When culture supports biodiversity: The case of the wooded meadow

Kalevi Kull, Toomas Kukk & Aleksei Lotman 2003

Since most human activities decrease biodiversity, including the traditional types of nature protection which only slow down the speed of biodiversity loss, the only way to preserve biodiversity in the long run is to find ways of ecosystem management which could also increase the local species richness, without any active introduction of new species. Wooded meadows, together with several other semi-natural ecosystems, propose traditional examples of this type. This paper examines the history of wooded meadows in Estonia, gives a short review of the mechanisms of species richness preservation, and discusses current activities in the restoration and protection of wooded meadow communities. We argue for the hypothesis that the wooded meadow as a type of landscape originated in the culture of settled hunter-gatherers, and that it has in remarkable ways organised the culture-nature relationships in Estonia during eight thousand years, until the beginning of the 20th century.

Introduction

When cataloging vegetation found during our fieldwork in the semi-natural meadow communities of western Estonia, we were very surprised to find that the species diversity at some of the sites happened to exceed the highest known values of micro-scale vegetation diversity in the entire world. Neither in any other community of Western Europe, nor anywhere in the tropics, does the number of vascular plant species within a few square meters reach the numbers counted on the Estonian wooded meadows. Wooded meadows, now close to disappearing, still exist in a few places along the coasts of the Baltic Sea. They represent a common landscape which has been kept and managed by many generations of farmers probably without any thought to biodiversity in its modern sense. However, understanding the mechanisms which have created these ecosystems may be helpful in coming to grips with the much more general

problem of how human activity is possible without the loss of a diverse nature.

Here we have a problem which has two quite different facets. One is a basic ecological problem; how is it possible for high biodiversity to persist in a certain management regime? The other is a challenge to cultural theory as it asks a similar question from the point of view of culture-nature relationships. Seemingly, these two problems can be integrated by an *ecosemiotic* approach, i.e, a semiotic approach to the ecosystem of culture (see Noth 1998, Kull 1998, Hornborg 1999),

Different views on the 'ideal' of a national park represent particular nature-culture relationships and specific images of 'valuable' nature. One view is the idea of *wilderness*, based on a sharp boundary between the space of human management and that of untouched nature, and practised particularly in the United States (cf. Oelschlaeger 1991). Another view is that of *countryside*, as idealised, for example, in British or French concepts of nature protection ('landscape as 'a garden'). The first implies a picturesque wilderness, where human influence is kept at a minimum; the second a well-designed landscape in which most of the biocommunities are controlled and reshaped by humans. The example we will describe here does not fit well into either of these categories: Unlike the wilderness, it is managed, and unlike the countryside, it includes almost only local (i.e. non-introduced) species and it is much less controlled by human activity. Therefore, we shall call this unique type of nature the idea of *wooded meadow*.

Every species influences its environment in one way or another. This influence can lead to improved living conditions for both the actor itself and for other species, or it may be inhibiting or disastrous for both. The species may persist, whether competitive or symbiotic, if the influence is so extensive that it allows the species to use their adaptiveness to find the resources they need. We claim that some human activities throughout history have contributed to diversity and hence to our survival, whilst others have been destructive. The few examples, however, of an human influence on nature that have enhanced the species richness of communities, all deserve more detailed study, both from a point of view of ecology and of cultural history.

The importance of the biodiversity problem comes from the fact that most types of nature protection only slow down the speed of species loss, which is caused by the growth of human-induced changes on the Earth. In the long run, this could mean that the number of species in the world's ecosystems are greatly impoverished (Jablonski 1991). Therefore, the only way to preserve biodiversity is to find ways of ecosystem management, which may also increase the local species richness without the introduction of new species.

The work by Kukk & Kull (1997) reviews various available data on wooded meadows, using both literature sources and the authors' own studies. The main research undertaken previously on wooded meadows can be attributed to H. Hesselman (1904), E. Julin (1948) and H. Sjérs (1954) on Sweden; C. Cedercreutz (1927, 1931), A. Palmgren (1915-1917) and C.-A. Haggstrém 1983, 1987, 1990) on Finland; and H. Krall (1975, 1990) and K. Pork (Krall & Pork 1970) on Estonia. 'Wooded meadow research in Estonia has been concentrated in the Laelatu Biological Station in recent decades.

In this paper, we draw some conclusions from our research on wooded meadows, formulate the general conditions for high diversity in a plant community, and discuss some general aspects of ecosemiotic relationships in the context of biodiversity and species co-existence, thus on the part of biology,.making an attempt towards a dialogue with anthropology (cf. Kaarhus, this volume).

Wooded meadows: a short natural history

Until the middle of the 20th century, wooded meadows were widespread traditional semi-natural ecosystems, particularly abundant in the countries around the Baltic Sea. However, they have now almost entirely disappeared due to fundamental changes in land management.

Of the many names given in various languages to wooded meadows, the best known are *Gehölzwiese* (*Laubwiese* in older literature) in German, *löväng* in Swedish, *lehtoniity* in Finnish, *lesolug* in Russian, and *puisniit* in Estonian.

