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PLANTING SUSTAINABILITY? ON THE MANAGEMENT OF HEDGEROWS IN ALPINE BOCAGE LANDSCAPES

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The paper deals with hedgerows as a building material in cultural landscapes, focusing on the role of maintenance and management for their sustaining. Based on investigations carried out in several alpine regions, where hedgerow management has traditionally been an integrated part of peasant farming systems, a typology of hedgerows has been elaborated and linked to certain patterns of management. Historical and current economic contexts of peasant farming systems have been considered. The presented "cycle of maintenance and rejuvenation" – founded on the basic techniques of trimming, pollarding and coppicing – subsumes some general and recurring principles of hedgerow management, as practiced by mountain farmers. Taking this scheme as groundwork, ongoing dynamics in alpine bocage landscapes could be identified and linked to the transformations in alpine farming systems. By retracing changes in hedgerow management and their economic backgrounds we may reconsider possible success or failure of current efforts in implementing new hedgerows in alpine landscapes, in order to improve their ecological and aesthetic qualities. It is argued that planting of hedgerows may only contribute to sustainability and diversity of rural landscapes, if they are integrated into the current farm households` practice, their farming systems and the underlying economies of labour. It can be observed that without adequate maintenance and management, planting of hedgerows is not only reduced to decoration, but beyond may even become a serious problem for cultivation of the agricultural land. The paper summarizes some central aspects from research that has been published in more detail in a book project.

Keywords: cultural landscape, landscape management, agro-ecosystems, green infrastructure

1. Hedgerows as an outcome of cultivation

Hedgerows are constitutive design elements of the rural countryside. They have been acknowledged for their various effects on agricultural ecosystems, as well as for their significance for landscape aesthetics. Baudry et al. (2000) have figured out their importance for biodiversity, microclimate, soil-stabilisation and water regulation in various regions of the world. They have emphasized the multifunctional character of hedgerows, but – beyond that – have pointed out their integrated role within agro-ecosystems: Hedgerows function as living fences, in order to separate arable- from pastureland, and they provide facilities to produce various kinds of wood, fodder and litter (see also: Kurz and Machatschek, 2001). Rackham (1988), Burel (1996) and many other have reminded us, that bocage landscapes are the outcome of political movements, aiming at the enclosure of open common land, in order to intensify agricultural production, and to optimize natural resource management in the age of pre fossil agro-ecosystems. In alpine regions, bocage landscapes have been established to replace and compensate peasants` various utilization of extensive forests (pasturing, wood, littering...) to provide the support for mining industries (Bauer, 1925; Koller, 1970; Kurz et al., 2011). On that background, hedgerows have become an integrated part of peasant farming economies. Peasant farmers have been developing techniques and knowledge on their maintenance and management, referring to biological preconditions, economies of labour and the products to be harvested out of the hedgerows (Busch, 1989). All this underlines the fact, that hedgerows are cultural elements of landscape, not naturally stable, but being dependent on recurrent maintenance and management. Peasant farmers have been developing typical management patterns to sustain hedgerows in their morphology and to regenerate their natural productivity. They have found ways of rejuvenating hedges over decades and even centuries (Baudry et al., 2000; Kurz et al., 2011). However, currently we find considerable evidence for dynamics in bocage landscapes, having their reasons in changes in hedgerow management and its abandonment. On the other hand, efforts of nature conservation and landscape planning on conserving established bocage landscapes and promoting the planting of new hedgerows are well known. Debates on the concept of "green infrastructure", have only recently updated the interest in hedgerows on European level (European Union, 2013). Within the

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"green infrastructure"-approach to landscape, planting of hedges is suggested as a measure to improve urban and rural countryside in terms of multifunctionality and resilience.

This paper focuses on the management of hedgerows in alpine landscapes and their changes in time. We provide an outline of the basic principles of hedgerow management, as it has been practiced and perfected by peasant farmers over centuries. We further highlight some economic backgrounds and sketch linkages between various types of management, referring to groves most frequently employed in alpine hedgerow landscapes. Based on that analysis we figure out evidence for ongoing changes in hedgerow management, trying to set them in context to developments in the history of regional agricultural land uses. Concluding, we take our insights as a starting point for discussing the preconditions for sustainability of current efforts in planting hedgerows in agricultural landscapes as an attempt to improve landscape qualities.

