Grazing as a conservation management tool in peatland

Report of a Workshop held 22-26 April 2002 in Goniadz (PL)

Edited and compiled by

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Cover
Cattle versus Reed and Birch in the peat zone near Stojka, Biebrza National Park, Poland, photographed by Alexander van Braeckel.
Inserted: European bison.

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GRAZING AS A CONSERVATION MANAGEMENT TOOL IN PEATLAND.

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Preface

This report contains the written results of the workshop ‘ Grazing as a conservation management tool in peatland’. Part I includes the results of the discussions of suitability, feasibility and recommendations. The papers presented during the sessions I (Introduction), II (Suitability in Western Europe), III (Suitability in Eastern Europe), IV (Feasibility) and V (Research) are published in Part II.

Important results not included in this report were the personal contacts, exchanged experiences and publicity that the workshop provided. These may contribute to new thinking, management and research by the participants and their organisations. Parts of the discussions and interviews with discussion leaders were broadcast by one regional and two national Polish TV-channels and by Radio Bialystok. Reports also appeared in the regional newspapers. La Cañada, the newsletter of the European Forum on Nature Conservation and Pastoralim agreed to publish a summary of this Report.

We express our gratitude towards all persons and organisations that have contributed to the realisation of the workshop and this report. The workshop was organised by Wageningen University & Research (WUR), The Biebrza National Park (BNP) and the WorldWide Fund for Nature (WWF) “Biebrza National Park” project. Przemek Nawrocki (WWF) did essential preparatory work.
The workshop was carried out with financial support from the Dutch Ministry of Foreign Affairs (DGIS) under the Global Peatland Initiative, managed by Wetlands International, in cooperation with the IUCN-Netherlands Committee, Alterra, the international Mire Conservation Group and the International Peat Society (Grant WGP1-23/GPI_34). We wish to thank Herbert Diemont (Alterra-WUR) and Marcel Silvius (Wetlands International) for their essential contributions before and after the workshop.
Przemek Nawrocki, Marzenna Kierus and Agata Klimkowska did a great job during the workshop by the direct sentence-to-sentence translation Polish-English and English-Polish of all lectures and discussions. The Polish editors and Marzenna Kierus provided for the translations in the report. Rory Harrington gave editorial advice and improved the English text of part I.

The editors

PART I: GENERAL CONCLUSIONS

1. INTRODUCTION

J. Bokdam & A. van Braeckel.

Summary

The biodiversity of low-productive pastures and hayfields is threatened across Europe by intensified land use and abandonment. The question is whether and how Extensive Farming can be maintained or restored, or whether conservation management should shift to New Wilderness. Suitability and feasibility of both strategies differ and depend on local conditions. The aim of the workshop was to discuss and clarify the strategic management dilemma for peatlands by taking the Biebrza National Park (BNP) in N.E.Poland as a case study. The BNP authorities are facing a tremendous and difficult problem to stop and reverse succession on 20.000 ha abandoned fen peat. Questions addressed during the workshop were 'Which extensive farming methods (grazing, mowing, cutting, and burning) are suitable for BNP- peatlands in view of the management objectives? Which methods are most feasible in view of the actual and future socio-economical environment of the BNP ? Which management recommendation and research recommendations can be given to the BNP authorities?

Streszczenie

Bioróżnorodność nisko produktywnych pastwisk i łąk kośnych jest zagrożona w całej Europie z powodu intensyfikacji produkcji rolnej bądź ich porzucania. Rodzi się pytanie: czy i jak ekstensywne rolnictwo może zostać utrzymane oraz czy ochrona przyrody powinna zmierzać w kierunku stworzenia nowych „dzikich" środowisk? Właściwości i możliwości przeprowadzenia obu strategii różnią się i zależą od warunków lokalnych. Celem warsztatów była dyskusja i potrzeba wyjaśnienia problemów związanych z zarządzaniem i ochroną torfowisk na przykładzie Biebrzańskiego Parku Narodowego w północno-wschodniej Polsce. Władze BPN stoją przed ogromnym i trudnym problemem związanym z powstrzymaniem sukcesji wtórnej (regeneracyjnej) na ponad 20 000 ha opuszczonych torfowisk niskich.

Tematyka warsztatów toczyła się w oparciu o pytania:

- Która z metod ekstensywnego rolnictwa (zgryzanie, wykaszanie, wycinanie, wypalanie) jest najlepsza do wykorzystania w BPN w świetle celów ochrony?

- Które z metod są najbardziej dostępne i możliwe do zastosowania w świetle aktualnych i przyszłych socjoekonomicznych uwarunkowań w BPN?

- Które wytyczne ochrony i jaka problematyka badawcza powinny być przedstawione służbom BPN?

1.1 Peatlands

Peatlands are important ecosystems for nature and nature conservation. Hydrology is the major key factor determining their soils, vegetation and the accessibility for large animals and man. Peatlands can therefore dramatically be changed by drainage.

Peatlands include minerotrophic fens fed by upwelling seepage and ombrotrophic, rain-fed bogs. Flooded fens may be eutrophic. The development of ombrotrophic bogs requires impeded drainage and a precipitation surplus. Bogs may occur on top of fen peat or as a floating mat on water. Upwelling seepage and fens are found in river valleys and coastal areas in zones between dry upland (the source of the seepage) and mineral floodplains (discharging the rain and seepage water). Floodplain soils may be mineral or peaty. Pleistocene dunes and moraines can occur as isles in the Holocene fens. Dry uplands, fens and floodplains form a soil catena or ecohydrological gradient. Together they function as an ecosystem in which water, animals and man are connecting the zones.

Undrained and drained fens may be covered by short (< 50 cm) vegetation dominated by graminoids and mosses, by tall sedges and reed, shrub (willow, birch) or by woodland (alder). Undrained ombrotrophic bogs are usually open. Drainage favours the succession to tall sedges, reed, shrub and woodland in fens and bogs.
Since pre-history, animals, hunter/gatherers and traditional farmers, often entering the peat zone from the uplands have exploited peatlands. They removed plants, game and fish, forage, fuel and other useful products generating a nutrient transport to the upland. Land use intensified after drainage, which started in W-Europe in the Middle Ages. Despite the drainage, fens remained marginal for arable farming and sylviculture. Livestock farmers could use fens very successfully as pasture, hay field and for after-grazing. The lower groundwater level, especially in summer, made peatland more accessible for herbivores and man. A frozen soil facilitated mowing, woodcutting and the extraction of the harvests during wintertime. It may also have played a role in the accessibility for animals.
Traditional extensive farming and peat extraction created open landscapes with low-productive hay field and meadows, reed beds and occasional coppice wood. The successional mosaic landscape offered habitats for foraging and breeding waders, waterfowl and marsh birds. Open water in peat pits, ditches and canals favoured water birds.
After 1900, traditional extensive farming gradually lost its economical viability. It was replaced by intensive farming, using machines, manure and synthetic fertilisers. Less accessible and productive areas were abandoned. Both developments have changed the landscape and reduced its biodiversity in a dramatical way. Abandonment initiated ecological succession. Tall sedges, reed, shrub and woodland invaded abandoned meadows, hayfields and reed beds. Succession reduced the density of breeding waders and other species of short, low-productive vegetation (Dyrcz et al 1985). Since the early 20th century nature conservation organisations have bought and managed peatlands in an effort to preserve its biodiversity by sustained grazing, mowing, reed and woodcutting.

1.2 Extensive Farming or New Wilderness

Extensive farming and grazing and haymaking are considered as crucial for the survival of many threatened plant and animal species in Europe (Bignal *et al* 1992). Densities of breeding waders on mown and grazed peat grassland are low if the farmland is drained and heavily manured (Dyrcz *et al* 1985; Kleijn *et al* 2001). Unfortunately, extensive farming is uneconomic. Continuation by private farmers requires financial subvention and much social and political support, especially if it concerns large areas. Nature conservation organisations in the Netherlands apply traditional livestock farming in their reserves. For haymaking and shrub removal they sometimes receive the assistance of volunteers. Traditional haymaking with mowing machines (mowing, reaping and sometimes dumping of unmarketable hay) costs in the Netherlands roughly 300-500 € /ha.yr. The revenues of marketed hay may reduce these costs.

Limited conservation goals are another disadvantage of traditional farming. Its objectives are restricted to plants and small animals and exclude large animals. Large wild herbivores and carnivores, conflicting with livestock and crops, have been exterminated or banned to high altitudes, marshes, woodland and other marginal habitats.

To meet both disadvantages, a new nature conservation strategy has been launched: the “New Wilderness” (Baerselman & Vera 1989; Bal *et al* 1994). It claims to be cheaper and to realise a more complete biodiversity by restoring and using natural (spontaneous, self-organising) processes without human intervention. Openness and low-productive early-successional stages are guaranteed by large herbivores through interacting with ageing and abiotic disturbances (Olff *et al* 1999). These claims are based on the openness and biodiversity of pristine Eemien and early-Holocene wilderness (Vera 1997; Prins 1998), and preceived wilderness systems in Africa (Serengeti) and North America (Yellowstone). In Medieval

wood-pastures, livestock had substituted wild grazers (Vera 1997). The large herbivore assemblage of complete wilderness systems includes three functional groups. The first group includes the Grazers: cattle, horses and other social herbivores digesting the cell content and a major part of the cell wall of their food. The Browsers (e.g. elk, roe deer) are very selective solitary herbivores digesting mainly the cell content. The third group concerns the Intermediate Feeders (e.f. red deer and European bison), social herbivores that can switch between the grazing and browsing strategy (Hofmann 1989).
The "New Wilderness" concept may be economic and hence feasible, as long as compensatory payments for damage in surrounding areas remain low. Pure Wilderness may generate marketable products (books, films) and services (recreation, education, research). The "New Wilderness" strategy is applied in the Swiss National Park (16.000 ha alpine and sub-alpine zone, abandoned in ~1920) and in the Oostvaardersplassen The Netherlands, (5000 ha, fenced, partly drained mineral floodplain, grazed by feral cattle, horses since the early 80-s and by red deer since the early 90-s).

1.3 Complemented Wilderness

It may be argued that "New Wilderness" concept will fail to keep the landscape open in incomplete ecosystems. In these cases openness and low-productive species-rich-early-successional stages might require complementary management, i.e. substitution of lacking components and processes (Bokdam 2002).
In a complete soil catena, large herbivores will use the nutrient-rich floodplain (and peat zone) as summer foraging habitats, the uplands as winter habitat. In case of absence, the function of the floodplain may be substituted by fertilised upland sites or by supplements. Winter supplementation or a shed may substitute a lacking upland site.
In complete successional mosaics animals shift daily and seasonally between grassland and woodland for foraging and resting respectively. Lacking grassland may be substituted by hay, lacking woodland by shelter. Inbreeding and genetic loss in fenced populations may be compensated by controlled exchanges of individuals.
Conservation areas in Europe have strongly impoverished herbivore faunas if compered with former interglacials. Megabrowsers Elephant and Rhinoceros disappeared since the Weichselien. (Prins 1998). Incomplete substition by browsing elk and roe deer may justify tree ringing, cutting or uprooting by the manager. Aurox and tarpan can be substituted by feral or domestic cattle and horses, or by mowing and cutting.
Each herbivore has its own typical spatial/temporal pattern of offtake, excretion, treading and seed dispersal. Multi-species assemblages have therefore a higher offtake and more effects than a mono-specific herbivore population. The locally extinct European bison and other species could be reintroduced under the "New Wilderness" strategy, or they should be substituted. Various types of hunting can mimic wild carnivores. *Homo sapiens* have – as super omnivorous mammals – in principle the same type of impact as other large herbivores and carnivores. The difference is in the intensity, scale and timing.
Complementary management has much in common with hunting/gathering and traditional farming, but the aims (mimicking and harvesting respectively) are different. Mimicking carnivores and herbivores by hunting, grazing or mechanical methods requires knowledge of the ecological behaviour and influences of herbivores and carnivores in pristine ecosystems. The problem however is that these influences are so difficult to trace since pre-historic wilderness have been lost (Vera 1997). Therefore the influences are often deduced from actual reference areas, despite other climates and species compositions. The similarity is in the functional types and processes.
During the pristine wilderness and hunting/gathering periods (in W-Europe until ~ 7000 BP) herbivores had free access to all ecological zones and all successional stages. Nomadic/trans-

human pastoralists followed their livestock, shifting night camps across the season and year. Sedentary pastoralists fixed the night camp and limited the foraging range. In mixed farming systems, the stalling period and manure harvest was maximised. The overgrazing and the long housing period further depleted the nutrient pools of pastures. Pastures received only dung and urine produced during the grazing (~ 8 hours/day). This system changed dramatically by the manuring of pastures and hayfields after 1900.

The feasibility of Extensive Farming, New Wilderness and Complemented Wilderness depend on technology, funds, legislation, regulations, and the attitude of the (local) population. In the past, transitions from hunting/gathering to traditional farming and industrial farming were induced by technological innovations that changed their economic profitability and competitiveness. The intensification after the Second World War in Europe was however also stimulated by the CAP (Common Agricultural Policy). After 40 years of favouring production, the new EU policy will change and favour extensive ecological and multi-purpose farming. Farm size, food security, animal welfare and health, environmental quality, landscape quality and biodiversity will become the new criteria for subvention. It means improved perspectives for nature conservation and extensive farming, and may even give rise to a ” New Wilderness”.

1.4 The Biebrza National Park

The aim of the workshop was to discuss succession by grazing and mowing in peatlands by taking the Biebrza National Park in N.E.Poland as case. The Biebrza (‘Beaver’) river is a tributary of the Narew, which belongs to the watershed of the Wisla, which discharges into the Baltic Sea. Biebrza National Park was established in 1993. The core area (60.000 ha) is surrounded by a protection zone of 67.000 ha . The core area includes 40.000 ha of wetland and 20.000 ha of dry upland of moraine and dunes (‘hillocks’) covered by forest and arable fields. The valley wetland consists mainly of fen peat and – mainly in the Lower and Middle Basin – of a 1-2 km-wide mineral floodplain (~ 4000 ha) (Sykora); (N.B.. author names without year refer to papers presented during the workshop). About 43 % of the core area are privately owned. BNP is a renowned European ecosystem because of its rich community of waders and marsh birds (Sienko, Werpachowski). It also forms an interesting natural reference area for wetlands in Western Europe.

Farming in the Biebrza Valley dates back at least to the Middle Ages. The floodplain is mainly used as permanent pasture, the peat zone as hayfield with aftermath grazing, wood and reed cutting. The farmhouses and arable fields are situated on the dry sandy upland edges. The predominant livestock is dairy cattle. The herds graze freely in the valley during the daylight. At the end of the day they turn back to the farmyard of their owner, often crossing the Biebrza river spontaneously. The mineral floodplain plays a crucial role in the pastoral system (van Braeckel). The peat zone was locally drained in the 19th century, but reclamation never took place.

Following the Second World War many local farmers have ceased traditional pastoralism and hay making. Abandonment and local drainage are solely responsible for the actual succession (Schmidt et al 2000). In 1997, shrub and forest covered about 44 % of the BNP. The annual net transition rate from open wetland to shrub is about 300 ha, or 0.5 % of the BNP area (Schmidt *et al* 2000) .The rate of transition from short Sedge-Moss communities and grassland to Tall Sedges and Reed was not assessed. The area of open peatland annually mown by private farmers is not known, but apparently low. In dry years farmers make more hay in the valley than in wet years. The area mown by BNP is very small if compared to the total area of open peatland. Comparison of the breeding bird communities across a gradient from short vegetation to tall herbs, shrub and forest showed that the invasion of tall sedges

and Reed has a dramatic negative effect on the density of breeding waders in short grassland and sedge-moss communities. Ruff (*Philomachus pugnax*), Black-tailed Godwit (*Limosa limosa*) and Lapwing (*Vanellus vanellus*) disappeared after the invasion of tall sedges. Other species, e.g. Snipe *(Gallinago gallinago*), Corncrake (*Crex crex*) and Aquatic Warbler (*Acrocephalus paludicola*) strongly declined after shrub encroachment. In open, drained and intensively used peat grassland, a low residual population of wader species was found (Dyrcz et al 1985).
According to the Nature Protection Plan (Matuszkiewicz 1999) and the BNP Director (Sienko) the major part of the peat zone in BNP must remain open (free of shrub and trees) and short (moss-sedge communities and grasslands without tall sedges and Reed). Openness and short vegetation are also crucial in the moraine and hillock zones, e.g. for Black Grouse (*Lyrurus tetrix*). BNP wants to maintain all actual species in viable populations (Sienko). Successional mosaics in all zones will serve this aim.
The area of shrubs and trees in the peat zone – mainly Willow (*Salix spp)*, Birch (*Betula pubescens*) and Alder (*Alnus glutinosa*) has substantialy increased since 1960 and covers actually ~ 12.000 ha (Schmidt *et al*. 2000; Werpachowski). The actual pressure of Elk (BNP population ~ 400 or 0,7. km^{-2} is substantial, especially on Willow but it remains insufficient to stop shrub encroachment. The actual area of tall sedges and reed in the BNP area is ~ 15.000 ha (Werpachowski).
The BNP authorities are therefore facing a tremendous problem; How to stop and reverse succession on > 20.000 ha of peatland? (Werpachowski). One dilemma is how to select priority locations for succession management and what methods to use. The realisation of this effort is problematic (Bartoszuk). Management should maintain the residual short moss-sedge communities by succession prevention and reverse tall sedge, reed, shrub and woodland into to moss-sedge or other short vegetation (Werpachowski). Can extensive traditional livestock farming with grazing and haymaking be continued or restored? Or can mowing or burning mimic it? Can wild herbivores be used? The expected entry of Poland to the EU in 2004 will certainly affect the feasibility of the alternative management strategies.

1.5 Aim of the workshop

The following questions were addressed:

1. Which grazing/mowing strategies are most suitable in view of the management objectives?

2. Which grazing/mowing strategies are most feasible in view of the actual and future socio-economical setting of the Biebrza National Park?

3. What are the management priorities?

4. What are the research priorities?

The programme included lectures and discussions during 5 sessions: Orientation (I), Suitability in W-Europe (II), Suitability in Poland and BNP (III), Feasibility (IV) and Recommendations (V).

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2. SUITABILITY

J. Bokdam & A. van Braeckel.

Summary

The suitability of grazing, burning, mowing and cutting as tools for succession control in peatland was assessed and expressed on a scale from 0 - 1. All management tools are suitable, but their effects are conditional. The suitability depends on the targeted vegetation transition and on their intensity and timing. Maintenance and restoration of short vegetation requires an annual or short cyclic (2-5 years) removal of the major portion of the aboveground annual production during the growing season. Grazers, Intermediate Feeders, Browsers and mechanical removal (including burning) fulfil a complementary role. Taking a suitability value of >0.66 as criterion, a complete herbivore assemblage at saturation density might realise all objectives, except regression from Alder to short vegetation. This requires cutting. Lacking herbivory may be substituted by removal by man or by fire. Suppression of invading shrub by winter burning requires sufficient inflammable biomass. Winter burning cannot substitute the effects of summer grazing on tall sedges and Reed. Burning in late winter may damage early shoots of sedges and Bush grass.

Streszczenie

Właściwości zgryzania, wypalania, wykaszania i wycinania związane z kontrolą procesu sukcesji na torfowiskach niskich zostały poddane oszacowaniu i ocenie w skali od 0-1. Wszystkie te narzędzia są możliwe do zastosowania, ale ich efekt jest uzależniony od wielu czynników. Uwarunkowania te to pożądany przez nas typ roślinności oraz intensywność i czas stosowania danej metody. Utrzymanie i zachowanie niskiej roślinności wymaga rokrocznego usuwania dużej części nadziemnej biomasy - rocznego przyrostu. Typowi trawożercy np. krowy, inni roślinożercy jak jeleń i żubr, „zgryzacze" jak sarna i łoś oraz mechaniczne usuwanie (włączając wypalanie) spełniają komplementarną rolę.

Przyjmując wartość właściwości >0.66 jako kryterium, całkowity zespół roślinożerców w optymalnych warunkach wysycenia może zrealizować wszystkie postawione cele, za wyjątkiem sytuacji powrotu lasów olchowych do roślinności o charakterze niskim. To ostatnie wymaga wycinania drzew i krzewów. Brak obecności roślinożerców może być oczywiście zastąpiony usuwaniem biomasy przez człowieka, np. w wyniku wypalania. Z dwoma zastrzeżeniami: 1) zimowe wypalania nie mogą zastąpić letniego wypasu, 2) wypalanie późnozimowe lub wiosenne może zatrzymać rozwój wczesnych gatunków turzyc i traw.

2.1. Introduction

One of the major aims of the workshop was the assessment of the suitability of grazing and mechanical removal (including burning) as tools for succession control. The objectives were:

1.Maintenance of short vegetation (moss-sedge communities and other short (< 50 cm) herbaceous vegetation) by preventing establishment and expansion of taller (>50 cm) herbaceous and woody species.

2. Regression of tall sedges and reeds and their replacement by short vegetation.

3. Regression of shrub and woody vegetation through their removal and replacement by herbaceous species.

2.2. Methods

The participants expressed and discussed their judgements, based on practical experience and theoretical knowledge. The concluded suitability was expressed as suitable (+), unsuitable (-), more or less suitable (+/- or -/+) and uncertain (?). Uncentainty was attributed to + or – (+? resp -?). Based on these qualifications, a numerical value between 1 and 0 was calculated in two steps. In the first step the symbols were transformed into values: '+'-> +1; '-' -> –1. In case of combined symbols, a lower value was attributed to the second one. The second, less important symbol was given half of its basic value, e.g. '+/-' -> (+1) +(– 0.5) = 0.5; and '-/+' -> -0.5 In the case of '+ & -' both symbols were equally valued: (+1)+ (-1) = 0. A ? -symbol reduced the value of the previous sign by 0.5. In the second step the range 1 to –1 was transformed into a range of 1 (suitable) – 0 (unsuitable) (Table 1).

2.3 Results and discussion.

Table 1 summarises the results. Explanations and arguments for the ratings are given in the following section:

Burning

Fire is a natural evolutionary and ecological factor in (semi-) arid climates. Hunters and pastoralists used fire to remove unwanted biomass and litter and to accelerate early growth. While fire is relatively non-selective, sites and plants may have a different probability and vulnerability for fire. Fires may therefore create mosaics of plants, communities and zones. Winter burning of Reed (*Phragmites*) can prevent shrub encroachment. In the Netherlands, unmarketable hay and other biomass is legally burned by managers before or after mowing.

Burning is a cheap tool, but not a simple one. It may also damage wanted plants and animals. Controlled burning requires understanding of its functioning and effects. The flammability of the fuel and the timing and technique control the vertical temperature profile and its duration.

Table 1. Suitability of management tools for maintenance of moss-sedge communities (short vegetation) and regression of later successional stages. For the meaning of symbols and numerical values: see text. Numbers in italic refer to conditions: *1*: if accessible; *2*: in dry year/period only; *3*: depending on season; *4*: depending on breed and size; *5*: depending on burning technique; *6*: depending on fire conditions; *7*: in small or loose stands only; *8*: young developmental stages only; *9*: depending on site; *: conditions for all herbivores: season, accessibility, density, forage availability, availability of alternative food resources.

Management objectives		Management tool						
		Burning	Mowing and cutting	Cattle *	Horse *	Wild herbivores		
						Elk*	Red Deer*	Bison *
WET	Maintenance of Moss-sedge community	-? 0	*+1 / - 3,5* 0.75	+ /-? 0.875	+ /-?*4* 0.875	+?/-? 0.625	+?/-? 0.625	+/-? 0.875
	Regression of tall sedges (*Carex elata, C. appropinquata*	+/-? *2,3,5,6* 0.875	*+1* & -? *3,5* 0.875	+? / -? 0.625	+/ -?*4* 0.875	- 0	+?/- 0.5	+?/-? 0.625
	Regression of Reed (*Phragmites australis)*	- 0	+3 1	+ 1	+ 1	- 0	- 0	+? 0.75
	Regression of Willow (S*alix cinerea* and *pentandra)*	*+3* 1	*+ 8* 1	+? *7,8* /- 0.5	+? *7,8* /- 0.5	*+ 7,8 /- ,9* 0.75	*+ 8* /- 0.75	+? 0.75
	Regression of Birch *Betula spp*	*+3* 1	*+ 8* 1	-/+? 0.125	-/+ 0.25	+/- 0.75	-/+ 0.25	+?/-? 0.625
	Regression of Alder (*Alnus glutinosa)*	*+3* 1	*+ 8* 1	-/+?*8* 0.125	-/+ 0.25	- 0	- 0	+?/-? 0.625
DRY	Regression of Bush grass (*Calamagrostis epigejos)*	+ 1	+ (2x) 1	+ 1	++ 1	- 0	-/+? 0.125	+ 1

Combustibility and wind velocity and direction change during the season and day. Summer and winter fires have different effects because of the variable presence and vulnerability of seeds, seedlings, rhizomes, sprouts and stems across the year. Damage to fauna will be minimal during winter. Summer fires may be more common in continental climates than in Atlantic areas.

Burning removes volatile nitrogen and carbon. Non-volatile phosphorus and potassium may escape in smoke and by leaching. Burning may increase the pH of the soil.

In the Biebrza valley fire has been used until the 80-s (pers. comm. Wiesław). It is now forbidden within the limits of the BNP by law. Reintroduction of burning may therefore be regarded as an essential component of a restored traditional livestock farming.

To kill aboveground living parts of woody species temperature and duration should be sufficient (Table 1). Combustibility of roughage will normally be restricted to the late winter, but summer fires may occur in dry, unmown sedges and perhaps Bus-grass but not in summer-green Reed. Winter burning of Reed may kill woody invaders; it will not suppress the Reed. Reed hibernates below ground by rhizomes. The young shoots of early sprouting tall sedges and Bush-grass may be damaged by late winter burning. The loss of nutrients from ash by leaching on dry sandy hillocks may contribute to the suppression of Bush-grass by fire.

Mowing and cutting.

Mowing, cutting and other removal methods are suitable tools. In vegetation management they mimic natural defoliation, twig consumption or tree damage by herbivores or wind. Hay making in W-Europe dates back to early medieval times. Before this period, livestock were fed dried leafy branches and straw of arable crops, or the animals were grazed outside. Mowing for litter occurred where straw was scarce. Hay making is more important in continental E-Europe because of the long snow period. Mowing removes organs and species unselectively. It favours therefore short plants with a good regrowth capacity and mosses. Late and occasional mowing as practised in litter meadows creates tall herbaceous vegetation. Winter mowing favours roughage (tall herbs e.g. *Molinia* and *Phragmites).* Traditional farmers in the Biebrza Valley used a scythe. Mowing is now carried out using machinery.

The long tradition and ecological knowledge suggest that mowing is a most suitable management tool for open and short peatland habitats (Table 1).

Grazing

Grazing affects ecosystems by defoliation, excretion and trampling. It may be assumed that wild plants are adapted to herbivores since they evolved together. Defoliation, treading and excretion in farming landscapes may exceed levels in natural systems. Herbivores defoliate and tread selectively. Unselective defoliation favours short plants, selective defoliation also

unpalatable tall plants. Treading creating gaps in the sward has a positive effect on the establishment of annual and bi-annual species. Excretion affects the nutrient and seed distribution.

There is a wide array of grazing methods. Major variables are the grazed area (size, zones, and successional stages) and the herbivore assemblage composition. Prediction of their effects requires modelling (Van Oene) These models include the spatio-temporal distribution of herbivore influences across zones, successional stages and plant species and subsequent responses. Changes in the soil and the competitive balances between the plant species are also important explanations for succession.

Abiotic zones and successional stages have a different attractiveness for foraging and resting herbivores. Floodplains with short grass lawns are preferred foraging habitats for Grazers and Intermediate feeders. Woodland on nutrient-poor fens and bogs are unattractive. Short vegetation in minerotrophic, base-rich fens take an intermediate position. Woodlands on uplands are a second-choice foraging habitat but they may be preferred for resting. Such differential use generates nutrient transports.

