

MANAGEMENT STRATEGIES AND LANDSCAPE DIVERSITY IN COMMONLY GOVERNED MOUNTAIN PASTURES: A CASE STUDY FROM AUSTRIAN ALPS

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Abstract: The paper explores the relationships between alpine pasture management and pastoral landscape ecosystems, based on research set in the Austrian limestone Alps. The focus of inquiry is laid upon the different management practices employed by pasturing communities. Therefore, the concept of “farming styles”, as introduced by Ploeg (1994) is adapted. Five different types of alpine pasture management could be identified. Those types are investigated further on their impacts on natural environments of vegetation- and landscape patterns, taking diversity of plant communities as an indicator. It is figured out that management strategies as a central factor shaping diversity in mountain pastureland shall be considered in the design of agro-environmental policies and in nature conservation.

Key words: cultural landscape management, farming styles, pastoral landscapes, biodiversity, adaptive co-management, social-ecological systems.

Zusammenfassung: Im Aufsatz werden Zusammenhänge zwischen Formen der Alpbewirtschaftung und den alpinen Landschaftsökosystemen untersucht. Aufbauend auf eine Reihe von Fallstudien an Gemeinschaftsalmen in den Oberösterreichischen Kalkalpen wurden verschiedene Bewirtschaftungsstrategien herausgearbeitet. Es konnten 5 Typen der Alpbewirtschaftung identifiziert werden, die bezüglich ihrer Wirkung auf die Vegetations- und Landschaftsmuster, innerhalb derer sie verortet sind, analysiert wurden. Anhand der Beispiele wird gezeigt, wie die verschiedenen Formen der Bewirtschaftung die Diversität der Pflanzengemeinschaften der Alplandschaften beeinflussen. Darauf aufbauend wird für eine Berücksichtigung des Faktors der Bewirtschaftungsstrategien bei der Konzeption von Agrar-Umweltprogrammen sowie im Naturschutz argumentiert.

Schlüsselwörter: Kulturlandschaftsentwicklung, Almwirtschaft, Alpine Kulturlandschaft, Landschaftsplanung, sozial-ökologische Systeme, integriertes Landmanagement.

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1. Introduction

Pastoral landscapes are a formative feature of the European mountain countryside. Extensive pasturing systems have been shaping upland environments from the beginnings of human settlement, forming a complementary counterpart to intensive lowland agriculture (O'Rourke et al 2009). Due to their remote position, restricted accessibility and the need to adapt to difficult natural conditions, mountain pasturing systems have proven rather resistant to agricultural modernisation. Up to present day principles of so-called "traditional" land-use systems, as rotational uses, spatial fuzziness (Plieninger et al. 2006) and common governance (Nettig 1993) have persisted in mountain pasturing. In the Alps, management practices connected to alpine pasturing have created well-known typical landscape patterns, containing diverse mosaics of extensive grasslands, semi-wooded areas and woodland, which nowadays are appreciated for their high nature value and their multifunctionality (Trixl 2006, Holzner 2007). In Austria – for instance – a majority of Austrian Nature 2000-areas are situated within alpine pastureland, containing important repositories for biodiversity and priority habitats listed in the European Habitats Directive (92/43/EEC). Several of them, such as the types "siliceous alpine and boreal grasslands" (6150), "alpine and subalpine calcareous grasslands" (6170), or "species-rich *Nardus* grasslands, on silicious substrates in mountain areas" (6230) are the imminent product of alpine pasturing practices and techniques, depending on continuous human use and management (Glatz et al. 2006). At the same time, mountain pasturing systems – and with them pastoral landscapes and the associated ecosystems – have been recognized as being far from static. Only recently, O'Rourke and Kramm (2009, 2012) have highlighted the complex relationships between management practices, landscape dynamics and changing economic, social and political frameworks for Irish upland pasturing systems. Similar developments have been detected for uplands of the Alpine region, where mountain pasturing up to date gains remarkable importance (Kurz 2009): In Austria, where the period after World War II had experienced a strong decline of pasturing activities, reaching a negative peak in the 1970s (Zwittkowitz 1974, Baldele 1994), past years saw a "revival" of mountain pasturing, promoted by governmental efforts on sustaining pastoral landscapes. Subsidies granted for pasturing activities implicated a slowdown in processes of withdrawal and abandonment in mountain pasturing (Parizek 2006). Beyond that, it encouraged many farmers and pasturing communities to modernise the management of their mountain pastures and adapt it to their economic needs (Tasser et al. 2002; 2007). These days, pastoral landscapes in the Austrian Alps experience a well-known paradox, characteristic for many "traditional", low intensity agricultural landscapes in transformation: alpine pasturing is valued as the constitutive element shaping pastoral landscapes at the same time it is estimated as a major threat for existing ecosystem diversity. Reasons are being located in changing management practices, getting them in conflict with established nature conservation goals. This has evoked recurring discussions on "proper management" of diversity in alpine pasturing landscapes amongst conservationists, agricultural experts, farmers and planners (Aigner et al. 2003, Guggenberger et al. 2007).

The following paper explores the relationships between current practices in mountain pasture management and their impacts on pastoral landscapes on a regional scale level. Investigations are conducted on commonly governed mountain pastures in the Austrian limestone Alps. Based on a general introduction into mountain pasturing systems of the region, the article analyses management practices and sets them in context to the related vegetation and landscape patterns. A typology of management strategies is elaborated, characterising economic features as well as pasturing communities' attitudes as the cornerstones of current mountain pasture management. Inquiry is founded on the assumptions, that:

- a) Commonly governed mountain pastures are complex social-ecological systems (Berkes & Folke 1998), incorporating numerous endogenous and exogenous parameters in their developments. The immediate linkages between social and ecological systems are the practices in pasture management applied by pasturing communities. Landscape and vegetation patterns are a material evidence of those practices (Lühns 1993).
- b) Management practice is structured by strategies, characterising the general pathways tracked by pasturing communities in utilizing and maintaining their pastureland. Strategies organise management practice within the social systems of pasturing

communities, but beyond, they also promote certain patterns in the ecological systems they are embedded in.

Aim of the paper is to illustrate, how diversity in mountain pastoral landscapes is essentially influenced by the practiced approaches to management. As a conclusion it is argued, that long-term efforts in sustaining biodiversity in European mountain pastures will have to incorporate the various strategies practiced as a starting point for considerations on programmes and measures.

Methodological remark

The approach to typecasting of management practices and strategies chosen in this study refers to the concept of “farming styles”, as it was introduced by Jan Douwe van der Ploeg (1994). Farming styles were elaborated as a conceptual framework in order to describe and explain patterns of behaviour in farm households’ ways of practicing agriculture. The idea behind this concept of a “hermeneutic typology” (Whatmore 1994) is to learn about the way how actors give meaning to their practice: *“It centres on the role of human actors in giving meaning to the world they inhabit and acting on the basis of those meanings, and the incorporation of these subjective processes into the terms of analysis of patterns of behaviour or relationships. The methodological construction of typologies in this framework prioritises the meaningfulness of the categories, or classes, of phenomena identified for the social actors whose experiences and activities they depict”* (Whatmore 1994:34). Schmitzberger et al. (2005) have successfully employed the “farming styles”-concept for the investigation of correlations between different management practices and biodiversity in various Austrian landscapes. To capture the complexity of farming practice, they typecast several styles of farming and could identify significant relationships between farmers’ attitudes and approaches to agriculture and the landscape patterns they produce. Or, as Schmitzberger et al put it: *“The concept of farming styles, which integrates human attitudes, farming objectives and economic success can be used to show the different ecological performances of farmers. A close link between mentality of farmers, land-use intensity and biodiversity could be established”*. (p. 274). In the following the concept is adapted to explore practice and strategies of mountain pasturing communities in utilizing their common resource bases, aiming to understand their “logics”. Therefore communities are considered as “collective actors”, pursuing common goals. Referring to Deffontaines et al. (1995) and Baudry et al. (2000), this shall be defined as a holistic perspective on the relationships between human land use systems and landscape patterns.