2. Material and methods

The paper is based on an explorative study conducted in several alpine regions (Salzkammergut, Eisenwurzen, Salzachtal, Lungau, Hohe Tauern).Research formed the groundwork for a book project on hedgerows and their management in the alpine area (Kurz et al., 2011). Investigations were carried out on various levels: a) Around 60 hedgerows were analysed in a comparative survey on their morphology, their management and their phytosociological structures, containing graphical mapping and photographic documentation. b) Phytosociological analysis was based on 200 records, adopting the method by Braun-Blanquet, 1964c) Empirical evidence was complemented by interviews with farmers, discussing current management strategies and former utilisations, aiming at a reconstruction of traditional knowledge on hedgerow management in context to the agricultural systems. Results of the investigations were organised in a typology of hedgerows, reflecting different management practices and regarding the diverse characteristics of wood species employed in alpine regions. d) Investigations on land-use history contained evaluation on historical archive data and literature on regional land-use history.

3. Results

Chapters 3.1. to 3.3. summarize some of the basic findings from our studies: 3.1. presents a synthesis of management patterns that form the groundwork of maintenance and rejuvenation in alpine bocage landscapes. 3.2. sets these patterns in relation to the most widespread groves in alpine hedgerows and their utilisation, referring to their ecological and biological characteristics. In 3.3. a chronology of hedgerows and their management in the alpine regions is retraced by reconnecting current types of management to evidence in land-use history.

3.1 Hedgerow morphology and management patterns: The cycle of regeneration

Fig. 1 gives an outline of the practices of hedgerow management and their effects on morphology and growth shaping alpine hedgerow types. The graphic schema is based on generalized depiction from cross-section perspective. Management is based on the practices of trimming (cutting of leaves and seasonal growths in annual frequency), pollarding (cutting of perennial wooden growths from an aged framework in 2–5 year frequency) and coppicing (utilizing the hedgerow as a linear coppice wood, cutting it down as a whole each 10–15 years). These management types express different economies of labour, providing different products out of the hedgerow (Fig. 1).