Floodplains in the lower basin of the BNP are still intensively grazed. Grazing and hay making in the peat zone has been abandoned. In 2000 there was only one dairy cattle herd left in the peat zone of the lower basin at Stójka. Until the 70-s, 3 herds were driven into the peatland from this place (Van Braeckel, pers. comm. Wiesław). The preference for the floodplain may be based on the superior forage quality and production. It suggests that grazing is more suitable for the mineral flood plain than for the peatland. Peatland may nevertheless act as an overflow zone during early spring (floodplain inundated) and late summer (floodplain exhausted). The highest quality of sedges in the peat zone is provided in spring and – after mowing –in autumn (Bokdam). The proportion of species from the Sedge-moss community in cattle diets in the peat zone peaked in May and – in mown areas- again in September (Bokdam). Hay making improves the forage availability and quality of the regrowth .

Accessibility did not limit the habitat use of the Stójka cattle herd (van Braeckel). Their energy intake surpassed maintenance level, but phosphorus content in the diet was very low (Bokdam). Access to the floodplain would improve their performance. Eventual deficiencies may be prevented by licks.

Little is known about the habitat use and diet of other herbivore species and cattle breeds under free ranging conditions. Dairy cattle with a daily return to the stable (Stojka and Brostowo) remained within 2-5 km distance from the stable. Local traditional Polish Red lowland cattle may be more resistant to horseflies than other breeds and its use should be stimulated (Nawrocki). The

actually used workhorses seem less suitable for the peatland than the light Polish konik pony (Nawrocki, Borkowski).

Maintenance of short grassland and sedge-moss communities.

Grazing by cattle, horses, or a mix of grazers and intermediate feeders can maintain lawns (short herbaceous vegetation) on floodplains and peatland. These lawns may occur as 'monoculture' or in small-scaled mosaics with unpalatable species. The mosaics may be important for breeding birds. Continuous or rotational grazing during the growing season can remove > 50 % of the production. Inaccessibility caused by floods or wet soil may restrict the grazing period and off-take (Wasilewski). The actual grazing intensity in the peat zone of the BNP is extremely low because of abandonment (Bokdam, Van Braeckel).

An earlier start of the grazing season, higher population densities and diversification of the herbivore assemblage may contribute to a better suppression of invading tall sedges. Year-round grazing in a complete catena (including three zones) may lead to defoliation of early sedges during spring and late summer. The peat zone and sedges might act as transitional habitat and food in spring and late summer during the migration between upland and flood plain. In the Biebrza Valley year-round grazing by horses is already practised (Borkowski). The involved Konik ponies survived due to their fat reserves (winter weight loss up to 25%).

Regression of tall sedges and Reed

It is uncertain whether large herbivores can suppress established tall sedges (Carex elata, C. appropinquata) and restore short sedge or sedge-moss community. Literature on *Magnocaricion* vegetation mentions mowing, but never grazing as land use or management (Sýkora). It is known that Reindeer in N-Europe (van Eerden, M. R,. 2000) and Wood Bison in Canada (Reynolds et al. 1978) consume sedges during late winter. Gebczynska & Raczynski (1989) found that elk preferred sedge-covered patches in the Middle Basin of the BNP in spring. During the workshop excursion, the participants observed elk grazing in tall sedge vegetation. Palatability of early sedges declines after April. The phenology of sedges and their consumption by large herbivores should be studied. The suitability of different free ranging herbivore species and breeds for suppressing large sedges should be studied in more detail. The research should include European bison. Horses may be superior because of their high capacity to digest low-digestible sedge leaves and to graze sedges early in the growing season.

Reed is suppressed by cattle and horses if their density is sufficient (Piec, Vulink). Stójka cattle selected reed as community and diet species from June until August (Van Braeckel, Bokdam). European bison may have a similar effect. Defoliation during summer limits the photosynthesis and prevents the reallocation of carbo-hydrates and nutrients from the above ground biomass to the rhizomes. It leads to a rapid exhaustion of the clonal plant. Current mowing experiences (Bartoszuk and Kaminski) will check these expectations in the next years. Elk and red deer are unsuitable for ensuring regression of reed.

Regression of woody species.

Regression of woodland demands browsing of shoots and bark. Elk is the main agency for browsing and debarking. Ruminants are known to digest woody species better than horses (Vulink). Effective suppression of shrubs is therefore also expected from the European bison. Elk and perhaps red deer seem suitable to achieve regression of young willow, aspen and birch stands. Alder is avoided. It may be cut back. More information on differential use of the many willow species is required.

Grazing Impacts on hillocks.

Positive effects of grazing in the peat zone may involve unwanted effects on the hillocks. The desired mosaics on hillocks have not been specified. BNP wants small gaps in the forest for Lady Slipper but also large gaps with short vegetation for black grouse (Werpachowski). The effects of intensified grazing on hillocks may be predicted on the basis of the expected terrain use (see research recommendations). In view of the uncertainty, a gradual increase combined with monitoring (step by step) may be applied. Herding and fencing may eventually be used to control the use of the terrain.

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3. FEASIBILITY

J. Bokdam & A. van Braeckel

Summary

Extensive livestock farming, including hay making, seems the most feasible management strategy for open peatland. In the longer term, wilderness grazing may become more feasible. The loss of economic viability of traditional livestock farming and related haymaking may be reversed by innovation of new marketable 'Biebrza' products, 'green services', e.g. eco- and agro-tourism, and by financial subventions by the EU and the Polish Government. Large scale mechanical harvesting of hay and litter is very costly, unless the harvested hay can be marketed. The feasibility of New Wilderness, especially complemented Wilderness, may increase in the longer term. The BNP offers excellent perspectives for a growing role of wild herbivores and natural processes. An eventual step-by-step transition may pass through stages with increased densities of elk, red deer, and wild boar, (semi-) feralisation of Konik ponies, re-introduction of European Bison and finally (semi-) feralisation of cattle. New Wilderness in an enlarged 'Greater Biebrza Ecosystem' will create a unique, complete ecosystem in Europe, with large economic potentials.

Streszczenie

Wydaje się, że najbardziej możliwym do zastosowania sposobem gospodarowania na obszarze torfowisk powinien być ekstensywny wypas bydła połączony z produkcją siana. W dalszej perspektywie znaczącą rolę mogą odgrywać dzikie zwierzęta roślinożerne. Brak ekonomicznych możliwości prowadzenia wypasu bydła i związanej z tym także produkcji siana może być zażegnany przez wypromowanie nowych produktów i usług „biebrzańskich", np.: eko- i agro-turystyki oraz dzięki dofinansowaniu z UE i Polskiego Rządu. Mechaniczne koszenie i pozyskiwanie siana na wielką skalę jest bardzo kosztowne, pomimo, że zebrane siano może zostać sprzedane. Przyroda Biebrzańskiego PN stwarza doskonałe możliwości dla zwiększającej się roli dzikich roślinożerców i rozwoju naturalnych procesów. Ewentualne stopniowe przejście może polegać na łagodnym zwiększaniu liczebności populacji łosia, jelenia, dzika, hodowli konika polskiego, reintrodukcji żubra, a na koniec półdzikiej hodowli bydła. Doprowadzenie do stanu zbliżonego do pierwotnego spowoduje powstanie unikalnego i kompletnego ekosystemu Kotliny Biebrzańskiej o wielkim potencjale ekonomicznym.

3.1. Introduction

The second objective was to assess the feasibility of grazing and mechanical management. Criteria were:

Practical knowledge in general

Experience of the BNP staff, Facilities (e.g. animals, machines, equipment)

Financial means (BNP-budget, revenues from the market)

Subsidies (EU, national and local government, NGO's)

Legislation: statutory support by laws and regulations.

Attitude of the local society.

Feasibility was assessed separately for private and state owned land, because of the importance of land ownership, separately for the present and future situation because of expected changes and separately for the use by livestock and feral animals (for cattle and horses).

3.2 Methods

The participants expressed and discussed their feasibility judgements, based on their own practical experience and knowledge from literature. When opinions conflicted, experiences and arguments were exchanged and discussed. The conclusions of the assessment were expressed as feasible (+), non-feasible (-), more or less feasible (+/- or -/+). Uncertainty (?) was attributed to + or – (+? respect. -?). Based on these symbols, a numerical value between 1 and 0 was calculated in two steps. In the first step the symbols were transformed into values: '+'-> +1; '-' -> –1. In case of combined symbols, the second – less important symbol – was given half of its basic value, e.g. '+/-' -> (+1) +(– 0.5) = 0.5; and '-/+' -> -0.5. In case of '+ & -' both symbols were equally valued: (+1)+ (-1) = 0. The '?' symbol reduced the value of the previous sign by 0.5. In the second step the range 1 to –1 was transformed into a range of 1 (feasible) – 0 (non-feasible) (Table 2).

3.3 Results and discussion.

The results are summarised in Table 2. The integrated feasibility value was obtained by averaging the values of the feasibility as assessed for individual criteria. Explanations for the rating are given in the following sections.

Burning

The feasibility of burning is low (value 0.25). The main limiting factor is existing Polish legislation prohibiting burning – even as a tool – in National Parks (Sienko). Therefore BNP staff have little experience of burning and use of fire. General practical knowledge is available (e.g. in Ireland and Great Britain). If necessary, BNP staff can acquire the knowledge from local farmers.

Facilities and funds are lacking. Burning is cheap. The costs may be covered by the budget if the legal ban is lifted. A demand to lift the ban on burning could form a solution (Harrington), but making an exception for the BNP would raise strong criticism amongst private landowners in and around the National Park.

Table 2. Feasibility of grazing and mechanical management as tools for succession control in peat zones in the Biebrza National Park. For the meaning of symbols and regular numerical values: see text. Numbers in italics refer to remarks: *1*) Historical knowledge; *2*) Mechanical mowing with low wheel pressure; *3*) Developing technology; *4*) Costs of 1ha = € 315; *5*) Time limitation for mowing; *6*) Product marketing; *7*) Fence harmful for elk? ; *8*) actual BNP policy; *9*) Possibility of BNP-owned animals; *10*) future EU subsidies; *11*) EU funds: Life, INTEREG, Agro-Biodiversity; *12*) disease contamination;

			Management tools											
			Burning	Mowing		Grazing								
						Cattle		Horse		Cattle and horses		Wild herbivores		
						Traditional,		Traditional		Feral		Elk	Red deer	Bison
Land ownership			State	Private & State		Private	State	Private	State	State				State
Time			Future	Actual	Future	Actual & future	Future	Actual & future	Future	Actual	Future	Actual		Future
Criteria	Practical knowledge	General	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1		+ 1
		BNP	+/- 1 0.75	- 0	+2 1	+ 1	+/- 0.75	+ 1	+/- 0.75	- 0	- 0	- 0		- 0
	Facilities (animals, fences, machines etc)		- 0	-2, 5 0	+2,3/-5 0.75	+/-7 0.75	-7 0	-7/+9 0.5	+ 1	-12 0	-12 0	-12 0		-12 0
	Financial basis: budget or revenues from marketing.		- 0	-4 0	-6/+ 0.25	+6 1	+ 1	+6 1	+ 1	+? 0.75	+? 0.75	-? 0.25		+? 0.75
	Subsidies		- 0	+ 1	+ 1	+10, 11 1	+11 1	+ 10, 11 1	+11 1	+? 0.75	+? 0.75	-? 0.25		+? 0.75
	Legislation		- 0	+ 1	+ 1	+ 1	-8 0	+8 1	+8 1	+? 0.75	+? 0.75	+ 1		+ 1
	Attitude Local Society		- 0	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	- 0	+ 1	- 0		+ 1
Feasibility Value			0.25	0.57	0.86	0.96	0.68	0.93	0.96	0.46	0.61	0.36		0.64

Mowing.

The feasibility of mowing – the actual BNP policy– is moderate (value 0.57) but may be improved. The main limiting factors are the high costs (€ 350/ ha) and the lack of funds. There is no market for the harvested material. Processing means dumping, burning or composting. A secondary factor is the lack of adequate machinery.

The basic problem is the loss of the former market for hay from the peat zone. Hay making in the peat zone of BNP is no longer economically competitive with other winter forage. It means that nature conservation has to pay for the mowing, both on private and public land. The costs of the mowing of the targeted 20.000 ha may be estimated at > € 7 million /year (based on € 350/ha) excluding the costs of large distance removal of the harvested material. The total area seems much too large to be mown by volunteers using scythes. Feasibility in the floodplain seems to be better than in the peatland. Large areas of the floodplain hayfields (*Glycerietum maximae* and *Phalaridetum arundinaceae*) are still mown. The difference may be explained by the higher yield and quality (Bokdam), the better accessibility (soil and distance to the farms) and utilisation of the aftermath in the floodplain. The farmers currently use machines for mowing and transport. In the peat zone only a small area is mown every year. The major part has been completely abandoned or is occasionally mown during very dry summers. In such summers (e.g. in 2000) the winter forage production on improved land is lower and the peat zone is more accessible for machines. BNP has neither machinery nor staff for large-scaled annual mowing, reaping and transport. They depend on contractors and farmers. Peatland hay harvested by nature conservation personnel is mainly dumped.

A related constraint for haymaking is the short suitable period, causing a peak in the workload. Experiments to optimise mowing as a technique to suppress reed are carried out (Bartoszuk, Kaminski). Treatments vary in timing, frequency and machinery. BNP may invest in machines like the peat harvester (see Intermezzo) with a low wheel pressure allowing mowing in early summer. Earlier mowing means an improved hay quality, aftermath grazing and more effective suppression of tall species (Bokdam). Advice and experiences on this modern management practice as an alternative for the hand scything is a high priority of the BNP. Information does exist and the use of machines with caterpillar tracks is advised. International exchange of experience with the fen harvester machine is strongly recommended.

Regular funds for mowing by contractors or investment in mowing machines are lacking (Sienko, Werpachowski). A special request has to be made for each mown area. The magnitude of the required mowing capacity should not be underestimated. The mowing of 20.000 ha may require 60.000 machine hours (assuming 4 hours mowing time for 1 ha). It means 6000 machine days (assuming 10 workable hours/day). If the mowing has to be realised within 8 weeks or 40 workable days in July + August, BNP needs 150 mowing machines. Reaping and processing are not included. This order of magnitude emphasises the tremendous problem and enormous impact of former traditional haymaking.

With an increasing area mown, the problem of processing of the harvested product will also grow. Processing of harvested biomass from conservation areas is an international problem. A solution is urgently

wanted. On this moment a sustainable process or market is not available. More over, BNP – as a state organisation – is not authorised to start a commercial project (Sienko, pers. comm). The processing of mechanically harvested products from peat conservation areas (wood, reed, hay, and turf) needs more international attention and involvement of international organisations is desirable.

Polish law does not contain any restrictions on mowing. Modern mechanical harvest practices are seen as a continuation of the traditional land use and can rely on a positive response from the local society.

INTERMEZZO: THE PEAT HARVESTER

(Information derived from the internet site of the Living Lakes Partnership: http://www.livinglakes.org/broads/fen.htm)

Conservation organisations such as English Nature, the Norfolk Wildlife Trust, RSPB and Broads Authority are now involved in a project using new specially-designed harvesting equipment (fig 1.) and finding alternative markets for the harvested material. This 'New Wetland Harvester' project (sponsored by European LIFE-programme) is the first stage of a project to develop an environmentally sustainable wetland management technology, used for restoring the 'open' state of selected fens as it was until the 1920s.

FIGURE 1: A fen harvester machine

Traditional hand mowing by volunteers or employees using a scythe may offer a solution for small areas. Scything by local farmers sponsored by WWF-BNP costed 315 € per hectare (including costs to support local people, Nawrocki). These public projects are of high importance tin maintaining a good relationship with the local people (Nawrocki). The expectations of financial support or subsidies in the future are promising. The mosaic of private and state owned land are even an advantage for getting money from Agro-environmental schemes.

Traditional grazing

The feasibility of traditional grazing by dairy and beef cattle and horses (for meat and riding) is considered as high (0.96 and 0.93 for cattle and horses respectively). The only restriction is the low economic profitability. Feasibility of future traditional grazing management by the BNP-authorities is also high (0.96) for horses but lower for cattle, because BNP is only authorised to use horses, not cattle, for managing public land. The BNP has no facilities but with financial support the necessary animals, stables, fences and other equipment can be acquired.

There is sufficient knowledge of grazing as a tool in land use and conservation tool. The vanishing knowledge and experiences of traditional livestock farmers in the Biebrza Valley and other East-European peatland areas should be surveyed and published to make it available for actual and future wetland management.

The BNP authorities do not dispose of a budget to develop grazing or to stimulate grazing by livestock on public or private land in the Park. Eventual funds can only be used for managing state-owned land since the BNP is a state organisation (Sienko). BNP deserves to be a priority site for agro-environment schemes because of its high conservation values, mosaic of private and state-owned land and because BNP is the largest National Park of Poland with an important flag function. According to recent publications in the Financial Times, Poland will receive € 2.5 billion for rural aid and environmental programmes on joining the EU. Other resources may also be explored. Agro-biodiversity programmes of The, EU stimulating the conservation of rare domestic breeds may be used for the implementation of grazing by Red Polish Lowland Cattle (Nawrocki).

Polish legislation offers no constraints for traditional grazing. The attitude of the local society for the use of traditional grazing is mostly positive. BNP managers and farmers should co-operate to get funds for agro-environment schemes (Harrington).

Wilderness grazing

The actual feasibility of grazing by feral cattle and horses and wild herbivores is moderate-low (Table 2). The main constraints are the conflicts with agriculture and forestry in and around the core area. The perspectives may improve in the long-term.

There is a growing volume of scientific and practical knowledge on the use of reintroduced large herbivores (Wallis de Vries et al 1998; Vulink 2001; Groot Bruinderink et al 1999; Menart et al. 2002). The densities of the present elk, red deer, wild boar are maintained below the carrying capacity. Negative effects on livestock in the valley and arable crops and forest in the upland dominate discussions on feralisation of cattle and horses and reintroduction of European Bison. Nevertheless, there is also a growing awareness of the contribution of feral and wild herbivores to the conservation objectives in BNP (Sienko, Raczynski & Gebzynska).

The constraints of year-round grazing by Polish low winter temperatures and snow was discussed (WWF). In the Biebrza Valley year-round grazing is already practised by Polish Koniks (horses). They seem to survive well according to Borkowski. In winter, cattle and horses use fat reserves up to 25% of their autumn body weight (Vulink).

Little is known about actual and potential revenues from wild herbivores. This issue was not discussed. Experiences in the USA, Great Britain and Ireland show that net benefits of culling, hunting tourism and eco-tourism might exceed the income from livestock farming or forestry. ‘Green’ meat of (semi-)feral Koniks and free-ranging cattle is commercialised in the Netherlands and Belgium by the Foundation ‘Ark’ and Natuurpunt respectively. Expectations for funds and subsidies for feralisation are positive, especially for Koniks. This light horse breed appeared to be very suitable for feralisation in the Oostvaardersplassen and many nature reserves along the rivers Meuse and Rhine. A pilot project for feralisation of Koniks in the BNP was suggested (Vulink).

Polish legislation offers no constraints to the use of feral or wild herbivores. The BNP is not fenced but is surrounded by farmland. Risks for disease transmission (e.g. Foot and Mouth) from feral to domestic populations in the park should be minimised. This may lead to veterinary restrictions, especially for cattle. BNP-authorities are considering the use of feral horses. Feralisation of cattle is considered as unrealistic in view of the economic value of domestic cattle (Sienko). The culling and consumption of horsemeat may raise conflicts if the animals are not handled in a proper way.

Long-term perspectives for New Wilderness are promising. There is a growing international need and support for restoring wilderness areas in Europe. BNP as Poland's largest National Park covers a complete soil catena with a great potential to become a wilderness with a complete (Holocene) European large herbivore and carnivore assemblage. The necessity for the protection of the whole river catchment could be considered in conjunction with the desirability of enlarging the upland zone of the BNP core area. The best perspectives are expected in the Middle and Lower Basin. Re-introduction of the European bison and feralisation of Koniks and cattle as key and flag species would have a tremendous impact on nature conservation in Europe and boost the international fame of the BNP (Harrington).

Feralisation of Koniks and re-introduction of European bison demand involvement of all stakeholders. Forestry is still profitable, so browsing can be damaging (WWF). Livestock farmers will be reluctant because of veterinary risks. Free ranging horses could represent a danger to stallions of local farmers (WWF). Agreements should be made with farmers because 43% of the BNP is still private. The increase in the Koniks population may lead to an increased wolf population.

Local people in Bialowieza are afraid of the European bison (Borkowski). In the Biebrza Valley, 20 years ago when a bison was seen in the valley, the people asked local guards to remove it. Literature counteracts most of the fear. European bison herds usually flee from an approaching man. Only solitary bulls in rut could form a threat (Cabon-Raczynska et al 1987).

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4. MANAGEMENT RECOMMENDATIONS

J. Bokdam & A. van Braeckel

Summary

The acute succession problem justifies an opportunistic use of all suitable methods on the short-term (10 years). The ban on winter burning should be (temporally) lifted. The mown area should be enlarged by activating volunteers, raising budgets and funds for mowing of BNP-owned peatlands and by using peat harvesters. BNP and farmers should co-operate to raise funds and conclude Management Agreements for livestock farming on private and BNP-owned peatland. Agreements should include the use of Biebrza hay and litter. In the longer term (>10 years) extensive grazing seems the most promising tool. It may be implemented as traditional dairy farming, ranching of beef cattle, horses or (semi-) wild herbivores or as Wilderness. Suitability and feasibility may differ between the three basins. The entry of Poland to the EU will affect the feasibility of the strategies.

Streszczenie

Ostro zarysowany problem sukcesji tłumaczy i usprawiedliwia konieczność oportunistycznego zastosowania wszystkich możliwych metod - w możliwie krótkim terminie (10 lat). Oficjalny zakaz wypalania powoduje, że z tej metody (przynajmniej na razie) musimy zrezygnować. Powierzchnia obszarów wykaszanych powinna zwiększać się poprzez aktywizowanie grup ochotników oraz przez rosnące subwencje z budżetu i funduszów wspierających finansowo projekty związane z czynną ochroną torfowisk niskich w Parku. BPN i rolnicy powinni zwiększać nakłady i zawierać umowy na działalność w postaci hodowli bydła na prywatnych i będących pod zarządem BPN torfowiskach. Umowy te powinny uwzględniać wykorzystanie pozyskanego nad Biebrzą siana i podściółki. Z dłuższej perspektywy (>10 lat) ekstensywny wypas wydaje się być najbardziej korzystnym narzędziem gospodarowania. Może to być wprowadzane pod postacią tradycyjnych gospodarstw mlecznych, hodowli bydła mięsnego, hodowli koni lub wpółdzikich roślinożerców. Właściwości i możliwości zastosowania w/w narzędzi różnią się między trzema basenami Kotliny Biebrzańskiej. Wejście Polski do UE powinno zwiększyć możliwości zastosowania tych strategii.

4.1 Short-term strategy (<10 years).

BNP-authorities are facing an acute succession problem. It justifies an opportunistic use of all suitable methods for the short-term (10 years). During this period a long-term strategy may be developed.

The ban on winter burning by BNP should be (temporally) lifted as long as more suitable alternatives for shrub removal are lacking. Once the shrub vegetation is closed, burning is excluded by the lack of flammable material.

BNP should activate volunteers and raise funds for mechanical mowing on private-owned and BNP-owned peatlands. The use of machines with caterpillar tracks is advised. International exchange of experiences with the peat-harvester machine is strongly recommended.

4.2 Long-term strategy (> 10 years)

In the longer term, extensive grazing with more or less additional mechanical removal seems the most promising strategy. Political support for an annual expenditure of 7 million € to harvest an unmarketable waste product seems unlikely. The natural 'market' for plant biomass is the herbivore (and peat).

Extensive grazing may be realised by traditional livestock farming, ranching and wilderness grazing. Traditional livestock farming and ranching may involve private farmers using private and BNP-owned pastures and hayfields. The farming systems need to broaden their economical basis.

Extensive grazing may also be implemented by ranching producing beef cattle, horses or venison. Grazing and haymaking may take place in large paddocks (> 1000 ha) allowing livestock to move between floodplain and peatland as preferred foraging grounds and upland as preferred resting and wintering grounds. Fences can be constructed with facilities allowing the selective passing of wild animals. Extensive grazing may also be implemented as New Wilderness or as Complemented Wilderness.

Ranching, using large paddocks covering the whole catena and mixed herds may be gradually (step-by step) turned into a wilderness system. Paddocks can be enlarged, the number and density of wild Browsers and Intermediate Feeders can be increased and the domestic livestock can be replaced by feral ones. The last and most difficult step is the removal of the fence. It means a shift from husbandry to culling or hunting or no intervention. Mowing and cutting may complement insufficient grazing pressure.

The suitability and feasibility of mowing and grazing strategies may differ between the Lower, Middle and Upper Basin. Grazing seems most promising in the Middle and Lower basin because of the higher soil fertility and larger flood plains. Mechanical management and rewetting may solve the succession problem in the ombrotrophic bogs of the Upper basin. The eventual entry of Poland to the EU will affect the feasibility of these strategies.

4.3 Co-operation

It is imperative that the BNP authorities should make special provisions to engage with the local rural (farmer) communities to develop feasible management plans for the short and longer term. Bottom-up influence is essential for success (Piec). BNP, farmers and other stakeholders should co-operate and plan joint actions for raising awareness, political support and funds for Management Agreements to ensure grazing and mowing on private and BNP-owned land. Agreements for livestock farming should include the use of local Biebrza hay and litter. Examples of such local co-operation are available (e.g. Ann Valley Project, Ireland, info Harrington)

Wilderness grazing requires co-operation with farmers and with forestry and hunting authorities. Increased wild herbivore populations in the peat zone will increase the need for winter habitats and food in the upland zone. Damage in the upland zones might be compensated by increased revenues from culling, controlled hunting, eco-tourism, subsidies etc.

5. RESEARCH RECOMMENDATIONS.

J. Bokdam & A. van Braeckel

Summary

The following research subjects were proposed to optimise succession management in (BNP) peatland: Holocene landscape development; Land-use history; Grazing Model; Hydrology, vegetation and herbivores; Terrain use of European Bison; Defoliation responses of tall Sedges and Reed; Mosaic scale and dynamics and biodiversity; Biomass processing and marketing; Allocation and prioritising of BNP-targets.

Streszczenie

W celu zoptymalizowania zarządzania ochroną torfowisk i przeciwdziałania zjawisku sukcesji zaproponowano następujące tematy badawcze:

Holoceńska historia rozwoju krajobrazu; Historia użytkowania ziemią; Modele zgryzania; Hydrologia, roślinność i roślinożercy; Wykorzystanie żubra; Wpływ defoliacji (usunięcia liści) na turzyce i trzcinę; Mozajka – skala, dynamika i bioróżnorodność; Pozyskiwanie biomasy i marketing; Nakłady i główne cele stojące przed BPN.

5.1 Introduction.

During the workshop several research subjects were proposed to optimise the management of the peatland zone in the BNP. Most of them are relevant for other peatlands. Monitoring of ongoing management was excluded.

Research should be primarily aimed to test and improve knowledge about suitability, feasibility and implementation. It may however have useful side effects by raising international interest for the area and subject. Research results may be used as information and material for visitor centres, field sites, mobile exhibitions, web sites etc. and they may yield marketable products (books, photos, films, maps, videos etc)

5.2. Propositions.

Holocene landscape development.

More knowledge is required about of the role of large herbivores during the Holocene development of the Greater Biebrza Ecosystem (Biebrza Watershed) with emphasis on the peat zone. The peat landscape has passed through several developmental stages with changing hydrology, soil, flora, vegetation and fauna. Insight into the role of changing hydrology, wild herbivores (aurox, tarpan, red deer, European bison, elk), livestock and man (land use) will contribute to a better understanding of the functioning of the actual landscape. The results could provide important useful knowledge for future land use and management. Involved disciplines are Geology, Soil sciences, Eco-hydrology, Palaeo-ecology, Archaeology, Historical Geography and Agricultural History.

Land-use history.