2. Research design

Analysis was carried out in three steps (see Fig. 1): Step 1 comprised a socio-economic survey on pasturing communities and their various practices, resulting in a typology of management patterns. Step 2 involved investigations on the actors’ perspectives on their practice. Step 3 covered the study of landscape and vegetation patterns in 15 case study pastures, representing the five management patterns identified. Socio-economic analysis was organised in a multi-stage setting:

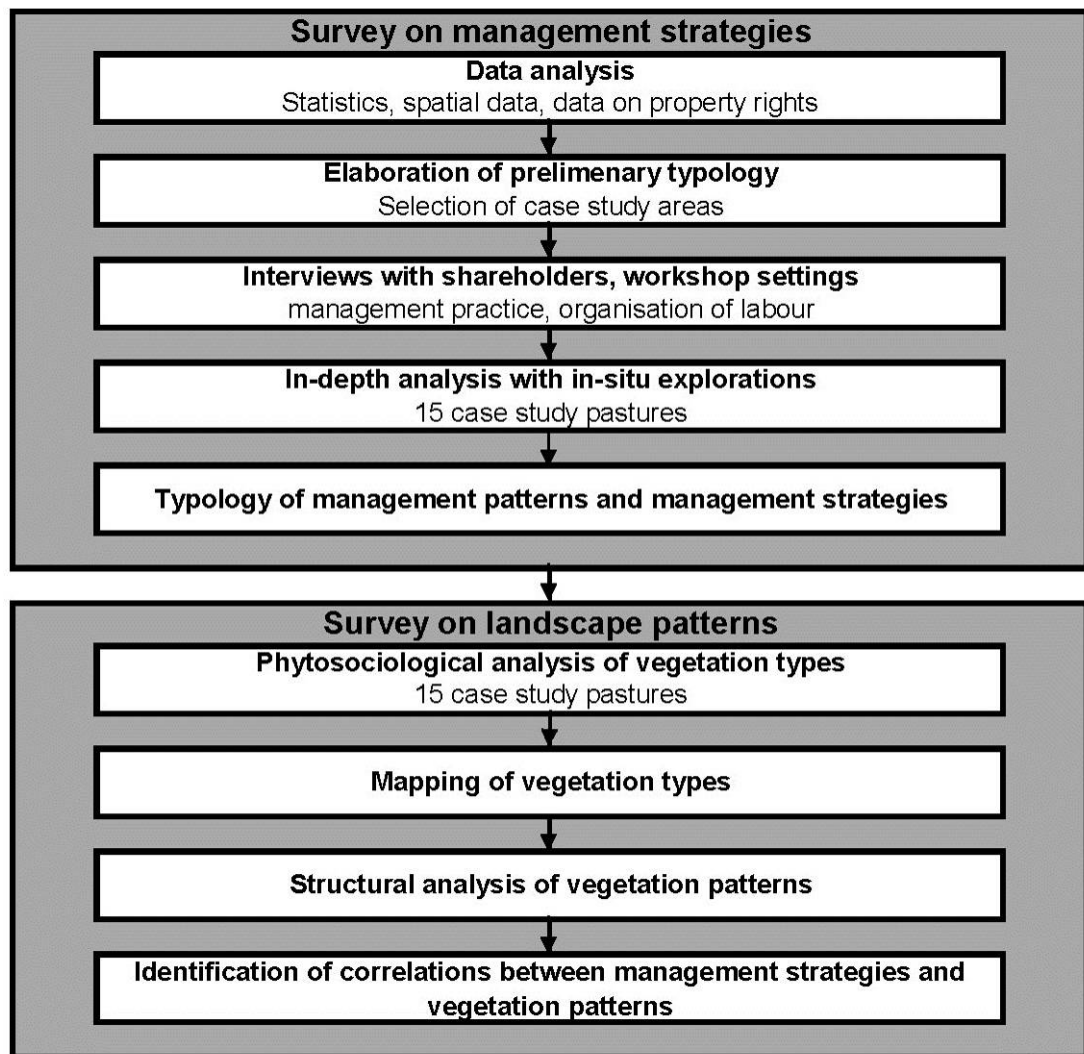


Fig 1. Research design

a) First, a comparative survey of structural data on the mountain pastures of the study region was carried out. Data collected and evaluated embraced statistics (livestock data, areal data, information on natural conditions, pasturing season, endowment and infrastructure), legal framework conditions (ownership, organisation of property rights) and social organisation of labour (herding staff, organisation of pasturing and maintenance). Those data were evaluated for a totality of 65 mountain pastures, resulting in a preliminary typology regarding structural and organisational framework conditions.

b) Stage 2 consisted of 25 semi-structured interviews, conducted with shareholders in the investigated pasturing communities. Conversations centred on questions on management practices (organisation of labour, institutional frameworks, investments, problems and challenges) as well as on strategies and goals in the management and development of pasturing businesses. These data were complemented within several workshop sessions and in-situ ascents. Evaluation of that information formed the basic material for the typecasting process.

c) Within a third stage, in-depth analysis on 15 case-study pastures was carried out. This contained further in situ explorations on the relationships between management strategies and management practices identified, as well as comprehensive investigations of local environmental conditions.

Vegetation assessments were undertaken, using the method of Braun-Blanquet (Zürich-Montpellier-Schule, s. Braun-Blanquet 1964). Vegetation types were assigned on the level of associations, their spatial patterns were recorded in field mapping (resolution of 10 x 10 m), aided by GPS- equipment and aerial photos (Fig. 2). For analysis of spatial distribution GIS-

tools were used. Classification of vegetation types follows the systematic proposed by Mucina et al. (1993).