Wooded meadows can be defined as *sparse natural stands with an annually mown herb layer*. Tree canopy cover is usually in the range 10-50%. With regard to the horizontal structure of the traditional wooded meadow, only

10-20% of its surface area is not covered by a mowable herb community. Typically, deciduous trees and several shrub species are present, which are distributed in quite small irregular patches. Regular mowing (once a year) is important, but there may be some years when mowing is interrupted. Grazing on wooded meadows can vary quite a lot, usually they are lightly grazed by sheep or cattle in late summer (after mowing), but many sites are not grazed at all. Wooded meadows look like parks, but they differ from them due to their natural (not planted) vegetation and the natural unploughed soil. However, through the selective removal of trees, their species composition and appearance are influenced by humans.

More than five hundred years ago, wooded meadows were quite common in many areas of Europe, including England. As Schama (1995: 143) describes it:

> Much of the forest, even in the early Middle Ages, was already being managed as a special kind of micro-economy for its inhabitants..Hardwoods were cut at regular twelve-year intervals four to six feet from the ground, sufficiently high to prevent deer from eating the new shoots. The base 'stool' would then be left to regenerate itself rapidly into the kind of light timber that could be used to meet all manner of essential needs: fencing, wattling, tools and implements. The result was the underwood, or coppice, that was the distinctive mark of the medieval forest and which in a very few locations, like Hatfield and Hadley Chase, can still be seen in England. In contrast to the most ancient forests of Germany and Poland and to the conifer woods of the Scottish Highlands and the oak forests of the English aristocratic estates — all products of the eighteenth and nineteenth-century crazes for picturesque and Romantic 'improvements' — these ancient woodlands seem thinner and almost patchy, with swathes of grassy meadow and wild flowers blooming between pollarded and truncated broadleaf trees. The exact opposite of what is now considered to be the ideal norm of a forest habitat — the untended wilderness — they have light and space and variety: a working room for an authentic woodland culture.

The main distribution area of wooded meadows covered (at least, during the last several centuries) the region around the Baltic Sea (many islands, western and northern Estonia, south-western Finland, central and southern

Sweden), and the mountains and hillsides of central and southern Europe, but there are also cases found in North America and Asia. The wooded meadows were typically found in geographical areas that were permanently covered by snow in winter, thereby necessitating the production of hay for cattle. However, during the last 50 years, these meadows have been abandoned and have disappeared almost everywhere. The best preserved of the remaining few are situated in Estonia. Some have also been restored in Sweden and Finland.

An interesting aspect of wooded meadows is that they supposedly constitute some of the oldest human-made landscapes, formed by a continuous long-term use. Therefore, it is of interest to reconstruct a possible history of this type of nature. In the following we propose a sketch of Estonian wooded meadows as an example.

Some 13-14 thousand years ago, the area now known as Estonia was still covered by a glacier that was melting relatively quickly, and within a period of approximately two thousand years it was gone. However, as large areas were still under water, only the innermost parts of the country were inhabitable for humans and other dry land dwellers when man — the hunter — came (first signs documented are from 9,500 years ago). As a result of this glacial melting, development of the Baltic Sea and a post-glacial land-lift, the present-day Estonia was gradually shaped.

Judging from the climatic zone, the climax plant-cover of the land must have been mixed forest. Accordingly, about seven thousand years ago almost all the land should have been covered by forest, and forest-free areas would only have been expected in narrow stripes along the sea coast and along the regularly flooded riversides. However, pollen analyses indicate that there have been more open areas than predicted by this scenario. For instance, among the tree species, oak (Quercus robur) and hazel (Corylus avellana) were quite frequent. Seedlings of these species require much light and cannot survive under a dense canopy. Pollen analyses have shown that this Ulmus-Corylus period started 8,000 years ago in Estonia. Accordingly, there must have been some open sites.

Vera (1997, 2000) has argued for a hypothesis, which explains this phenomenon via the influence of large herbivores. If access to food was limited, large herbivores (auroch Bos primigenius, wild horse Equus

caballus, European bison Bison bonasus, elk Alces alces, red deer Cervus elaphus, roe deer Capreolus capreolus) would prefer to graze in forest glades with abundant herbal vegetation. This would inhibit the trees from regenerating in these places and keep the sites open. In a primeval forest, such openings appear naturally when a large tree, due to age or storm, falls down. Also, particular deciduous species could have been severely damaged since their bark and stems were used for food by these animals (cf. Falinski 1998). According to this hypothesis, 'in prehistoric times, the natural vegetation in the lowlands of Central and Western Europe was a park-like landscape, a mosaic of grasslands, scrub and solitary trees and groves surrounded by cover and border vegetation' (Vera 1997: 421). In these conditions, oaks and hazels could regenerate. Accordingly, the history of wooded meadow-like ecosystems in Europe may go back to the beginning of the Holocene.

We would like to argue that in some cases the influence of humans on the landscape could have had a similar effect, thereby supporting the influence of large herbivores. The early humans depended very much on trees for firewood, building materials, tools etc, Different tasks required different species of trees, and furthermore, diverse herbal vegetation was likely to have been important for food and medicine, This suggests that human settlements would have been established in those places where many different species of trees and herbs grew nearby, i.e., where the local species diversity, and, accordingly, the diversity of soil conditions (particularly as related to water conditions and pH) were high. Suitable sites were to be found along river banks, also because fishing and hunting were essential. Game preferred these areas: what was good for game was also good for hunters. The sites might therefore have been prepared by animals, so that humans did not have to start from zero. Thus, the places preferred by large herbivores — and turned by thetn into half-open park-like sites — were almost certainly the same sites preferred by human settlers. Wooded meadows may thereby have been a traditional ecosystem for hunter-gatherers when they established themselves in one place.