An in-depth study of the land-use history of the BNP (core and protection zone) during the last (19th and 20th) centuries is needed (Werpachowski). It would provide knowledge of the types, extent and intensity of the traditional land use, which shaped the BNP landscape.

The vanishing practical knowledge and artefacts of traditional farming, fishing, hunting and gathering should be conserved. They should cover the local food chain and include methods, tools and buildings for catching, collecting, cultivation, harvest, transport, conservation, processing, trading, use as food, medicine or other purposes. Livestock breeds and their use are especially important. They materialise how rural man used and modified the Biebrza ecosystem and landscape.

Documents and artefacts should be surveyed, collected, analysed and conserved. Actual and retired traditional farmers could be interviewed. The results will indicate the suitability and constraints of the peat zone as permanent pasture, hay field, aftermath pasture, reed bed and coppice wood. It may be helpful in the selection of methods and breeds using traditional farming as conservation tool. Major disciplines involved are historical geography and agricultural/rural history.

Biomass processing and marketing.

The processing of harvested products from peatland (wood, reed, hay, and turf) needs international biotechnological research. New marketable products would prvide a new economical basis for extensive land use and nature conservation.

Grazing models

Spatially explicit simulation models should be developed to compute the effects of grazing and other management on vegetation succession and related ecosystem properties and management targets in the peat zone and neighbouring zones. Models can facilitate the comparison of management scenarios only if they are reliable. The development of reliable predictive models is an ambitious, integrative long-term objective. Chaotic (unpredictable) events may restrict its reliability. Models should be tested.

Existing precursory succession models of grazed mineral wetlands (van Oene; Groot Bruinderink et al 1999) can be used to develop the structure for peat wetlands. The model output consists of maps with ecosystem and target variables e.g. soil fertility, successional mosaics, population densities of dominant and target species. It might also include the seasonal change of the herbivore condition. Inputs are maps with the actual soils and climate, hydrology, land use and management interventions. The major management variables are the grazed area (zones, drainage, initial successional mosaic), the herbivore assemblage (guilds, species, wild or domestic, density, timing within the 24 hr period, season and year), herbivore control by herding or fencing and additional mechanical vegetation management. Required knowledge includes:

* Phenology of plant and vegetation, production and quality,

* Habitat and food selection (grazing and resting, offtake and excretion, zones and successional stages and food plants) by all large herbivores (horses, cattle, European Bison, Red deer, Wild Boar, Elk) and man (mowing, cutting, burning etc.),

* Plant and vegetation response (production and quality) as a result of herbivory

* Herbivore response (growth, reproduction, health, emigration) as a result of the terrain use.

Some priority aspects and subjects are dealed with in more detail below.

Hydrology-vegetation-herbivory interaction.

More knowledge is required about the complex role of hydrology in grazing systems. Hydrology may control accessibility, attractiveness, defoliation intensity and defoliation response of the vegetation.

Terrain use by European Bison and Konik Ponies.

It was suggested to give priority to the study of the terrain use of European bison and Konik ponies as potential key species in the peat zone. These large herbivores might prefer open landscapes and consume substantial amounts of invading tall sedges and shrub. It has been shown that 'Intermediate Feeders' may select grasslands and graminoids if given the opportunity (e.g. Red Deer in the Oostvaardersplassen , Vulink). Bison diets in the Bialowieza Forest contained 88 % and 86 % of graminoids (Grasses, Sedges) and herbs. In autumn and winter, these percentages were even higher (Gebczynska et al 1991).

Defoliation response of tall Sedges and Reed.

The study of the effects of defoliation (by mowing or herbivory) on regrowth and quality of tall sedges and reed in the peat zone should be sustained (Bokdam). It should be co-ordinated with current mowing experiments of WWF, BNP and IMUZ (Nawrocki, Bartoszuk, Kaminski).

Mosaic scale and dynamics and biodiversity

The effects of scale and dynamics of successional mosaics on biodiversity is insufficiently known. Vegetation mosaics are nested and dynamic. Insects and other small animals require mosaics of other scales than waders or red deer. Plants and animals with a r- or K-strategy may invade and disappear from a phase during different developmental stages. A constant mosaic fixed by management may therefore not be adequate for all species. Mosaics should remain dynamic to remain a suitable habitat for these species. This means for the peat zone that short vegetation should be allowed to change sooner or later into taller herbaceous or woody stages, while these later stages should be allowed to change back into bare soil or short vegetation. The knowledge of cyclic succession might become very important for defining management prescriptions for rare species.

Allocation and prioritising of targets

The management targets of the BNP have been expressed in general terms. They have neither been quantified nor allocated yet (Sienko). Hot spots of target species and communities need to be mapped.

Special Protection Areas may be defined for priority target communities e.g. Poligonetum bistortae, Molinietum caeruleae (Sýkora) and priority target species e.g. Lady Slipper (*Cypripedium calceolus*), Black Grouse and Red- and Blue-winged Grasshopper (*Oedipoda* spec), (Werpachowski).

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PART II: PAPERS

Session I: Orientation

Biebrza National Park. Management targets and problems – animal species and their habitat requirements.

mgr inż. Adam Sieńko

Summary
*The Biebrza valley acts as a refuge for many rare fauna species. It is the most important breeding place in Central and Western Europe for several threatened bird species such as Aquatic Warbler (*Acrocephalus paludicola), *Great Spotted Eagle (*Aquila clanga), *Great Snipe (*Galinago media), *Corn Crake* (Crex crex), *Black Grouse (*Tetrao tetrix), *Ruff (*Philomachus pugnax). *The valley is also an important fuelling station for migrating waders, ducks and geese. For many of them vegetation succession of the abandoned peatlands is a serious threat.*
Long term objectives of fauna protection in BNP are biodiversity and related natural processes, survival in viable populations of all native species registered in BNP, maintenance of viable populations of regionally or globally threatened species and creation of conditions for increasing their numbers, suppression of alien species, maintenance, restoration and management of special biotopes for animal species if natural mechanisms are not effective. The maintenance of wild animals of open landscapes (especially avifauna) requires active management by mowing and grazing. According to the (draft) BNP management plan, an area of ~ 18.300 ha needs active protection. The achievement of the objectives is constraint by a lack of finances, the land ownership structure (43% of the park area is privately owned by ~ 5000 landowners) and by technical and organizational problems.

W projekcie Planu Ochrony Biebrzańskiego Parku Narodowego przyjęto następujące cele strategiczne ochrony fauny:

- ochrona różnorodności biologicznej i procesów jej sprzyjających,
- zapewnienie ciągłości występowania wszystkich rodzimych gatunków zwierząt,
- zapewnienie warunków do prawidłowego funkcjonowania zoocenoz poprzez ochronę, odtwarzanie i kształtowanie siedlisk,
- utrzymanie rzadkich w skali regionalnej i globalnej populacji zwierząt oraz zapewnienie warunków do wzrostu liczebności gatunków rzadkich i zagrożonych wyginięciem,
- ochrona środowisk mokradłowych, sprzyjających występowaniu cennych gatunków i zgrupowań kręgowców i bezkręgowców,
- niedopuszczanie do introdukcji oraz rozprzestrzeniania się gatunków obcych,
- odtwarzanie właściwej dla poszczególnych biotopów liczebności i struktury populacji zwierząt, które w wyniku przekształcenia siedlisk nie podlegają skutecznej kontroli biocenotycznej (naturalnym mechanizmom regulacyjnym) - duże ssaki, gatunki owadów podlegające gradacjom,
- stworzenie odpowiednich warunków do wykorzystania zasobów faunistycznych dla celów naukowych i edukacyjnych.

Pojęcie „ ochrona bioróżnorodności" zawiera w sobie ochronę zasobów genetycznych, ochronę gatunkową i ochronę ekostystemów. Obecnie w Parku realizowane są prace zmierzające do ochrony różnorodności biologicznej na poziomie gatunku i ekosystemu. Brak w tej chwili wiedzy i danych, aby realizować działania związane z zachowaniem różnorodności genetycznej w obrębie puli genowej gatunku.
Podejmowane działania ochronne realizowane są w oparciu o rozpoznanie zasobów faunistycznych oraz preferencje środowiskowe i wymagania ekologiczne poszczególnych gatunków.

Stan inwentaryzacji fauny BPN przedstawia się następująco: kręgowce 376 gat. w tym ptaki 273 gat., bezkręgowce ok. 2500 gat. w tym: motyle większe 716 gat., chrząszcze 700 gat., pająki 450 gat., chruściki 43 gat.
Stan zbadania struktury i funkcjonowania zespołów zwierząt występujących w dolinie Biebrzy jest bardzo nierównomierny. Dość dobrze poznane są ptaki i ssaki. Największe luki występują w rozpoznaniu fauny bezkręgowej. Dla szeregu taksonów brakuje nawet danych dotyczących składu gatunkowego.
Za priorytet działań ochronnych prowadzonych przez Park przyjęto założenie, że dla zachowania całości walorów przyrodniczych Bagien Biebrzańskich nie wystarczy jedynie ochrona bierna. Stworzenie sieci rezerwatów na tym terenie nie zapewni właściwej ochrony bagien i zespołów fauny ze względu na silne powiązania funkcjonalne obszaru całej doliny. Konieczne zatem są aktywne działania zmierzające do ograniczenia procesu sukcesji drzew i krzewów lekkonasiennych, oraz trzciny. Dobrym przykładem obrazującym negatywny wpływ sukcesji na różnorodność gatunkową są ptaki, których bogactwo gatunkowe w dolinie Biebrzy obok unikatowych zespołów roślinnych dostarczyło najsilniejszych argumentów przemawiających za ochroną Bagien Biebrzańskich.

W dolinie Biebrzy istnieje wiele cennych populacji rzadkich gatunków ptaków osiągających liczebności nie spotykane w innych miejscach w kraju. Wśród nich można wymienić:

wodniczkę *Acrocephalus paludicola* (ponad 2000 śpiewających samców, najważniejsze lęgowisko w Polsce),
orlika grubodziobego *Aquila clanga* (13-15 rewirów, 100% krajowej populacji),
dubelta *Gallinago media* (ok. 400 samców, najważniejsze lęgowisko w Europie Środkowej),
cietrzewia *Tetrao tetrix* (ok. 130 samców),
bataliona *Philomachus pugnax* (ok. 50 lęgowych samic – największa populacja w Polsce).

Sukcesja gatunków krzewiastych i drzew oddziaływuje nie tylko na skład gatunkowy miejscowej ornitofauny, ale również na ich wzajemne korelacje ilościowe i stosunki troficzne. W wyniku sukcesji tego typu następuje wzrost liczebności pewnych gatunków, które do tej pory na tym terenie nie występowały, kosztem innych. W ostatnim dziesięcioleciu zanotowano silny wzrost liczebności np. potrzosa, dziwonii i strumieniówki, a więc gatunków związanych z zaroślami wierzbowymi. Niezwykle dla nich korzystny wzrost powierzchni terenów lęgowych jest jednocześnie katastrofą dla wielu rzadkich w skali kraju, Europy, a nawet globu gatunków gnieżdżących się na otwartych torfowiskach np. wodniczki, dubelta, bekasika, bataliona, derkacza, rycyka, błotniaka zbożowego czy związanego ze środowiskami bagiennymi cietrzewia. Znaczne obszary Parku będące niegdyś otwartymi torfowiskami obecnie niemal całkowicie pokryte są nalotem brzóz, olch, wierzb, czy osiki. Dotyczy to między innymi: korytarza łączącego Czerwone Bagno z kompleksem leśnym Grzędy, Trójkąta leżącego między rzekami Jegrznią, Ełkiem a Kanałem Woźnawiejskim czy terenów na północ od Brzezin Kapickich. W niepokojącym tempie zarasta również basenu południowy doliny. Temu negatywnemu procesowi towarzyszy również wyrąb lasów prywatnych, z których usuwane są wszystkie grubsze drzewa. Powoduje to, że obszary te nie pełnią już roli jaką niegdyś pełniły tzn. ostoi rzadkich gatunków ptaków żyjących w starych lasach bagiennych. Coraz częściej w miejscach gdzie do niedawna występował dzięcioł białogrzbiety, orlik czy muchołówka mała obecnie spotkać możemy piecuszka czy czarnogłówkę. Zarastanie otwartych torfowisk jest dla niektórych gatunków odcięciem dostępu do pokarmu. Ptaki te gnieżdżą się w lesie jednak czynnikiem determinującym lokalizację gniazda jest odległość od dogodnych areałów łowieckich. Z przeprowadzonych badań wynika, że sukces lęgowy ptaków, których gniazda zlokalizowane są w pobliżu koszonych łąk był większy niż u ptaków, których tereny łowieckie są znacznie oddalone od gniazda.

Dla zachowania awifauny związanej z ekosystemami nieleśnymi konieczne jest stosowanie takich zabiegów ochrony czynnej jak wykaszanie i wypas. Związane jest tym wiele problemów:

Brak środków finansowych na realizację zabiegów ochrony czynnej. Wg projektu Planu Ochrony BPN zabiegami należy objąć należy ok. 18 300 ha rocznie.

Struktura własności – ok. 43 % powierzchni Parku należy do ok. 5000 prywatnych właścicieli. Działki własnościowe są często bardzo rozdrobnione. Przed rozpoczęciem działań na danej powierzchni trzeba uzyskać zgodę wszystkich właścicieli, a często jest ich bardzo wielu, niektórzy są nieosiągalni (nie żyją bądź przebywają za granicą), nie wszyscy też muszą się zgodzić.

Trudności techniczne. Nie ma zbyt wielu doświadczeń w prowadzeniu prac tego typu (mechaniczne koszenie na dużych powierzchniach, zbiór i wywóz biomasy) na takim terenie. W pewnym sensie działania Parku na tym polu są pionierskie.

Zmiany środowiska spowodowane sukcesją roślinności na otwartych torfowiskach jest również zagrożeniem dla wielu grup czy gatunków bezkręgowców np. motyli. Charakterystycznymi gatunkami motyli dla torfowisk niskich są: (*Coenonympha tullia)*, (*Heteropterus morpheus*), *Maculinea alcon* – z motyli dziennych; *Ckariaspilates formosaria*, *Scopula caricaria, Cabera leptographa, Epirrhoe tartuensis* – z miernikowców, *Catokala pacta*, *Diachrysia zosimi*, *Senta flammea, Paradiarsia punicea, Coenophila subrosea* - z sówek. Wszystkie z nich są gatunkami stenotypowymi. Przekształcenie się środowiska w brzezinę bagienną lub ols doprowadzi do ustąpienia w/w gatunków z obecnych miejsc występowania w Parku lub do defragmentacji populacji. Najlepszym sposobem ochrony byłoby zapewnienie trwałości środowiska poprzez regulację stosunków wodnych, i usuwanie podrostu drzew i tworzenie korytarzy ekologicznych. Wśród oddziaływań antropogenicznych coraz większą rolę zaczyna odgrywać turystyka. Środowiska bagienne i występujące w BPN wydmy o charakterze muraw kserotermicznych są szczególnie wrażliwe na zadeptywanie. Często w takich miejscach występują specyficzne zbiorowiska roślinne, które wraz z żyjącymi tam motylami ograniczone są do niewielkiej powierzchni i z tego powodu są narażone na zadeptanie. Ze względu, na to że w BPN stwierdzono występowanie wielu rzadkich w Polsce i Europie gatunków motyli istnieje ryzyko odłowów motyli dla celów komercyjnych. O ile stosowanie metod odłowu do celów badawczych takich jak samołówki świetlne nie ma znaczenia dla zubożenia lokalnej fauny, to działalność skierowana wyłącznie na jeden czy dwa gatunki, zwykle o specyficznych wymaganiach środowiskowych może doprowadzić do wyeksploatowania całej lokalnej populacji. W Parku przykładem gatunku zagrożonego taką działalnością jest *Caocala pacta*. Motylom do rozwoju często wystarcza bardzo mała przestrzeń. Dlatego szczególną rolę w ochronie ich zasobów odgrywa duża mozaikowatość środowiska. Utrzymanie sródbagiennych grobli i różnych środowisk okrajkowych w znacznym stopniu przyczyni się do zachowania bogactwa gatunkowego tej grupy.

Odrębnym zagadnieniem jest prowadzenie ochrony „dużych" ssaków takich jak łoś, jeleń, sarna i dzik. W przypadku łosia i jelenia mamy do czynienia z zupełnie nową sytuacją na Bagnach Biebrzańskich. Po raz pierwszy w historii stan ilościowy populacji jelenia przewyższył stan ilościowy łosia. Nie spotykana na taką skalę inwazja i lawinowy wzrost populacji jelenia wynikł z następujących powodów: zmiana uwilgotnienia terenów bagiennych- stopniowe osuszanie, spokój w ostoi (brak penetracji terenu przez ludność zbierającą grzyby i pozyskującą drewno-szczególnie w okresie rykowiska- w okolicznych Lasach Państwowych, bogata baza żerowa zarówno na terenach zarastających jak i otwartych), całkowite zaniechanie wpływu na strukturę ilościową i strukturę płci. Obserwowany wzrost ilości jeleni wywiera coraz większy wpływ na zachowanie i sposób bytowania łosia. Pokrywające się terminy rykowiska i bukowiska wywołują zakłócenia w

okresie godowym łosia. Bez regulacji i ograniczenia ilości jelenia w stosunku do łosia należy spodziewać się coraz większych dysproporcji w stanach populacji obu gatunków.
Ochrona fauny musi być prowadzona poprzez zabiegi czynne. Bierne obserwowanie doprowadzi do nieodwracalnych zmian z wyraźnym przewartościowaniem cennych zespołów zwierząt w kierunku bardziej pospolitych. Należy spodziewać się zatem pewnych oporów ze strony środowisk preferujących bierne podejście do zasobów przyrody. Dotyczyć to będzie w szczególności regulacji liczebności populacji drapieżników takich jak lis, jenot i norka amerykańska oraz redukcji populacji jelenia w odniesieniu do łosia mającej na celu odtworzenie proporcji sprzed dwudziestu lat. Wykonywanie zabiegów ochronnych takich jak odkrzaczanie i wykaszanie nie napotyka już na większe opory i sprzeciw.

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Biebrza National Park. Management targets and problems – plants and vegetation.

Cezary Werpachowski

Streszczenie

Z istniejących opracowań (np. Plan Ochrony Przyrody BPN), wynika potrzeba stosowania w miarę możliwości ochrony czynnej - ekstensywnego użytkowania kośnego i kośno-pastwiskowego - na całym obszarze zajętym przez ekosystemy nieleśne. Podstawowe zabiegi ochronne powinny naśladować zabiegi, stosowane w ekstensywnej gospodarce rolnej. Powinno to być więc koszenie połączone z usuwaniem biomasy (ewentualnie uzupełniane ekstensywnym wypasem) i mechaniczne usuwanie zakrzaczeń. Wskazane jest koszenie późnym latem (od końca lipca do początku września). Na wielu terenach wystarczające powinno być koszenie raz na 2-3 lata, jednak tam, gdzie już rozpoczęły się procesy sukcesyjne, na początku wydaje się być wskazane koszenie co roku. Dotyczy to zwłaszcza terenów, zarastających trzciną. Badania sugerują także znaczną rolę łosia w ograniczaniu rozwoju zakrzewień wierzbowych.

Co powinno zostać zrobione?

rozpoznanie skali problemu (dokładne dane ilościowe i jakościowe – np. jak duże są poszczególne płaty zbiorowisk na których doszło do rozwoju zakrzaczeń lub (i), które zostały zdominowane przez trzcinę),

analiza ekonomiczna problemu i jego możliwych rozwiązań,

utworzenie listy rankingowej – (ustalenie priorytetów w oparciu o walory przyrodnicze i możliwości ekonomiczne) powierzchni, na których bezwzględnie powinna być stosowana ochrona czynna (koszenie, wypas), oraz tych które można byłoby zostawić działaniu naturalnych procesów regeneracyjnych,

podjęcie badań naukowych mających na celu: poznanie przyczyn, czynników, wyjaśnienie ich działania (jakie dokładnie procesy sukcesyjne zachodzą na tych powierzchniach i jaka jest ich dynamika, itp.), poznanie wpływu stosowanych zabiegów ochronnych (koszenie, wypas, naturalni roślinożercy),

wykup gruntów prywatnych – przynajmniej części z nich,

wdrażanie programów rolno-środowiskowych.

Introduction

One of the most frequent comments of visitors concerns the vastness of the open bogs and fens of the Biebrza National Park. Vegetation of Reed (*Phragmition*) and tall sedge communities (*Magnocaricion*) dominate the open peatland, together with the – from a biological point of view most precious – moss-sedge community (*Scheuchzerio-Caricetea nigrae*). While the first two successional communities are relatively stable – they remain in the area of flooding influence (a-zonal communities) – the third community (moss-sedge) depends on human activity since many centuries.

The recent decades showed positive and negative changes for nature conservation. An area of 60.000 ha was brought under protection of the BNP. The most serious threat of these decades is the progressive secondary vegetation succession in its open peat land. This succession is explained by the following factors:

- lowering of the ground water table by drainage works during the XIX-th century, land reclamation and more recent climatic changes;
- water eutrophication;
- cessation of mowing, grazing and burning, the traditional types of land use, after their banning by the authorities;
- a decreased density of elk – the biggest natural herbivorous animals.
- other events.

Management targets and problems.

The aims of the BNP are:

- maintenance of the remaining open peat land;
- restoration of open ecosystems where they have been infested with shrub (e.g. *Salix* sp., *Betula pubescens*, *Alnus glutinosa*, *Populus tremula*) or reed.

What are the problems?

The achievement of these aims is constraint by a complex of related factors concerning the ceased land use and lacking conservation management;
changes in the mentality of the farmers;
small profitability of hay making – especially by mowing and gathered in the traditional way – and grazing;
unregulated and still very negative structure of ownership(over 40% of the Park area is private-owned);
lack of funds for subsidizing traditional mowing and grazing;
lack of information concerning the level of the problem;
insufficient understanding of the ecological and social-economic causal factors.

What should be done?

assessment and ecological analysis of the unwanted and threatening vegetation changes: quality, quantity, geographical and ecological distribution (mapping);
Socio-economical analysis of the problem and its possible solutions;
Assessment of priorities for management according to nature values and economic possibilities. It should result in a list of priority areas, which should decisively be protected by mowing and grazing, and areas where succession might progress;
scientific investigation of the succession processes, their causal factors and effects of succession control methods (mowing, grazing, natural herbivores);
buying of private-owned land;
implementation of agro-ecological programs.

What do we actually know?

- the are of the open peat bog ecosystems (table 1),
- the approximate scale of the problem (table 2).

Table 1. Area of open peat land in the BNP (on the basis of the Biebrza NP Nature Protection Plan).

Type of land bog ecosystems	Area [ha]
Reeds and sedges	14 950
Peatlands	13 368
Meadows and tall herbaceous	8 143
Post burning first steps of regenerations	1 475
Shrubs of Betula humilis	125
All together	38 061
	65%

Table 2. Area of dense shrubland and woodland on peat in the BNP (on the basis of the Biebrza NP Nature Protection Plan).

		Upper Basin	Middle Basin	Lower Basin	**All together**
Semi natural open peatland (without improved meadows and cultivated areas)	[ha]	3 574	18 783	16 425	**38 782**
Dense (closed) shrubs	[ha]	255	1 127	502	**1 884**
Peatland covered by shrubs and trees	[ha]	1 247	5 409	5 664	**12 320**
	[%]	2,1	9,1	9,6	**20,8**

Conclusions

On the basis of the existing knowledge (e.g. The Biebrza National Park Nature Protection Plan) it may be concluded that active management (e.g. by mowing and aftermath grazing) is crucial for the whole open peatland area if we want it to be preserved. A significant problem

is that an important proportion of the open peatland is privately owned. According to the regulations only landscape protection can be exercised here by the BNP.
The management methods should mimic the land use of the extensive rural economy, which created and maintained the open Biebrza Valley for centuries. This might implicate hay making (mowing with biomass removed), grazing of the aftermath (autumn regrowth) and (mechanical) shrub removal. Mowing should be done in late summer (from end of July to September) to allow late plant species to complete their reproduction cycle. Many of the short areas might need only mowing once per 2-3 years. In reed beds and other areas with advanced succession mowing should be done every year to restore short vegetation. When the reed has been reversed, mowing may become less frequent.
The research done by Pałczyński and Tomaszewska (1981) suggest a significant role of the Elk (Moose) in preventing willow shrub expansion.

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Pattern in plant communities in the Lower Basin of the Biebrza National Park.

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Streszczenie

Występowanie zbiorowisk roślinnych, ich rozmieszczenie w krajobrazie i ich związek z niektórymi czynnikami abiotycznymi były badane w południowym basenie doliny Biebrzy w latach 2000-2001. Wykonano 312 zdjęć fitosocjologicznych metodą Braun-Blanqueta w okolicach Brzostowa, Barwika, Olszowej Drogi, Stójki, na Bagnie Ławki i niektórych grądzikach. Wykonano również mapę roślinności pasa o szerokości 1 km z Brzostowa do osady Stójka, zlokalizowanego poprzecznie do rzeki Biebrzy. Wyróżniono cztery typy krajobrazu: strefę przyrzeczną, strefę przejściową między rzeką a torfowiskiem, strefę torfowiskową, strefę przejściową między torfowiskiem a grądzikami, grądziki i wydmy. Głównymi czynnikami tłumaczącymi podstawowe zróżnicowanie składu roślinności są: wilgotność, światło, zasobność i pH gleby oraz obecność intensywnego wypasu. Na charakter roślinności ma wpływ system zasilania hydrologicznego: stosunek udziału wód zalewowych do podsiąku wód gruntowych. Jedynie niewielka strefa przyrzeczna jest intensywnie użytkowana. Pozostała część obszaru pozostaje niemal nie użytkowana, co spowodowało wzrost udziału trzciny, wysokich turzyc, zakrzaczeń i roślinności drzewiastej - ma to negatywny wpływ na różnorodność biologiczną obszaru i powinno być powstrzymane.

Introduction

The Biebrza (Biebrzanski) National Park with its extensive floodplains, diverse flora and vegetation is one of the most important river ecosystems in Europe. Man has used the floodplains for centuries. Human influence resulted in a considerable biodiversity. Nowadays the greatest threat is abandonment and cessation of agricultural practices like mowing and grazing. As a consequence large areas are encroached by bushes, trees and reed. This has a detrimental effect to many bird species depending on marshes covered by short vegetation. The maintenance of sufficient open landscape is a major challenge for future nature management. Important questions are whether it will be possible to counteract succession by grazing using domestic or wild grazers. To be successful, economic aspects should be taken into consideration. Will sustainable agricultural practices including agro-tourism be feasible? For an appropriate introduction of this future management a solid knowledge of the composition, ecology and spatial distribution of the plant communities in the Biebrza valley is needed. The vegetation composition and structure are a basis for the occurrence of different animal species. When sufficient insight is available about the relation between vegetation and fauna, predictions can be made about future developments.

Since 2000 we studied the occurrence of plant communities in the Biebrza lower basin, their distribution in the landscape and the relation with some abiotic factors.

Methods

In the year 2000, 312 relevés were made according to the Braun-Blanquet method, in the Biebrza lower basin near Brostowo, Barwik, Olszowa Droga, Stojka, Bagno Lawki and on some hillocks. These data were classified using TWINSPAN and names were given according to the overview of Polish plant communities. Subsequently a determination key to the plant communities was constructed for vegetation mapping.

Abiotic parameters were measured and the relation with species composition was analysed using multivariate analysis (DCA).

In the year 2001 the vegetation was mapped in an approximately 1 km wide transect from Brostowo to Stójka and perpendicular to the Biebrza river. The vegetation was mapped in the field using GPS. The plant communities were named using the determination key made in the year 2000 and Matuszkiewicz (2001). Vegetation maps and interpretation maps were constructed by means of GIS.

From 13 plant communities soil profiles were described and bulked soil samples were taken. The soil was analysed for texture, the presence of calcium carbonate, presence of iron concretions and pH-H_2O etc. Purpose of these activities was the detection of seepage and the influence of river flooding.

