



## Orchards as traces of traditional agricultural landscape in Slovakia



Jana Špulerová<sup>a,\*</sup>, Veronika Piscová<sup>b</sup>, Katarína Gerhátová<sup>b</sup>, Andrej Bača<sup>b</sup>,  
Henrik Kalivoda<sup>a</sup>, Róbert Kanka<sup>a</sup>

<sup>a</sup> Institute of Landscape Ecology of the Slovak Academy of Sciences, P.O. Box 254, Štefánikova 3, 814 99 Bratislava, Slovakia

<sup>b</sup> Institute of Landscape Ecology of the Slovak Academy of Sciences, Branch Nitra, Akademická 2, 949 01 Nitra, Slovakia

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### ABSTRACT

Orchards are typical landscape features with a long history in traditional agricultural landscape management. They are situated from lowlands to mountains, mostly in upland areas, where natural conditions are favorable for fruit tree cultivation. Traditional orchard landscape that represents one class of traditional agricultural landscape (TAL) in Slovakia is created by mosaics of arable-land, grasslands and orchards and provides evidence of former small-scale farming in Slovakia. They are areas with irreplaceable ecological, landscape-aesthetic, social, cultural, historical and production values, and it is imperative that they are preserved for future generations as a memorial of the past. The aim of this research is to investigate distribution of traditional orchard landscapes in Slovakia and to evaluate their current state, the threats they face and their importance in biodiversity conservation and protection in traditionally cultivated farmland. Biodiversity assessment showed that forms of anthropogenic relief (balks) are islands of increased plant species richness with a mixture of species from surrounding grasslands, arable fields and orchards. Although traditional orchard landscapes are decreasing and their plots are threatened by abandonment or intensification, almost half are still regularly managed. Parts of abandoned traditional orchard landscape plots have already been changed to recreational landscape overgrown with shrubs and trees. Nevertheless, in order to preserve traditional orchard landscape structure and their scenery for future generations, we must institute new instruments to preserve traditional orchard landscape and its biodiversity.

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## 1. Introduction

Anthropogenic landscape deforestation with gradual transformation into an agricultural landscape has left its traces. Orchards, however, have a long tradition in Slovakia. They are part of the traditional agricultural landscape (TAL); mostly forming mosaics interspersed with other land use forms including the permanent grassland and arable fields adjoining dispersed settlements. They reflect own history of agricultural landscape, specific to each region. Archaeological findings demonstrate that apple, pear, peach and plum trees have been cultivated since 4–5 thousand years B.C. For example, a pear tree and a peach stone found in Danube lowland (Šárovce village, Palárikovo village) have been dated into 6th century B.C. Development of fruit and vine-growing

in south-eastern Slovakia below the Trenčín region was influenced by Roman legionaries from the 1st to the 4th century. These soldiers cultivated fruit trees and grapevines to supplement their daily diet (Komžík, 2007).

Orchards are significant landscape elements, creating and changing the landscape character and thus improving its beauty and adding to its interest (Komžík, 2009). Based on TAL classification in Slovakia (Špulerová et al., 2011), traditional orchard landscape is regarded as TAL with arable-land, grasslands and orchards. Orchards are also present in other classes, such as TAL with dispersed settlement, or TAL with vineyards. Traditional orchard landscapes promote high biodiversity in rural agricultural landscapes (Horak et al., 2013) and are considered to be species-rich High Nature Value Farming Systems in Europe (Bailey et al., 2010). The combination of land use and plots size provides information on land use and farming methods in given areas. The configuration of the surrounding landscape, e.g., landscape heterogeneity, habitat fragmentation, and connectivity, acts as a species filter that defines the regional species pool and controls seed flow (Gaujour et al., 2012). Although the importance of orchard meadows as fodder has decreased, their

\* Corresponding author. Tel.: +421 220920341.

E-mail addresses: [jana.spulerova@savba.sk](mailto:jana.spulerova@savba.sk) (J. Špulerová), [veronika.piscova@savba.sk](mailto:veronika.piscova@savba.sk) (V. Piscová), [katarina.gerhatova@savba.sk](mailto:katarina.gerhatova@savba.sk) (K. Gerhátová), [andrej.baca@savba.sk](mailto:andrej.baca@savba.sk) (A. Bača), [Henrik.Kalivoda@savba.sk](mailto:Henrik.Kalivoda@savba.sk) (H. Kalivoda), [robert.kanka@savba.sk](mailto:robert.kanka@savba.sk) (R. Kanka).

importance for biodiversity conservation in an intensive agricultural landscape is increasing (Žarnovičan, 2012). They influence on fauna dynamics and in some cases may provide important habitat for threatened species as well a refuge for arthropods, coleopterans and birds which otherwise cannot occur in modern, intensified agricultural landscapes (Herzog, 1998; Luck et al., 2014). Since flowering plant species on woody vegetation in hedgerows and orchards provided food for insects, they played a major role in biodiversity conservation and agro-ecosystem functions (Barbosa and Benrey, 1998; Minarro and Prida, 2013) and form one of the crucial levels in the trophic pyramid and pollination service (Klein et al., 2012). Coleopterans provide important ecosystem services as biocontrol agents in contributing to the regulation of key agricultural pests (Honek et al., 2014). Orchards significance as important habitats for birds is universally acknowledged, and some endangered species recognized throughout Europe nested in orchards (Myczko et al., 2013; Vogrin, 2011). Orchards managed in traditional way remain irreplaceable areas, with ecological, landscape-aesthetic, production, social, cultural and historical importance (Boček et al., 2008; Chen and Wu, 2011). Similar to other TAL classes, traditional orchard landscapes maintain the cultural heritage of agricultural land and therefore must be preserved for future generations as a memorial of the past (Štefunková and Dobrovodská, 2009).