If it was only the trees nearest to the settlement which were cut, the surrounding glade would permanently grow. This in turn would increase the distance between the settlement and the supply of wood, perhaps resulting in a move to another place. Conversely, if the trees were used

selectively, i.c., if the nearest trees were not chopped down, a mosaic of small glades would appear, whose growth was naturally restricted. In this balanced state, the intensity of usage would equal the growth rate of new trees on the same territory. In contrast to the open meadow management, the wooded meadow can therefore be seen as a stable type of land-use already before the period when draught animals were widely used.

In Estonia, the domestication of animals first came into effect during a period of warmer climate (late Atlantic), when it was possible for the animals to find food throughout the winter. Mosaic meadows around human dwellings proposed a good place for them to graze, as well as to find twigs and the bark of trees and bushes for food. Their diet, seemingly, did not differ initially very much from that of wild herbivores, whom they replaced near the human settlements. As the climate worsened after the end of the Atlantic optimum, about 4000-5000 years ago, the winters started to become colder. The number of wild game decreased, and as a consequence domestic animals gained more attention to compensate the loss. This meant an increased communication between humans and the animals living around the settlement. Because of the deep cover of snow, these animals were dependent on human help for food. The gathering of loppings (leafy twigs from trees or shrubs) was probably the main method of obtaining fodder during two millennia, before the discovering of the scythe. Leafy twigs are more plentifial, carry more leaves, and are available closer to ground if the tree canopy is not completely closed, thus allowing more light to reach the ground. For this purpose, the wooded meadow is an ideal community — much more suitable than the forest. In Sweden, as well as in many places in Western Europe, the pollarding of trees was used for the purpose of collecting twigs (Higgstrom 1998, Haas et al. 1998). According to existing data, however, this method was rarely used in Estonia, which can be explained by a less intensive land use. There was a preference toward single farms and the population density was low. Thus, every farm could have its own wooded meadow (sometimes called heinaaed, ‘hay-garden’). The tradition for collecting loppings for fodder from wooded meadows was preserved, in rare cases, until the 20th century.

Thus, wooded meadows probably started to appear considerably before mowing was invented in the Baltic area. Multifunctional use of land around settlements, which included the selective cutting of trees, the collecting of

twigs for leafy fodder, and grazing, led to quite a stable wooded meadow-like ecosystem already 4000- 5000 years ago. Mowing by scythe, which began about 2000 years ago, gave the meadows their typical form that is still familiar today.

Since domestic herbivores competed with humans for the plant resources available, the need for additional food plants for humans was evident.'The cultivation of land started in Estonia about 3000 years ago, but the settlements mainly consisted of single farms — this has indeed been the typical type of settlement for a very long time (Lang 1996) — and the appearance of small fields hardly changed the general structure of the landscape. Later (about 1,500 years ago), the growing dependence on land cultivation and the availability of materials for tool-making, seemingly correlated with the development of a more differentiated social structure. However, the majority of man-made meadows in the Baltic area were probably wooded meadows until approximately the 19th century, when the proportion of open and cultivated meadows began to increase.

It is important to note that the introduction of agriculture did not change the traditional relationship to nature in this area. Although the inhabitants began field agriculture and ploughing, they did not change from being hunters-gatherers to being graziers (livestock farmers). There was always a piece of forest alongside the farmhouse. The fields that were established were small, and they rarely grew much. They therefore only partially fulfilled the needs of the peasants, and many plant products were still collected from the natural plant communities. The wooded meadow therefore remained a main organiser of most of their daily life.

The regular management of a wooded meadow included a series of related tasks performed in a certain order. These included: (a) the raking and picking of fallen branches (in spring), which were later burned or used as firewood; (b) mowing (in July); (c) making loppings from twigs (after hay-making), which were dried and used notably for sheep fodder in winter; (d) coppicing (not every year); (e) the cutting of trees (in winter); (f) pasturing (in August and September); (g) collecting of secondary products — birch sap in spring, berries, mushrooms, medicinal herbs, tea herbs, hazelnuts, wild apples, flowers, etc.; (h) widespread wild bee managing; (i) hunting, due to a good feeding area for large herbivores; (j) bird egg collecting (used

locally); (k) maintaining of drainage systems in some wet meadows; (1) use of the place for religious rituals, and festivals.

Wooded meadows thus represented a perfect example of green management, with a very long-term and stable multifunctional use of the land. An important aspect to add is that the stability and continuation of wooded meadows was supported by their aesthetic value, a fact confirmed over and over again by old local farmers whom we questioned in our fieldwork over the last decades. This includes the colourfulness of the meadow (notably in early summer, but flowers of different colours are also present throughout the snow-free season), the presence of interesting forms of trees in different sizes and tones (which were selectively kept, and included many old ones), the hovering of insects (butterflies, dragonflies, bumblebees), the concert of birds, the even, lawn-like surface (in late summer, after mowing), and multistage views with a variable play of light and shade. These qualities have throughout thousands of years continued to impress human beings, and they are probably the reason why park-like landscapes developed independently in many parts of the world.