Results

The vegetation clearly appeared to reflect the environmental gradient perpendicular to the river. The influence of seepage from the hillocks and from the morainic plateau is obvious in the distribution of the plant communities.

The vegetation map (see Appendix 1, vegetation map on the alliance level) could clearly be used to draw interpretation (indication) maps showing the distribution of acidity, water level, wetness, trophic status, mineral or peat soil and succession stages. The presence of plant communities indicating basic conditions is linked to seepage near the hillocks and morainic plateau.

Figures 1 and 2 represent a schematic overview of the zonation of the plant communities of the Biebrza valley and the grazed situation near Brostowo. In table 1 an overview is given of the plant communities described in the year 2000. The numbers correspond with the numbers in the profile diagrams.

Fig. 1: profile diagram of the plant communities in the Biebrza valley perpendicular to the river (left).

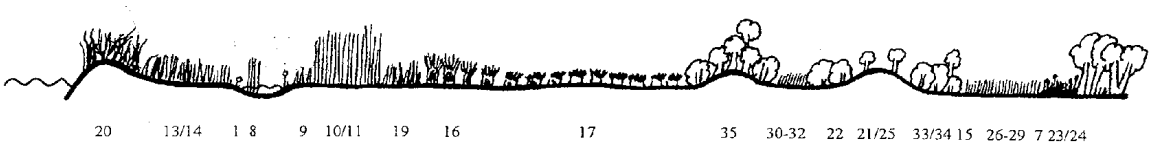
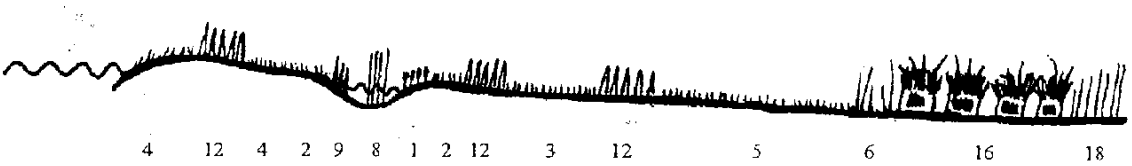


Fig. 2: profile diagram of the plant communities in the Biebrza valley near Brostowo perpendicular to the river (left).



The plant communities occur in clear zones and can be ordered according to landscape type (see appendix 2). From river zone, via the transition zone between river zone and peat zone, peat zone, to hillock the fertility of the soil as expressed by the indicator values of Ellenberg decreases. The river zone and the hillocks are mainly characterised by mineral soils. The remaining zones occur on peat. Each zone is clearly characterised by plant communities.

Table 1 Overview of the plant communities. Transitions are indicated by /.

Bidentetea tripartiti

Bidentetalia tripartiti

Bidention tripartiti

1. **Polygono hydropiperi-Bidentetum tripartitae**

Plantaginetea majoris

Agrostietalia stoloniferae

Lolio-Potentillion anserinae

2. **Basal community of Agrostis stolonifera [Lolio-Potentillion anserinae]**
3. **Fragmentary Triglochino-Agrostietum stoloniferae with Oenanthe aquatica**
4. **Fragmentary Triglochino-Agrostietum stoloniferae**
5. **Triglochino-Agrostietum stoloniferae**
6. **Triglochino-Agrostietum stoloniferae / Caricetum gracilis**
7. **Basal community of Agrostis stolonifera and Carex panicea [Lolio-Potentillion anserinae/Molinietalia]**

Phragmitetea

Phragmitetalia

Phragmition

8. **Scirpetum lacustris**
9. **Sparganietum erecti**
10. **Phragmitetum communis with Phalaris arundinacea**
11. **Phragmitetum communis**
12. **Acoretum calami with Ranunculo-Alopecuretum geniculati**
13. **Glycerietum maximae with Galium palustre**
14. **Glycerietum maximae**

Magnocaricion

15. **Caricetum acutiformis**
16. **Caricetum elatae**
17. **Caricetum appropinquatae**
18. **Caricetum gracilis with Calamagrostis stricta**
19. **Caricetum gracilis**
20. **Phalaridetum arundinaceae**

Sedo-Scleranthetea

Festuco-Sedetalia

Armerion elongatae

21. **Diantho deltoides-Armerietum elongatae**

Molinio-Arrhenatheretea

Molinietalia

Molinion

22. **Molinietum medioeuropaeum**

Calthion

23. **Cirsio oleracie-Polygonetum bistortae with Salix cinerea and Betula pendula**
24. **Cirsio oleracie-Polygonetum bistortae**

Arrhenatheretalia

Arrhenatherion

25. **Community of Crepis biennis and Galium verum [Arrhenatherion / Festuco-Sedetalia]**

Scheuchzerio-Caricetea fuscae

Caricetalia fuscae

Caricion fuscae

26. **Basal community of Calamagrostis stricta [Caricion fuscae] / Caricion lasiocarpae**
27. **Basal community of Calamagrostis stricta [Caricion fuscae]**
28. **Basal community of Calamagrostis stricta [[Caricion fuscae] / Caricetum cespitosae / Caricetum**

appropinquatae]

29. Basal community of Calamagrostis stricta [Caricion fuscae] with Parnassia palustris

Scheuchzerietalia palustris

Caricion lasiocarpae

30. **Caricetum lasiocarpae**

31. Caricetum lasiocarpae with Salix cinerea

32. Caricetum lasiocarpae with Parnassia palustris

Alnetea glutinosae

Alnetalia glutinosae

Alnion glutinosae

33. Salicetum pentandro-cinereae

34. Salicetum pentandro-cinereae with Betula pendula

Querco-Fagetea

Fagetalia sylvaticae

Carpinion betuli

35. Tilio cordatae-Carpinetum betuli

According to Detrended Correspondence Analysis the main factors explaining the main variation in the vegetation composition are moisture, light, nitrogen, acidity and the presence of intensive grazing.

The hydrology appears to be very important. The vegetation reflects the hierarchy (relative impact) of river water, seepage water and rain water on the sites. According to the soil research results of 2001, the following categories could be distinguished:

Influenced by the river:

Caricetum acutiformis

Salicetum pentandro-cinereae

Influenced by river and seepage:

Phragmitetum communis

Glycerietum maximae with Galium palustre

Phalaridetum arundinaceae

Caricetum appropinquatae

Occurring on peat near the hillock and influenced by both river and seepage:

Molinietum medioeuropaeum

Cirsio oleracie-Polygonetum bistortae

Basal community of *Calamagrostis stricta [Caricion fuscae]*

Influenced by seepage only

Caricetum lasiocarpae

On hillocks, ground water independent.

Diantho deltoides-Armerietum elongatae

Tilio Cordatae-Carpinetum betuli

Near the foot of hillocks the peat layer is less pronounced allowing more seepage to reach the surface. The transition of peat zone to hillock is of botanical importance.

Conclusions

Five landscape types can be distinguished (three zones and two transitions):

river zone (mineral soil)

transition zone between river and peat (peat)

peat zone (peat)

transitional zone between peat and hillock (less peat)

hillocks and dunes (mineral)

Master factors are:

moisture
fertility
grazing
pH

Seepage appears to be an important master factor differentiating communities as follows:

only influenced by river flooding
influenced both by flooding and seepage
transition zone between hillock and peat on shallow peat, increased seepage
only influenced by seepage
neither influenced by seepage nor by flooding
transition between hillock and peat is botanically very interesting

Management:

Intensive management (actually use) only occurs in a small zone near the river
The largest part of the remaining area is not or hardly managed
large area's changed into tall reed, sedge vegetation, shrubs and wood
This process is detrimental for the biodiversity in the area and should be counteracted

Recommended research

The vegetation of the whole Biebrza valley should be phytosociologically mapped.
The synecology (ecological amplitude) of the plant communities should be studied in more detail. This especially applies to the hydrology of the area.
The relation between grazing and plant communities should be studied. It is important to know the preference of grazing animals to the different plant communities as well as the reaction of these plant communities to grazing. Also the accessibility of these communities for grazers is important.
The relation between plant communities (structure and species composition) and fauna (e.g. birds, insects) should be studied.
Using spatially explicit models the suitability of grazing as a management tool and the influence of grazing on biodiversity can be studied.

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Session II + III: Suitability

Suitability of grazing and mowing as management tools in Western Europe. Experiences in Scotland and the United Kingdom.

Roy A. Harris

Streszczenie

Wypas jest niezwykle ważnym mechanizmem, który ukształtował wiele siedlisk i jest istotny dla ich zachowania w Wielkiej Brytanii. Jednakże taka sama intensywność wypasu może być różna na różnych siedliskach: zbyt wysoka w zbiorowiskach leśnych, a przez to uniemożliwiać regenerację, optymalna do utrzymania wrzosowisk, lub zbyt mała by „wytworzyć" bogate w gatunki łąki czy mokradła. Często na obszarach, gdzie zbyt intensywny wypas powoduje zniszczenia, główną tego przyczyną jest fakt, że wypas jest prowadzony w określonym, krytycznym dla roślin okresie, a zwierzęta są dodatkowo dokarmiane, tak by mogły przetrwać trudne warunki na pastwisku zimą; a nie samo zagęszczenie zwierząt.Skuteczność wypasu pozwalająca na osiągnięcie określonych celów ochronnych jest ograniczona głównie umiejętnościami i zasobami ludzkimi umożliwiającymi ścisłą kontrolę wyników wypasu.W 1987 roku na wyspie Hoy (Orkady) rozpoczęto realizację projektu na obszarze 126 ha, którego celem było wypracowanie strategii łączącej wypas ukierunkowany na osiągniecie specyficznych celów ochronnych z ekstensywną produkcją zwierzęcą. Wiosną i latem nie użytkuje się najżyźniejszych łąk i wrzosowisk by następnie intensywnie je wypasać jesienią i zimą, co pozwala na usunięcie rocznej produkcji biomasy. Liczebność endemicznego gatunku pierwiosnki Primula scotica wzrosła z 659 roślin w 1987 do 5806 w 2000. Podobnie u blisko 50 innych gatunków zanotowano wzrost liczebności i ilości wytwarzanych kwiatów. Straty w produkcji zwierzęcej zostały wyrównane dzięki płatnościom z programu rolno-środowiskowego.Większość projektów realizowanych w Wielkiej Brytanii, szczególnie na rozleglejszych obszarach, ma na celu głównie kształtowanie struktury roślinności i opiera się na długotrwałym wypasie przy niskich zagęszczeniach zwierząt, często z dodatkowym usuwaniem zakrzaczeń. Na mniejszych obszarach i bardziej wrażliwych, szczególnie kiedy mamy do czynienia z rzadkimi i zagrożonymi gatunkami, najwłaściwsze jest prowadzenie bardziej pracochłonnego i wymagającego większej wiedzy wypasu koncentrującego się na ochronie specyficznych gatunków.Obie te metody mogą być wykorzystywane na różnych powierzchniach tego samego obszaru w zależności od tego, czy celem jest ochrona bioróżnorodności, czy faworyzowanie określonych gatunków.

Introduction

All terrestrial habitats in the United Kingdom have been much modified, and some actually created, by human impact over long periods of time, except for the extreme environmental conditions of vertical cliff faces and inaccessible montane ledges. Arguably the greatest influences have been pastoralism and other forms of agriculture.

Our present grassland and heathland plant communities are in most cases a product of grazing, primarily by domestic livestock, and have been derived from a range of woodland and scrub vegetation types. Wet grassland, fen and mire communities depend on grazing pressures and the height of the water-table to prevent succession to scrub and carr woodland. Only in the most exposed coastal or upland situations is grazing not necessary to halt natural processes of succession to some form of dwarf shrub, scrub or woodland climax vegetation.

Ancient woodlands have a varied history. Most southern woods are now ungrazed by domestic livestock but in the past wood pasture systems were widespread. The largest surviving example is the New Forest, in Hampshire. It is common practice for woodlands (but not forestry plantations) in upland Wales and in northern England and Scotland to be grazed by sheep and cattle as part of extensive livestock systems.

Although domestic livestock represent the main large grazing animals shaping wildlife habitats in the UK, wild deer also exert substantial grazing pressures. Six species occur in the wild but only two of these are native. Upland and montane habitats in Scotland are the ones most dramatically influenced by deer grazing and browsing pressures, because of the large free ranging populations of red deer, *Cervus elaphus,* which have in the past been maintained for sporting shooting and to a lesser extent for venison production.

Current grazing impacts

There is a widespread lack of understanding about the mechanisms of grazing and their impacts on vegetation in the UK and there is often confusion and inconsistency about the benefits or damage generated by grazing practices. Nature conservation interests have become very critical about the density of domestic livestock, especially sheep, in the uplands. "Overgrazing" is frequently, and sometimes simplistically, blamed for the loss of biodiversity richness, especially in dwarf shrub and woodland habitats. This reflects current concerns about the loss of heather (*Calluna vulgaris)*-dominated habitats and decline in native woodlands where grazing pressures are too high to permit significant seedling establishment. However, if the number of grazing animals was to be drastically reduced it is likely that some species-rich grasslands and heaths would be adversely affected. In reality, while there are areas where grazing pressures are damaging because of stocking levels, often it is not the number of animals that is the problem so much as where they are at certain critical times and the way in which they are fed supplements in order to keep them outside in harsh environments through the winter.

At the same time as concern is expressed about damagingly high grazing levels in the uplands, there is frequently a lack of adequate grazing in lowland areas. This is the cause of serious deterioration in the biodiversity interests of grasslands, heaths and wetlands, as successional changes towards scrub and woodland alter sensitive wildlife habitats.

Underlying these perceived problems of excessive or inadequate grazing impacts are major changes in agricultural practices and land management objectives. During the second half of the Twentieth Century there was strong emphasis on the need to maximise the production of homegrown food. This leads to an intensified use of upland areas for livestock, particularly sheep. At the same time lowland areas were increasingly converted to arable production, especially wheat, barley and oilseed rape. Many areas that previously supported substantial livestock numbers were left with very few grazing animals, often too few or inappropriate breeds to graze even the severely reduced areas of grassland and heath. Currently, the role of agriculture in the UK is being re-examined and it seems likely that there will be more emphasis placed on buying food on the world market and less on producing it at home at a higher cost. At the same time the role of the countryside for maintaining biodiversity and providing opportunities for recreation and tourism is being seen as increasingly important.

Objectives

Grazing is neither beneficial nor harmful: it is simply a natural mechanism that can be used as a tool of management. "Overgrazing" and "undergrazing" are meaningless terms, unless they relate to defined objectives. The same grazing pressure may be too heavy to permit woodland regeneration, ideal to maintain dwarf shrub heath or too light to develop species-rich grasslands or wetlands.

Conservation grazing

Grazing is a form of predation on vegetation and is necessarily a damaging impact on the grazed plant. Some plants are intolerant of grazing and cannot survive in grazed habitats: others have successfully adapted to grazing and can survive in a prostrate from, reproducing

vegetatively. Between these extremes, there are species that are unable to survive being grazed when they are actively growing in spring and summer but are able to thrive if grazing is delayed until the late summer or autumn. Once it is understood how plants are affected by grazing, it becomes possible to determine what kind of vegetation grows where, even down to individual plant species and their relative abundance in a particular area. The effectiveness of grazing to achieve specific conservation management objectives is primarily limited by the skills and manpower resources available to closely control grazing impacts so that the benefits achieved outweigh any disadvantages.

There are two broad categories of conservation grazing. Targeted nature conservation grazing uses livestock husbandry to control grazing impacts, over-riding feeding preferences when necessary, to achieve carefully defined biodiversity objectives. Stocking intensity, duration and timing are the principle factors that can be used to achieve targeted grazing impacts. In contrast, low intensity livestock grazing often carried out throughout the year relies on the natural behaviour and feeding preferences of grazing animals to deliver the desired biodiversity benefits.

Loft and Hill of White Hamars Grazing Project

This grazing project was established in 1987 to develop strategies to integrate targeted nature conservation grazing with low intensity livestock production.

The starting point for the project was neither conventional nature conservation practice nor conventional farming. It was founded on the conviction that grazing impacts could be used positively to shape the species composition and relative abundance of plants in grasslands, wetlands and heaths and that such grazing patterns could be successfully incorporated into a low intensity commercial sheep rearing regime. The intention was to find an environmentally sensitive way of using the natural vegetation growth, without any fertiliser or pesticide use, to produce a commercial crop of wool and lambs. There was the overriding constraint that the impacts of grazing should produce nature conservation benefits through maintaining overall biodiversity and increasing the abundance of notable species, especially the endemic Scottish primrose, *Primula scotica*.

Underpinning the project was the concept that good conservation management of vegetation should allow plants to flower and set seed. This is vital not only to maintain genetic diversity but also to increase the relative abundance of flowering plants, to provide rich food resources of pollen and nectar for insects and other invertebrates and to create a diverse three dimensional vegetation structure for invertebrates.

Developing the full potential of species rich grasslands, wetlands and heaths depends on the structure of the vegetation at critical times. Letting plants flower and produce seed is not enough: there is also a need for the impact of grazing animals to shape the structure of the vegetation and to create short, open areas suitable for seedling establishment within a competitive turf.

This grazing project covers 126 hectares of South Walls, at the southern end of Hoy, one of the Orkney islands which lie to the north of the Scottish mainland. The core of the project is 80 hectares of grazed grasslands, wetlands and heaths: 25% is previously improved agricultural grassland, while 75% is a mosaic of vegetation communities with high conservation value.

Leaving the richest grasslands and heaths ungrazed in spring and summer has allowed flower-filled, species-rich grasslands, heaths and wetlands to develop. These are also good habitats for ground nesting birds and many invertebrates. But this period without grazing must be followed by a heavy grazing pressure in autumn and winter to remove the year's crop of grasses and herbs. This heavy grazing after flowering and seed set is essential to maintain the

vegetation structures necessary to ensure species richness and abundance of flowers in subsequent years.

Achieving sufficient autumn and winter grazing impacts, but without too much grazing on dwarf shrubs like heather, while maintaining a healthy sheep flock, are the most difficult factors to reconcile. The key is careful timing: leaving areas ungrazed long enough for seed to set, but grazing them heavily before they are flattened and damaged by salt-laden autumn and winter storms. It is a critical balancing act, made all the more difficult here because of the violence and unpredictability of Orkney weather.

This grazing strategy has proved very successful for the endemic Scottish primrose, *Primula scotica*: the number of plants has increased from 659 in 1987 to 5806 in 2000. In addition, nearly 50 other species have shown impressive increases in flowering and abundance under the same management regime. This successful conservation management is based on the natural productivity of unfertilised grasslands, wetlands and heaths. Accordingly, agricultural productivity was not as high as on an equivalent purely commercially managed farm: nevertheless, between 200 and 240 lambs were produced annually from the 80 hectares that we graze directly with approximately 150 ewes, usually achieving over 150% lambing. The reduced livestock production was balanced by Agro-Environment payments made on 58 ha of land managed under the Habitat Scheme, which makes an annual payment of £125/ha for carrying out approved conservation management practices.

This project has demonstrated how carefully targeted, labour intensive conservation grazing management can achieve dramatic biodiversity benefits within the framework of low intensity livestock production. Although the grazing species used here has been sheep, the essential principles apply to other livestock species, to other parts of the UK and to a range of grazed habitats.

Few other conservation grazing schemes are as detailed as this one. There is a wide variety of other projects throughout the UK, some long established and built on traditional low intensity pastoral systems and many others based on managing individual conservation sites, without a direct linkage to agricultural production. In the latter cases commercial grazing animals from neighbouring farms are used to carry out periods of grazing.

Extensive wetland areas in the East Anglian region of England perhaps have more similarities with the Biebrza National Park, although they are generally much smaller in scale. There are extensive grazing marshes like the Holkham National Nature Reserve, which is managed through a combination of seasonal cattle grazing and control over water levels. A series of other National Nature Reserves exists to protect and rehabilitate surviving fragments of fenland that are all that survive of formerly extensive fens that have been drained and converted to intensive agriculture. Woodwalton Fen uses cattle grazing, Chippenham Fen is experimenting with water buffalo and Redgrave and Lopham Fen uses sheep and cattle as well as Konik ponies, which apparently originally came from the Biebrza National Park! Konik ponies also feature in the management of other wetland sites in East Anglia at Hickling Broad and Sutton Fen.

Most of these grazing programmes, especially on the larger sites, rely on long periods of low intensity grazing to shape vegetation structure in order to deliver biodiversity benefits, often in combination with cutting and scrub clearance projects. This at one level is in contrast to the more targeted but labour and skill intensive management adopted in the Loft and Hill of White Hamars project. However, the two approaches are more complementary than contradictory. Targeted grazing is perhaps most appropriate when dealing with smaller and more sensitive sites and particularly when dealing with rare or threatened species; while extensive low intensity grazing can be more appropriate with large sites where the emphasis is more on broad habitat structures rather than on species. However the two approaches are not mutually exclusive, they can often overlap and it may well be appropriate to use both

techniques on different parts of the same site, depending on the concentration of biodiversity interests and the importance of favouring particular species.

Conclusion

Grazing management is a vitally important mechanism that has shaped, and is vital to maintain, a variety of wildlife habitats in the UK. Progress has been slow in implementing well-informed nature conservation grazing practices but, especially because of the major problems now facing commercial agriculture, it is now gaining momentum, particularly in southern England. There is still much to be learned and put into practice. Integrating conservation grazing management with the socio-economic needs of rural communities, especially those in remote areas, is an urgent challenge.

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Experiences with grazing in Flemish nature reserves (N. Belgium)

Maurice Hoffmann

Streszczenie

30% powierzchni rezerwatów przyrody we Flandrii (ogólnie 2500-3000 ha) jest wypasana przez udomowione zwierzęta roślinożerne: bydło, konie i owce. Zastosowanie wypasu spowodowało zmniejszenie się powierzchni zakrzaczonych, zwiększenie zróżnicowania struktury roślinności, ograniczenie występowania mniej pożądanych gatunków roślin i wzrost liczebności pożądanych gatunków roślin i zwierząt. Wyniki badań porównawczych użytkowania siedlisk oraz diety bydła i koni wykazały w większości przypadków jedynie niewielki podział zasobów, spowodowany różnicami w użytkowaniu i gatunkami zjadanych roślin. Użytkowanie różnych typów siedlisk zarówno przez konie jak i bydło w dużym stopniu zależy od przestrzennego zróżnicowania struktury roślinności, dostępności składników odżywczych, wilgotności i dostępności siedliska. Dlatego też przewidywanie efektów stosowania wypasu na dużą skalę (poziom gatunkowy lub struktury roślinności) bez posiadania wiedzy na temat warunków środowiska (zróżnicowanie przestrzenne i czasowe) oraz zachowania branych pod uwagę roślinożerców pozostaje w sferze domysłów. Dlatego też przed podjęciem decyzji o zastosowaniu wypasu, niezbędne jest przeprowadzenie badań w ww. zakresie.

Introduction

With less then 14.000 km², Flanders (Northern part of Belgium) is a rather small region in Europe. From time immemorial human impact on nature has been very high. Due to that severe human impact factor, nature protection is an important political issue. It is translated into several spatial measures, such as the designation of European Bird and Habitat Directive areas. Some of the larger wetlands are protected by the Ramsar Convention, but most of these are in relatively intensive agricultural use. None of these types of designated areas are managed specifically for nature conservation purposes. Active nature management only takes place in true nature reserves.

The total area of nature reserves (NR) is ca. 10.000 ha (0,7 % of the total area), with a mean area of ca. 45 ha/NR. They range from ca. 1000 ha to less then 1 ha[1]. They are scattered all over the region, with a concentration in the eastern part, but all in all with a high degree of fragmentation. In general they are the result of some form of historical land-use and are influenced by several anthropogenic factors, such as drainage, surrounding land-use and air and water pollution.

Grazing in Flemish nature reserves, an overview

Up to ca. 30 % of the nature reserves (2500-3000 ha in total) is estimated to be grazed by large introduced (semi-) domesticated herbivores. The main biotopes that are grazed are heath land, wet and dry grassland and roughage. Wetlands in nature reserves are relatively small, while peat land is extremely rare and tiny. Grazing steadily gains in importance as compared to other management measures. Cattle are the favoured and increasingly used herbivores, though several horse (Konik, Shetland, Iceland pony) and sheep breeds are popular as well (fig. 1).

[1] Just for the sake of comparison, the Polish Biebrzanski National Park encloses over 59.000 ha, with almost 67.000 ha of surrounding protection zone; a minor part of the NP is actively managed.

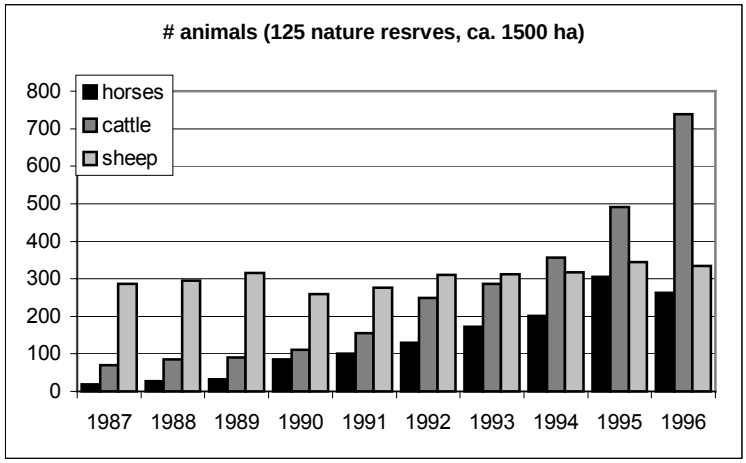

Fig.1 The evolution in numbers of domesticated herbivores grazing in Flemish nature reserves between 1987 en 1996 (based on Eggermont et al., 1996)

An inquiry dating from 1996 (Eggermont et al., 1996) revealed that quite different objectives for grazing management were posed (table 1) and very different, often contrastive results were experienced by managers of 125 nature reserves.

Table 1 –The most important nature conservation objectives for grazing by large herbivores mentioned by managers of 125 nature reserves in Flanders (summarized after Eggermont et al. 1996); %= percentage of the 834 answers given).

Objective	*%*
1. Stimulate variation in vegetation structure	*23,1*
2. Increase botanical diversity	*15,6*
3. Alternative for other management (e.g. for reasons of cost-effectiveness)	*11,6*
	11,5
4. Increase biodiversity in general	*10,3*
5. Increase zoological diversity	*8,3*
6. Preservation and maintenance of old cultural landscapes	*6,0*
7. Stimulate nature development on former agricultural land	*6,0*
8. Stop or slow down forest or scrub encroachment (maintain an open landscape)	*4,1*
	0,7
9. Stop or influence specific succession processes other then forest/scrub encroachment	*0,6*
	0,5
10. Education – recreation	*1,7*
11. Maintain rare breeds of livestock	
12. Because herbivory is considered a natural process	
13. Other	

In general they observed that decreasing and disappearing species are mainly competitive roughage species, among which *Cirsium arvense, C. vulgare* and *Urtica dioica*. Among increasing or newly appearing species we find several plant species of special interest to nature conservation, such as *Cardamine pratensis* and several other *Arrhenatherion*-species, *Calluna vulgaris* and *Caltha palustris*. Most spectacular increase is found among grass species (table 2). Less appreciated was the regularly mentioned increase of the roughage species *Juncus effusus* (7/195 cases).

Table 2 – Examples of newly appearing, decreasing and increasing plant species after grazing was introduced in 125 Flemish nature reserves (species that were mentioned > 5 times per category of 195 answers; after Eggermont et al. 1996).

Newly appearing plant species	Decreasing species	Increasing plant species
Melandrium spp	*Cirsium* spp.	*Several grass* spp.
Lychnis flos-cuculi	*Urtica dioica*	*Calluna vulgaris*
Cardamine pratensis	Roughage species in general	*Cardamine pratensis*
Leucanthemum vulgare	71 species abundances	*Melandrium* spp.
91 plant species appeared newly	decreased	*Lychnis flos-cuculi*
		Caltha palustris
		Saxifraga granulata
		Carex spp.
		Rumex acetosa
		Juncus effusus
		135 species abundances increased

The abundance of roughage thistles (*Cirsium arvense* and *C. vulgare*) decreased in 31%, increased in 15% and remained the same in 15% of the cases. They were not present or their status was unknown in the rest of the cases. It indicates that in general there is a (wanted) effect of roughage decrease, although the number of increases can not be ignored. For most taxonomical animal species groups the number of times in which increase in species number was experienced was far greater than that of species decrease (table 3).