• The trimmed types

Trimmed types have been established to get dense, narrow hedges that

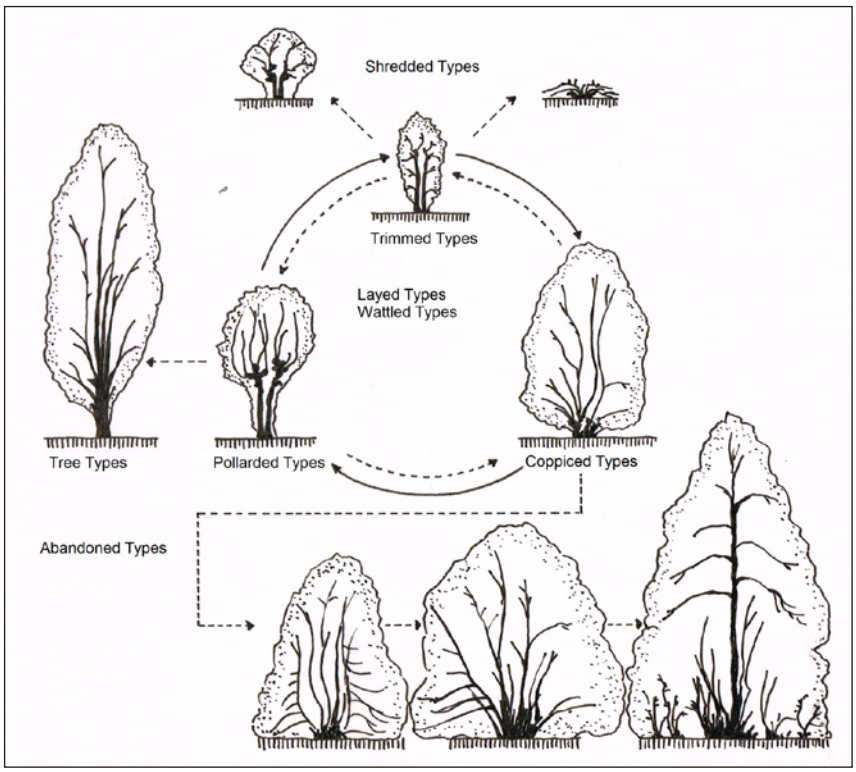

Figure 1 Management patterns and the cycle of management and regeneration

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function as fences, require little space and can be maintained using hand tools. These characteristics particularly were (and in some cases still are) important with smallholder peasant economies, poorly equipped with agricultural land. Products out of trimmed hedges are leaves for additional fodder and litter. These are the most labour-intensive types and nowadays rarely found in the rural countryside. By reducing the labour input, they can without any difficulty be transformed into pollarded types.

• The pollarded types

Forming a stable framework with a narrow basis, pollarded types also require little space while forming rather dense hedgerows. By rotational cutting the perennial wooden growths each 2–5 years, not only labour inputs can be regulated, but beyond pole crop and wood for various tools is to be harvested out of the hedgerow. Yield depends on the species cultivated and their wood characteristics. Particular variations of trimmed and pollarded types contain various layed and wattled types, where the living branches get formed, in order to achieve certain qualities of the hedgerow resp. its crops.

• The coppiced types

Coppiced types are characterised by their long periods of turnover, going hand in hand with strong dynamics in morphology. Stems are cut down near the ground level, which means that the hedgerow has to be re-shaped totally. Coppicing allows rejuvenating (trimmed or pollarded) hedgerows that have become jagged after long periods of continuous utilisation. After coppicing a new framework for a hedgerow can be built by trimming and pollarding. However, currently the majority of alpine hedgerows are maintained by coppicing, harvesting crop or firewood.

• Labour economies and the effects of abandonment

The outer circle of the management schema in Fig. 1 depicts the development paths most frequently to be observed in our survey. These contain transformations into tree-shaped types, emergence of gapped and atrophied forms as a result from mechanical shredding and formation of abandoned types, gradually expanding in their breadth and height (Fig. 2).

3.2 The groves of the hedgerow, their biology and their economy

Table 1 compiles ecological characteristics, constitutive management practices and important utilizations within peasant economies for the most widespread hedge groves in alpine landscapes. It figures out hazel (*Corylus avellana*) as the dominant grove in alpine hedgerows of the investigated regions. Hazel combines a wide spectrum of traditional uses with broad ecological amplitude and strong abilities to recover, which causes its competitiveness. Coppicing, the predominant current management practice, additionally fosters expansion of hazel. Other groves, such as hornbeam (*Carpinus betulus*), or Beech (*Fagus sylvatica*) which had been promoted as hedgerow groves historically (Koller, 1970), are currently seeing decline due to changes in management. While trimming and pollarding fit well to those species, recurrent coppicing weakens their ability to rejuvenate. It seems remarkable, that most of the peasant hedgerows are built from one single, or just a few species. The idea of the diverse hedgerow has to be seen as a rare exception to the rule. It also may be a question of labour economy to organise management around one or a few groves with similar attributes and qualities. Mixed, diverse hedgerows – on the other hand – can be found as a result from abandoned management, when cultivation factors get replaced by natural competition between grove species. This could be proofed by phytosociological analysis (Kurz and Machatschek, 2001), Tab 1.

Figure 2 Pollarded Hedgerow

3.3 Changing economies

Tracing the history of the establishment of hedgerows in alpine regions, we could identify several periods, being connected with the expansion of alpine mining industries. From 1600 to 1800 many new settlers were introduced as labourers, cultivating former common land, while – on the other hand – forestry for mining issues was intensified and peasant usage rights on wood and pasturing was gradually reduced (Bauer, 1925). In these times, hedgerows may have

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Table 1 Characteristics of important groves in alpine bocage landscapes

