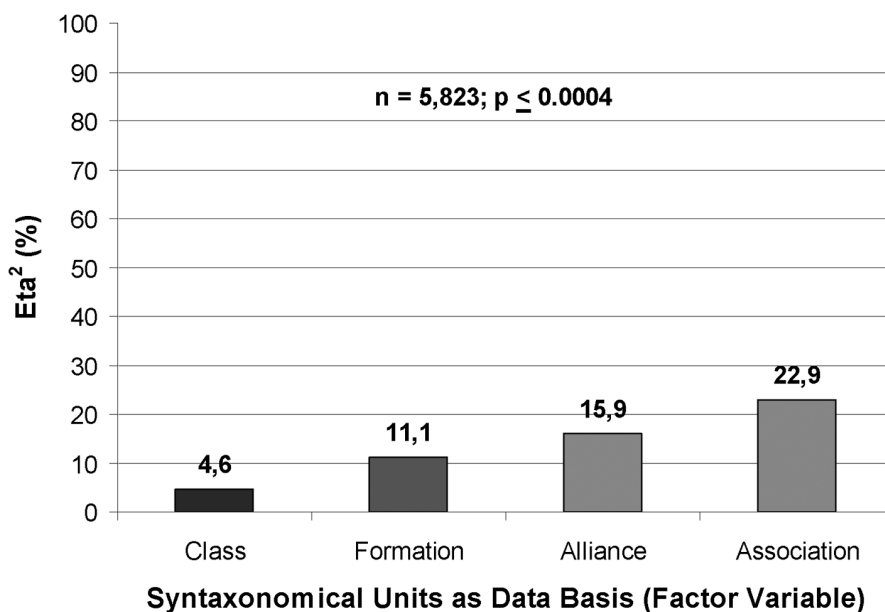
Figure 6. Effect of spatial resolution of vegetation data on landscape preferences:
ANOVA (criterion: perceived beauty)
6. ábra A vegetációadatok térbeli felbontásának hatása a tájpreferenciára:
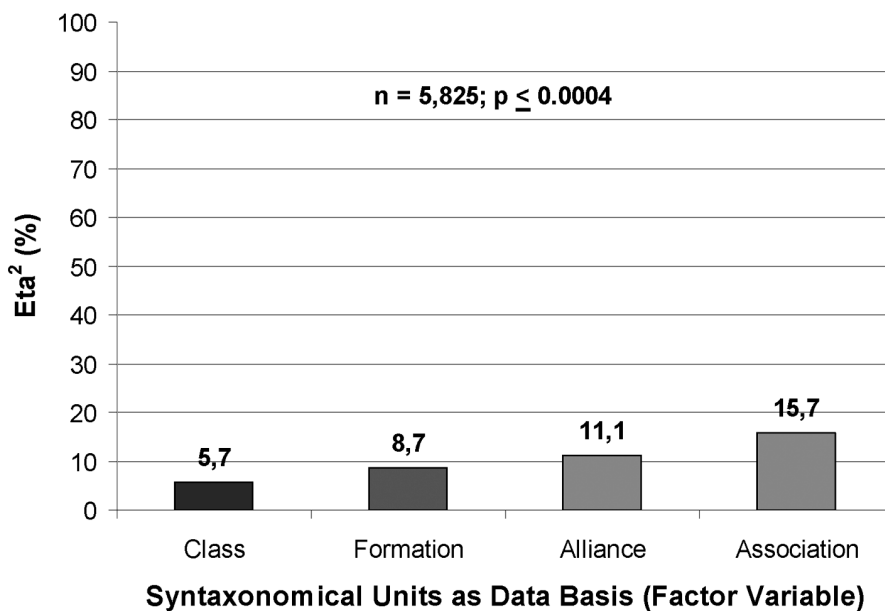ANOVA (kritérium: tapasztalt szépség)

Figure 7. Effect of spatial resolution of vegetation data on landscape preferences:
ANOVA (criterion: perceived variety)
7. ábra A vegetációadatok térbeli felbontásának hatása a tájpreferenciára:
ANOVA (kritérium: tapasztalt változatosság)