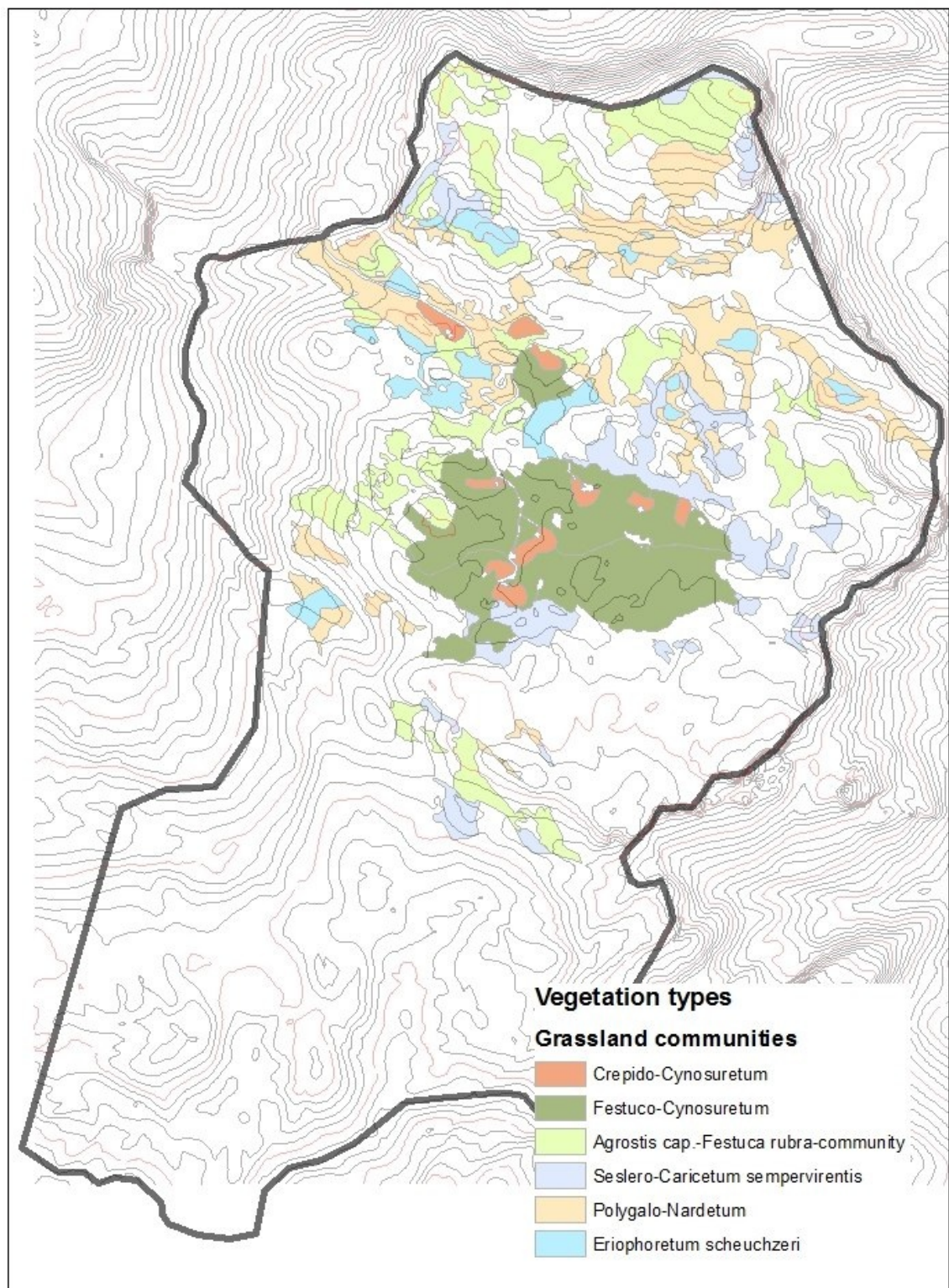


Fig 2. Example for a map of vegetation types.

3. Introduction to mountain pasturing in the Upper Austrian limestone Alps

Research was carried out in the limestone Alps of the province Upper Austria. The region is part of the northern limestone fringe of the Eastern Alps. It consists of 5 massifs, containing three extensive limestone plateaus (Dachstein, Totes Gebirge and Hölleengebirge) each of them covering several square-kilometres, and two cordilleras (Sengengebirge, Haller Mauern).

Natural conditions – mean annual average rainfall of 1,700 mm with average temperatures of 8°C in the lowlands – predestine the region for cattle-breeding with focus on dairy farming (Gamerith et al. 2007). Seasonal transhumance and the support with common pastureland are integrated parts of regional agriculture: In the study area currently about 200 mountain pastures are in use, covering roughly 26,000 ha (Parizek 2006). Approximately half of those mountain pastures are commonly governed, taking three quarters of mountain pastureland. The region features a number of large-scale nature reserves, containing the conservation areas “Totes Gebirge”, “Warscheneck”, “Dachstein”, the national park “Kalkalpen” and the UNESCO-World heritage region “Hallstatt-Dachstein”.



Fig 3. Location of the study area.

Natural conditions and organisation of mountain pasturing

Mountain ranges of the region are vastly covered with forests, reaching the climatic timberline around 1700 m. Forestry was historically an important fundament for regional mining businesses (salt, iron). Therefore, forests were brought under sovereign governance from the Early Medieval period (Koller 1970). Regional structures of settlement and agriculture likewise have been shaped by mining industries: Smallholder agriculture and sideline farming provide evidence for traditional combinations of employment in mining businesses and self sufficiency agriculture (Moser 1994). Forests are currently mostly taken by conifers as Common spruce (*Picea abies*). Further tree species contain common beech (*Fagus sylvatica*), European larch (*Larix decidua*), Fir (*Abies alba*), Swiss stone pine (*Pinus cembra*), in the higher regions being replaced by Mountain pine (*Pinus mugo*). Mountain pastureland stretches from altitudes between 700 m and 2000 m. Pasturing traditionally is organised in seasonal progressions following altitudinal belts. It starts at the stage of the “Niederalm” (lower pastures 700 - 1100 m), either in private or in common property, completed by the commonly governed “Mittelalm” (middle pastures 1200 - 1400 m), the “Hochalm” (high pastures 1600 - 1700 m) and the “Galtalmen” (1800 - 2000 m). The latest, in former times were utilized by young cattle and undemanding sheep (Moser 1994), whereas on the former three milk cows, mother cows, horses and occasionally pigs were held, supervised by alp staff. Nowadays most of the pastures situated above the climatic timberline are abandoned, while considerable parts of the pastures in lower and middle altitudes have remained in use (Fig. 4).

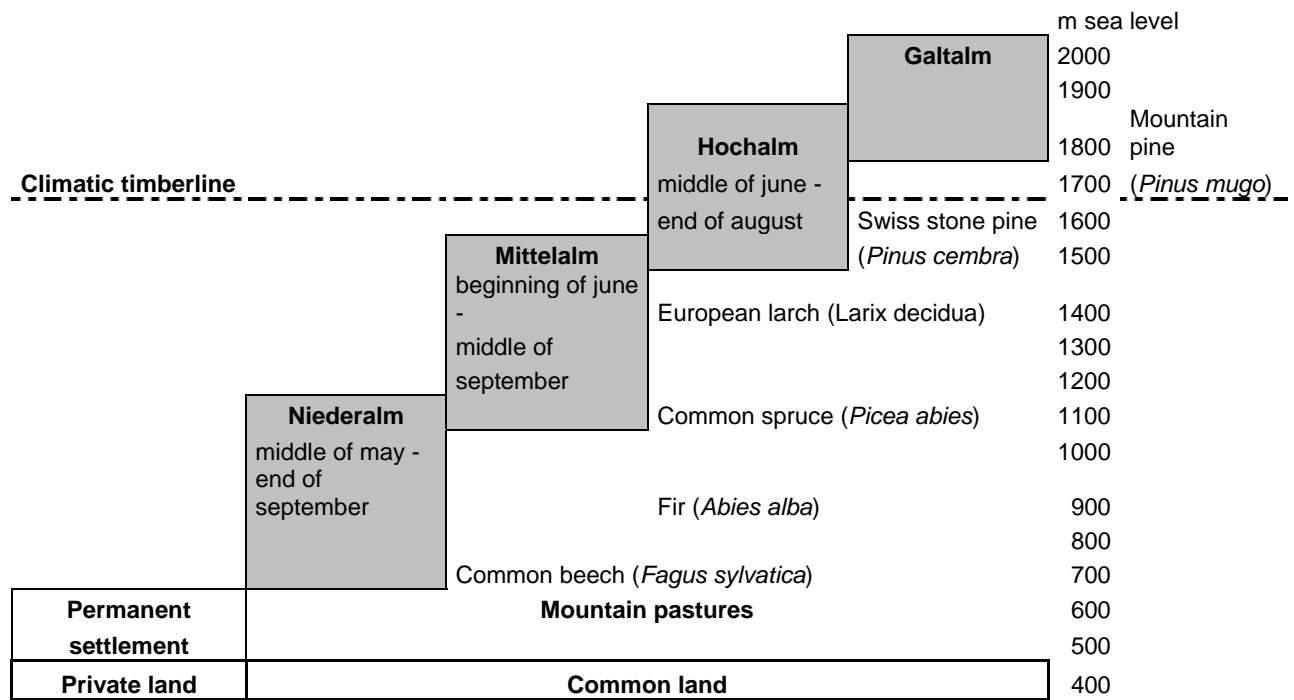


Fig 4. Organisation of agriculture and the mountain pasturing system in the study area.

Up to present day a majority of about 150 alpine pastures are situated within the forest belt. In those areas, grazing is a major shaping factor of landscape and ecology, being responsible for the characteristic appearance of patterned and interwoven open, semi-open and wooded areas, combining elements such as pastures, meadows, larch-meadows, shrub, coppice, dwarf shrubs and bog (Fig. 5).



Fig 5. Mountain pasture in the Upper Austrian Salzkammergut-Region.