In most areas of Western Europe, wooded meadows disappeared already in the Middle Ages, but they persisted for a longer time in marginal regions. According to Diekmann (1994: 9), the extension of wooded meadows in Sweden culminated during the 18th century. After the introduction of more effective ploughs and artificial fertilisers, arable lands, including leys and fertilised meadows, extended their areas at the expense of wooded meadows, which suffered from a deterioration of soil and were either cut down and turned into arable land and pastures, or allowed to regrow into forest. Many of the present deciduous forests originate from former wooded meadows, often through an intervening stage of wooded pastures. The rapid decrease of the wooded meadow area can be illustrated by some figures from Gotland, where about 32,000 hectares in the year 1900 had become reduced to only 284 hectares in 1983 (Diekmann 1994: 10}. Most of the wooded meadow sites that exist in Sweden today have been restored after having suffered temporal overgrowth accompanied by a reduction in the original species richness.

In the case of Estonia, the area encompassed by natural grasslands reached its maximum somewhat later, at the end of the 19th or beginning of the 20th century, when wooded meadows covered 850,000 hectares (18.8% of

Estonia's surface area) (Sammul et al. 2000), According to the agricultural census of 1939, natural grasslands of various types covered altogether one-third of the surface area of Estonia, and this was considerably more than in adjacent countries. There were slightly more meadows than pastures, and more than a half of the meadows were wooded meadows. Particularly in the western part of Estonia, almost all meadows were wooded meadows. They were often quite large, covering several square kilometres, and they could include all the meadows from a whole village.

The abandonment of wooded meadows in Estonia took place in several steps: (1) a reduction of farming during World War II; (2) the cessation of mowing by hand; (3) the cessation of mowing using horses. The first meadows to disappear were wet-wooded meadows, of which no well-preserved examples exist.

A general reason for this rapid decrease was the change in agricultural management from an extensive to an intensive type. This meant that natural grasslands were replaced by cultivated grasslands, and that mowing by scythe was replaced by tractor-mowing. However, this change took place more slowly in Estonia than in Sweden and Finland due to the fact that Estonian farmers, although working on collective or state farms, kept a small number of animals for their own use. Hay was made for these animals from the old natural grasslands, often by hand or with the help of horses. It was only in the 1960s that this situation changed. After that, overgrowth in wooded meadows occurred very rapidly.

Our fieldwork from 1995-99 revealed that there are still about 500 hectares of species-rich wooded meadows preserved in quite good condition in western Estonia, plus about 200 hectares of species-poor and flooded wooded meadows in other regions of Estonia. These are mainly small, less than 5 hectares one-farm meadows. From these, about 200 hectares (in about 40 sites) of the traditional Estonian wooded meadows are mown contemporarily, i.e. these are old sites, probably never having suffered overgrowth. In addition, there are many sites where the meadow was abandoned in recent years due to the cessation of cattle raising, or due to the advanced age of those people who had worked there.

The factors of species richness

Paradoxically, there is not a single ecosystem in the world that has been completely inventoried, i.e. of which a full species list is known. In order to make such a census of species in an ecosystem, a great deal more knowledge in field biology is required than is currently available. Therefore, it is necessary for us to restrict ourselves to data about some taxonomic groups, for example, plants. Furthermore, we need to consider several methodical problems in species richness measurements,

Species richness is largely scale-dependent. By small-scale richness we mean the number of species found on plots of a size less than 10 square meters, Measurements of species richness are quite sensitive to differences in counting methods. We define the number of species in a plant community as follows:

(a) the plot is quadratic (i.e. not longitudinal), its boundaries are fixed on the ground level, and only those ramets (individual shoots) which are rooted inside the plot belong to it; (b) only ramets which possess living above-ground parts on the day of measuring are included; (c) diaspores or other unrooted parts of plants are not included. Reliable results require a good knowledge of local flora (i.e., to be able to identify vegetative shoots and seedlings), and enough time to make the descriptions.

In Estonia, the number of vascular plant species in a 1 x 1 m plot does not normally exceed 20 in forests and 30 in natural meadows; in the richest alvar meadows it can be slightly over 40; and only in wooded meadows has it been found to exceed. 50. The maximum (76 species in a 1 x 1 m plot) is recorded from the Laelatu wooded meadow in Estonia. A high value (74 species in a 1 x 1 m plot, or 68 as an average of ten plots) is also recorded from the Vahenurme wooded meadow (for the list of species see Kukk & Kull 1997). The top five wooded meadows according to their local (1 m^2) vascular plant species richness, on the basis of our existing data, are Laelatu (76) and Vahenurme (74) in the western part of mainland, Tagamõisa (67) and Küdema (65) in Saaremaa, and Tärkma (61) in Hiiumaa.

What are the factors determining the species richness in wooded meadows? The wooded meadows which have the highest richness in their plant

communities, have been found to be similar in the following characteristics:

- They are very old, regular mowing has taken place sometimes for several centuries.
- Soil is neutral, calcium -rich.
- Grazing has not taken place and if so, not intensively.
- Their territory has been large (tens of hectares, as a minimum).
- They include some moist or wet patches.
- The tree layer is species-rich.
- The local species pool is large.

A large species pool requires a diversity of niches on a small territory — i.e. nearby sites with conditions of shade and light, moisture and dryness, rich and poor soil nutritiousness. This corresponds exactly to the conditions found in wooded meadows. The richest community patches were usually found in sites of lower productivity and with a relatively open canopy.

The density of the seed bank is quite low in wooded meadows. The number of annual species is very low; they are represented almost only by hemiparasites (*Rhinanthus*, *Melampyrum*). Life cycles are extended, and vegetative reproduction dominates.