Table 3 – Number of times of first appearance or disappearance of species per animal species group since the introduction of grazing in 125 Flemish nature reserves (250 answers; after Eggermont et al. 1996).

Taxonomical group	# new	# disappeared
Butterflies	15	2
Other insects	14	1
Amphibians	10	1
Birds	65	39
Mammals	23	4

Experiences with vegetation-structural features varied between increase and decrease of roughage, increase and decrease of scrub and forest, increase in grass abundance, etc. (table 4). In short, experiences with structural features were far from unequivocal.

Table 4 – Experiences with changes in vegetation-structural features in 125 Flemish Nature reserves expressed as a percentage of the answers given by the nature conservation managers (after Eggermont et al., 1996).

habitat	Increase	Decrease
Roughage	5,7	19,8
Scrub	6,3	12,5
Forest	2,3	1,7
Reed	1,7	-
Open vegetation	4,0	-
Grassy appearance of vegetation	1,7	-
Unknown: 30,7%		

Diet preferences and habitat use in some Flemish nature reserves.

Extensive investigations on diet preferences and habitat use of Konik, Shetland pony and Scottish Highland Cattle in spatially very heterogeneous coastal dunes in Belgium (PhD research of Eric Cosyns and Indra Lamoot; Hoffmann et al., 2001; Cosyns et al., 2001) revealed a strong habitat and diet overlap between both ungulate species (table 5). Depending on the availability of habitat and the specific spatial heterogeneity between both areas, quite large differences in mean grazing time were found.

Table 5 – Distribution of grazing time of Konik ponies and Scottish Highland Cattle and of Shetland ponies and Scottish Highland Cattle respectively in two separate parts of a coastal dune nature reserve (The Westhoek, both areas ca. 60 ha) in Flanders (Meert 2002; Neels 2002).

Westhoek-north	open sand dune	dune grassland	Roughage	dune scrub	woodland
SH Cattle	0	20,0	64,2	15,3	0,5
Konik	4,5	16,6	56,3	21,9	0,6
Westhoek-south					
SH Cattle	2,7	29,7	18,9	27,0	21,6
Shetland	0,3	49,0	15,2	18,6	16,9

Comparison with data from other Flemish nature reserves in different landscapes (PhD research Else Demeulenaere in heath land and Van Braeckel & Van Looy (2002) in an alluvial plain) reveal quite contrastive indications as far as habitat preference is concerned. Depending on the landscape (spatial heterogeneity) and ecological context (nutritive value of habitats and plants, moisture conditions, seasonal differences, etc.) both species groups (horses and cattle) show differences in preference for moist versus dry habitats and open pioneer, grassland, dwarf scrub, marsh, scrub versus forest habitats. Presenting detailed results from these studies would be preliminary, but first indications are that grazing behaviour is strongly context dependent.

Conclusions

In general introduction of large herbivores in nature reserves is evaluated in a moderately to strongly positive way by nature managers in Flanders. They experience dominantly scrub decrease, increase in vegetation-structural diversity (spatial heterogeneity), decrease of less desirable plant species and increase of wanted plant and animal species.

Results of research on diet and habitat use reveal that horse and cattle breeds show strong habitat overlap. In most cases there is a rather minor form of resource partitioning through the differentiated use of habitats and plant species (see also Menard et al. 2002). Comparison between different types of habitats shows that habitat use of both horse and cattle breeds highly depend on spatial heterogeneity in vegetation structure, nutrient availability, moisture and accessibility of the habitats. Therefore, predictions of grazing effects on a high-resolution scale (species or vegetation structure level) without proper knowledge of the environmental (spatial and temporal heterogeneity) conditions and behavioural data on the herbivores under

consideration remain speculative. Both ecological and behavioural research remains therefore necessary.

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Hungry Herds: Management of temperate lowland wetlands by grazing

J. Theo Vulink

Celem badań było określenie, w jakim stopniu wypas dużych roślinożerców, np. bydła i koni może opóźnić sukcesję roślinności na obszarach mokradłowych i w związku z tym faworyzować gatunki roślin i zwierząt preferujących siedliska z niską roślinnością. Badania były prowadzone na dawnym obszarze ujściowym Lauwersmeer w północnej Holandii oraz dawnym słodkowodnym jeziorze Grevelingen w środkowej Holandii.

Ekologia odżywiania bydła i koni jest niemal identyczna, oba gatunki preferują zmeliorowane łąki i posiadają zbliżony skład botaniczny i jakość diety. Małe różnice, które mogą wystąpić związane są z różnicami fizjologicznymi i socjalnymi w zachowaniu stad. Badania wpływu wypasu na rozwój roślinności prowadzone przez ponad 20 lat wykazały, że wypas nawet przy wysokim zagęszczeniu zwierząt (ponad 1 os. na ha) może jedynie opóźnić sukcesję roślinności, nie może jej natomiast zatrzymać. Całoroczny wypas bydła i koni nie miał niemal żadnego wpływu na rozwój roślinności. Kartowanie roślinności w Schildhoek wykazało, iż bydło i konie wypasane latem mogły utrzymać niską roślinność na niżej położonych terenach (około 80 ha z 145 ha powierzchni badawczej), pozostała część obszaru przekształciła się stopniowo w zarośla z udziałem trzciny, dominujące na obszarze badawczym Sennerplaat, pozbawionym wypasu. Wkraczanie wysokich gatunków roślin na obszary o niskiej roślinności ma negatywne konsekwencje dla niektórych zagrożonych gatunków roślin, lęgowych siewkowców i zimujących gęsi. Na powierzchni badawczej Sennerplaat ograniczenie przez wkraczającą trzcinę roślinności łąkowej do małych fragmentów spowodowało pod koniec lat osiemdziesiątych znikniecie związanego z nią zespołu łąkowych ptaków lęgowych. Na wypasanym obszarze Schildhoek zespół ptaków łąkowych przetrwał znacznie dłużej, ale przy zmniejszonych zagęszczeniach.

Zarządzanie mające na celu zachowanie ustalonych wzorców zbiorowisk stoi w sprzeczności z właściwościami systemu. W zamian, ochronę dużych obszarów w stanie nierównowagi lepiej realizuje zarządzanie takimi procesami jak roślinożerność, sukcesja, erozja, sedymentacja, zalewy i wypalanie. Odtworzenie procesów związanych z dynamiką roślinności i jakością wody uzupełnione przez wypas kompletnego zespołu dużych roślinożerców tj. bydło, konie, żubr europejski, jeleń, łoś i sarna istotnie wpływa na funkcjonowanie ekosystemów.

Introduction

New mineral wetlands have developed in the Netherlands as a spin-off from reclamation works (Schultz 1992). Several thousands of hectares of this ecotype have been created in polders and dammed estuaries. Cattle and horses have been introduced in order to realise certain vegetation types or landscapes by using the (natural) process of grazing. In many areas the management goal is short vegetation to facilitate endangered plant species, breeding waders and wintering herbivorous waterfowl. In floodplains grazing is also used to prevent succession to tall herbs, shrubs and forest. The maintenance of short vegetation should minimise the resistance for discharging river water and the related safety risk.

The core question in all these cases is to what extent grazing can retard vegetation succession in wetlands and favour plant and bird species of short open vegetation (Vulink 2001). Three sub-questions were investigated:

(1) What are the ecological differences between cattle and horses?
(2) What is the effect of these ungulate herbivores on the vegetation?
(3) Can grazing facilitate birds?

Methods

To understand the effect of grazing we need knowledge of the feeding ecology of cattle and horses. The research was conducted in former estuarine areas Lauwersmeer, located in the north of the Netherlands; in Grevelingen, located in the south; and in Oostvaardersplassen, a former fresh water lake in the centre of the Netherlands. The study areas and the methods were described in Vulink (2001).

Results

Do cattle and horses differ in feeding ecology?

The results showed that both cattle and horses preferred well-drained grasslands over wet grassland, roughage (*Phragmites australis and Calamagrostis epigejos),* shrubs and woodland respectively (Figure 1). This preference can be explained by the higher digestible organic matter (DOM) content of the food plants in well-drained grassland (Figure 2).

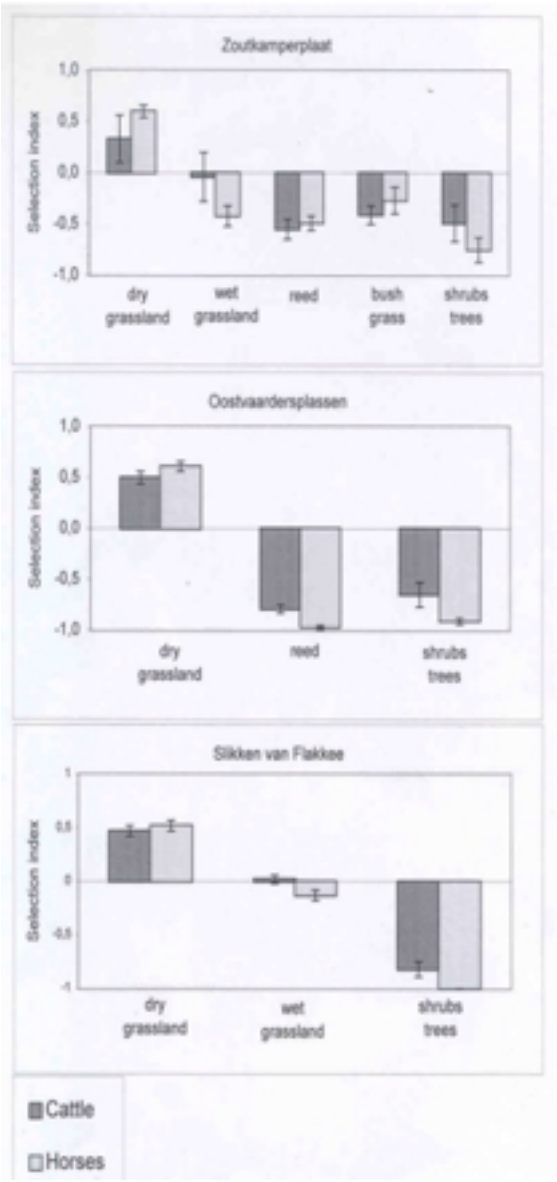
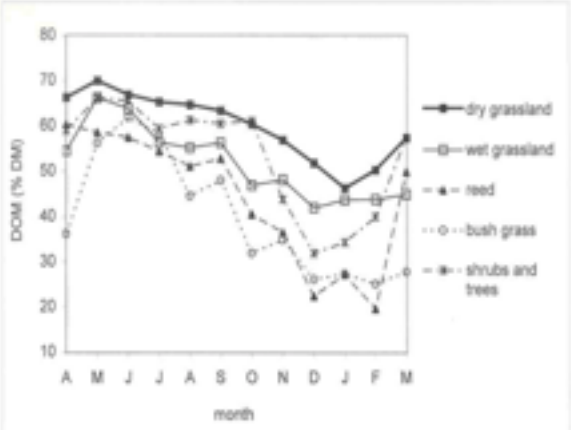


Figure 1. Selection indices according to Jacobs (1974) of cattle and horses for the different vegetation types (after Vulink 2001).

Figure 2. Digestible organic matter (DOM) contents (% dry matter (DM) of five vegetation types, averaged over the study areas based on bite samples during the period April 1991 to May 1993 (after Vulink 2001).



The results in Figure 3 are crucial for the understanding of the functioning of grazing systems. If the efficiency of grazing (consumption as percentage of net primary production) on well-drained grassland is low, the grazers consume very few unpalatable species such as *Phragmites australis*, *Calamagrostis epigejos*, tall *Carex* sp. and scrubs and trees. On the

other hand if the efficiency of grazing on well-drained grassland is high, the grazers are forced to feed on these normally avoided species. So, only hungry herds can suppress unpalatable species. The feeding ecology of cattle and horses is almost the same. Both species prefer well-drained grassland. They select the same botanical and chemical diet.

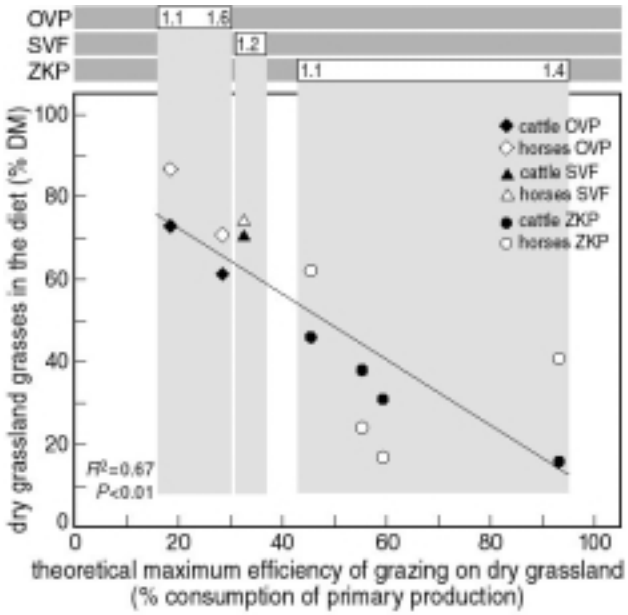


Figure 3. Theoretical maximum efficiency of grazing on dry grassland and the percentage of dry grassland grasses in the diet (% dry matter (DM) of cattle and horses. The efficiency of grazing is based on estimated potential consumption as percentage of the total net primary production from 15 May to 16 October. The percentage of grasses in the diet is given as an average percentage of dry grassland grasses during the same period. The clear horizontal bars at the top of the figure give the average theoretical maximum stocking rate (animals per hectare) of dry grassland at Oostvaardersplassen (OVP), Slikken van Flakkee (SVF) and Zoutkamperplaat (ZKP) (after Vulink 2001).

What is the effect of ungulate herbivores on the vegetation?

The small ecological differences between cattle and horses relate to their different physiology (ruminant, foregut fermenter versus hindgut fermenter) and social behaviour (female herd vs. harem). These differences have consequences for the impact on vegetation (Figure 4). Cattle suppressed *Sambucus nigra* more or less, while grazing by horses showed almost the same Sambucus development as ungrazed plot. Monitoring of grazed vegetation in the former estuarine area Lauwersmeer over more than twenty years indicated that even at high stocking rate (more than one animal per hectare) grazing only retarded vegetation succession, but did not stop it. Figure 5 shows the development of the vegetation in the study plots. The vegetation types are grouped in three categories: short vegetation dominated by *Puccinellia maritima*, *Agrostis stolonifera* and *Festuca rubra*; tall grasses and herbs dominated by *Phragmites australis*, *Calamagrostis epigejos, Aster tripodium* and *Circium arvense*; shrubs and trees dominated by *Salix* spp. *Hippophae rhamnoides*. Initially, shortly after the embankment, the flats were dominated by halophytic pioneers (e.g. *Salicornia europaea*, *Spergularia maritima* and *S. salina*) (Joenje 1978). As the flats became brackish, other species invaded and became dominant; first *Puccinellia* spp., quickly succeeded by *Agrostis stolonifera* and *Phragmites australis*. After four to six years, glycophytes (e.g. *Calamagrostis epigejos* and *Salix* spp.) started to invade the sandy more elevated areas, which desalinated more rapidly than the lower wet areas. Year-round grazing with cattle and horses had almost no effect on the vegetation development. Vegetation mapping at the Schildhoek showed that

summer grazing by cattle and horses maintained short vegetation on 80 ha (our of 145 ha) of low lying parts. The remainder changed progressively into *Phragmites* and shrub, similar as in the ungrazed Sennerplaat.

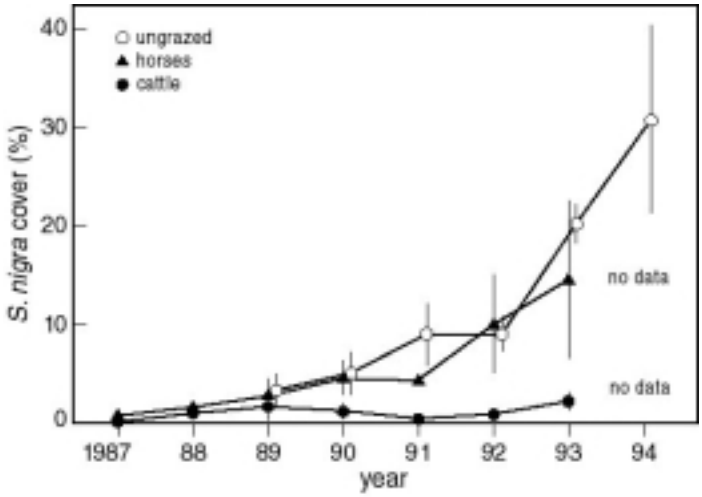


Figure 4. Average Sambucus nigra *cover (± SE) in the summer-grazed study fields grazed by cattle and by horses and the average cover in four exclosures fenced off in 1989 in the study fields (after Vulink 2001).*

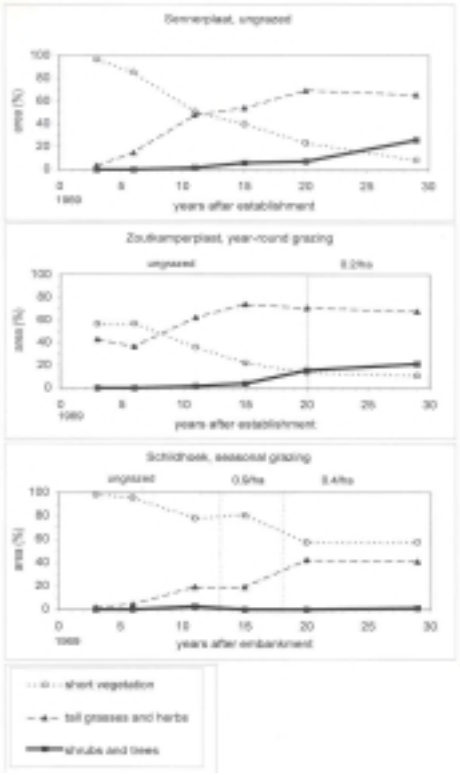


Figure 5. Vegetation development in the Lauwersmeer, based on satellite images and aerial photographs. In the grazed situations the stocking rate is given at the top of the figures. The stocking rate is expressed as the total number of cattle and horses per ha total area). The X-axis is presented as the years after embankment. The vertical dotted lines in the figures show the start, changing or end of grazing treatment (after Cornelissen & Vulink 2001).

Do cattle and horses facilitate grassland birds?

Encroachment of short vegetation by tall species had negative consequences for some endangered plant species, breeding waders (Fig. 6) and wintering geese. As the short grassland became restricted to small pockets, the associated waders (known as meadow birds) disappeared from the control plot Sennerplaat. In the grazed area Schildhoek, the meadow bird association survived considerably longer, but their density declined. The cause-effect chain may have been complicated due to the arrival and explosive increase of the red fox Vulpes vulpes in the mid 1980s (Beemster *et al*. 1989). The tall vegetation contained high densities of common vole (*Microtus arvalis*) – a preferred food for the foxes – and offered them also cover.

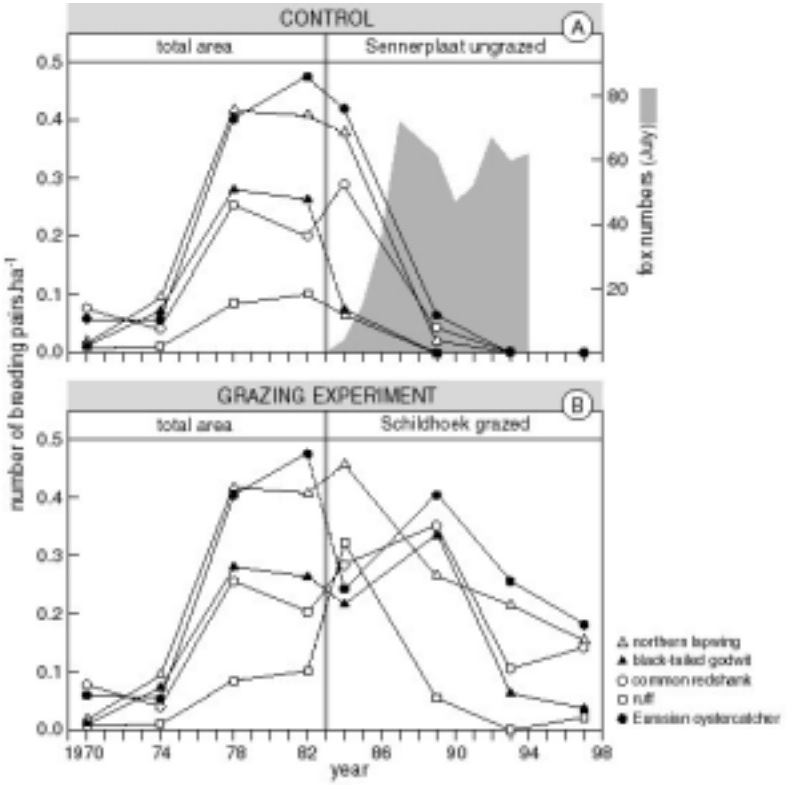


Figure 6. The development in number of breeding waders (meadow birds) per ha grassland and number ofred fox *Vulpes vulpes* in the ungrazed area of the Lauwersmeer (A) and the number of breeding meadow birds in the area that was grazed in the summer since 1982 (B). Data for breeding meadow birds concerning averages of 1969-71, 1973-75, 1977-79, 1981-83,1983-85, 1988-90, 1992-94 and 1996-97. Data of the period 1969 to 1983 are based on complete counts of the Lauwersmeer nature reserve (about 2700 ha short vegetation) calculated from data of Van Eerden (1985). Data from 1983 onward in Figure A are based on the ungrazed study plot Sennerplaat in the Lauwersmeer and in figure B on data from the summer-grazed study plot Schildhoek in the Lauwersmeer (after Vulink 2001).

Discussion and conclusions

Cattle and horses display a similar feeding ecology. Their effects on the vegetation are also similar. The small differences relate mainly to their physiology. Cattle are foregut fermenters, while horses are hindgut fermenters. In the rumen of cattle (and other ruminants) cell wall compounds such as cellulose and hemicellulose are fermented. Secondary plant compounds are also detoxified, allowing them to consume (moderate quantities of) pioneer shrubs and trees containing such anti-herbivore compounds (e.g. *Sambucus nigra*, *Betula* sp. and *Alnus*).

Other species (e.g. *Crataegus monogyna*, *Hippophae rhamnoides* and *Prunus spinosa*) use thorns and spines as defence. These defence mechanisms may protect invading tall species against the herbivores, leading to succession. So grazing may not be able to prevent vegetation succession.
I support the theory that ecosystems fluctuate between different successional states following the non-equilibrium paradigm (Vitousek & White 1981, Westroby et al. 1989, Rietkerk & van de Koppel 1997, all references quoted in Vulink 2001), instead of fluctuating around a steady state. A management aimed to fixate a mosaic pattern conflicts with a basic trait of grazed ecosystems, i.e. mosaic dynamics. The conservation of biodiversity in large areas at non-equilibrium is better served by managing processes (e.g. herbivory, succession, erosion, sedimentation, flooding and burning) rather than by managing the patterns. Processes that determine vegetation dynamics are of primary importance for management.
Grazing and hydrology are key factors in the functioning and management of wetlands. The restoration of a complete assemblage of large herbivores must receive high priority in the Biebrza National Park. The assemblage should include grazers such as cattle, horses and European bison *Bison bonasus*, intermediate feeders such as red deer *Cervus elaphus* and browsers such as moose *Alces alces* and roe deer *Capreolus capreolus*. All species may have an important influence on the functioning of the ecosystem.

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Habitat selection of cattle and horses in the Lower Basin of the Biebrza National Park

Alexander Van Braeckel & Jan Bokdam

Streszczenie

Badania nad wykorzystywaniem terenu przez bydło i konie prowadzone były latem 2000 roku w dolnym basenie doliny Biebrzy na obszarze BPN w okolicy wsi Brzostowo oraz w pobliżu uroczyska Stójka. Główną strefą wypasu w tym basenie jest mineralny teras zalewowy w pobliżu rzeki. Torfowiska i grądziki są wykorzystywane w dalszej kolejności. Dlatego też wypas może opóźnić, zatrzymać lub odwrócić sukcesję roślinności znacznie łatwiej w mineralnej strefie zalewowej, niż na torfowiskach czy grądzikach. Bydło i konie pasące się w okolicy wsi Brzostowo na obszarze około 300 ha w zagęszczeniu 1os/2 ha nie wykorzystywały równomiernie badanej powierzchni. Codzienny powrót mlecznych krów do obory był czynnikiem limitującym odległość penetracji oraz wykorzystanie terenu ograniczając je do strefy mineralnej wzdłuż rzeki. Wypas ciągły bydła mógłby mieć większy zasięg i skutkować większym zróżnicowaniem struktury terasu zalewowego, wystąpieniem mozaiki późniejszych stadiów sukcesyjnych roślinności i zwiększeniem wpływu wypasu na strefę torfowisk. Wykaszanie mogłoby również zwiększyć wykorzystanie tej ostatniej strefy przez bydło.W pobliżu uroczyska Stójka można zwiększyć zagęszczenie bydła i lekkich ras koni z dotychczasowych 25 zwierząt wykorzystujących około 16 km^2. Wypas na grądzikach tylko na niewielką skalę powstrzymywał rozwój ubogiego zbiorowiska z dominującym trzcinnikiem piaskowym Calamagrostis epigeios.. *Na dużym obszarze torfowisk pasące się zwierzęta zapobiegały lub przynajmniej ograniczały wkraczanie trzciny. Nie mogły natomiast przywrócić zbiorowisk turzycowo - mszystych w miejscach wykształconych turzycowisk kępiastych. Wcześniejsze rozpoczynanie wypasu pozwoliłoby na zwiększenie wpływu zwierząt na wysokie gatunki turzyc na torfowiskach. Wykaszanie pozwala na odtworzenie niskiej, smacznej warstwy roślinności i wzmacnia efekt spasania na torfowiskach i może pomóc rozszerzyć obszar wypasu oraz go ułatwić. W celu zatrzymania inwazji gatunków drzewiastych, obok zwiększenia zagęszczenia zwierząt udomowionych, zalecane jest zwiększenie zagęszczenia dzikich roślinożerców.*

Introduction

The abandoning process of the Biebrza Valley in the last decades has induced the invasion of tall grassy, herbaceous and woody plants into wetland pastures and hay fields. The main question is whether grazing can be useful as a conservation management tool to stop or reverse this succession process. Research of terrain use of cattle and horses in the peatland and the flood plain of the Lower Basin within the Biebrza National Park (BNP) was carried out in the summer half year of 2000.

Mineral flood plain – peatland gradient

Methods

The unfenced area near Brostowo (~ 300 ha), covering the gradient from mineral flood plain to peatland, was grazed in the summer half year of 2000 by 139 dairy cattle and 21 meat or workhorses. The density was ~ 0.5animal / ha with a different daily presence time: cattle 12h and horses 24h. The plant community availability, terrain use and plant community selection in these pasture were investigated using 7 transects, evenly running over the flooded pasture on mineral and peat soil from the riverbed towards the alder forest. The availability of the plant communities was based on vegetation characterisation at cross points (129 1x1 m² quadrates). The spatial distribution of presence across the area and the plant communities was based on the faecal pellet density along the transects. At each cross point, the distance to the 4 closest pellets within 4 quarters was measured according to the Point-centred-quarter method (Mueller-Dombois & Ellenberg 1974). The faecal pellet density of cattle and horses was used as a measure for the presence of the grazer and reflect the overall influence of grazing, walking and resting behaviour.