Legal and institutional frameworks of mountain pasturing

Governance of mountain pastures is shaped by two systems, both with long-standing historical backgrounds: Basic institutional framework is the commons system. Having evolved from common land tenure of the Middle Ages, commonage builds upon sets of rules and regulations handed down between shareholders, concerning pasturing (date, period, number of livestock) and organisation of labour for maintenance of commonly used infrastructure (paths, fences, water supply, buildings). Many of the responsibilities in the commons system traditionally were held by the alp staff, frequently consisting of non-married members of farmer communities who were assigned by the cooperatives (Moser 1994). They also were responsible for the spatial-temporal organisation of pasturing. But each shareholder commits to contribute to common duties, for instance to take part in periodically recurring maintenance of pastureland and their clearing from shrub and bog. Pasturing communities involve between two and more than 50 obligees, depending on the size of the pasture. A special characteristic of the study area is the so-called “servitude system”, which provides the legal framework for mountain pasturing in a majority of cases. Resulting from sovereign’s historical efforts to assure the supply with wood for mining issues, extensive forests of the region were declared as sovereign forests, granting farmer cooperatives usage rights for pasturing (Koller 1970, Johann 1994). Starting in the 10th century, the servitude system saw a number of historical transformations and adaptations, following the demands of mining businesses. Originally, the servitudes consisted of regulations, prohibiting clearance activities on certain areas and codifying the amount of wood that could be gained by farmer communities (Gottfried 1952). Servitudes in the following gradually were detailed, when a strictly centralised resource-management system was established (Koller 1970). A general law on servitudes stipulated that each single obligee of servitudes had to get an individual certificate, where all singular authorities are specified (Feichtner 1995). The latest considerable changes within the servitude system took place in the mid-19th century, when the Austrian national forest law was introduced and mining forests were brought under the responsibility of the state. As a result, more than half of alpine pastures in Upper Austria up to present day are situated within and surrounded by state forestland (Fig. 6). Being highly dependent on decisions in state forest management forms a rather complicated groundwork for cooperatives to govern their pastures (Hellebart 2006).

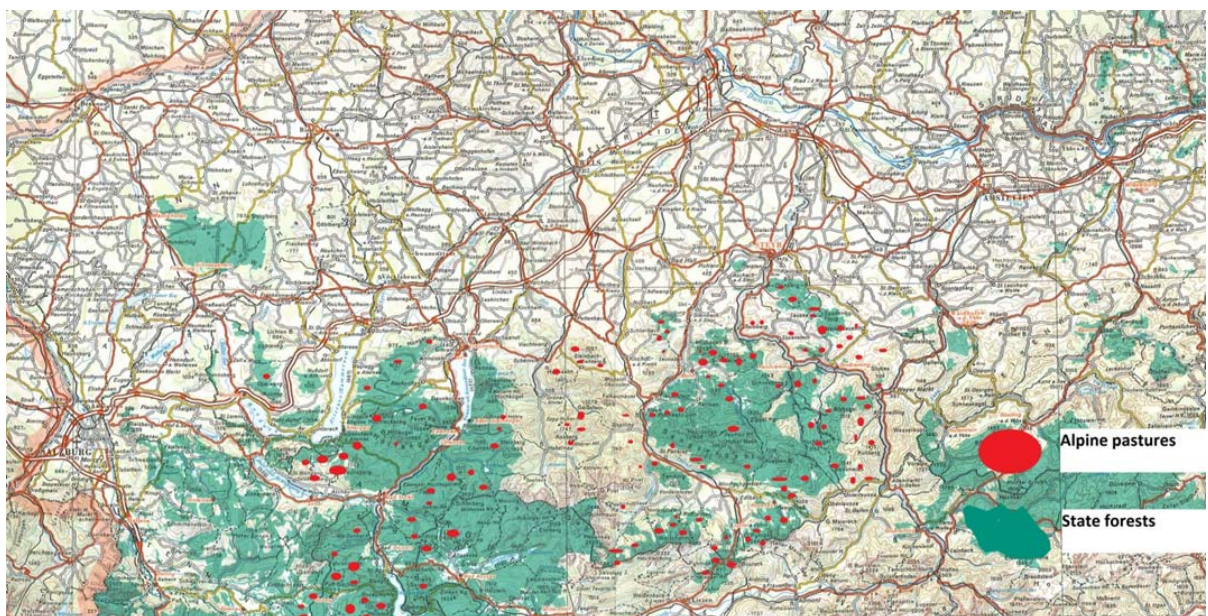


Fig 6. Location of alpine pastures within state forestland.

Dynamics concerning mountain pastureland in the study area

Up to the 1940ies regional farming systems were focused on self-support of farm households. Farming was characterised by mixed agriculture, incorporating mixed livestock breeding. Lowland agriculture was organised in alternate husbandry with arable land, whereas livestock

breeding had its focus on alpine pastures. Centres of dairy-farming were the lower and middle pastures, whereas young cattle, sheep and goats were to the high pastures (Moser 1994). Transformations in traditional farming systems started with World War II, when lack of personal caused neglect in the maintenance of mountain pastures. From the 1950ies the region experienced specialisation on dairy farming, introducing the Simmental breed, replacing traditional regional breeds as the “Ennstaler Bergschecken” (Zwittkowitz 1974). Former mixed, subsistence-orientated systems of agricultural land-use were converted to intensive, specialised grassland systems. Farm units were augmented, based on area released by abandoned smallholder farms. Improvement and intensification of farmland focused on lowland regions, concentrating dairy production there (Moser 1994; Kurz 2009), whereas alpine pastures in those days were merely affected by modernisation processes and pasturing communities frequently were thinning out (Seher 2007). More than half of the mountain pastureland in the study area has been abandoned in that period, while many of the remaining pastures ran through general modifications in pasturing systems. Diverse livestock systems were gradually replaced by young cattle pasturing, in order to reduce operating efforts for staff and transport. Many of the pastures now are managed without local herding staff, and supervision of herds, maintenance of pastures and infrastructure generally has been downsized (Kurz 2009).

Year	1952	1974	1986	2004
Number of pastures	403	275	365	221
Area in ha	55.342	35.792	33.612	26.684

Tab 1. Development of alpine pastureland in the study region. (Source: Parizek 2006)

From the late 1960ies withdrawal of alpine pasturing was damped by the introduction of several national support programmes. First and foremost stands the so-called “Alpungsprämie”, granted to farmers for each livestock-unit brought up on mountain pastures. In addition, support was completed by facilitation for investments in buildings, infrastructure and projects on re-cultivation of pastureland (Aigner et al. 2003). Eventually, mountain pastureland was integrated into single farm payments of current agro-environmental schemes. When entering the national agro-environmental scheme ÖPUL farmers have to verify sufficient area of forage acreage for the number of livestock held. Alpine pastures are a welcome opportunity with farmers to optimize this balance. However, they are only accepted if kept in a good condition, while areas covered with weed, shrub, heather or wood are excluded from the balance adopted for calculation of subsidies (s. ÖPUL 2007). This recently has stimulated renewed economic appeals to improve conditions of alpine pastures and their management.

4. Typology of management strategies

Tab. 2 gives an outline on the patterns of mountain pasture management identified in our survey. We could distinguish 5 types of management, which include the strategies “intensification”, “rationalisation and simplification”, “diversification and multifunctionality”, “traditional rotation” and “maintenance and withdrawal”. Current diversity in pasture management finds evidence in the parameters “livestock management”, “organisation of labour in communities” and “investments”. *Livestock management* is either practiced in mixed forms (cattle with other types of livestock, such as sheep and/or horses, mixed cattle pasturing) or in specialised forms (young cattle). An important parameter characterising the intensity of pasturing is the *stocking rate*, varying from 0.1 up to 1 livestock units/ha. Another parameter characterising livestock management is the spatial and temporal *organisation of pasturing*, ranging from paddock management over herding organised by herding staff, to partly or fully unregulated pasturing. Pasture management is an indication for the manpower available and – together with other parameters characterising labour organisation, such as inputs of maintenance labour – provide evidence for intensity of pasture management. Combined with information on investments in buildings, infrastructure and (re-)cultivation of pastureland those parameters provide insights into current management patterns, as well as they integrate information on pursued strategies.