According to the measurements in Laelatu wooded meadow, the herb community's above-ground biomass reaches its maximum at the end of June. The peak of the seasonal maximum of species richness (i.e., of the number of species which have some living green organs above-ground) is wider than the biomass peak, but they generally coincide.

The number of bryophyte species in a 1 x 1m meadow plot is usually between 4 and 10 in the Laelatu wooded meadow. In a contrast to vascular plants, less rare bryophyte species are growing on these meadows (Ingerpuu et al. 1998).

The total number of species in a terrestrial ecosystem is roughly proportional to the number of plant species. However, this correlation is not very strong. Still, according to our estimations, the diversity of bird, mammal and reptile species is higher in a wooded meadow, if compared with either a forest or an open meadow site in otherwise similar conditions.

A case study about the species diversity of terrestrial molluscs and carabid beetles gave similar results (Talvi 1995; Tiina Talvi, unpublished).

In natural meadows, only about 15% of the annual biomass production is removed with the hay. Equilibrium hay-yield (i-e., productivity after long-term management) from a wooded meadow is higher than from an open meadow in otherwise similar conditions. This is due to the additional input of mineral elements from tree leaf litter, since tree roots take nutrients from deeper layers than herb roots. From the point of view of nutritional quality, the hay from wooded meadows is richer than that produced on cultivated grasslands.

The horizontal variation in small-scale species richness was very large in the investigated meadows, and the patches with extremely high richness are quite small. However, the local species richness was very stable from year to year, under regular management conditions. A great deal of the horizontal variation in the berb layer in wooded meadows is connected to the distance from trees. Closer to trees, the herb community is higher, and individual ramets are bigger, whilst the ramet density and species richness are lower than in more open sites.

Of course in stating that small-scale species richness is extremely high in west-Estonian wooded meadows, we should first ask whether plant communities with greater small-scale species diversity exist anywhere in the world? It appears that there is not much known about this, because a comparative analysis of small-scale richness in plant communities on a worldwide scale is still absent.

We do know, however, that the maximum recorded and published number of vascular plant species on a 1 x 1 m plot has been found in a meadow steppe site, located in a forest steppe region of the Central Chernozem Nature Reserve (Strelets Steppe), where Alechin (1934) described a plot with 77 vascular plant species. Later, six plots with species numbers from 61 to 87 were recorded in a regu~ larly mown community (Afanaseva, Golubev 1962). There also exists a note about a 1x 1 m plot of 89 species in a traditional slightly grazed mountain meadow of Argentina (Cantero et al. 1999; however, no species list has been. published). These are the only sites known in the world where the small-scale species richness exceeds that of Estonian wooded meadows. However, similar communities exist in which

species richness is also very high, e.g., wooded meadows in Czech mountains (L. Klimes, pers. comm.) and chalk meadows in the Netherlands. In all these sites, sev- eral features coincide:

- These are semi-natural communities with very long-term, regular and moderate management, either mowing or non-intensive grazing.
- The soil is close to neutral and calcium-rich.
- The vegetation is low.
- The local variation of conditions is high.
- The local species pool is high.
- Geographically, these sites are situated in a temperate zone.

The species richness of a community is the result of an equilibrium between immigration and extinction. Therefore, a turnover with two different pools is essential: On the one hand, the species pool (the species present in the vicinity, outside the plot), on the other hand, the dormancy pool (the species which are in a dormant state, below-ground on the plot; it includes the seed pool). The first is defined as an external turnover, the latter as an internal turnover; both are scale-dependent with a greater importance in smaller plots.

There is a clear latitudinal trend in the size of the species pool; this excludes high latitude sites from the richest ones. This also causes a good negative correlation between species richness and latitude if comparing plots of one hectar or more in size. In addition, local heterogeneity of habitat conditions increases the local species pool. On the other hand, the number of specimens on a plot is connected to the size of plants, which shows a contrariwise trend; this is one of the reasons that excludes the tropical areas from being the richest in small-scale diversity. An impor- tant factor is mowing, which diminishes the size of plants, reduces the level of competition and makes the competition more symmetrical.

The high species diversity is strongly connected to history. Although species richness may decline very quickly, it only increases again very slowly. This is the rea~ son why the highest diversity has been found in those sites which have been in permanent use over a long period of time, perhaps for several centuries. When a wooded meadow, for example, has not been used for a while and has overgrown, the richness of the plant community is reduced, and then if the meadow is restored later, it will take considerable

time to reach the previous species diversity. This is probably the main reason why most of the current wooded meadows in Sweden have much lower species diversity than the Estonia meadows. In Sweden, the wooded meadows in question have all been out of use for some period, and have only been restored later.

In global terms, the geographical region where hay-making takes place is latitudinally not very wide. The combination of relatively undisturbed nature (compared to the surrounding areas), calcareous soils, low population density, and a persistent culture possessing a long tradition for non-intensive land-management, has given these rare examples of still existing, rich and beautiful, semi-natural ecosystems.

Protection, restoration and the contemporary management of wooded meadows

The existing ways and experience in keeping and protecting wooded meadows may, give some hints for understanding the possibilities of preserving biodiversity, also in more general terms. Below we describe briefly the Estonian experience on this issue.