Results

The vegetation pattern of the flood plain and adjacent peatland was characterised by a regular transversal zonation (Van Braeckel in prep.). The zonation is a result of abiotic conditions and

intensive grazing (Ten Brink & Van Haaften 2001). The faecal pellets of large grazers (horses + cattle) were unevenly distributed over the flood plain-peatland gradient. The mineral flood plain, covered mainly by *Lolio-Potentillion* vegetation, showed a higher density of faecal pellets than the adjacent peatland. The more remote peatland seemed to be a less attractive as pasture. The short *Lolio-Potentillion* community covering almost 50% of the study area had the highest densities of faecal pellets of the mineral zone. Cattle, the most numerous grazer, preferred obviously this plant community. The horses in the mineral flood plain showed a preference for the higher *Phragmition* community. The high density of horse dung found in the high vegetation patches (e.g. *Acoretum*) could be partly due to active latrine behaviour. Horses are known for such dung concentration under intensive grazing (Edward & Hollis 1982). In grazed reed beds only horse dung was found.
In the peatland area cattle dung was nearly restricted to the mown *Magnocaricion* community. The horses, who were on the pasture day and night, used the peatland communities also and preferred the adjacent alder forest, presumably a resting ground.

Conclusions
Faecal density in intensively grazed areas represents presence better for cattle (without an active latrine behaviour) than for horses, who display active latrine behaviour. Presence includes grazing and resting, each with different influences on the vegetation. To separate them, direct observations are required (see next section). Our conclusions should therefore be considered as preliminary.
The terrain use of cattle and horses was unevenly spread over the gradient. The preferred habitat for cattle and horses is presumably the mineral flood plain dominated by a short *Lolio-Potentillion* plant community (Ten Brink & Van Haaften 2001). The daily return to the stable at the moraine edge in Brostowo may have limited the radius of action of cattle, linking them to the flood plain. Under continuous 24 hr grazing (without return to the stable) free ranging cattle could spread their influence across a wider range. It might result in a less intensively grazed and more structured floodplain and more influence on the peat zone. Use of the peat zone by cattle can also be affected by mowing.

The peatland - hillock gradient

Methods
In the peatland-hillock gradient near Stójka (Trzcianne) the most intensive part of the research was done (Van Braeckel in prep.). In the summer half year a herd of 25 dairy cows grazed freely in an unfenced peatland area during daytime. By ~17.00 hr the animals were brought home, where the cows were milked at 18.00 hr and at 5.00 hr the next morning. After the milking, the animals were released at ~ 6.30 for their daily grazing. The terrain and habitat use of the cattle was determined by direct observation . During 4 observation days (~ 11 hr) at the end of each month, the behaviour and the used habitat of a cow was noted every 10 minutes. The home range covered ~ 4x4 km (pers. comm Wiesław). The habitat availability in the home range was determined using the transect method. The habitat use was expressed as time spend in the habitat as proportion of the total time spend and as selection (accounting for the availability or proportion of the habitat in the total area).

Results
During an average day in the summer half year (11 hours) the cattle of Stójka spent 80% of their time foraging, 5% walking and 15% resting. Resting time corresponded roughly with the rumination period at noon. Cattle spent most of their foraging time in the peat zone: 69% in May, 67% in June, 74% in July and 79% in August. The rest of the time was spent on the mineral hillock. The high foraging time in the peat in July and August corresponded with a

low biomass production on the hillocks, forcing the cattle to forage in the peat (Verbanck 2001; Bokdam in this report). The preferred foraging habitat in the peat zone was short grassland/sedge-moss community. Only during the warm period of June 2000 forest was preferred. In July 48% and in August 94% of the foraging was located in peat grasslands, probably because of the availability of palatable regrowth after mowing in July.
The roughage (tall vegetation) in the peat zone was characterised by dominating and invading species such as *Carex appropinquata, Carex elata* and *Phragmites australis*. Foraging in this rough peatland type had a high importance in spring: 25% in May and 20% in June of the total foraging time. In May tussock forming communities were most important. Reed became the main roughage foraging habitat in June.
The portion of foraging time allocated to the dry hillocks decreased from 1/3 in May and June to 1/4 in July and 1/5 in August. Due to the low availability of the hillock habitat (12%) versus peatland (88%), cattle appeared to select the hillock for foraging during the whole summer half year. The small area of grassland on the hillock was selected above the hillock forests, especially in May and August.

Ecological conclusions
The peatland-hillock zone of the lower Basin seems to be a second choice foraging ground for grazers, if compared to the mineral floodplain. During the 11 hours in the field, cattle were forced to realise their daily intake. Most of the peatland was accessible for cattle, only a few places were avoided in May. The peatland attracted the highest grazing time impact despite a preference for the hillocks. Grassland communities were the most important grazed successional stage in the peatland zone. They showed a little dip in June, corresponding with more grazing in peat forest. Mowing intensified the grazing on the peat grasslands in autumn and decreased the foraging on hillocks. The hillock grasslands were the most preferred grazing habitat in the peatland-hillock gradient.

Management conclusions and recommendations
Within the Lower Basin of the Biebrza Valley, mineral floodplains represented the major foraging zone for grazers. This conclusion is also supported by the results of biomass production and forage quality (Verbanck 2001, Bokdam in this report). The peatland and hillocks are a secondary foraging ground.
Grazing can therefore affect succession to tall herbs and woodland more easily in the mineral flood plain than on hillocks and peat. Near the river, the actual grazing is still preventing invasion of reed and other tall grasses or sedges in the pastures. On the hillocks, invasion of *Calamagrostis epigejos* was prevented on a small scale. In the vast areas of peatland the grazers kept some of the peat grassland open and prevented or at least slowed down the reed invasion. They were not able to revert tussock forming plant community to sedge moss communities.
The densities of cattle and light horses might be increased in the peat-hillock gradient to intensify the grazing impact on the short vegetation. To increase their impact on the tall sedges in the peat, grazing could take place earlier in the season.
Re-introduction of grazing might be preceded and facilitated by mowing. Mowing restores palatable short vegetation and amplifies the grazing impact on the peat grasslands.
An increase of the densities of the natural wild herbivores together with the grazers is recommended for the inhibition of woody encroachers.
We conclude that grazing can be a useful management tool for the future of the Biebrza National Park to restore natural and traditional landscapes. Herbivore types, grazed zones and successional stages and timing are critical and should be investigated in more detail to optimise the tool.

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Diet selection by free-ranging cattle in the peat zone of the Biebrza National Park and defoliation responses of invading roughage species.

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Streszczenie

Badania nad wybiórczością pokarmową i siedliskową jak i również eksperyment pozwalający na ocenę składu zjadanej przez bydło biomasy prowadzone były w strefie torfowisk i sąsiadującym z nią terasie zalewowym południowego basenu doliny Biebrzy w pobliżu uroczyska Stójka w 2000 roku. Stwierdzono, iż głównym komponentem diety bydła była roślinność trawiasta, udział roślin o częściach zdrewniałych pozostawał poniżej 10%, ziołorośla stanowiły 10-30%. Strawialność pokarmu pozostawała powyżej zapotrzebowania minimalnego (40%) w ciągu całego okresu badań. Również zawartość azotu i potasu w diecie utrzymywała się powyżej zapotrzebowania minimalnego dla tych pierwiastków - inaczej niż fosforu, który był czynnikiem ograniczającym wzrost i laktację zwierząt. Niska zawartość roślin o częściach zdrewniałych w diecie sugeruje, iż przy obecnym systemie wypasu bydło może przeciwdziałać inwazji pewnych gatunków drzewiastych jedynie na intensywnie użytkowane pastwiska. Ze względu na fakt, iż nie obserwowano zgryzania kory wydaje się, iż bydło nie może przywrócić zbiorowiska trawiastego w miejscach rozwiniętych zakrzaczeń lub zbiorowisk leśnych. Przywrócenie takiego zbiorowiska wymaga obecności zwierząt odżywiających się zdrewniałymi pędami (bóbr, łoś, jeleń, żubr), wykarczowania lub zaburzenia warunków abiotycznych (wypalanie). Wczesne wysokie gatunki turzyc mogą być zjadane bardziej intensywnie jeżeli bydło, konie lub inni roślinożercy będą miały do nich dostęp późną zimą lub wczesną wiosną, kiedy młode pędy posiadają wysoką wartość odżywczą. Wyższe zagęszczenie pasących się zwierząt w maju może również zwiększyć tempo defoliacji. Konsumpcja odnowionej runi latem i jesienią wymaga poprzedzającego ją wiosennego wypasu lub letniego wykaszania. Wykaszanie zastępuje wiosenny wypas i odtwarza smakowitość wysokich gatunków turzyc. Defoliacja i osłabienie zbiorowisk wczesnych turzyc (>10 tys. ha w BPN) wymaga obecności dużych stad udomowionych lub dzikich roślinożerców, które miałyby do dyspozycji duże letnie (obszary zalewowe) i zimowe (na wysoczyźnie) siedliska. Wykaszanie i wypalanie zastępuje częściowo wypas. Zalewy na początku sezonu wegetacyjnego ograniczają możliwość powstrzymywania przez duże ssaki roślinożerne rozwoju wczesnych gatunków ziołorośli. Bydło może natomiast ograniczać lub powstrzymywać rozwój gatunków takich jak trzcina, manna, trzęślica, które rozpoczynają swój wzrost późną wiosną i wczesnym latem, ze względu na dostępność ich młodych pędów.

Introduction

Peatlands have been exploited by man since prehistory. Land use included hunting, gathering of wood, litter, peat and hay, and grazing. Unwanted pasture plants were cut or burned. The open peat landscapes became or remained very rich habitats for meadow and marshland birds. During the last century, socio-economical developments 'polarised' the traditional extensive farming. Peat soils in economically viable areas were drained and the land use was intensified. In marginal areas the land was abandoned, allowing short sedge vegetation and grasslands to change into roughage, shrub and finally woodland. The succession caused a decline of the typical biodiversity of open, low-productive ecosystems. Nature conservation has tried to stop this process by sustained extensive use. Grazing and mowing was carried out by employees of conservation bodies, volonteers, contractors or farmers, in nature reserves and on public and private land. Haymaking has become very expensive. It has raised the question whether haymaking might be replaced by grazing by cattle or horses, both typical grass consumers ('Grazers' sensu Hoffman 1989). Maintaining landscapes with short grasslands requires either the prevention of invasion by taller species in existing grasslands or restoration by regression turning later-successional stages back into grassland. Potential measures are cutting, burning, mowing and grazing by livestock or wild herbivores. Grazing may be preferred since it has ecological and socio-economical advantages over mowing and burning.

Therefore the management question was addressed 'can grazing replace mowing and delay and reverse succession in peatland areas?' Mowing is unselective, removing all species. Grazers select grasses, but they may also consume invading palatable roughage and woody species. Unpalatable ('resistant') invaders are avoided and may replace short grassland. Under persistent, high grazing pressure, tall species may be replaced by short grass after mortality or

other disturbance. Roughage, shrubs and trees may die by ageing, abiotic disturbance (e.g. storm, fire, inundation) and biotic disturbance (herbivory, trampling). This process of succession and regression is called 'cyclic succession' and leads to dynamic 'successional mosaics' (Olff et al 1999; Bokdam & Gleichman 2000; Bokdam et al 2001).
Maintenance and regression by grazers may be limited by 4 factors: inaccessibility by flooding or a low physical carrying capacity, a short grazing season, a low stocking rate and unpalatability. The unpalatability may be increased if palatable neighbours are disappearing. The probability of regression declines with progressing succession.

Research
In 2000, habitat and diet selection by cattle and regrowth capacity of invading roughage species was assessed in the peat zone and floodplain in the Lower Basin of the Biebrza valley, near Stojka. (Verbanck 2001; van Braeckel in prep). Habitat use and diet from May until August were measured by direct observation and bite counting, using free-ranging dairy cows, 5 grazing days (6.00-18.00) with alternating animals, per month. The animals were released in the early morning and returned at night to the stable at the edge of the valley. Their home range covered about 1600 ha. Use was < 1 %, meaning a full opportunity for selection. The diet composition strongly reflected the preference of the animals.
The nutritional value of the diet species and diet were assessed by chemical analyses of hand-plucked bite simulation samples for DOM (Digestible Organic Matter content on dry matter basis), Nitrogen, Phosphorus and Potassium content.
The phenology and quality of growth and regrowth of 5 major invading roughage species Carex acuta, Glyceria maxima, Carex lasiocarpa/rostrata, Phragmites australis and Calamagrostis epigejos (on dry soils) were assessed by monthly clipping of undisturbed standing crops and by re-clipping of the May standing crop plot. These clippings were submitted to the same chemical analyses as the diet.
Defoliation tolerance was measured as the sum of regrowth of June, July, August and September. For capacity reasons, only 1 exclosure per invader could be clipped. In each exclosure, 4 pseudo replicates of 50 x 50 cm were clipped per treatment. The results are based on the average values of the 4 replicas. The lack of replicates excluded appropriate statistical analysis. The conclusions should therefore be considered as preliminary.

Diet composition
The proportion of woody plants in the diet (% of bites) remained below 10 % in each month. Roughage took an intermediate position (10-30 %). Grassland plants constituted the major component of the cattle diet. Monthly values for monocotyledonous grassland plants (grasses, sedges and other graminoids) ranged between 40-70 %, with the highest value in August (due to the preferential grazing on regrowth of mown peat grassland). Dicotyledonous grassland herbs contributed between 10 % in August and 30 % in July. The preference for grassland plants explained the preferential use of grasslands as foraging habitat (van Braeckel, in prep.).
The diet was dominated in May by Equisetum fluviatile (20 %) and Carex lasiocarpa (16 %), in June by the roughage species Molinia (12%) and Phragmites (10%), in July by Melampyrum nemorosum (20 %) and Calamagrostis stricta (13 %) and in August by Agrostis stolonifera (16 %). Proportions of Carex appropinquata and C. elata remained below 5 %. Their highest values were recorded in May and August (regrowth). Individual woody species never exceeded 2 %, except Rhamnus frangula (6 % in June). Carex acuta and Glyceria maxima were absent in the home range and in the diet. Species proportions displayed typical seasonal changes between May to August. Equisetum fluviatile and Carex rostrata/lasiocarpa displayed a steep decline. A U-shaped (bimodal) curve was found for Carex appropinquata and a hump-back shaped (unimodal) curve wit a maximum in June and July for Phragmites, Molinia and Calamagrostis stricta.

Diet Quality

Diet - DOM varied between 50 and 55 % until July. In August a lower value (40 %) was measured. It means that the digestibility remained above the maintenance level (40 %). Nitrogen and Potassium contents remained above the maintenance levels of these elements, but Phosphorus concentrations were mostly below this level. It suggests that Phosphorus acted as limiting factor for animal growth and lactation. The extreme preference for Melampyrum nemorosum, a plant with exceptional high Phosphorus content, stresses this assumption.

Phenology

The clipping revealed important phenological differences concerning the growth and regrowth of the invaders. Early Carex species displayed a constantly high standing crop (Carex appropinquata/elata) or a U-shaped curve (Carex acuta, Calamagrostis epigejos) across the 5 months. They had apparently two growing periods, one in early spring and one in late summer, after flowering and fruiting and a mid-summer depression. They hibernate by a green (regrowth) shoot, eventually protected by dead leaf sheaths, above ground level. Removal of the autumn sheaths by grazing, mowing or burning exposes the palatable young shoots to grazers in early spring.

Glyceria maxima displayed a late start and a typical increasing biomass (continuous growing season) without a mid-summer depression. Intermediate species (Phragmites australis) displayed a humpback biomass curve with a maximum standing crop in July, also pointing to the absence of a midsummer depression and regrowth in late summer. These species hibernate by belowground rhizomes (Glyceria and Phragmites) . Molinia caerulea has a similar growth phenology and buds at soil level (in tussocks).

The monthly regrowth declined across the season for all 5 species. The regrowth sum (June+July+ August +September) differed remarkably between the species. The high regrowth of Carex acuta, Glyceria maxima and Carex appropinquata/elata pointed to more defoliation tolerance if compared with Calamagrostis epigejos and Phragmites. The regrowth sum of the former two species exceeded 3 ton DM/ha. The sum of Calamagrostis epigejos and Phragmites remained below 1 ton DM/ha.

Nutritional value

The nutritional value of the standing crop declined across the season due to ageing. The regrowth quality remained high by rejuvenation. Similar trends were found in DOM, Nitrogen and Phosphorus. The decline in the Potassium concentrations in the regrowth of Carex appropinquata /elata and Phragmites after July suggested luxury uptake of Potassium by these species during the first months and depletion by clipping. It pointed to limitation of plant growth by Nitrogen and Phosphorus, at least during the first half of the growing season.

The nutritional quality levels in the diet followed the regrowth quality. The standing crop quality declined far below these levels. It emphasises the importance of regrowth provided by the early sedges and grasses for grazers in late summer and the effects of spring grazing or summer mowing rendering this regrowth accessible.

Ecological conclusions

1. The combination early growth start, nutritional quality decline, inaccessibility in spring by inundation and a late turning out of cattle by the farmer prevented the defoliation of the tall sedges. Carex appropinquata, C. elata were scarcely grazed in May. The defoliation of the Carex species in August concerned regrowth with a high nutritional value induced by mowing.

2. Late starters (Phragmites, Molinia) were substantially defoliated. Phragmites appeared to be grazing sensitive. It produced little regrowth. Molinia offers a same character. It was not included in the clipping experiment. Glyceria maxima did not occur in the home range of the cattle. It may be consumed during mid and late summer after demersion, as was observed in the Junner Koeland The Netherlands (Bokdam 1987) and in the floodplain at Brostowo.
3. The capacity and nutritional value of regrowth of early sedges were high. Accessibility of Glyceria and Carex acuta habitats is delayed by spring flooding. Both species are important components of hay meadows.
4. Calamagrostis epigejos displayed also a midsummer depression. This species may be suppressed by grazing since its habitat and green shoots are accessible during winter and early spring (Vulink 2001).

Management implications.
1. The low proportion of woody plants in the diet suggests that under the actual grazing management cattle can only prevent invasion of certain woody species in intensively used grassland. Cattle seemed unable to reverse established shrub and woodland to grassland, since barkstripping was not observed. Reversal requires browsers and intermediate feeders (Beaver, Elk, Red deer, and European bison), cutting or abiotic disturbance (fire).
2. Early sedges are a greater problem than later grasses (Molinia, Phragmites and Glyceria maxima). Early sedges might be consumed more substantially if the grazers or other herbivores would have access to them in winter or early spring, when the young shoots provide high nutritional values. Increased stocking rates in April and May contribute also to the spring defoliation. The suppression of early roughage plants is constraint by immersion and low food availability in general in these habitats in early spring.
3. Suppression of early sedges is strongly enhanced by spring and summer grazing or mowing. Mowing acts as substitute for grazing and may be applied in summer. Both types of defoliation increase the palatability of the regrowth. Defoliation and regression of closed early sedge communities (> 10.000 ha in BNP) require large herds of domestic or wild grazers grazing in spring and autumn, in combination with large summer habitat (flood plains) and winter habitats (moraine plateau's). Mowing and burning substituted cattle partially.
4. Cattle may suppress and reverse rough grasses with an intermediate and late start
More easily because their site is more accessible during the early growth/bite.

Recommended research.
1.The results presented in this paper reflect one grazer (cattle), one year (2000) and one exclosure per invader. To provide a more solid basis for grazing management decisions, our measurements should be repeated and extended to cover more herbivore types (horse, Red deer, European bison, Elk), more plant invaders, more weather conditions and replicates.
2. The studied grazing period should also be extended in time and include the transition from winter to spring, from inaccessible to accessible conditions. It is hypothesised that a mixed grazing regime would suppress early Carex spp better than grazing by one species.

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Koszenie jako sposób na hamowanie ekspansji trzciny (*Phragmites australis*) w BPN

Jan Kamiński

Summary

Reed encroachment causes problems in the Biebrza valley, especially in the Lower Basin. It is a serious threat for some sedge and moss communities in the Biebrza National Park. The paper presents initial results of an investigation started in 1999. It states that return to mowing of sedge communities with invading reed clearly reduces necromass accumulation. It favors plant species with lower competitive abilities. So far mowing influences on reed were very low. Autumn mowing slightly weakened its vitality and growth rate, but it had no influence on shoot density. Density fluctuated mostly depending on weather conditions.

Słowa kluczowe: ekosystemy bagienne, ekspansja trzciny, wykaszanie

Trzcina pospolita (*Phragmites australis*) występuje w środowisku eutroficznym, najczęściej na podłożu torfowo-mułowym. Szczególnie obficie rośnie na pobrzeżu jezior, wolno płynących wód (rzeki, kanały) oraz w licznych zastoiskach wodnych (torfowiska i mułowiska zatopione). W tych naturalnych dla niej warunkach ekologicznych, trzcina jest głównym komponentem zespołu roślinnego *Scirpo-Phragmitetum.* Miejscami tworzy prawie jednogatunkowe facje - przez niektórych badaczy traktowane w randze odrębnego zespołu *Phragmitetum communis* [NOWIŃSKI, 1967; MATUSZKIEWICZ, 1984]. Z mniejszą lub większą stałością gatunek ten pojawia się również w innych zespołach roślinnych, głównie szuwarach właściwych związku *Phragmition* i szuwarach wielkoturzycowych związku *Magnocaricion* [PAŁCZYŃSKI, 1975]. W ostatnich latach trzcinę spotyka się coraz częściej również w typowo emmersyjnych zbiorowiskach klasy *Scheuchzerio-Caricetea fuscae*, w tym i w zespołach mechowiskowych związku *Caricion lasiocarpae* [OŚWIT, 1991].

Ekspansja trzciny na obszarach mokradłowych

Ekspansja trzciny stanowi poważne zagrożenie dla objętych ochroną prawną ekosystemów mokradłowych o wysokich i unikatowych w skali europejskiej walorach przyrodniczych na terenie Biebrzańskiego Parku Narodowego [MATUSZKIEWICZ i in., 1999]. Proces ten przybiera duże rozmiary na obszarach bagiennej części doliny rzeki Biebrzy, zwłaszcza w Basenie Południowym (Bagno Ławki). Konsekwencją nadmiernego zatrzciniania są niekorzystne zmiany w zbiorowiskach roślinnych. Polegają one na silnej redukcji lub całkowitym ustąpieniu wielu cennych przyrodniczo, mniej okazałych gatunków roślin naczyniowych oraz mszaków o mniejszej sile konkurencyjnej. Do głównych przyczyn nadmiernego zatrzciniania się ekosystemów należy zaliczyć:

zaniechanie w ostatnim czterdziestoleciu rolniczego użytkowania obszarów mokradłowych, głównie okresowego wykaszania;

eutrofizację wód napływowych - rzecznych rozlewiskowych (zanieczyszczenia zlewni);

eutrofizację miejscowych wód gruntowych powodowaną:

uruchomieniem procesów mineralizacji gleb organicznych przy okresowym, niewielkim nawet obniżaniu się lustra wody gruntowej,

wypalaniem posuszu roślinnego i pożarami torfowisk:

Procesowi zatrzciniania sprzyjają cechy biologiczne samej trzciny, decydujące o jej sile konkurencyjnej:

okazałe pędy nadziemne,

masywne rozległe kłącza (rozłogi), umiejscowione głęboko w profilu glebowym.

Wymienione cechy biologiczne tego gatunku zapewniają:

- ekspansywność - łatwy rozwój na drodze wegetatywnej z rozłogów podziemnych,
- konkurencyjność - zacienianie innych gatunków roślin,
- odporność na niesprzyjające warunki siedliskowe, zwłaszcza okresowe przesuszenie wierzchnich warstw gleb - głęboko umiejscowione kłącza,
- żywotność i zdolność regeneracji - kłącza magazynujące składniki pokarmowe.

Zakres i metody badań

W 1999 r. rozpoczęto prace badawcze, których celem jest określenie możliwości hamowania ekspansji *Phragmites australis* w najbardziej zagrożonych ekosystemach turzycowych łąk bagiennych. Badania prowadzone są w Basenie Południowym Doliny Biebrzy, w rejonie Grobli Honczarowskiej na podstawie dwóch eksperymentów.

Eksperyment I - założono metodą łanową w 1999 r. z uwzględnieniem:

1. łan wykaszany (termin jesienny), powierzchnia ok. 45 ha,
2. łan kontrolny (brak koszenia).

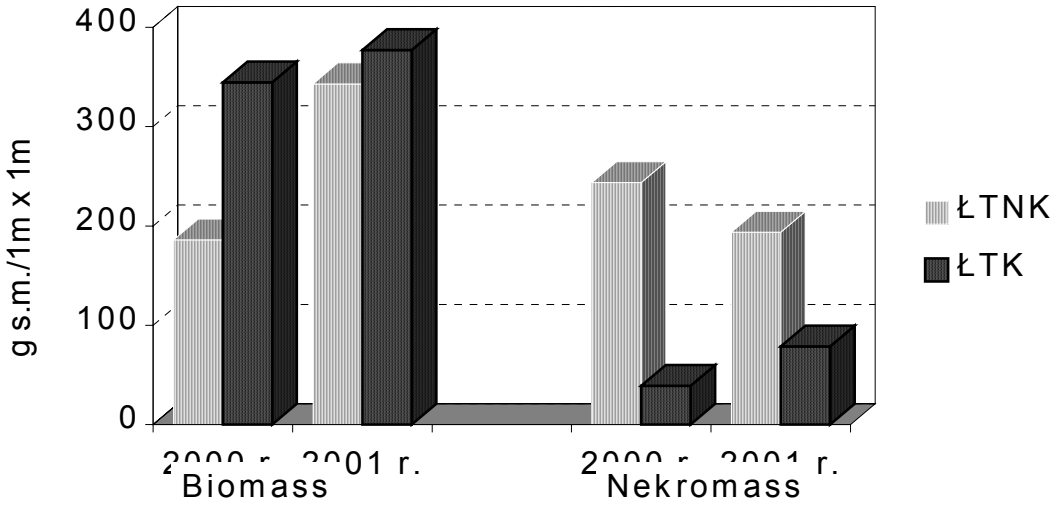
Na poszczególnych łanach wytypowano po 11 stałych powierzchni obserwacyjnych, każda o wymiarach 2 x 2 m.

Eksperyment II - założono w 2001 r. metodą losowanych bloków w pięciu powtórzeniach, z uwzględnieniem wysokości i terminów wykaszania. Łącznie przyjęto sześć obiektów badawczych, w tym obiekt kontrolny - bez wykaszania.

Wpływ wykaszania na biomasę i strukturę zbiorowisk

Zaniechanie wykaszania łąk bagiennych powoduje wiele niekorzystnym zmian w ekosystemach. Do najważniejszych należy zaliczyć: rozwój zakrzewień i zadrzewień (*Salix cinerea*, *Betula pubescens*), inwazję *Phragmites australis*. Nie bez znaczenia są też zmiany w strukturze warstwy zielnej zbiorowisk, powodowane gromadzeniem obumarłej masy roślinnej [PAŁCZYŃSKI, STEPA, 1992]. Posusz roślinny sprzyja zwłaszcza zanikaniu mniej okazałych gatunków roślin naczyniowych jak *Carex chordorrhiza*, *Carex limosa* oraz warstwy mszystej. W dalszej kolejności powoduje przekształcanie się zbiorowisk z klasy *Scheuchzerio-Caricetea fuscae* w turzycowiska związku *Magnocaricion*, co jest zjawiskiem niepożądanym. Dwuletnie wyniki badań uzyskane na podstawie Eksperymentu I wskazują na korzystny wpływ przywróconego ponownie po wielu latach wykaszania łąk bagiennych (*Carici-Agrostietum caninae* wariant z *Carex elata*) z usunięciem masy roślinnej na zbiorowiska. Wpływ ten zaznacza się między innymi:

zmniejszeniem udziału nekromasy to jest posuszu roślinnego z lat wcześniejszych (rys. 1), ograniczającym wzrost i rozwój roślin, zwłaszcza gatunków o mniejszej sile konkurencyjnej, .
nieznacznym zwiększeniem różnorodności florystycznej w poszczególnych płatach zbiorowiska.