- a) The prevalent management strategy identified is intensification. The *intensification type* (Pattern 1, app. 30% of the analysed cases) is characterised by above average stocking rates and increasing numbers of livestock over the past years. Further attributes of the intensification pattern are considerable investments in buildings and infrastructure of mountain pastures and in the re-cultivation and amelioration of pastureland. Goals of those activities are to adapt as much area as possible to management and maintenance with mechanical equipment. Pasture management is characterised by the organisation of pastureland into several paddocks, in order to optimize grazing activities. Pasturing communities pursuing the intensification strategy follow the idea of adapting mountain pastureland to lowland standards, concerning labour organisation and yield. Driving forces within pasturing communities promoting intensification are farmers who follow a modernisation course within their farm households. Favourable framework conditions are an important groundwork for pursuing the intensification strategy: Good allotment of pastureland and little constraint due to the legal status of nature conservation area are prerequisites promoting intensification strategies. Intensification in addition is more likely to be found under well-confirmed property rights. It frequently can be found with pastures being in ownership of pasturing communities. Non-surprisingly, core areas of the intensification pattern are lower regions. Nonetheless, we also find them in higher areas.

Management type	Livestock management	Organisational attributes	Management strategy	Favourable framework conditions
Intensification	increasing number of livestock units; stocking rate ≥ 1	investments on buildings, infrastructure; re-cultivation and amelioration of pastureland; organisation of pasturing in several paddocks	adapting mountain pastureland to lowland standards; extend natural resource base and yield by raising monetary inputs	good allotment; little constraint caused by legal framework conditions (nature conservation, servitudes); well confirmed property rights
Rationalisation / Simplification	increasing number of livestock units focus on young cattle; stocking rates 0,3-0,5; tendencies of under-grazing; unregulated pasturing in large areas	investments focusing on improvement of pasturing areas; extensive inspection of herds; mechanical mulching at the end of the pasturing season	relieving farm households during summer months; broadening of area for fodder production; minimization of labour input	large pasturing communities with heterogeneous mixes of obligees; favoured natural conditions; constraints by legal conditions (servitudes, leasing treaties)
Diversification/ Multifunctionality	mixed livestock patterns; stocking rates 0,6-0,7; partly regulated pasturing	investments focusing on buildings, infrastructure; additional businesses linked to mountain pasturing; engagement of staff permanently involved in management	relieving farm households during summer months; gaining additional incomes through gastronomy, tourism and maintenance activities in nature protection	good allotment; location in nature-protection reserves; farm households engaged in organic farming and/or farm holidays
Traditional rotation	mixed livestock patterns; stocking rates 0,6-0,7; regulated pasturing	investments focusing on common labour inputs for maintenance and re-cultivation of pastureland; rotational management; engagement of herding personal	relieving farm households during summer months; broadening of area for fodder production; continuous maintenance of variable resource base	well confirmed property rights; stable conditions within pasturing communities; small-medium sized communities; low-priced herding personal
Maintenance and gradual withdrawal	decreasing number of livestock units; focus on young cattle; stocking rate 0,1-0,3; unregulated pasturing	vastly reduced labour inputs, focusing on indispensable inspections and maintenance activities	keeping the open-field character of the pastureland; maintaining minimum infrastructure	poorly developed areas; weakly secured property rights (servitude); weak, shrinking communities

Tab 2. Management patterns and management strategies in Upper Austrian mountain pastureland.

- b) Second referring to dispersion comes a pattern identified as rationalisation type (Pattern 2, 25% of cases). Its most remarkable features are the focus on young cattle and average-low stocking rates. Mountain pastures associated with the rationalisation type show a general tendency of being under-grazed. Typically, we find substantial investments, focusing on the improvement of pasturing areas, aiming at mechanical maintenance of alpine pastures (stone removal, smoothing...). Inputs of labour concentrate on occasional inspection of the herd every other or third day and mechanical mulching at the end of the pasturing season to clear the pastures from weed and shrub. Communities' motivations for practicing the rationalisation strategy combine relieve of their farm-households from livestock in the summer period, to broaden their fodder area with minimized labour input. The rationalisation pattern is frequently practiced by large communities with heterogeneous mixes of obligees. While natural conditions for pasturing in many cases are advantageous, legal and/or institutional framework conditions often appear unfavourable for intricate investments. Either servitudes or short-term, awkward leasing treaties distract pasturing communities from making enduring investments. Typical management patterns contain unregulated pasturing in large areas, allowing cattle to select fodder from their favoured areas. The rationalisation pattern is to be found from lowest up to the highest pasturing locations of the study area.
- c) Diversification is a strategy pursued by another 15% of the analysed cases. Similar to the intensification type, the diversification type (Pattern 3) is characterised by considerable investments. Unlike the first, investments rather focus on buildings, infrastructure and the associated equipment. Gastronomy practiced in the chalets is an important additional source of income. Therefore staff is engaged, who is responsible for livestock management as well as for refining and selling of alp products. Pasturing is usually organised in partly regulated modes, focusing on central parts of mountain pastureland, whereas major areas experience extensive, unregulated pasturing. Investments for improvement, maintenance and management of pastureland are kept on a rather low level. Typical features are mixed livestock patterns, frequently involving several milk-cows, as well as certain numbers of sheep, goats, horses and/or pigs. Pasturing communities' management strategies are built upon the idea to relieve their farm households during the summer months and yet gain additional incomes through gastronomy and tourism. A superior part of farm households involved practice organic agriculture and offer farm holidays on their farms. As an additional offer, guests are invited to visit mountain pastures. Another source of income eminent for this type of management is subsidies for maintenance activities in nature protection areas. An above-average percentage of pastures managed in the "diversification"-pattern are located in nature-protection reserves. Core areas are regions in medium altitudes.
- d) Type 4, traditional rotation (app. 5% of cases), is characterised by a medium stocking rate and mixed livestock composition. No specific livestock pattern is to be identified. A remarkable attribute of the type is the labour organisation practiced in management: We find commonly organised, recurring labour inputs for maintenance and re-cultivation of pastureland, following rotational patterns. Another outstanding characteristic is the regular attendance of herding personal, supervising pasturing patterns, looking after the cattle and maintaining pastures and the associated infrastructure. Compared to the other types, this strategy requires proportionally higher inputs of labour, being rewarded by continuous improvement and broad varieties of pasture quality (Machatschek 1996). Herding personal usually consists of retirees, who spend their summers on mountain pastures and get remunerated modestly by pasturing communities. Minor parts of the salaries are paid from subsidies granted for herding personal by the stately agro-environmental scheme ÖPUL. The strategy of traditional rotation continues principles of traditional mountain pasture management. We find this organisational pattern scattered over the study region. It is characteristic for small- to medium-sized pasturing communities operating in a secure legal status of land tenure, usually in private property. We have found this type in all altitudinal regions.

- e) Eventually, we can observe a type identified as *maintenance and gradual withdrawal* (Pattern 5, app. 25% of cases). It is characterised by below average stocking rates, progressing decline of livestock numbers over the years, minimized investments in buildings, infrastructure and reduced labour inputs for maintenance and management. Pasturing is practiced in an unregulated mode, focusing on young cattle. Labour input is vastly limited to inspections of the herd and inevitable maintenance activities on infrastructure. Pasturing is seen by the practicing communities as a task to keep the open-field character of the mountain pasture. It is practiced either as open-land management for tourist needs, for maintenance of wildlife habitat or for conservationist issues. Farmers involved frequently argue that they see it as their inherited responsibility to maintain pastures, providing them for coming generations. Most of the cases identified with the maintenance type are characterised by certain features: They are usually poorly developed, accessible only on long footpaths, property is organised in servitudes, and there are only a few members of the communities left currently practicing their property rights. Processes of withdrawal can extend over several decades, running through various stages of phasing out.

5. Management strategies and landscape patterns

Fig. 7 displays an overview on landscape- and vegetation patterns found with the introduced types of management. Diagrams depict the percentage coverage and the number of plant communities recorded, classified by vegetation types: These contain: intensive and extensive grasslands, wetlands, tall-forb, shrub, forests.