Species	Site specifics	Growth characteristics	Management practice	Utilization
Hazel (*Corylus avellana*)	– Most widely dispersed species in hedgerows of the alpine regions – Broad ecological amplitude, prefers fertile, but well drained soils	– pioneer plant, highly recoverable vegetatively and competitive, fast growing; produces numerous saplings after coppicing	**Coppicing type** – (5–15 years) frequently becomes dominant in extensively maintained and abandoned hedgerows	– basket weaving and other basketry – barrel hoops for transportation in salt and iron industries – wood for tools – firewood – leaves for fodder and littering
Blackthorn (*Prunus spinosa*)	– Demand for summery warm, preferentially fertile and alkaline soils	– Intensively branched shrub, slowly growing, well developed storing capacities in the root wood	– *Trimming* (2–5 years) or **coppicing type**, pollarding or frequent coppicing may cause rotting of stems and create gaps in the dense body of the hedgerow	– turning wood – rake wood – living fence
Hawthorn (*Crataegus monogyna, C. laevigata*)	– Important wood in hedgerows, but certain demands on soils and climate; in the alpine regions restricted to warmer sights with alkaline soils	– Not too fast growing, root- and stem storing type of wood; intensively branched and dense growth character	– **Trimming** (2–5 years) and **pollarding type**; reacts also well to **laying**	– living fence
Dogwood (*Cornus sanguinea*, C. mas)	– Well aerated soils in lower and warmer regions of the alpine area	– Slowly growing shrub with strong abilities of rejuvenation; well developed storing capacities in the root wood	– **Trimming** (1–3 years) or **pollarding type** (candelabra shape), rejuvenation through coppicing	– fruits – wood for turning and carpenting
Hornbeam (*Carpinus betulus*)	– Second most widely spread hedgerow wood in alpine regions, historically strongly promoted by planting; broad ecological amplitude, but constrained to the lower regions of valleys, up to 700 meters.	– Moderately growing, intensively branched and dense growth.	– **Trimming** (1–3 years) or **pollarding type** (candelabra shape), rejuvenation through coppicing, frequent coppicing may cause rotting of stems and create gaps	– wood for various utilizations: tools, turning wood, wagon making – leaves for fodder and littering – living fence
Beech (*Fagus sylvatica*)	– Needs well developed, fertile and humid, but well drained soils.	– Adaptable in its growth behaviour to management: develops a dense character when trimmed frequently.	– **Trimming** (1–3 years) or **pollarding type** (candelabra shape), rejuvenation through coppicing	– wood for various utilizations: tools, furniture – leaves for fodder and littering – living fence
Field maple (*Acer campestre*)	– Moderately fertile, stony and loamy sands, but restricted to the lower regions of the alpine area	– Moderately growing, well adaptable to frequent trimming	– **Trimming, pollarding or coppicing type,** as well as **laying or wattling types;** very mutable	– leaves for fodder and littering – living fence
Elder (Alnus incana, A. glutinosa)	– Prefers moist and wet soils with high groundwater level.	– Quickly growing; produces numerous saplings after coppicing, from which later on only few remain as stems, while the rest gets rotten	– Coppicing type, rotational cutting (10–15 years) forms the foundation for rejuvenation	– wood for various utilizations: tools, water buildings – leaves for fodder and littering – stabilisation of banks – draining

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Continued Table 1

Species	Site specifics	Growth characteristics	Management practice	Utilization
Black cherry (*Prunus padus*)	– Growth optimum on fertile, deep, moist and wet soils; on floodplains	– Quickly growing and competitive;	– **Coppicing type** (10–15 years)	– barrel hoops – firewood – draining
Ash (*Fraxinus excelsior*)	– Moisted, deep and fertile, preferably alkaline soiles, from lower up to mountainous areas.	– Quickly growing tree with strong abilities of rejuvenation by pollarding; ability to fix moving soils on slopes	– **Pollarding type**, if not pollarded grows quickly as a tree and can displace other woods in the hedgerow	– wood for various utilizations: tools, furniture – leaves for fodder and littering – stabilisation of banks and slopes