Although traditional orchard landscapes have been preserved as only small remnants, mapping results illustrate their present and past significance. Because of their heterogeneous structure even in a relatively small area, traditional orchard landscapes are complex patches, which spatial patterns impacts ecological processes (Steffan-Dewenter et al., 2002). The aim of this research is to identify distribution of traditional orchard landscapes in Slovakia and to evaluate their current state and structure, threats they face and their importance in biodiversity conservation and protection in traditionally cultivated farmland.

## 2. Methodology

Our research centers on mosaics with traditionally managed orchard plots, unmodified during the socialist period in the second half of the last century. The field mapping was performed in accordance with methods approved for the nationwide TAL inventory within the whole territory of Slovakia (Dobrovodská et al., 2010). All together 3013 TAL plots were initially identified in 1 km<sup>2</sup> grid network on aerial photographs. The following characteristics of TAL were recorded from aerial images: (1) management intensity, (2) the presence of land use elements, (3) the abundance of woody vegetation, (4) land parcel shape, (5) relief configuration of individual parcels and (6) visible forms of anthropogenic relief. Simple random statistical sampling was used to select 20% of the sites located in the grid network for the natural-settlement nodal regions of Slovakia (Miklós, 2002), characteristics of which were verified in the field.

To study present land use, the following degrees of management intensity were determined from aerial photos: Managed areas; (1) more than 70% of regularly managed mosaics; (2) 30–70% of occasionally or regularly managed but partly abandoned mosaics and (3) less than 30% of managed plots containing mostly abandoned mosaics overgrown by shrubs and trees.

To study landscape pattern and its impact on biodiversity following characteristic were analyzed:

- land parcel shape: (1) narrow fields – where two parallel sides of the plots are at least twice as long as the remaining two sides, (2) rectangular – where plot sides are not markedly longer than other sides, and (3) plots with different shape to the previous two categories.

- relief configuration indicating field boundary directions: (1) along contour lines, where field boundaries run parallel to contour lines, (2) along the fall line, where field boundaries follow slope direction, and (3) mixed configurations.
- woody vegetation – shrubs, trees and small woodland complement TAL mosaic in the following three forms: (1) solitary trees, (2) linear vegetation and (3) small woodland.
- additionally, in order to track biodiversity forms of anthropogenic relief (balks) were studied in greater detail, including records on their structural characteristic, plant species composition and threats to traditional orchard landscapes maintenance. Eight variables collected in the field reflect the structure of forms of anthropogenic relief: type of bound (Ružičková et al., 1999), skeleton content, width, height, continuity of bounds, presence of land use elements, woody vegetation on bounds and continuity of wood cover. The habitats were described on the basis of species with the highest frequency, the extent of cover and protected and threatened species. The species' nomenclature followed Marhold and Hindák (1998). The vegetation provides habitat for fauna, therefore butterflies survey was conducted on selected habitats of traditional orchard landscape.

Distribution of traditional orchard landscape was expressed by area within the natural-settlement nodal regions of Slovakia (Miklós, 2002), the average plot area and percentage categories of individual characteristics. The interrelation between structural characteristic of traditional orchard landscape plots and variables of bounds were analyzed using statistical tests. The mode, as the value that appears most often in a set of data, was counted for each variable of traditional orchard landscape plots and for variable of bounds relevés. Because of the nominal – categorical data for parameters the Cramer's V tests (Liebetrau, 1983) was used for calculation of correlation between particular variables. The calculation was performed using Monte Carlo test 9999 iterations on 99% confidence interval.

## 3. Results

### 3.1. Distribution and land use of traditional orchard landscapes

Aerial photo interpretation and field survey established that traditional orchard landscapes cover 1883.44 ha of the Slovak Republic. These are remnants of traditional extensive farming unaffected by collectivization and accompanying dynamic land exploitation over the past 50 years. Collectivisation of agriculture lasted in Slovakia from 1955 to 1989 and was linked with hedges removal and transformation of mosaic of arable fields and semi-natural meadows to intensively utilized large-block fields (Bezák and Petrovič, 2006). Traditional orchard landscape plots are particularly prevalent in lowland to mountain areas, and especially in the upland areas following regions: Považský (Trenčiansko-Žilinský), Dolnozemplínsky, Gemersko-Novohradský, Šarišský, and Pohronský (Table 1). Major fruit-growing centers were also located in the Považie, Horná Nitra and Gemer regions in the 18th century; as described by Matej Bel's 1739 hand-written testimony "De rustica Hungarorum", deposited in the Budapest Széchényi Library.

Traditional orchard landscapes are classified in five types based on the presence and dominance of land-use elements; as in Špulerová et al. (2011):

- A.) Traditional orchard landscape with dominant arable land (Fig. 1a),
- B.) Traditional orchard landscape with dominant grasslands (Fig. 1b),
- C.) Traditional orchard landscape with dominant orchards (Fig. 1c),

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