- a) Vegetation cover of the cases in *Type 1 (intensification pattern)* is characterised by predominance of grassland communities with medium-high productivity, taking more than 50% of the area. Focal point of the vegetation spectrum lies with intensively used grasslands. Minor proportions less than 25% consist of poor grasslands, of shrub communities and of wooded pastures. Tall forb communities indicating over-fertilization take areas up to 10%. Vegetation patterns provide evidence for the practiced paddock systems. Diversity of detected plant communities stretches between 12 and 15.
- b) Study areas assigned to *Type 2 (rationalisation and simplification)* are characterised by superior percentages of tall forb communities, covering more than 25%. Tall forb appears as an indication for under-grazing in combination with mechanical maintenance of under-grazed areas. The spectrum of detected plant communities comprises between 10 and 15.
- c) In case studies representing *Type 3 (diversification and multifunctionality)* no particular focal point in the vegetation patterns could be identified. Grassland communities, as well as tall forb, shrub and forests contribute to the vegetation cover in various percentages. This may be construed from the various modes pasturing is organised within this type, reaching over a broad range of intensities. All cases analysed show a slightly above average percentage of tall forb communities in a broad variety of associations. This may indicate tendencies of under-grazing in parts of the pastures. Diversity of plant communities detected reaches around 20.
- d) Within *Type 4 (traditional rotation)*, similarly to the diversification pattern, there is no predominant vegetation type to be recognized. Evident is the broad spectrum of vegetation types established in all three cases analysed, reaching from various grassland communities, wetland communities, various tall forb communities, shrub communities to several forest communities. Diversity of plant communities varies between 25 and 28. Rotational management practices in pasturing and maintenance promote the coexistence of various vegetation types in different stages of development.
- e) Contrary to this, evidence from the cases assigned in *Type 5 (maintenance and gradual withdrawal)* exemplify the effects of retracted management. The focal point lies with a small number of shrub communities taking areas up to 50% and providing the predominant formations shaping the vegetation cover in those pastures. Diversity of plant communities stretches from 11 to 14.

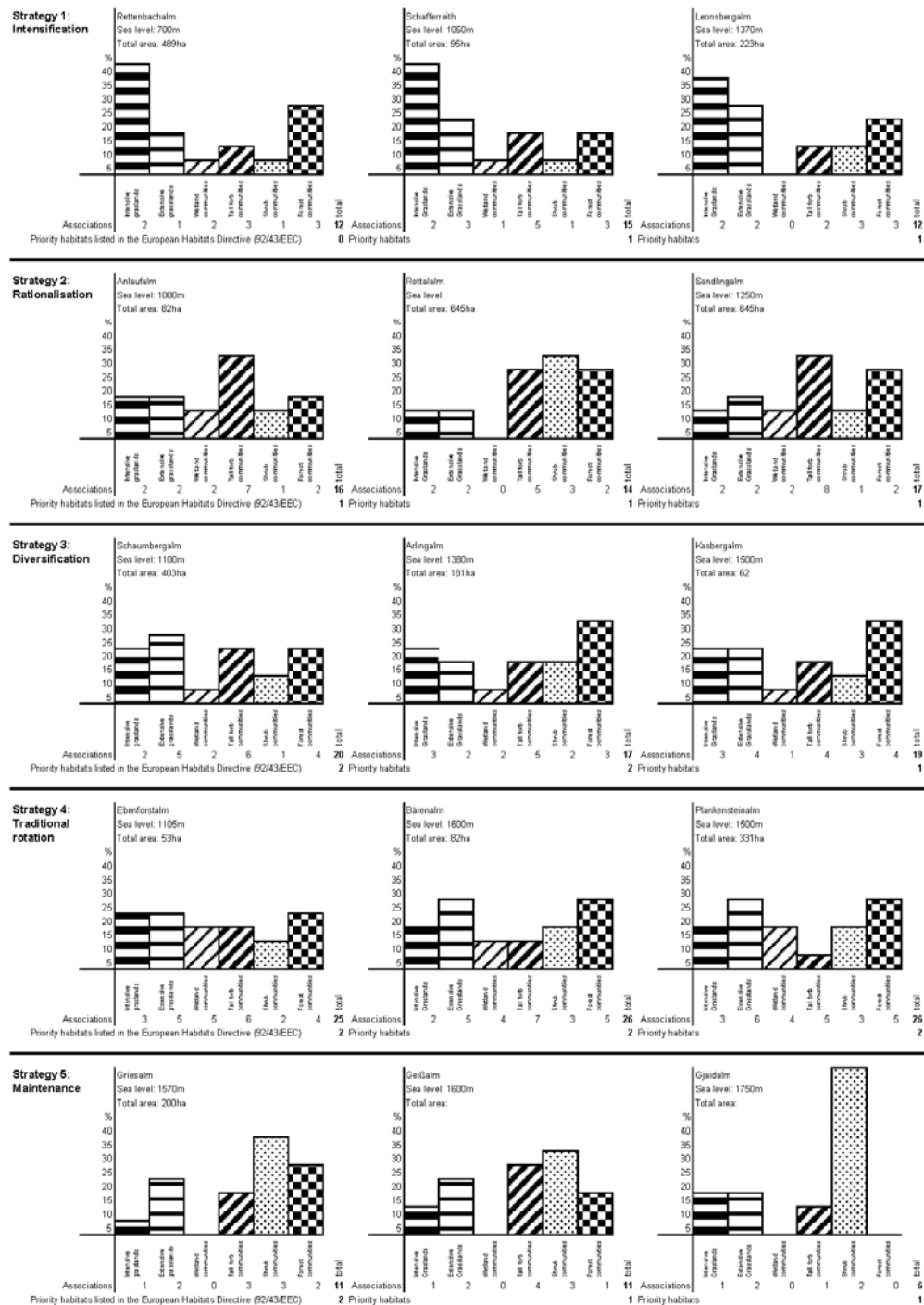


Fig 7. Management strategies and vegetation patterns.

Case study evidence supports correlations between management strategies and pattern diversity on a highly generalised level. Highest diversity on level of plant associations could be observed with the comparatively labour-intensive management strategy “*traditional rotation*”, followed by the type “*diversification and multifunctionality*”. Significantly lower is the diversity in the strategic patterns “*intensification*”, “*rationalisation and simplification*” and “*maintenance and gradual withdrawal*” (Fig. 8).

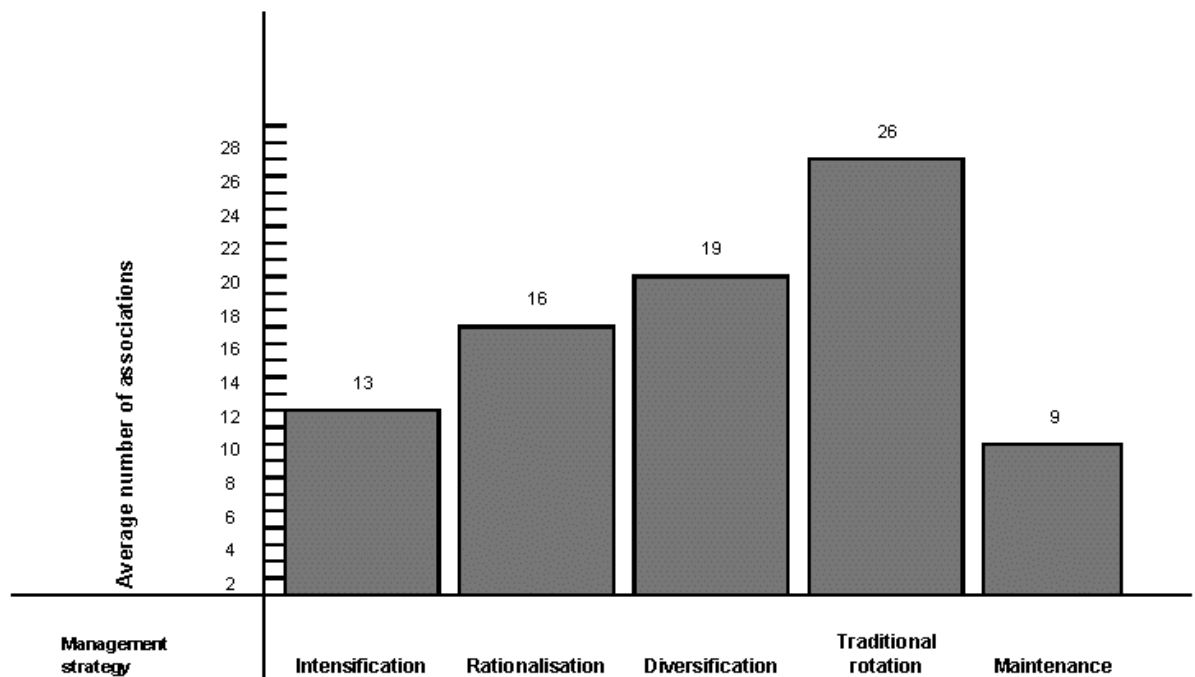


Fig 8. Management strategies and vegetation pattern diversity.