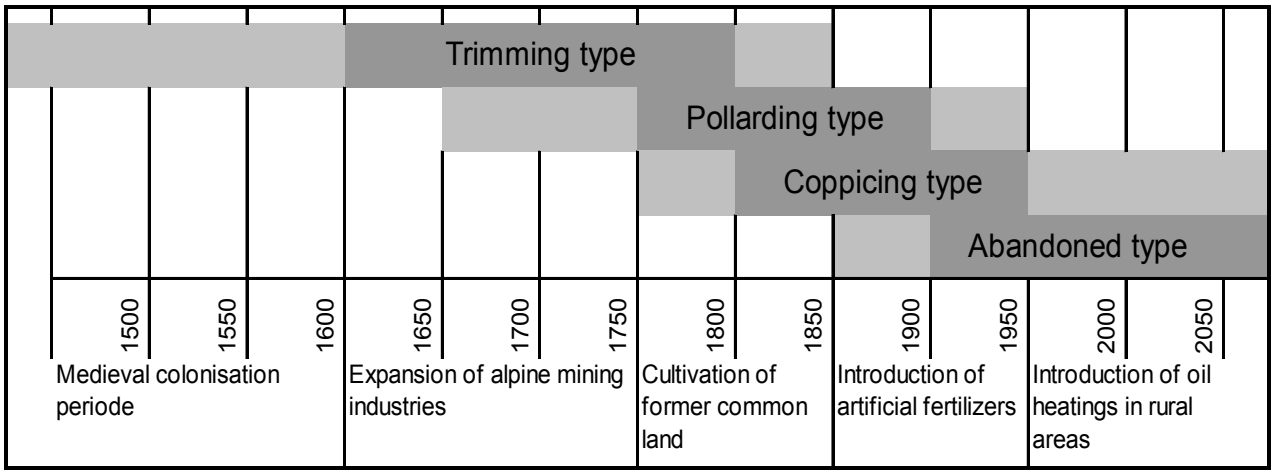

Figure 3 Chronology of hedgerow management

served as multifunctional features of pre-fossile peasant farming systems (Kurz et al., 2011). The loss of importance of hedgerows probably started with introduction of artificial fertilizers, beginning in the second half of the 19th century. Improvement of the fodder base for livestock devaluated the harvest of leaves as additional fodder and promoted transformations from trimming to pollarding and coppicing (Koller, 1970). Another considerable break can be identified from the 1950ies, when oil heating successively reached rural households and started the decline of wood as energy source. This assigned – in combination with ongoing mechanisations and technical rationalisations in land-use – the replacement of coppiced hedges by abandoned types (Fig. 3).

Figure 4 Reforestation initiated by abandoned hedgerows in the Salzachtal, Austria

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4. Discussion and conclusions Sustainable landscapes by planting hedgerows?

Hedgerows are cultivated nature, incorporating practical skills and knowledge on usage, stabilisation and regeneration. Management skills have been accumulated by generations of peasant farmers. Techniques and crafts are rooted in economic demands of sustaining the productivity of hedgerows as an integrated feature of farming systems, of keeping them stable in morphology and habitus. With advanced loss of economic backgrounds, we have to observe transformations in the appearance of hedgerows, influencing the character of whole landscapes as well: In mountain areas former hedgerows frequently have become the initial points for comprehensive processes of reforestation. One may question if these dynamics are appreciated effects in development of alpine cultural landscapes (Fig. 4).

In any case, the historical perspective claims critical and differentiated assessment of present initiatives in implementing hedgerows as a form of "green infrastructure" in rural landscapes. To improve multifunctionality, biodiversity and sustainability of the rural countryside, we should at any rate avoid trendy installations that either produce maintenance cost and waste, or contribute to the set-aside of farmland. Framework conditions for sustainability of newly introduced hedgerows shall be scrutinized thoroughly in every single case. Only if plans for the maintenance and a concept for management are already considered in the forefront of planting, a newly installed covey will contribute to sustainability. Beyond technical questions of stabilisation this will also require reasoning on the overall economy of possible generated yields. We agree with Hartke, who already had reminded us in the early 1950ies, that "Hedgerows are not a nostrum for our cultural landscapes. It is not enough to install or copy them to gain quick success, and to disclaim exhausting scientific labour in the run-up" (Hartke, 1951).

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