The oldest known regulations for nature protection in Estonia were connected with restrictions for the cutting of oaks (on the islands of Naissaar in the 13th century, and Hanikatsi in the 16th century), but since oak forests were often used for hay-making, this probably also meant the protection of some wooded meadows, At the end of the 1930s, a few nature reserves were established, in which territory some wooded meadow sites existed (Puhtu), and since 1957 there have also been some nature reserves specifically for protecting wooded meadows (Tagamõisa, Laelatu, Halliste, Koiva).

During the first half of the 20th century wooded meadows represented the most common type of semi-natural ecosystems in several counties of western Estonia. In 1995-96, about 200 hectares of them were still managed, of which 60 hectares were situated within the bounds of state nature reserves.

Considering the efforts needed to preserve wooded meadows, their persistence could be achieved by an additional evaluation of the work

needed (mowing, primaily). Species richness itself, as an important quality of the environment, could also be directly protected by law. Until now, there have been no regulations based on the number of species.

Biodiversity of the meadow ecosystems is connected to human use and it declines significantly if this use ceases. Since these plant communities are products of long-term interaction between man and environment, the possible man-induced threats are two-fold. Active threats include drainage, fertilisation, ploughing, etc. However, the passive threat of stopping traditional uses like grazing or mowing is just as serious. Any conservation of these communities must therefore include active management in the form of support to traditional uses like grazing or mowing.

We can give here an example of meadow conservation in the Matsahi Nature Reserve. The area ‘in question is situated on the western coast of Estonia, which includes Matsalu Bay, and it is surrounded by a wetland of international importance (particularly due to its value as a rich bird sanctuary) and a diverse variety of meadows, wooded meadows and forest. The Management Plan for Matsalu (MPM; for a summary see Lotman 1994) is a comprehensive document that briefly describes the wetland, evaluates its features and the threats to these, and prescribes actions to counteract these threats. Actions are assigned with budgets and with priorities that stem from the previous evaluation.

According to the MPM the meadows are among the chief values of the wetland. They are important from a botanical perspective and also as bird habitats. Activities like drainage, fertilisation, and ploughing are either banned or strongly regulated in the Nature Reserve and the passive threat caused by stopping traditional uses like grazing or mowing is recognised as being most acute at the present time.

Therefore measures to counteract abandonment of the meadows are given high priority in the MPM. These include the making of grazing or mowing contracts with farmers and paying compensation accordingly. Payments vary for grazing (either per cow or per horse day, or per sheep day) and mowing of open meadows (if mowed but not harvested, then only half of the sum is paid) and of wooded meadows (only paid if hay has been removed).

Currently all the people who participate in the meadow management in Matsalu Nature Reserve are compensated according to the MPM.The same principles apply to the management of a few other Estonian wooded meadows. Apart from mowing or grazing, bush cutting is carried out on the overgrown parts of the meadows. Some of the negative trends have fortunately been reversed, some merely slowed down. Therefore, to save the meadows in the long term, their wise use must become part of the resource use patterns once again.

In order to organise such work throughout the whole country, the Estonian Seminatural Community Conservation Association was established in 1997. In addition to the preservation of the existing old wooded meadows, the restoration of other sites has also been started. The restoration of wooded meadows could be justified for nature protection (as a habitat for many rare species, and as a very rich community), for green farming, for eco-tourism, for cultural history protection programmes, for scientific interest, for landscape design, for aesthetic reasons, etc.

The best results in wooded meadow restoration can be achieved when using abandoned wooded meadows, in which many old trees are still alive and the former structure of the meadow can be detected. Some patches of meadow vegetation may still exist in these sites, thus allowing herb species to establish more rapidly in newly opened areas.

In several cases (Viidumie, Laelatu, Nedrema, Matsalu), volunteer camps were used to organise the work. Similar volunteer camps have been organised in a few Finnish and Swedish wooded meadows during the last decades. The main aim, however, has been to guarantee stable long-term management, which cannot be based on volunteer camps, since they cannot fulfil the basic requirement of this type of ecosystem, i.e., the sophisticated and knowledgeable communication between people who manage the ecosystem, and the local species that they use.

A well-known and much used way of organising nature protection includes the establishing of national parks. Despite using the same name — national park — the designation covers two very different types of areas. The first type consists of re- serves and wilderness areas where no management is allowed and where the land is usually state- or federally-owned.This is the type of national park to be found in, for example, the United States or

Australia. The other type of national park allows different land~ownership, and various levels of regulation apply within each park (as in several European countries, including Estonia; cf. Dompka 1996). With this national park model, people live and manage the areas, but there are limitations with regard to the type and intensity of management. Due to these limitations, economic growth in its contemporary meaning may be limited, however, but living conditions in terms of environmental quality may be unusually high. These areas include the protection of semi-natural communities, and only this type of protected areas can preserve wooded meadows.

Ecosemiotic remarks

‘Wooded meadow analogues exist also in other ecosystems where human intervention can often facilitate the preservation of biodiversity:

- Traditional non-intensive fishery in lakes, rivers or marine ecosystems with a long-term regular harvesting of fish populations (or other water organisms) focusing on the more abundant species. This reduces the competition level in the water community, and keeps the species diversity permanently high.
- So-called ecological forestry. This means forest management that does not involve clear-cutting or forest planting and where mainly the dominant species are regularly harvested.
- Low-intensity (extensive) pasturing that keeps the pastures mosaic and where many sites on the pasture are rarely visited by the animals.