*Rys. 1 Produkcja biomasy zatrzcinionej łąki turzycowej (*Carici agrostietum caninae *wariant z* Carex elata*)*
ŁTNK - powierzchnie niekoszone, ŁTK - powierzchnie koszone

Wpływ wykaszania na Phragmites australis

Dotychczasowe wykaszanie zbiorowisk nie przyniosło większych zmian w zagęszczeniu *Phragmites australis* (tab. 1). Różnice w liczebności pędów tego gatunku jakie obserwowano w 2000 i 2001 r. na poszczególnych powierzchniach obserwacyjnych miały charakter zmian fluktuacyjnych. Wynikały one zarówno z biologii rozwoju tego gatunku, jak również z dość odmiennych warunków siedliskowych, zwłaszcza uwilgotnienia gleb w poszczególnych sezonach.

Tabela 1
Przeciętna liczba i wysokość pędów Phragmites australis *po I i II koszeniu, średnie z 11 powierzchni obserwacyjnych*

	Liczba pędów		Wysokość pędów (cm)	
	Rok obserwacji		Rok obserwacji	
	2000	2001	2000	2001
ŁTNK	38	34	109	114
ŁTK	32	43	82	109

ŁTNK - łąka turzycowa, łan niekoszony, ŁTK - łąka turzycowa, łan koszony

Korzystny wpływ wykaszania stwierdzono natomiast w aspekcie osłabienia żywotności i tempa wzrostu pędów *Phragmites australis*. Wpływ ten zaznaczył się zwłaszcza w 2000 roku, ubogim w opady atmosferyczne i głębszym obniżaniu się poziomu wody gruntowej.

Podsumowanie

Hamowanie ekspansji *Phragmites australis* w bagiennych ekosystemach łąk turzycowych jest zjawiskiem dość złożonym. Zabiegi wykaszania mogą powodować zmiany w zbiorowiskach roślinnych na wielu płaszczyznach:

zmniejszanie gromadzenia obumarłych roślin,
zmiana zachowań poszczególnych komponentów zbiorowisk (zmiany ilościowo-jakościowe),

możliwość zmian kierunku sukcesji roślinnej.

Wpływ przywróconego wykaszania na zachowanie *Phragmites australis* - gatunku o dużej sile konkurencyjności jest jak na razie ograniczony i wymaga stosowania tego zabiegu w okresie wielu lat.

Uzyskane wyniki świadczą o celowości i potrzebie kontynuacji prac w dłuższym okresie.

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Wpływ wypasu i koszenia na walory przyrodnicze ekosysemów Łąkowych

Jan Kamiński

Summary

The influence of grazing and mowing on nature values was investigated in four experimental plots in the NW part of the Middle Basin of the Biebrza river :

Unmanaged peatland, partially drained (soils Mt I-II).
Reclaimed peatland, intensively inundated (soils Mt II).
Reclaimed peatland, moderately drained (soils Mt II).
Valley margin, intensively drained (soils Me).

Effects of multi-annual twice a year mowing and grazing of meadow ecosytems were assessed on these experimental plots. Index of evaluation was assessed using phytosociological data. This index (from 1 to 10) allowed classification to four evaluation classes (A, B, C, D) according to the IMUZ Falenty method (Oświt, 2000).

Habitat conditions, especially water conditions, had a main influence on floral composition and nature values. Ecosystems of two (1 and 2) plots was classified as a class B (moderate nature value) and two others plots (3 and 4), more intensively drained, was classified as a class A (small nature value). Landuse clearly altered sociological structure of phytocenosis. As a result of different landuse (pastures vs mown meadows) different plant associations and communities developed in the same habitat:

- *plot 1.* Epilobio-Juncetum effusi *(pasture),* Deschampsietum caespitosae *(meadow);*
- *plot 2.* Epilobio-Juncetum effusi *(pasture),* Poa palustris-Alopecurus pratensis *(meadow);*
- *plot 3.* Festuca rubra-Poa pratensis: *with short species (pasture), with high grasses (meadow);*
- *plot 4.* Lolio-Cynosuretum *(pasture),* Arrhenatherum medio-europaeum *(meadow).*

Landuse altered also numerical value of indexes of evaluation. Grazing appeared as a less advantageous. It enriched, more then mowing, plant associations in common species, usually synanthropic, characteristic for soil with lesser porosity, from Plantaginetea *class and accompanying species. Grazing formed higher mosaic and tuft structures, which are advantageous for birds.*

Siedliska hydrogeniczne w Basenie Środkowym Biebrzy występują na powierzchni około 54 tys. ha. W przeciwieństwie do pozostałych dwóch basenów (północnego i południowego) duże znaczenie mają tu gleby torfowo-murszowe (48,5%), charakterystyczne dla torfowisk częściowo osuszonych i zmeliorowanych [CHURSKI, SZUNIEWICZ, 1991]. Dość znaczny jest też udział gleb murszowatych, występujących głównie w brzeżnej części doliny na pograniczu z wyżej położonymi gruntami mineralnymi. W większości obszary te znajdują się w ekstensywnym użytkowaniu łąkowym ze zbiorem jednego lub dwóch pokosów, w mniejszym stopniu służą jako trwałe pastwiska. Tylko niewielką część zmeliorowanych torfowisk, głównie na obiekcie Kuwasy użytkuje się dość intensywnie kośno-pastwiskowo.

Materiał i metody badań

Na czterech wybranych obszarach w północno-zachodniej części Środkowego Basenu Biebrzy, różniących się specyfiką warunków siedliskowych oceniono wpływ wieloletniego wypasu bydła (rasa nizinno-czarno-biała) oraz użytkowania kośnego na skład florystyczny i walory przyrodnicze ekosystemów łąkowych.

Tabela 1 Charakterystyka obiektu badań

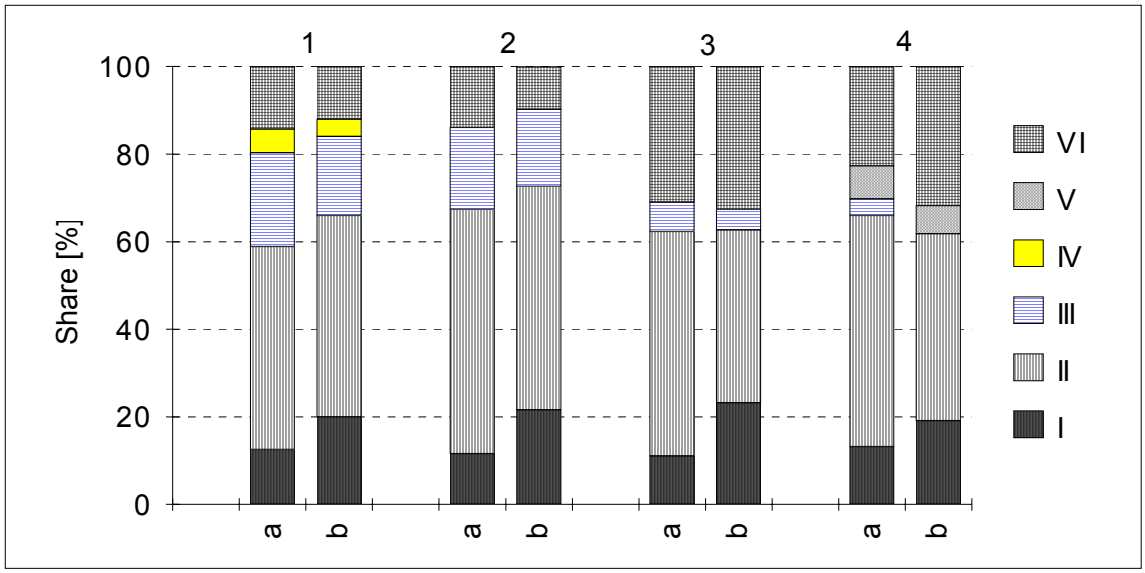
		h	Roślinność	
Lp	Obiekt (obszar), gleby	śred. cm	Wykaszanie (liczba pokosów)	Wypas (% niedojadów)
1.	Torfowisko niezagospodarowane, częściowo odwodnione, MtI-II	35	Deschampsietum caespitosae (1)	Epilobio-Juncetum effusi (70)
2.	T. zmeliorowane, intensywnie podtapiane, MtII	35	Poa palustris-Alopecurus pratensis (2)	Epilobio-Juncetum effusi (50)
3.	T. zmeliorowane, umiarkowanie odwodnione MtII	55	Poa pratensis-Festuca rubra z wysokimi trawami (2)	Poa pratensis-Festuca rubra murawa niska (25)
4.	Obrzeże doliny, Me	### 80	Arrhenatheretum medioeuropaeum (2)	Lolio-Cynosuretum (15)

Objaśnienia: h - średni dla okresu wegetacji poziom wody gruntowej w latach 1996-1999. Podstawową charakterystykę wybranych obiektów z uwzględnieniem warunków siedliskowych oraz roślinności rzeczywistej przedstawiono w tabeli 1. Zbiorowiska roślinne zbadano metodą Braun-Blanqueta. Na podstawie materiałów fitosocjologicznych określono średnie wskaźniki waloryzacji (skala 1-10), stanowiące podstawę oceny walorów przyrodniczych według opracowanej w IMUZ Falenty metody przyrodniczej waloryzacji mokradeł [OŚWIT, 2000].

Omówienie wyników badań

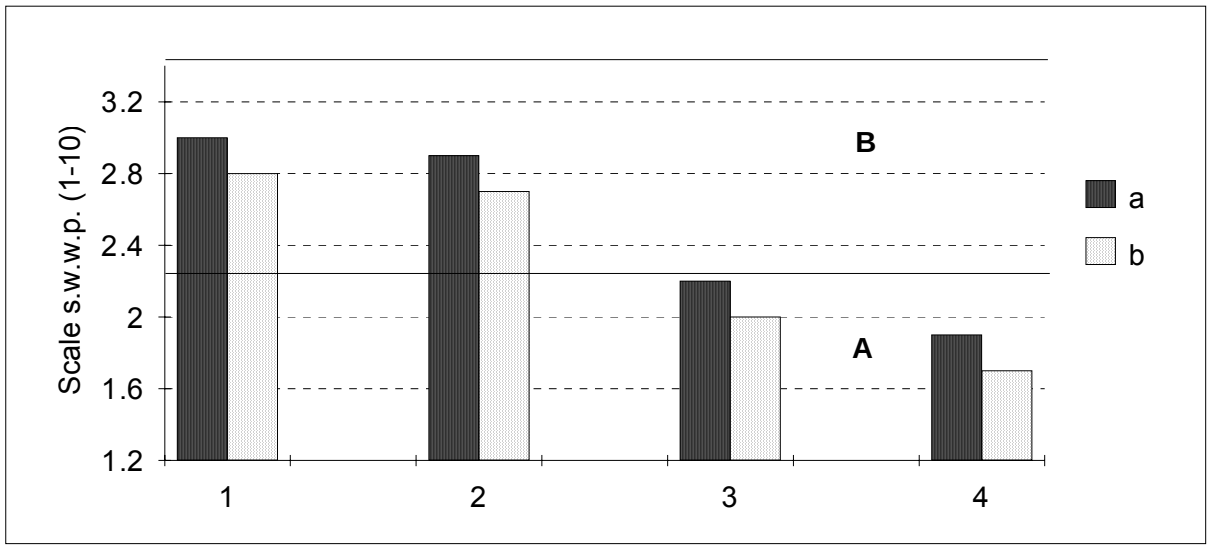
Z wcześniejszych badań [GRYNIA, 1967; OŚWIT, 1977; KAMIŃSKI, 2000], wynika że skład florystyczny zbiorowisk łąkowych zasadniczo zależny jest od warunków siedliskowych, głównie głębokości odwodnienia gleb. W dużym stopniu charakter fitocenoz może być też modyfikowany przyjętą pratotechniką, zwłaszcza sposobem i intensywnością użytkowania. Różnice te mogą umożliwić identyfikację nawet odrębnych zespołów i zbiorowisk roślinnych w tych samych warunkach wodnych gleb, co znajduje potwierdzenie w tabeli 1.

Odzwierciedleniem warunków wodnych siedlisk jest określona struktura socjologiczna fitocenoz. Zwiększone uwilgotnienie gleb, jakie obserwowano na niemeliorowanym, niezagospodarowanym inwestycyjnie torfowisku (obszar 1 - rejon Kapice), oraz na dawno zmeliorowanym, długotrwale intensywnie nawadnianym za pomocą sieci melioracyjnej (obszar 2 - rejon Miecze) sprzyjało wzbogacaniu fitocenoz w bagienne gatunki roślin, charakterystyczne dla klas: *Scheuchzerio-Caricetea fuscae*, *Phragmitetea*. Podczas gdy w siedliskach intensywniej odwodnionych wyraźnie malało znaczenie tych roślin, a zwiększało gatunków synantropijnych (obszar 1 - obiekt Kuwasy), bądź też na terenach przytorfowych (gleby murszowate) - roślinności kserotermicznej, charakterystycznej dla muraw napiaskowych klasy *Sedo-Scleranthetea* (rys. 1).



Rys. 1. Struktura socjologiczna zbiorowisk roślinnych. 1, 2, 3, 4 - obszary jak w tabeli 1, a - koszenie, b – wypas Gatunki charakterystyczne: I - Cl. Plantaginetea, II - Cl. Molinio-Arrhenatheretea, III - Cl. Phragmitetea, Cl. Scheuchzerio-caricetea fuscae, IV - Cl. Alnetea glutinosae, V - Cl. Sedo-Scleranthetea, Cl. Nardo-Callunetea, VI – Companions

O walorach przyrodniczych ekosystemów łąkowych decyduje skład gatunkowy występującej na ich obszarze flory. Walory te można precyzyjnie ocenić w skali 10-stopniowej z określeniem kategorii (klasy) według opracowanej metody [OŚWIT, 2000]. Z danych zamieszczonych na rys. 2 wynika, że dobrze uwodnione torfowiska, niezależnie od użytkowania reprezentowały umiarkowane walory przyrodnicze (klasa B), a obszary intensywniej odwodnione (obiekt 3, 4) - małe walory przyrodnicze (klasa A).



Rys. 2. Walory przyrodnicze ekosystemów łąkowych określone na podstawie występującej flory.
1, 2, 3, 4 - obszary jak w tabeli 1; a - koszenie, b - wypas; s.w.w.p. - średni wskaźnik waloryzacji przyrodniczej; A, B - Klasy waloryzacyjne: A - małe walory przyrodnicze (s.w.w.p.: 1,0-2,2), B - umiarkowane walory (2,3-3,4), C - duże walory (3,5-4,2), D - wybitne i unikalne walory przyrodnicze (###4,2)

Uwzględniając nieznaczne nawet różnice w kształtowaniu się wartości liczbowych średniego wskaźnika waloryzacji, należy nadmienić, że mniej korzystny niezależnie od siedliska okazał się wypas. Ten sposób użytkowania w większym stopniu jak koszenie wzbogacał zbiorowiska w gatunki pospolite, najczęściej synantropijne, charakterystyczne dla gleb o zmniejszonej porowatości klasy *Plantaginetea* i z grupy towarzyszących.
W przeciwieństwie do użytkowania kośnego wypas sprzyjał rozwojowi niskich gatunków trawiastych i zielnych, zwłaszcza w miejscach często przygryzanych. Gatunkami wyróżniającymi murawy pastwiskowe o małych walorach przyrodniczych były: *Poa annua*, *Plantago maior*, *Rumex crispus*, *Trifolium repens*, *Leontodon autumnalis*, *Carex hirta*, *Agropyron repens*. W siedliskach intensyweniej uwilgotnionych (obszar 1, 2) licznie pojawiała się natomiast *Agrostis stolonifera*, zaliczana do grupy gatunków o przeciętnych walorach przyrodniczych. Większość gatunków o umiarkowanych walorach przyrodniczych, głównie bagiennych oraz typowych dla zbiorowisk zmiennowilgotnych jak *Deschampsia caespitosa*, *Juncus effusus* rozwijała się zazwyczaj w miejscach mniej chętnie wyjadanych przez bydło. Sprzyjało to kształtowaniu struktury kępowej, zapewniało też dużą mozaikowatość terenu. Są to niewątpliwie cechy pozytywne, zwłaszcza w aspekcie ornitologicznym. W dużym stopniu decydują o warunkach bytowych i lęgowych zasiedlającej ekosystemy awifauny.

Wnioski

1. Walory przyrodnicze ekosystemów łąkowych określane na podstawie flory zasadniczo zależą od warunków wodnych siedlisk. Większość zbiorowisk rzędu *Molinietalia* reprezentuje umiarkowane walory, a rzędu *Arrhenatheretalia* małe walory przyrodnicze.
2. Sposób użytkowania w ramach określonego siedliska modyfikuje skład florystyczny fitocenoz, w niewielkim stopniu różnicuje też wartości liczbowe średniego wskaźnika waloryzacji (skala 1-10).
3. Wypas wzbogaca zbiorowiska w gatunki pospolite o małych walorach przyrodniczych, wyraźnie zwiększa mozaikowatość terenu i sprzyja kształtowaniu struktury kępowej.

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Mowing as a tool to suppress reed (*Phragmites australis*) in Biebrza National Park

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Summary

Discontinuous landuse during last decades has caused the expansion of willow, birch and reed on the vast sedge-moss communities of the Biebrza valley. The preservation of this characteristic fen plant community and its associated fauna, especially avifauna, needs a better knowledge of the optimal timing of mowing, in order to eliminate the invading reed. Therefore a mowing experiment was started in 1998 in 2 fen locations: Czarna Brzezina and Kapice. Every year 2 quadrats on each place were mown and biomass was removed in January (plots I), in June (plots VI), in July (plots VII) and in August (plots VIII).

*The results have confirmed that mowing can reduce reed growth. The density and height of reed shoots on all experimental plots decreased. The strongest decrease was found on plots mown in August and January, both on Kapice and Czarna Brzezina places and on control plots on Czarna Brzezina. The decreased reed density on these control plots is probably due to the increased competition (shading) by expanding Willow (*Salix cinerea). *The Willow share increased from 5% to 51%. The reed regression was more evident on drained sites of Kapice. In 2001, grass communities with a low reed share (6-16%), low reed vitality and a high share of nitrophilous species covered most Kapice experimental plots. As the duration was short, the experiment should be continued*

Wstęp.

Stopniowe zaniechanie ekstensywnego użytkowania doliny Biebrzy przez miejscową ludność w ostatnich kilkudziesięciu latach spowodowało ekspansję zakrzaczeń wierzbowo-brzozowych oraz trzciny. Skutkiem zainicjowanej sukcesji wtórnej jest przekształcanie się dotychczasowych zbiorowisk roślinnych, pojawianie się nowych gatunków i ginięcie innych, często bardzo rzadkich już w skali kraju czy Europy.

W ostatnich latach obserwuje się zainteresowanie miejscowej ludności komercyjnym pozyskiwaniem trzciny w okresie zimowym. Zrodziło to potrzebę monitorowania efektów wykaszania trzciny zimą w zróżnicowanych warunkach doliny Biebrzy. Realizacja celów statutowych Parku m.in. zachowanie różnorodności zbiorowisk roślinnych charakterystycznych dla torfowiskowej, ekstensywnie użytkowanej doliny Biebrzy i związanych z nimi gatunkami fauny a zwłaszcza awifauny uwidacznia konieczność określenia terminu i sposobu wykaszania prowadzącego do wyeliminowania trzciny wkraczającej na mechowiska, zbiorowiska turzycowo-mszyste czy turzycowe.

Cel badań.

Celem podjętych badań było poznanie wpływu terminu wykaszania na skład gatunkowy zbiorowisk roślinnych oraz określenie optymalnego terminu systematycznego wykaszania prowadzącego do wyeliminowania trzciny. Wyniki tych badań mogą pomóc w planowaniu i realizacji ochrony zarastających trzciną półnaturalnych zbiorowisk roślinności torfowiskowej zarówno w Biebrzańskim Parku Narodowym jak też w innych podobnych obiektach.

Przedmiotem badań był skład gatunkowy zbiorowiska z udziałem trzciny w warunkach zabagnienia i na torfowisku silnie przesuszanym oraz cechy populacji trzciny: pokrycie, zagęszczenie pędów, ich wysokość, grubość, żywotność.

Celem niniejszej pracy jest przedstawienie wstępnych wyników prowadzonych badań.

Obiekt badań.

Badania prowadzone są na 2 powierzchniach badawczych o odmiennych warunkach siedliskowych. Jedna z powierzchni zlokalizowana jest w południowo-wschodniej części Basenu Dolnego doliny Biebrzy w Uroczysku Czarna Brzezina w strefie emersyjnej zbiorowisk mszystych, nigdy nie zalewanej wodami rzecznymi a mimo to charakteryzującej się największym uwodnieniem siedlisk w dolinie, wynikającym z intensywnego zasilania wodami podziemnymi.

W roku 1998, przed rozpoczęciem eksperymentu, na powierzchni badawczej „Czarna Brzezina" rozwijało się zbiorowisko zespołu *Thelypteridi-Phragmitetum,* z dominacją trzciny *Phragmites australis* i stosunkowo wysokim udziałem turzyc: *Carex appropinquata, C. pseudocyperus, C. lasiocarpa; z* ziół - *Potentilla palustris, Ranunculus lingua, Thelypteris palustris, Peucedanum palustre,* a w części płatów także *Calamagrostis canescens.* Udział krzewów nie przekraczał 5% (2-5%) a ich wysokość 1m. Była to głównie wierzba szara *Salix cinerea.* Ponadto zbiorowisko charakteryzowało się niemal identycznym udziałem suchych pędów wierzbowych, będących pozostałością po pożarze, który miał miejsce na tym obszarze w 1997 roku. Warstwa mszysta zajmowała od 15 do 50 % powierzchni. Ściółka pokrywała od 10 do 15% powierzchni zbiorowiska.

W czasie trwania eksperymentu woda zawsze występowała powyżej powierzchni gruntu.

Druga powierzchnia badawcza - Kapice położona jest w Basenie Środkowym doliny Biebrzy charakteryzujacym się dużym udziałem (ok. 50%) torfowisk odwodnionych, z glebami torfowo-murszowymi i zbiorowiskami zastępczymi. Powierzchnia Kapice położona jest ok. 50 m na N od Kanału Kapickiego (jednego z tych, odwadniających Basen Środkowy).

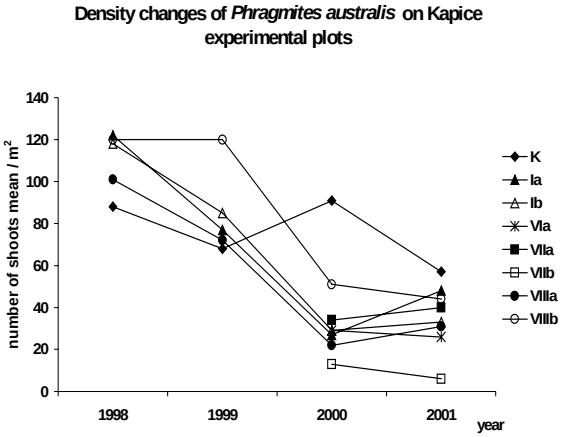
W sierpniu 1998 roku, przed rozpoczęciem eksperymentu, na powierzchni badawczej rozwijało się zbiorowisko z dominacją *Phragmites australis* i *Calamagrostis canescens*, z liczną reprezentacja gatunków łąkowych i obecnością gatunków wybitnie nitrofilnych np. *Urtica dioica, Solanum dulcamara.* Warstwa mszysta była słabo wykształcona i zajmowała ok. 5% powierzchni, maksymalnie do 20%. Udział nekromasy sięgał od 50 do 90 %. Nie stwierdzono obecności krzewów na powierzchni. Zbiorowisko rozwija się na płytkiej glebie murszowo-torfowej, z warstwą murszu do 35 cm. Nie stwierdzono zalegania wody powyżej powierzchni gruntu, z wyjątkiem okresów zimowych.

Metody badań

Eksperyment rozpoczęto w sierpniu 1998 roku na 2 obiektach: Czarna Brzezina i Kapice. Na każdym z obiektów wyznaczono 9 stałych kwadratów o bokach 10x10 m (po 2 do wykaszania w jednym terminie i jednym kontrolnym). Wykaszanie z usuwaniem skoszonej roślinności powtarzano corocznie w styczniu (powierzchnie I), w czerwcu (powierzchnie VI), w lipcu (powierzchnie VII) i w sierpniu (powierzchnie VIII). Przed skoszeniem każdej powierzchni eksperymentalnej w 10 losowo zlokalizowanych kwadratach o powierzchni 1m2: wykonywano zdjęcia fitosocjologiczne, określano liczbę pędów trzciny, jej udział % oraz udział suchej trzciny, mierzono maksymalną grubość pędów trzciny, wysokość maksymalną i przeciętną trzciny oraz warstwy drzew/krzewów, mierzono głębokość występowania wody nad powierzchnią. W celu pełniejszej charakterystyki warunków siedliskowych w roku 2001 wykonano na obu obiektach sondy glebowe.

Podsumowanie wstępnych wyników i wnioski.

1. Uzyskane wyniki potwierdzają, iż koszenie ogranicza możliwości wzrostu trzciny. Po trzykrotnym bądź dwukrotnym wykoszeniu powierzchni eksperymentalnych nastąpił spadek zagęszczenia trzciny na wszystkich powierzchniach (Fig.1). Najwyższy spadek zagęszczenia stwierdzono na powierzchniach wykaszanych w VIII i I na obu obiektach oraz na powierzchni kontrolnej na obiekcie Czarna Brzezina. Przeciętna wysokość maksymalna pędów trzciny na wszystkich powierzchniach była niższa w roku 2001 w stosunku do 1999 (Fig. 2).
2. Spadek zagęszczenia trzciny na powierzchni kontrolnej na obiekcie Czarna Brzezina jest prawdopodobnie efektem znacznego wzrostu udziału *Salix cinerea* z ok. 5% do 51 %. Stwierdzono też ślady wycinania trzciny zimą przez miejscową ludność.
3. Bardziej ewidentnie regresja trzciny uwidoczniła się w siedlisku przesuszanym na obiekcie Kapice. W roku 2001 na większości powierzchni eksperymentalnych tego obiektu rozwijało się zbiorowisko trawiaste z dużym udziałem nitrofilnych gatunków i niewielkim udziałem trzciny (6-16% w pokryciu) odznaczającej się osłabioną żywotnością (obecność pędów suchych, usychających wierzchołków pędów).
4. Efektem koszenia i usuwania skoszonej roślinności na obiekcie Czarna Brzezina, poza zmniejszeniem udziału trzciny, jest m.in.: wzrost liczby pędów *Salix cinerea* (które są zdecydowanie niższe i cieńsze niż na powierzchni K) lecz bez ewidentnego wzrostu udziału w pokryciu roślinności; lepiej wykształcona warstwa mszysta; brak nekromasy.



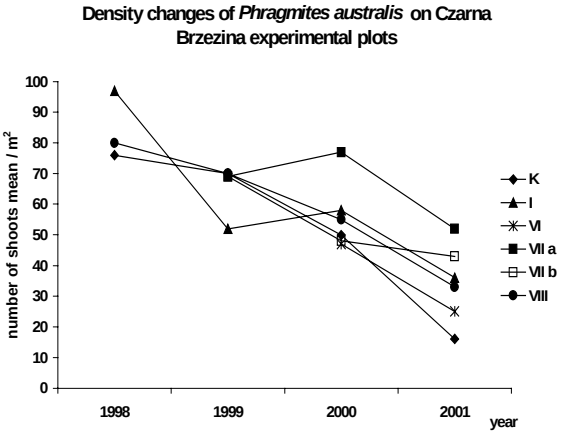


Fig.1+ 2

5. Z uwagi na krótki okres realizacji eksperymentu zwłaszcza na powierzchniach wykaszanych w VI i w VII, z których pierwotnie założone zostały zniszczone a nowe założono w 1999 i 2000 roku, badania powinny być kontynuowane.

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Przyrodnicze i organizacyjne ywarunkowania wipasu zwierząt w polsce

Zbigniew Wasilewski

Summary

The paper presents various conditions of grazing including such aspects as production, habitat and organization (wheather conditions, meadow types, production potential and limits to livestock density). Habitat types and their use for grazing, organization of grazing and some local customs were especially considered.