Effects of demographic and other predictors on landscape preferences concerning the criterion "perceived beauty" are presented in figure 8. Thus sex and education do not have effects on the perceived landscape beauty. In addition, it is worth mentioning that the perceived beauty of agricultural vegetation landscape due to extremely low eta-squared values is in practical terms independent of the age, importance of nature in the interviewee's life as well as their frequency of outdoor trips (Figure 8).
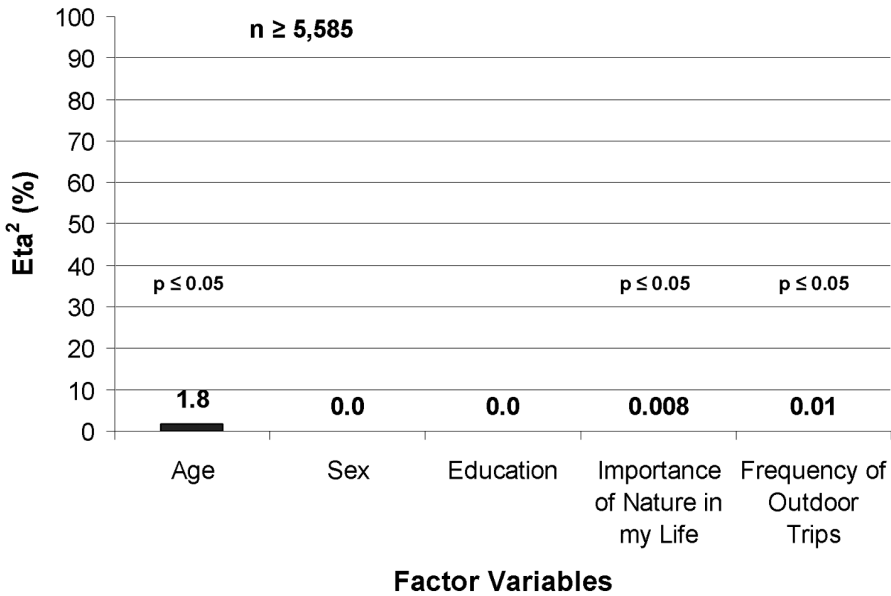

Figure 8. Effect of demographic and other factor variables on landscape preferences:
ANOVA (criterion: perceived beauty)
8. ábra Demográfiai és egyéb tényezőváltozók hatása a tájpreferenciákra:
ANOVA (kritérium: tapasztalt szépség)

Discussion

Whereas the data resolution of former research did not enable the distinction between different agricultural land use or habitat types, the results of the present study reveal that landscape perception is more affected by features of real (agricultural) landscapes on an object level according to Nohl (2001) than by demographic factors which more or less reflect subjective experiences on the subject level. As a consequence, future small-scale investigations of visual landscape assessment need a high resolution in terms of land use or habitat data. Further research should include types of meadows, pastures, heath land as well as bogs, which have been investigated in this study.

Owing to global warming, agricultural landscapes presumably will be affected and, therefore, agricultural landscape change scenarios considering scenic value of agricultural landscapes are needed.

The results supplement knowledge on landscape perception on different scale levels. In contrast to Bahrenberg et al. (1985) and Robinson (1950), a highly aggregated data level does not necessarily lead to overestimated coefficients in landscape preference studies.

In addition, the study confirms earlier results (GRUEHN et al. 2007, ROTH and GRUEHN 2005, ROTH 2006), that there are no significant differences in the way how people from different regions (e.g. Saxony vs. region of Berlin) perceive landscapes. Furthermore, it seems worthwhile to extend research on a European or even global level, including both interviewees as well as vegetation data from different countries.

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TÁJPREFERENCIA TANULMÁNY NÉMETORSZÁGI MEZŐGAZDASÁGI TÁJAKRÓL

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A cikk németországi mezőgazdasági tájakról készült fotók, mint ösztönzők által készített tájpreferencia vizsgálatok eredményeit közli. Jelenleg a mezőgazdasági tájak fejlesztés alatt állnak a mezőgazdasági vezetés irányítása alatt, csakúgy, mint a klímaváltozás szempontjából. Ennek megfelelően a jövőben nagyarányú változások várhatóak a tájban szerkezetükre, megjelenésükre vagy változatosságukra vonatkozóan. Németország különböző részein készültek felmérések a lakosság körében a demográfiai (pl. nem, kor, iskolai végzettség, szakma, a természet és környezet fontossága, a házon kívüli utak gyakorisága) viszonyokra, csakúgy, mint a különböző látvány minőségére (pl. a táj változatossága, egyedisége és szépsége) vonatkozóan. A tanulmány felfed különböző tényezőket, amelyek szerepet játszanak annak eldöntésében, hogy az egyes agrártájak (köztük elsősorban rétek, legelők és szántók) látványából melyiket preferálják, és azt hogyan döntik el. A változatosság vizsgálata és tárgyalása a preferenciához/látványminőség, a lehetséges csoportkülönbségek szintjéhez és a fitoszociológiai tipológiához kapcsolódik. Végezetül a további kutatásokra vonatkozó lehetséges témák tárgyalására kerül sor.