Chapter 19
The Swiss Mountain Wooded Pastures: Patterns and Processes

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Abstract Influenced by the combined action of grazing and forest management, wooded pastures represent a traditional form of multiple use of natural resources in some European mountains. This fragile semi-natural ecosystem is characterized by the coexistence of high biodiversity and extensive land use. Based on experimental and observational studies carried out at various spatial scales in the Swiss Jura Mountains, this chapter provides an insight into patterns and processes occurring in this typical silvopastoral ecosystem. Summer grazing by cattle is the main driving force affecting vegetation dynamics. Large herbivores influence vegetation in three ways: grazing and browsing, dung and urine deposition and trampling. Field observations reveal a high heterogeneity of cattle activities at both fine and large scales. Cattle habitat use controls the dynamics of plant species and functional groups in the herb layer. Natural tree regeneration is also closely affected by cattle activity and related to the heterogeneous environment. Distribution of tree seedlings is spatially associated with specific physical structures or nurse plants that facilitate their survival in the herb and the shrub layers. Moreover, the growth of tree saplings is related to grazing intensity. Knowledge of ecological functioning of wooded pastures has allowed the development of a novel, spatially explicit, mosaic compartment model of the dynamics of silvopastoral ecosystems. This model is able to explain some aspects of the origin of vegetation heterogeneity in pasture-woodland landscapes. The conservation of such ecosystems is an important challenge considering its complexity and the present change in agricultural practices in mountain regions. A better integration of ecological and socio-economic processes
into predictive multi-level models will permit the exploration of the conditions for sustainable management schemes compatible with biodiversity conservation.

**Keywords** Cattle activity, plant functional groups, modelling, spatial-temporal scale, tree regeneration

**Introduction**

Semi-natural silvopastoral ecosystems, such as wooded pastures, form traditional landscapes in Europe (Etienne 1996). Influenced by a combined action of cattle grazing and forest management, the wooded pastures represent a form of multiple use of natural resources. This type of land use is particularly interesting when considering the challenges in sustainable management of mountain areas. Due to changes in agricultural practices towards either local intensification or extensification, most of the silvopastoral ecosystems in Europe suffered a large decline during the last century (Gillet and Gallandat 1996b). Considering the high cultural, socio-economic, ecological and landscape values of this ecosystem, there is an increasing need to develop conservation tools.

Integrated management planning of wooded pastures requires an intensive collaboration between agronomists, foresters, ecologists and sociologists (Gmür and Wettstein 1986; Gmür et al. 1989; Perrenoud et al. 2003). In silvopastoral ecosystems, the question of management type and use intensity is critical. Strategic objectives may aim at the conservation of the state of wooded pastures, or to more or less severe restoration measures, even through re-creation starting from closed forests or open grasslands. Successful management, in particular for biodiversity conservation, requires traditional scientific observation and experimentation and is generally not yet founded on specific scientific tests, but based on anecdotal evidence or, at best, on inductive studies (Rook et al. 2004). The understanding of the main ecological processes occurring in wooded pastures is therefore essential for efficient management schemes of this threatened ecosystem.

In this context several studies were undertaken since more than 20 years in the wooded pastures of the Swiss Jura Mountains, where this ecosystem is still the most abundant type of man-made landscape (Gallandat et al. 1995). In this chapter we summarize results of our work and related studies describing ecological patterns and processes in wooded pastures. We first describe the management and the high biological value of this ecosystem. Second we present the hierarchical organisation of the system. Third we focus on three key processes participating in vegetation dynamics. Fourth we present a predictive spatially explicit model integrating all current knowledge. Finally we conclude with research and management perspectives.