To get a more detailed insight into correlations several single parameters and influences shall be analysed and discussed separately:

Stocking rates and vegetation diversity

Significant relationships could be detected between vegetation pattern diversity and the parameters “livestock management/composition of livestock”, “pasture management” and “organisation of maintenance labour”. Headmost stands the correlation between stocking rate and diversity. Highest diversity on associational level is related to medium livestock densities (0,4-0,6 livestock units/ha). Higher, as well as on lower levels of pasturing intensity goes along with decline in diversity. This meets with many other authors’ empirical findings and has been described as a general principle by Grime (1979). Still remarkable is the variance within the medium spectrum. This can be interpreted as an indication for the role of different modes of pasturing, concerning the composition of livestock and organisation of pasture management (Fig. 9).

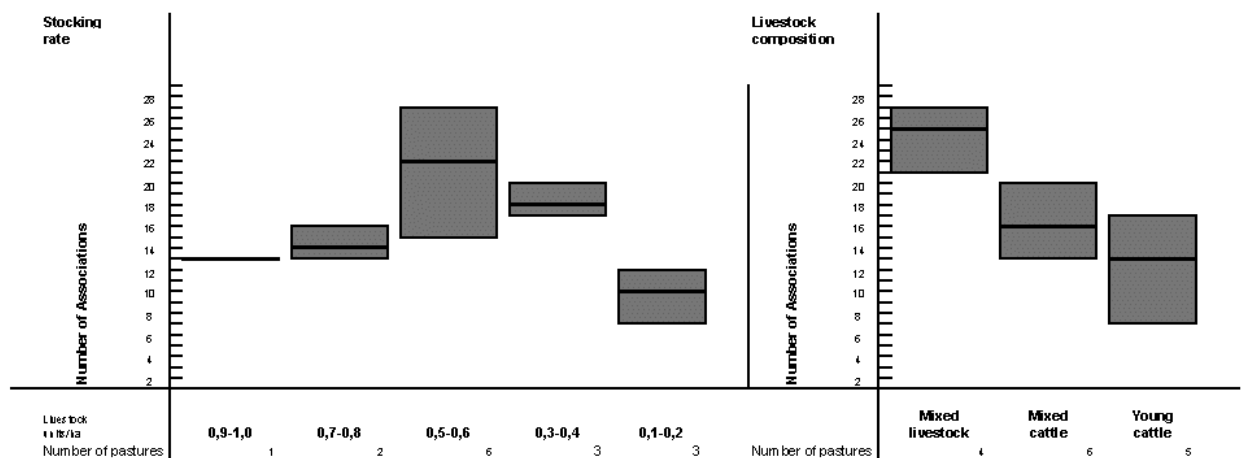


Fig 9. Vegetation pattern diversity related to stocking rate and livestock composition.

Livestock composition and vegetation diversity

Mixed livestock, containing mixed cattle, combined with sheep and/or horses is found in four of the investigated case studies and goes along with diversity of plant communities of an average of 25 (range from 20-26). Mixed cattle pasturing (milk cows, mother cows, oxen and young cattle) shows an average of 16 communities, while exclusive pasturing with young cattle is connected to levelling down to an average of 12 associations. O'Rourke (2006) has hinted to the fact, that combination of different types of grazers due to their selective feeding and the different patterns of pasturing may influence development of biodiversity in a positive way. This is confirmed by our evidence.

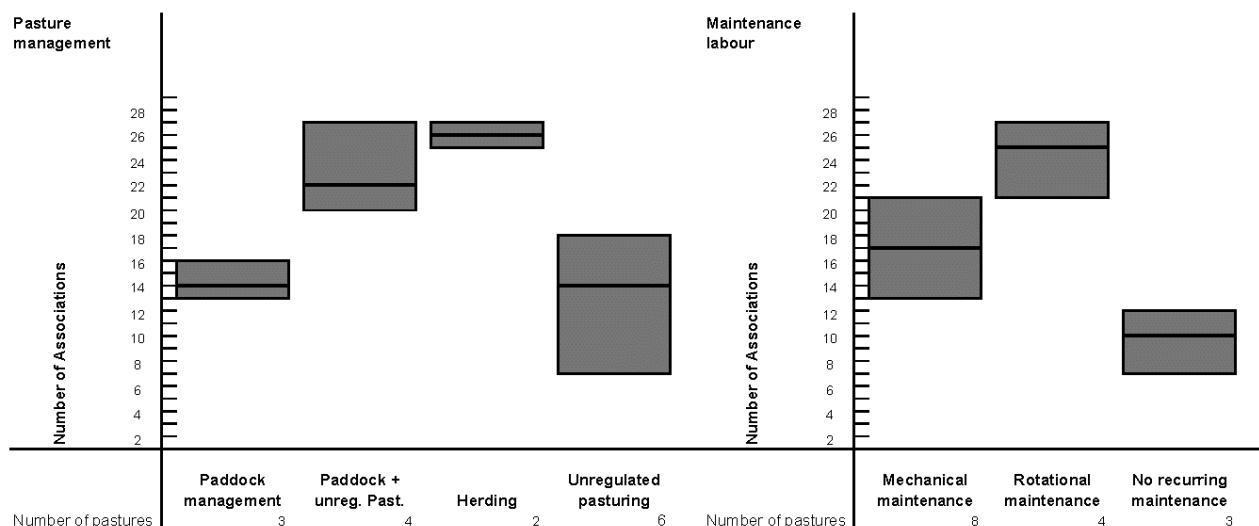


Fig 10. Vegetation pattern diversity and management practice.

Pasture management and vegetation diversity

Equally significant are correlations between vegetation diversity and the modes of pasture management. Herding, which means conduction of grazing livestock by shepherds, goes along with highest average diversity in vegetation patterns (25). This labour-intensive mode of pasturing could only be found in two of the investigated cases. Herding is connected to differentiated, individually shaped pasturing patterns, concerning natural environment conditions and utilizing them in adaptive management practices and therefore promote diverse vegetation patterns (Machatschek 1996). Combinations of paddock-organisation and unregulated pasturing range in second place, while intensive paddock management and unregulated pasturing go along with noticeable lower diversity around 13 associations. Extensive, unregulated pasturing sees reductions down to 6 associations. Paddock organisation – as a measure for increasing fodder outputs - may contribute to the improvement of pasture quality, but may also bring along spatial polarisation of vegetation patterns. While pasturing intensity is increased within paddocks, areas situated outside tend to be abandoned. Last not least organisation of pasture maintenance stands as another key factor for landscape diversity. Strongest effects can be deduced from rotational maintenance measures, organised in manual operation (rotational coppicing, burning, mowing and weed regulation – average of 24 associations), compared to mechanical maintenance (mowing, clearance of weeded area at the end of the pasturing season – 16 associations). Resignation of maintenance labour is ultimately connected to a massive decline of diversity (9 associations).

Environmental and legal parameters and vegetation diversity

Comparatively indistinct are correlations of vegetation patterns to a number of further parameters, concerning environmental and legal attributes (location and allotment of pastureland, size and number of obliges, organisation of property rights – Fig. 11), although they were identified as important factors for management decisions within the socio-economic survey. These parameters define framework conditions, influencing strategies, but they

obviously do not directly determinate management practices or – in further consequence – diversity of ecological patterns.