In all these examples, humans use some of the natural biotic production without removing any of the selected species entirely, and without adding new species in large quantities. The soil is not turned over, and the flow of waters is not redirected. This is a management of natural communities as they are: it does not remove any plant or animal community from the area, but it uses pieces of the community in a mosaic way, and reduces the number of some of the dominant populations thereby diminishing the competition intensity of the community. Thus, many species are given a niche that may allow them to survive.

When comparing the principal ways of human-nature relationships with regard to the spatial aspects, we can distinguish between three types:

- The spatial separation of large civilised and wild areas, according to the idea of wilderness.
- The total overlapping of nature and culture, as in the countryside (in the case of intensive management), parks, or gardens.
- The maximum spatial mosaic of nature and culture, as in wooded meadows, and other semi-natural ecosystems.

In addition, the latter can, of course, also include examples other than wooded meadows, *sensu stricto*, or the examples (a) — (c) listed above. For villages and towns, this would mean a mosaic greenery consisting exclusively of a local (i.e., non-introduced) flora and fauna that is not over-cultivated. Thus, we can develop the classification proposed in the beginning of this paper (see Table 1).

Landscape type	**Ecosystem type**	**Spatial relationship with cultural land**	**Dominant human activity**	**Occurrence of introduced species**	**Meaning of indigenous species**	**Impact on local species richness**
Wilderness	natural	separated	perception	none	positive (museal, rare)	unchanging
Countryside, park, garden	artificial	overlapping	operation	many	negative (weeds, parasites, dodo)	decreasing
Wooded meadow	semi-natural	mosaic	balanced communication	almost none	common	increasing

Table 1. Characterisation of three principal types of valued landscapes

We can, furthermore, see a difference in the communication aspect between these types of uses of nature. This is clearly seen if we apply the functional cycle, a model of the communicative act proposed by Jakob von Uexkiill (1982). The functional cycle can be seen as the basic mechanism behind any subjective Umwelt. It consists of the perceptual and operational worlds, which together comprise an Umwelt, the self world.

For humans, wilderness appears primarily via its grandiose influence on *perception*. As we are not allowed to use nature for material benefit, the perceptual side of communication (Merkwelt) dominates our relationships with wilderness.

The cultivated countryside has involved the work of people — a continuous *operation* to keep the order of things as designed by humans. Usage of nature in a well-ordered way means the dominance of motoric behaviour *(Wirkwelt)*, i.e., the operational world as a part of our communication activity. Indeed, for a well-designed area of countryside, as well as for a park or a garden, it is considered a disadvantage to leave any patch for weeds to grow. In this case, the perceptual side is subordinated to the operational, which may affect all plots of land.

With wooded meadows, neither perception nor operation can take over; they both participate as reciprocal constituents of *communication* with nature (of *Umwelt*). Operation is necessary, however restricted, in order to keep the semi-natural community in equilibrium.

Originally, wooded meadows were an integral part of the world of people, who lived as settled hunters and fishermen with some few domestic animals. In using the different products. of the diverse ecosystem which surrounded them, they contributed to the factors which preserved the high species richness.

Now, for contemporary Western people, primeval nature and natural plant communities only exist outside of their everyday world — their *Umwelt* — despite the existence of indigenous communities in some places. For current cultures, these wilderness areas serve the function of museums. Visiting these places means that people learn how it *was*, and see examples of previous, ancient times — something rare. For most people, natural species — as small populations in wilderness areas ~ do not play any real functional role in their everyday cultural life, either in a utilitaristic or in an ecosystemic (recycling) sense. That nature, which surrounds the majority of contemporary people in the civilised world, consists mainly of non-indigenous cultural forms, where the local flora and fauna are represented for the most part through weeds and parasites. Even if a garden seems to be well-designed with a high concentration of developed species, the overall number of species in such an ecosystem is much lower than in a natural community, particularly due to reduced soil and insect fauna, and microbiota.

An alternative or additional possibility would be to live as a *part* of local nature, thus requiring a different type of communication with other

species. This *living together* with local flora and fauna would allow us to use them to some extent, and allow them to carry on the eternal round-dance of our common nature. All this is possible if we surround ourselves with ecosystems consisting of local, indigenous biota. This is the basic idea of the wooded meadow.

References

- Afanaseva, V.A. & V.N. Golubev 1962. *Pochvenno-botanicheskij, ocherk Streleckoj stepi*. Kursk: Centralno-Chernozemnyj zapovednik.
- Alechin V-V. 1934, Centralno-Chernozemnye stepi. Voronezh: Kommuna.
- Cantero, J., M. Partel & M. Zobel 1999. Is Species Richness Dependent on Neighbouring Stands? An Analysis of the Community Patterns in Mountain Grasslands of Central Argentina. *Oikos* 87: 346-54.
- Cedercreutz, C. 1927. Studien über Laubwiesen in den Kirschpielen Kyrkslätt und Esbo in Südfinnland mit besonderer Berücksichtigung der Verbreitung und Einwanderung der Laubwiesenarten. *Acta Botanica Fennica* 3: 1-181.
- — 1931. Vergleichende Studien iiber die Laubwiesen im westlichen und éstlichen Nyland. *Acta Botanica Fennica* 10: 1-63.
- Diekmann, M. 1994, Deciduous Forest Vegetation in Boreo-nemoral Scandinavia. *Acta Phytogeographica Suecica* 80: 1-112.
- Dompka,V. 1996. *Human Population, Biodiversity and Protected Areas: Science and Policy Issues*. Washington: American Association for the Advancement of Science.
- Palinski, J.B. 1998. Dynamics of *Salix caprea* L. Populations during Forest Regeneration after strong Herbivore Pressure. *Journal of Vegetation Science* 9(1):57~64.
- Haas, J.N., S. Karg & P. Rasmussen 1998. Beech Leaves and Twigs used as Winter Fodder: Examples from Historic and Prehistoric Times. *Environmental Archaeology* 1: 81-86,
- Häggström, C.A. 1983. Vegetation and Soil of the Wooded Meadows in Nåtö, Åland. *Acta Botanica Fennica* 120: 1-66.
- — 1988. Protection of Wooded Meadows in Åland — Problems, Methods and Perspectives. *Oulanka Reports* 8: 88-95.
- — 1990. The Influence of Sheep and Cattle Grazing on Wooded Meadows in Åland, SW Finland. *Acta Botanica Fennica* 141: 1-28.
- — 1998. Pollard Meadows: Multiple Use of Human-made Nature. In *The Ecological History of European Forests*, KJ. Kirby & C. Watkins (eds.). Wallingford: CAB International, 33-41,

- Hesselman, H. 1904. Zur Kenntniss des Pflanzenlebens schwedischer Laubwiesen: Eine physiologisch-biologische und pflanzengeographische Studie. Beihefie z. Bot, Centralbl, 17: 311-460.
- Hornborg, A. 1999. Money and the Semiotics of Ecosystem Dissolution. *Journal of Material Culture* 4(2): 143-62.
- Ingerpuu, N., K. Kull & K. Vellak 1998. Bryophyte Vegetation in a Wooded Meadow: Relationships with Phanerogam Diversity and Responses to Fertilisation. *Plant Ecology* 134(2): 163-71.
- Jablonski, D. 1991. Extinctions:A Paleontological Perspective. *Science* 253: 754-57.
- Julin, E. 1948. Vessers Udde: Mark och vegetation i en igenväxande löväng vid Bjärka-Säby. *Acta Phytogeographica Suecica* 23: 1-186.
- Krall, H. 1975. Liigirikkad puisniidud Eestis. In *Eesti loodusharulduste kaitseks*, O. Renno (ed.). Tallinn: Valgus, 114-25.
- — 1990. Meadows and Wooded Meadows. *In Flora and Vegetation of Saaremaa Island*,V. Masing, E. Roosaluste, A, Koppel (eds.). Tartu: Estonian Academy of Sciences, 46-48.
- Krall, H. & K. Pork 1970. Laelatu puisniit. In *Lääne-Eesti rannikualade loodus*, Kumari E. (ed.). Tallinn: Valgus, 115-28.
- Kukk, T. & K. Kull 1997. Puisniidud [Wooded Meadows]. *Estonia Maritima* 2: 1-249.
- Kull, K. 1998. Semiotic Ecology: Different Natures in the Semiosphere. *Sign Systems Studies* 26: 344-71.
- Kull, K. & M. Zobel 1991. High Species Richness in an Estonian Wooded Meadow. *Journal of Vegetation Science* 2:711-14.
- Lang,V. 1996, *Muistne Rävala* [Prehistoric Ravala]. Tallinn: ETA Ajaloo Instituut.
- Lotman, A. 1994, Management Plan for Matsalu Wetland. *WWF Baltic Bulletin* 1: 11-12.
- Nöth, W. 1998. Ecosemiotics. *Sign Systems Studies* 26: 332-43.
- Oelschlaeger, M. 1991. *The Idea of Wilderness: From Prehistory to the Age of Ecology*. New Haven: Yale University Press.
- Palmgren, A. 1915-1917. Studier öfver löfängsområdena på Åland: Ett bidrag till kännedomen om vegetationen och floran på torr och på frisk kalkhaltig grund. *Acta Societatis pro Fauna et Flora Fennica* 42(1): 1-634.

- Sammul, M., K. Kull & T. Kukk 2000. Natural Grasslands in Estonia: Evolution, Environmental, and Economic Roles. In *Conventional and Ecological Grassland Management: Comparative Research and Development*, R.Viiralt (ed.).Tartu: Estonian Agricultural University, 20-26.
- Schama, S. 1995. *Landscape and Memory*. New York:Vintage Books.
- Sjörs, H. 1954. Slåtterängar in Grangärde Finnmark. *Acta Phytogeographica Suecica* 34: 1-135.
- Talvi, T. 1995. Carabid Beetle Assemblages *(Coleoptera)* in a Wooded Meadow and in the Adjacent Habitats on the Saaremaa Island, Estonia. *Entomologica Fennica* 6: 169-75.
- Uexkiill, J. v. 1982. The Theory of Meaning. *Semiotica* 42(1): 25-82.
- Vera, EW. M. 1997. *Metaphors for the Wilderness: Oak, Hazel, Cattle and Horse.* Doctoral thesis. Wageningen: Wageningen Agricultural University.
- Vera, FW. M. 2000. *Grazing Ecology and Forest History*. Oxon: CABI Publishing,

- Paper published 2003 in
  - Imagining Nature: Practices of Cosmology and Identity
  - Edited by Andreas Roepstorff, Nils Bubandt & Kalevi Kull
  - Aarhus University Press