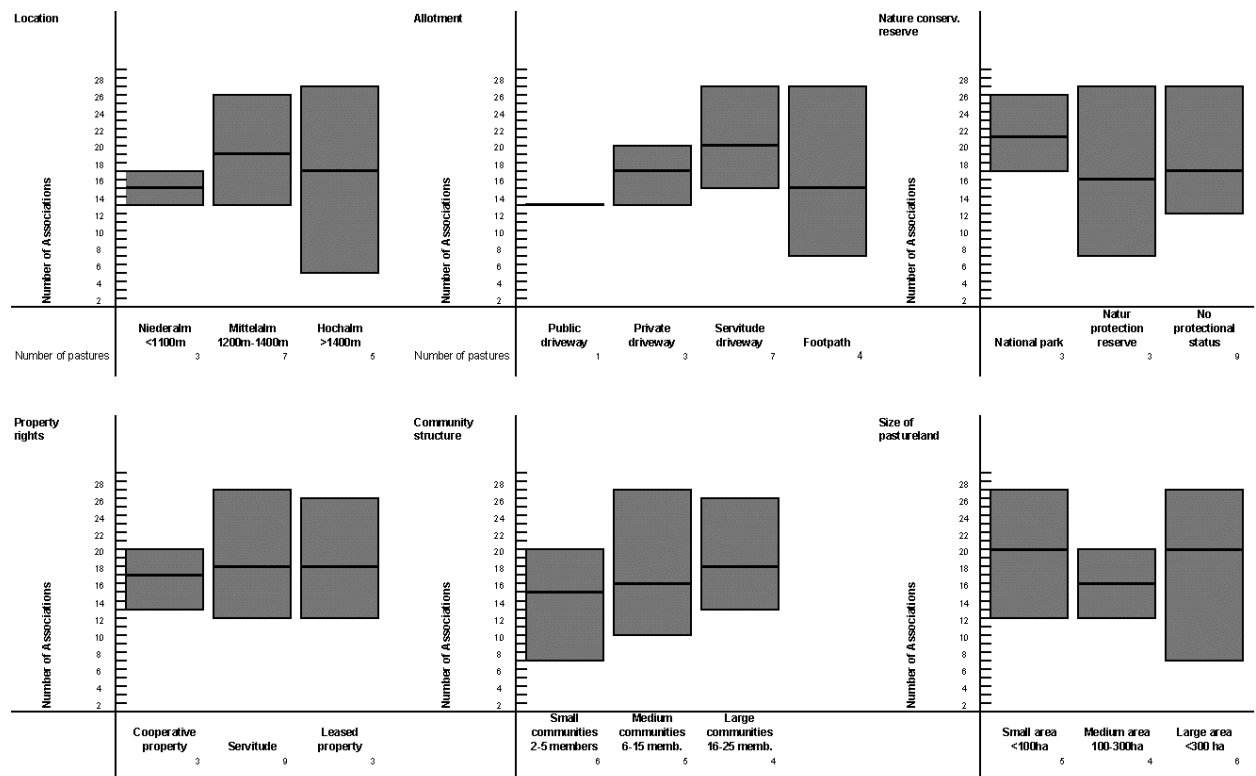


Fig 11. Environmental and legal framework conditions and vegetation pattern diversity.

Remarkable immediate relationships could be detected concerning the number of obliges being involved in pasturing communities and diversity in vegetation patterns. Particularly pastures of communities affected by withdrawal and a continuous decline of practicing members are coincidentally characterised by increasingly levelled landscape patterns.

6. Discussion and conclusions

Pasturing is the central factor shaping and sustaining mountain pastoral landscapes, but there is a broad variety of different approaches to pasture management, influencing structure and diversity of landscape patterns in different ways. Reflecting to modernisation processes in lowland agricultural systems, mountain pasturing communities are adapting their management strategies concerted to their economic needs, regarding particular framework conditions, but also following traditions and attitudes. As a result new practices have been emerging, partly replacing traditional modes, and accordingly (re-)shaping pastoral landscapes. Investigation of the various approaches to management practiced by farmer communities has brought forward a number of practices representing main development paths in mountain pasturing. Building upon case study evidence, it shall be summarized:

- The five management strategies detected in the survey describe “ideal types” of pasturing communities’ approaches to “navigating their pastureland through time” (Ploeg 1994). Although synthesized on a highly integrated and generalized level, significant correlations to landscape- and vegetation pattern diversity could be identified. Generalisation relies on the complexity inherent to the identified types, referring to the multitude of impact factors influencing and steering dynamics within the system: “A complex system is described as one that has more than one possible future, it is a non-deterministic system, whose future cannot be determined in advance” (O’Rourke 2006). By typecasting existing complexity can be simplified, in order to identify and systematize pathways of expectable developments (Whatmore 1994). This is why we

see analysis of management strategies and their typological classification as a feasible starting point for assessing landscape diversity as well as forecasting expectable dynamics in pastoral landscapes. The three dominant strategies “*intensification*”, “*rationalisation*” and “*maintenance*” draw responsible for current decline of diversity in vegetation- and landscape patterns in pastoral landscapes of the case study area. In comparison for the two minor strategies “*diversification*” and “*traditional rotation*” sustaining of pattern diversity can be diagnosed.

- b) Management strategies are essentially characterised by economic parameters. Core features distinguishing the different types of management contain pasturing intensity/grazing pressure, input of labour and input of production facilities. These parameters also could be carved out as central linkages between management practice and landscape patterns. Strategies are chosen by pasturing communities regarding environmental and legal framework conditions. However, there is no immediate relationship between those framework conditions and the chosen management practice. They rather provide more or less favourable backgrounds, while decisions, which strategies are chosen, are individually founded and influenced by social structures and power relationships within communities. This is why under similar environmental and/or legal framework conditions not only various types of management can be found, but also – as a consequence – various landscape patterns. Landscape and vegetation diversity varies strongly within similar environmental and/or legal settings due to different approaches to pasture management.
- c) Policies are an important factor influencing management strategies, but their impact is heterogeneous in the different types. Current policies supporting mountain areas are without doubt an important groundwork for sustaining of mountain pasturing and pastoral landscapes. However, when focusing on the typology it can be deduced that policies are received distinctively among pasturing communities, promoting management strategies in different ways – and achieve ambiguous effects on landscape diversity. For instance, indication from comparative fieldwork conducted within this study points to the fact that the strategies “*intensification*”, “*rationalisation*” and “*maintenance*” form the mainstream of development, being advanced disproportionately by current policy schemes. In contrast, the both remaining types strike as marginalities, rather being promoted by resistant/resilient behaviour and “collective mentalities” within communities than by favourable economic or political frameworks.

Efforts in sustaining biodiversity of pastoral landscapes should take into account the different approaches to pasture management to be able to handle them more accurately. On the level of agro-environmental policies this could be a precondition for future programme design. In accordance with Schmitzberger et al. (2005), payments granted from agro-environmental support should be targeted more specifically. In order to improve specificity in ecological respects, management practices and strategies and their environmental impacts should be considered stronger in programme development and its application. On the other hand, conservationist perspectives shall extend their focus on the diversity of management practices, as a source of ecological diversity. Therefore the well-established protectionist perspectives on conserving certain types of ecosystems not regarding the social and economic systems forming the groundwork of their existence shall be reconsidered and be replaced by an integrated and dynamic perspective including humans into perception. Adaptive co-management may provide a viable alternative approach to conservation in that context. The framework of adaptive co-management, as outlined in principle by Berkes & Folke (1998), Berkes (2004), Folke (2006) and others could complement the top-down policies supporting alpine pasturing by rather specific, custom-made bottom-up strategies. The presented typology therefore offers a starting point.

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abandonment in sustaining of pastoral landscapes and maintaining diverse landscape ecosystems. Accompanying research was conducted in order to analyse the situation of alpine pasturing in the study region and identify current dynamics within the social and the ecological systems in alpine pasturing and pastoral landscapes. I would like to thank the Regional Government of Upper Austria for providing financial support. Thanks also to Norbert Kerschbaumer and Dr. Michael Machatschek, who supported data collection and contributed invaluable inputs in discussions.

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