Wstęp

Letnie żywienie zwierząt przeżuwających w Polsce jest powszechne. Zwłaszcza w gospodarstwach posiadających nieliczne stada bydła, koni lub owiec (kilka sztuk). Wynika to zarówno z tradycji jak i aspektów ekonomicznych, bowiem ze wszystkich pasz, zielonka pastwiskowa jest paszą najtańszą i sprzyjającą pozyskiwaniu mleka najlepszej jakości. Doceniane są również aspekty poza produkcyjne wypasu, zwłaszcza przez jego korzystny wpływ na zdrowie zwierząt oraz jakość środowiska. Celem niniejszego opracowania jest zaprezentowanie wybranych uwarunkowań wypasu zwierząt w Polsce.

Klimatyczne i meteorologiczne uwarunkowania gospodarki pastwiskowej

Polska leży w strefie klimatu umiarkowanego. Północno-wschodnia jej część, leży w strefie styku klimatu morskiego i kontynentalnego co sprawia, że warunki meteorologiczne są bardzo zmienne i zróżnicowane. Występują duże wahania temperatur powietrza, głębokie przemarzanie gleby oraz przemarzanie nadziemnych części roślin w czasie ich wegetacji. Często nawet w okresie pełni lata występują krótkotrwałe przymrozki. Jak podaje Krzywonos (4) w ZD MUZ w Biebrzy zanotowano następujące najniższe temperatury powietrza mierzone przy gruncie: w kwietniu $-18,7^{o}$, w maju $-10,4^{o}$, w czerwcu $-6,7^{o}$, w lipcu $-2,6^{o}$, w sierpniu $-6,2^{o}$, we wrześniu $-15,0^{o}$ i w październiku $-22,0^{o}$C. Wtórnym aspektem tego zjawiska jest występowanie dużych różnic w długości okresu żywienia pastwiskowego i alkierzowego na korzyść tego drugiego.

Średnio w Polsce okres żywienia pastwiskowego trwa około 160-170 dni. Natomiast w regionie Biebrzańskim jest on o około 20-30 dni krótszy i trwa około 130-140 dni.

W warunkach Polski, przyrost biomasy na naturalnych użytkach zielonych nie jest równomierny. Jego przebieg można scharakteryzować następująco: od momentu ruszenia wegetacji zaczyna powoli wzrastać i około połowy maja osiąga swoje apogeum które trwa zwykle do połowy czerwca, a następnie stopniowo maleje aż do zakończenia wegetacji roślin. W warunkach intensywnej gospodarki towarowej rytm ten ulega zakłóceniom na skutek stosowania nawożenia. Krytycznym okresem dla gospodarki pastwiskowej w Polsce jest sierpień, kiedy na skutek występujących w tym czasie wysokich temperatur, niedostatecznego zaopatrzenia w wodę oraz słabnącego naturalnego rytmu rozwojowego, zwłaszcza traw, podaż paszy jest mała, a jej wartość żywieniowa obniżona (7).

Pogłowie bydła w Polsce a użytkowanie łąk i pastwisk

Rocznik Statystyczny (6) podaje, że pogłowie bydła w Polsce od 10 lat systematycznie się zmniejsza. Dotyczy to zarówno bydła ogółem jak i krów mlecznych (tab. 1).

Tabela 1. Pogłowie bydła w Polsce i woj. podlaskim w wybranych latach

Wyszczególnienie	Lata		
	1990	1995	2000
Bydło ogółem (szt. fiz.)	10.049	7.306	6.083
w tym krowy	4.919	3.579	3.098
Bydło na 100 ha UR (w SD) w Polsce	54	39	33
w tym krowy,	26	19	17
Bydło na 100 ha UR (w SD) w woj. Podlaskim			55
w tym krowy,			30

Istnieje w Polsce ścisła korelacja między pogłowiem bydła a stopniem gospodarczego wykorzystanie użytków zielonych. Zachodzące w ostatnim 10-leciu procesy restrukturyzacyjne w rolnictwie oraz malejące pogłowie bydła sprawiły, że znaczne powierzchnie łąk i pastwisk zostały wyłączone, nawet z ekstensywnego użytkowania. Wyrazem tego jest zwiększający się areał tzw. „nie eksploatowanych" użytków zielonych (tab. 2).

Tabela 2. Powierzchnia i plony z trwałych użytków zielonych w Polsce wg GUS (5)

Wyszczególnienie	Lata		
	1990	1995	2000
TUZ ogółem (tys. ha.)	3.900	3.800	3.900
w tym: łąki	2.400	2.300	2.500
pastwiska	1.500	1.500	1.400
Plony z łąk – siano ($t \cdot ha^{-1}$)	5,96	5,22	3,90
Plony z pastwisk – zielonka ($t \cdot ha^{-1}$)	22,5	16,6	15,2
Struktura użytkowania łąk:			
Eksploatowane (% w pow. ogólnej łąk)		82,5	76,5
nie eksploatowane (% w pow. ogólnej łąk)		17,5	23,5

Systemy i sposoby wypasu

W Polsce prowadzony jest na równi intensywny jak i ekstensywny wypas zwierząt. Oba rządzą się innymi prawami. Inne są ich cele. Intensywny wypas zwierząt odbywa się na użytkach właściwie urządzonych, w runi których dominuje kilka gatunków traw. Są one intensywnie nawożone, a obsada zwierząt wynosi około 3 DJP/ha. Celem nadrzędnym takiego wypasu jest maksymalizacja produkcji i zysku rolnika przy ograniczonej trosce o środowisko. Wypas ekstensywny polega na wykorzystaniu naturalnego potencjału produkcyjnego danego siedliska. Celem nadrzędnym jest uzyskanie, bez ponoszenia nakładów, niewielkiej produkcji, a szczególnie zachowanie cennych walorów przyrodniczych takich teren
ów.

W Polsce wyróżnia się dwa systemy wypasu tj. wypas rotacyjny oraz wypas ciągły. W ramach tych systemów wyróżnia się wiele sposobów i form w zależności od różnych kryteriów.

I tak pod względem sposobu spasania runi wyróżnia się w systemie rotacyjnym: wypas kwaterowy, wypas z dawkowaniem paszy, na uwięzi, a w systemie ciągłym: wypas intensywny i ekstensywny (wolny).
Każdy system i sposób wypasu ma określone zalety i wady. Nie ma rozwiązań idealnych. Co najwyżej mogą być bardziej lub mniej racjonalne. Zależy, jakie priorytety stawiane są w konkretnych warunkach i czemu ma wypas służyć.

Dla przykładu, intensywny wypas można prowadzić stosując zarówno system rotacyjny sposobem kwaterowym, z dawkowaniem paszy, na uwięzi lub kierować się zasadą intensywnego wypasu ciągłego. Natomiast wypas ekstensywny można realizować sposobem ekstensywnym ciągłym (wypas wolny) lub spasać określone powierzchnie (zagony) stadem kierowanym przez pasterza (wypas strzeżony).

Typologiczny podział łąk w Polsce a pastwiskowe ich użytkowanie

W polskim łąkarstwie funkcjonuje tzw. typologiczny podział łąk, który dość dobrze i precyzyjnie kwalifikuje siedliska łąkowe pod względem ich przydatności do rolniczego lub poza rolniczego użytkowania oraz jako użytki ekologiczne (3).
Według tego podziału wyróżnia się następujące ich grupy i rodzaje (siedliska):

A. łąki łęgowe (flooded meadows)
1. zgrądowiałe (partly dried),
2. właściwe (proper),
3. rozlewiskowe (with flowing water),
4. zastoiskowe (with stagnant water),

B. łąki grądowe (dry meadows)
1. zubożałe (impoverished),
2. właściwe (proper),
3. podmokłe (waterlogged),
4. popławne (moistened),

C. łąki pobagienne (murszowiskowe) (moorshed meadows – post-mire)
1. gradowiejące (drying),
2. zdegradowane (degraded),
3. właściwe (proper),
4. łęgowiejące (moistened),

D. łąki bagienne (bielawy) (swamp meadows)
1. podtopione (partly flooded),
2. wododziałowe (watershed),
3. właściwe (proper),
4. zalewne (flooded).

Do pastwiskowego i intensywnego użytkowania szczególnie przydatne są użytki zielone położone w siedliskach: A – 1; B – 1, 2, 4; C – 1, 3. Natomiast siedliskami na których możliwy jest tylko wypas ekstensywny i okresowy, są: A – 2, 3; B – 3; C – 2, 4 (1). Ich naturalny oraz możliwy do uzyskania potencjał produkcyjny kształtuje się następująco (3):

Siedlisko	Potencjał produkcyjny ($t \cdot ha^{-1}$ s.m.)		Dopuszczalna obsada (DJP/ha)	
	naturalny	możliwy	potencjał naturalny	potencjał możliwy
Siedliska przydatne do intensywnego wypasu				
A – 1	3 – 4	6 – 10	1 – 1,3[x/]	3 – 5[xx/]
B – 1	1 – 1,5	5 – 7	0,3 – 0,5	2,5 – 3,5
B – 2	1,5 - 2,5	6 – 10	0,5 – 0,8	3 – 5
B – 4	3 – 5	6 – 10	1,1 – 1,7	3 – 5
C – 1	1,5 – 2	6 – 9	0,5 – 0,7	3 – 4,5
C – 3	1,5 – 2,5	7 –10	0,5 – 0,8	3,5 – 5
Siedliska na których możliwy jest tylko ekstensywny wypas				

A – 2	4 – 5	0,6 – 0,7[xxx/]
A – 3	3,5 – 10	0,5 – 1,3
B – 3	2 – 2,5	0,3 – 0,4
C – 2	1 – 2	0,1 – 0,3
C – 4	2 – 3,5	0,3 – 0,5

[x/] niezbędna podaż paszy dla 1 DJP w sezonie pastwiskowym trwającym około 130 dni przy wykorzystaniu runi 60% wynosi około 3,0 t s.m.

[xx/] niezbędna podaż paszy dla 1 DJP w sezonie pastwiskowym trwającym około 130 dni przy wykorzystaniu runi 90% wynosi około 2,0 t s.m.

[xxx/] niezbędna podaż paszy dla 1 DJP w sezonie pastwiskowym trwającym około 130 dni przy wykorzystaniu runi 20% wynosi około 7,3 t s.m.

Wykorzystanie runi przez pasące się zwierzęta w warunkach intensywnej produkcji w siedliskach pierwszej grupy zamieszczonej w tabeli można oceniać na około 90%, natomiast bazując na naturalnym potencjale produkcyjnym na około 60%. Natomiast w siedliskach drugiej grupy na około 20%. Wierność plonowania w/w łąk jest oceniana jako dobra. Ponieważ bielawy oraz łęgi zastoiskowe położone są na glebach organogenicznych (torfowych) silnie uwodnionych o wyjątkowo niskiej nośności są one niedostępne dla zwierząt gospodarskich. Można rozważać tylko okresowe i krótkotrwałe spasanie niektórych partii takich łąk (1).

Wypas bydła i wypas mieszany

Najbardziej uniwersalnym gatunkiem zwierząt korzystającym z pastwisk jest bydło. Dotyczy to zarówno terenów przydatnych do tej formy użytkowania jak i terenów trudnych. Specyfika oddziaływania bydła na ruń, darń i środowisko wynika z kilu względów, a zwłaszcza: małej wybiórczości względem zjadanych gatunków roślin, dużej tolerancji względem jakości paszy, dość intensywnego wydeptywania roślinności i pewnego poruszania się po niestabilnym podłożu oraz tolerancji wobec innych gatunków zwierząt, a zwłaszcza awifauny (ustępowanie miejsca).

W drobnych gospodarstwach dość powszechnie stosowany jest wypas mieszany. Pod tym pojęciem rozumieć trzeba wspólny wypas dwóch, a często trzech gatunków zwierząt tj. bydła, koni i owiec. Selektywność pobierania określonych gatunków roślin przez te zwierzęta oraz inna „technika" ich zgryzania sprzyjały tworzeniu się na tak użytkowanych pastwiskach niskiej ale niezwykle zwartej runi i sprężystej darni. Wypas mieszany najlepiej spełnia swoją rolę kiedy między zwierzętami jest więź społeczna (2). Jeżeli takich więzi nie ma, wówczas tworzą się odrębne stada monogatunkowe pasące się oddzielnie, nawet w dużych odległościach.

Za wypasem mieszanym przemawia: lepsze wykorzystanie runi i lepsza jej jakość, mniejsze niszczenie runi oraz ograniczenie inwazji pasożytów.

Pasące się zwierzęta pozostawiają na powierzchniach spasanych swoje odchody stałe (łajniaki) i płynne (plamy moczu). Ich ilość uzależniona jest od czasu trwania wypasu, wielkości (ciężaru) zwierzęcia i jakości spasanej paszy. Na pastwiskach intensywnych ilość odchodów pozostawianych na jednostce powierzchni jest większa niż na pastwiskach ekstensywnych. Ich rozproszenie jest bardziej równomierne. Na pastwiskach ekstensywnych zachodzi zjawisko gromadzenia się zwierząt w określonych miejscach i pozostawiania odchodów i dlatego niektóre partie spasanego użytku są ich całkowicie pozbawione, nawet na przestrzeni lat.

Niektóre uwarunkowania zwyczajowe

Cechą charakterystyczną na Polskiej wsi jest zakładanie małych powierzchniowo pastwisk tuż przy zagrodzie. Są to raczej powierzchnie spacerowe dla zwierząt niż źródło wartościowej paszy. Wypas zwierząt rozpoczyna się na nich często wraz z początkiem wegetacji roślin lub kilka dni po. Użytkowane są sposobem wolnym. Takie pastwiska charakteryzują się bardzo niską produkcyjnością i są najczęściej przeciążone (duża liczba zwierząt na jednostce powierzchni). Jedną z ich charakterystycznych cech są kępy wyrośniętej runi w miejscach pozostawianych odchodów, które często stanowią miejsca lęgowe małych ptaków gniazdujących na ziemi.

Innym zjawiskiem, jeszcze funkcjonującym na wsi, jest wypas zwierząt bez żadnych ograniczeń własnościowych na wszystkich, nawet trudno dostępnych użytkach zielonych od końca września. Jest to zjawisko pozytywne, zwłaszcza dla łąk tylko koszonych, dla których wypas jest sprzymierzeńcem utrzymywania korzystnego i bogatego składu botanicznego runi.

Wnioski

Stwierdza się zmniejszenie zainteresowania pastwiskowym żywieniem zwierząt w specjalistycznych gospodarstwach mlecznych (towarowych). W gospodarstwach nie towarowych oraz ekologicznych żywienie pastwiskowe jest nadal preferowane.

Niepokojącym zjawiskiem jest postępujący proces zwiększania się powierzchni tzw. łąk nie eksploatowanych (wyłączonych z produkcji).

Warunki siedliskowe stanowią podstawę do określenia sposobu, rodzaju oraz intensywności pastwiskowego użytkowania terenów zadarnionych (użytków zielonych).

Ukształtowane przez długi okres czasu związki między zbiorowiskami roślinnymi a zwierzętami przeżuwającymi sprawiają, że utrzymanie użytków zielonych w obszarach wiejskich w warunkach spadku pogłowia zwierząt musi być stymulowane zachętami ekonomicznymi (finansowymi).

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Session IV: Feasibility

Feasibility of extensive livestock farming in wet conservation areas.
Opportunities and risks from a United Kingdom perspective

Roy A. Harris

Streszczenie
W Wielkiej Brytanii, po II wojnie światowej, tradycyjne, niskonakładowe systemy rolnicze sprzyjające ochronie przyrody zostały niemal całkowicie zastąpione przez intensywne rolnictwo. Współcześnie rekreacja, turystyka i ochrona przyrody nabierają coraz większego znaczenia i uważa się coraz powszechniej, iż są one tak samo lub nawet bardziej wartościowe niż obecne rolnicze wykorzystanie wielkich obszarów kraju. W ciągu ostatnich 10 lat wprowadzono wiele programów mających na celu finansowe wsparcie rolników gospodarujących w sposób, który wspiera różnorodność biologiczną. Jednakże większość tych programów staje się coraz bardziej złożona i niedostatecznie elastyczna, nie uwzględniająca przyrodniczego zróżnicowania. Płatności są zbyt małe by właściwie zrekompensować rolnikom konieczność posiadania dodatkowych umiejętności i nakładów pozwalających na osiągnięcie dobrych wyników. Ponadto całkowita wysokość dotacji jest wciąż zbyt niska w porównaniu ze środkami wspierającymi produkcję. Prawdopodobnie największą wadą jest to, iż programy te dążą do rekompensowania rolnikom zmiany sposobu gospodarowania. W wielu wypadkach jest to słuszne, jednakże nie sprawdza się w przypadku wspierania niskonakładowego systemu rolniczego, opartego na pozostałościach tradycyjnego rolnictwa. W Wielkiej Brytanii rośnie zainteresowanie rozwojem lokalnych programów, które mogą łączyć wykorzystanie wypasu w celu ochrony przyrody i ekologiczną produkcję wysokiej jakości mięsa, które może być przetwarzane i sprzedawane lokalnie na potrzeby zarówno mieszkańców jak i turystów. Działanie to uważane jest za nowatorskie, podczas gdy nie jest niczym więcej jak powrotem do powszechnej w przeszłości praktyki.

Introduction

Land management specifically for biodiversity interests can be effectively integrated with low intensity food production. Rich wildlife habitats can co-exist with, and indeed may depend on, traditional farming systems. The practicalities of appropriate management are relatively straightforward: the problems that arise are almost entirely economic and social.

Changing agricultural policies and support schemes

The most dramatic and rapid changes in British farming have occurred in the last 60 years during and since the Second World War. Before the War, the UK was very reliant on cheap food imported from all over the world and did not have the capacity to produce more than a relatively small proportion of its domestic needs. These imports were greatly reduced during and after the War, leading to food shortages and hunger. It then became a priority policy to boost home production of food in order to produce as much of our needs as possible from our own resources, reducing dependence on imports. Initially support for agricultural production was focused on grants for intensification and direct price support, at first as a national system and then later as part of the European Union Common Agricultural Policy.

The result has been the intensification of agriculture and reliance on mechanized, chemical-based management techniques. There has been a huge increase in the volume of home-grown food and indeed an exportable surplus of production in some commodities. These benefits have been achieved at the cost of wholesale destruction of previously rich wildlife habitats like wetlands, calcareous grasslands, hay meadows and heathlands; and, in many ways just as important, the loss of traditional mixed farming systems that maintained rich biodiversity alongside food production and supported rural populations and cultures.

Initially there were improvement grants to plough up ancient grasslands and heaths, to clear woodlands and to drain wetlands, as well as deficiency payments to ensure that the price for farm products in the market was maintained at a profitable level. Later the ‘improvement’ grants were phased out but price support, and hence production support, systems remained.

However, within the last 10 years there have been dramatic changes in UK agriculture of a type and at a scale that was unimaginable 20 years ago. Agro-environment measures have been introduced that seek to reward farming practices that produce less food but help to maintain environmental and biodiversity values. Initially these were very small scale and operated alongside much larger production support measures, but now they are beginning to replace them.

Hill Livestock Compensatory Allowances were headage-based subsidy payments for cattle and sheep that helped livestock producers in difficult terrain (primarily uplands and distant and exposed coasts and islands) to compete with lowland producers who did not operate under the same difficult environmental conditions. Payments were based on the number of breeding animals kept. Under reforms to the Common Agricultural Policy, at least in part due to pressure from the World Trade Organization, these production support payments have been replaced by the Less Favored Area Support Scheme which makes payments that are dependent on the type and area of land grazed. Stocking density limits and codes of practice seek to ensure that there are environmental and social benefits, without any linkage to the amount of livestock production. In Scotland, the rates of payment are:

Farm Type	Annual Payment per Hectare	
	Improved Pasture	Rough Grazing
Moorland	£30.40	£ 9.60
Northern Upland	£45.00	£12.50
Southern Upland	£39.40	£11.40

The Sheep Annual Premium is the major financial support for the sheep farming sector. Until this year it was based on market-linked price support, to compensate producers if the average market price fell below a pre-determined level. This has now been changed to a flat rate payment independent of fluctuating market prices (for 2002, 21 Euros plus a Less Favoured Area Supplement of 7 Euros equivalent to £17.20 per female sheep) but still linked to the number of animals kept. With the further impending CAP reforms it seems inevitable that these production-support payments will be phased out and replaced by a system of financial support to secure environmental protection and enhancement and/or broader social benefits. The benefits may include maintenance of rural employment and hence the maintenance of those communities that currently depend on agricultural activity.

Currently within the UK there is a major political re-evaluation taking place of the role of farming and the wider uses of the land. It seems that buying food on the world market at lower prices than the cost of much of our home production is likely to be favoured, rather than maintaining the previous policy of growing as much of our own food as possible. The use of the land for recreation, tourism and nature conservation is increasingly being presented as having a value equal to, or greater than, the present pattern of farming over large areas of the country.

Many rural communities, and especially the remote ones, are still dependent on agriculture even though the farming labour force has been dramatically reduced. Without a viable farming economy it seems likely that many remote rural communities will decline and probably in time would cease to exist. Over the last three years livestock farming in the UK has been in crisis because of disease (BSE and Foot and Mouth) and because of the high value of the £ against European currencies, both factors crippling export markets and encouraging imports. Government figures have revealed that most livestock producers have been barely financially viable and they have depended for survival on the various subsidy and support payments and additional income from members of the family finding jobs off the farm.

Land Management Contracts are seen in Scotland as a possible mechanism for supporting farming activity as much for its social and environmental values as for its food production. The details of the contracts between the state and individual farmers have yet to be worked out but the basic concept has been inspired by the system being implemented in France (CTE).

Sustainability and Economic viability

Traditional, low intensity, high nature conservation interest farming systems have developed over thousands of years in Europe: many habitats and the species they support have developed in association with traditional farming. In the UK such systems have mostly been swept aside by agricultural intensification, particularly during the Second World War and continuing up until the present day, but some elements of them remain, especially in the remoter and peripheral parts of the country. Wherever long-established, traditional farming systems that support rich biodiversity interests survive in a reasonably intact state, they should be highly valued and maintained if at all possible. It is almost always going to be better to keep an existing pattern of land use that produces a mixture of environmental, social and some level of economic benefits than to replace it with a system of pure conservation management that might not prove any more effective, but almost inevitably might lose its linkage to traditional rural community and culture. Similarly, intensification of traditional farming systems is likely to produce higher yields, and probably greater economic viability, but at the cost of high capital investment, expensive chemical use, a much reduced workforce and consequent disruption, and possible demise, of rural communities and cultures. Above all, mechanized, intensive farming systems reliant on high chemical inputs have a track record of badly damaging, if not destroying, the wildlife habitats that they have replaced in the UK.

High nature conservation value farming systems are usually low nutrient systems with relatively high manpower input, low mechanisation and low levels of food production. It is difficult for these systems to compete on purely economic grounds with high intensity mechanised agriculture using high chemical inputs.

For environmental farming systems to be financially viable it is essential that Society recognises, and financially supports, the benefits that they can deliver that are additional to basic food production: rich biodiversity, high quality organic status food, maintenance of rural communities and cultures and the consequent focus for tourism.

Within the UK there does seem to be confusion at the highest level between ‘sustainability’ and ‘economic viability’. Many of the less productive farms in the most remote and marginal areas of farming may be environmentally and socially more sustainable, in that they use the land sensitively, produce food crops in a way that maintains high biodiversity interests, avoid high levels of environmental pollution and support a relatively large labour force that underpins rural communities. In contrast, highly productive farms which are financially profitable may not be truly sustainable in the long term because their food production volumes depend on the destruction of rich wildlife habitats, the use of high levels of chemical inputs, environmental pollution, mechanisation and a labour force too small to sustain rural communities.

There needs to be a much clearer perspective on all the pros and cons that exist between different systems of agriculture.

Agro-environment schemes

There has been a range of measures introduced over the last 10 years which have all been intended to provide a measure of financial support for farmers operating in a way that supports rather than damages biodiversity interests. Although broadly well-intentioned they have not always been well-informed and they have tended to be short-lived, only to be

replaced by new measures after two years or so. This has caused confusion among farmers, environmentalists and those operating the schemes.
There are a number of basic problems: most of these environmental support measures are becoming increasingly complex and prescriptive and not flexible enough to accommodate natural variability; the payment rates are not sufficient to properly reward farmers for the extra skills and effort required to achieve good quality results; and the overall funding is still very low in comparison with the production support budgets. Perhaps the biggest failing is that overall the schemes tend to reward farmers for doing things differently and this is an expression of the will to undo past damage. This is admirable in many circumstances but it is an inadequate approach when it comes to supporting existing practice based on the surviving remnants of traditional, environmentally sensitive, low intensity farming systems.
In the UK we have the tragic situation that £ millions are being spent to undo or ameliorate past damage, especially within intensively farmed areas, while environmentally compatible farming systems are still being lost because there is no adequate mechanism to support them. It is almost as if we have to first damage the environment before we are prepared or capable of putting measures in place to protect it. Present policies are making payments to undo the environmental damage that was caused by earlier policy decisions: farmers who at one time were paid to remove ancient hedgerows can now receive payment for planting new ones that will have a fraction of the value of those that were lost. While undoing past damage must be good, not causing environmental damage or loss in the first place would be better!

Multi-functional farming and local grazing schemes
In the UK there is increasing interest in developing local grazing schemes that can integrate nature conservation grazing with high quality organic meat production that can be processed and marketed locally, both for residents and as part of a wider tourist experience. There are two main strands to this which are complementary. Food marketing has become concentrated in large supermarket outlets that use their purchasing power to drive down the price paid to the farmer while using economies of scale to achieve high profits. A by-product of this has been to transport food all over the country, at high environmental cost, rather than using it as close as possible to where it is produced. A largely urban population has lost contact with the source of its food and there is too seldom a connection made between wildlife-rich pastures being maintained by sheep or cattle grazing, generating a crop of wildlife and also producing high quality meat that ends up as a nutritious and enjoyable meal on your plate.
Publicising the relationship between sensitive land management and quality food production helps to re-establish the link between food, landscape, the whole rural environment and biodiversity. Direct marketing by farmers either through farm shops or farmers markets can add value to their crop, especially if it is directed to high value niche markets because of its organic status or the special qualities of particular breeds. Linked with imaginative tourism the relationship between specialised local food, local producers and the biodiversity of the local environment can enrich the experience of visitors and increase the income to the local community. While in the UK this approach is being seen as ‘new’, in reality it is really a return to what in the past would have been the norm. Re-discovering some of the commonsense of the past might point the way to a more sustainable future.

Conclusion
In the UK new thinking is starting to recognise the importance of other values within farming apart from just the level of food production and profitability. Nonetheless, the whole of farming and the countryside is in the process of major changes and it is not yet possible to predict the outcome in terms of agriculture, biodiversity or rural communities. I would argue that there is value in learning from the UK experience, but primarily to avoid our mistakes

and to ensure that you can retain the best of your own traditional land management culture and community.

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Kerry Cattle, their conservation and use in habitat restoration in Ireland

Rory Harrington

Streszczenie

Praca opisuje działania zmierzające do ochrony bydła rodzimej rasy Kerry i wykorzystania jej do zmiany składu i struktury roślinności na obszarach chronionych. Hodowla bydła ma długi i bardzo wyraźny wpływ na europejski krajobraz. Bydło zostało wprowadzone do Irlandii wcześnie, jeszcze przed okresem neolitu. Długa historia hodowli i spasania roślinności były kluczowymi czynnikami kształtującymi zbiorowiska roślinne i zespoły zwierząt, niezależnie od tego jak bardzo naturalne wydają się dzisiaj. Kerry jest ostatnią mającą znaczenie i rozpoznawalną rasą bydła obecną współcześnie w Irlandii. Liczebność tej rasy zmniejszyła się znacznie w ciągu ostatnich 50 lat. Całkowita wielkość populacji wynosi prawdopodobnie mniej niż 800 sztuk. Dzisiaj rasa ta kojarzona jest głównie z obszarami o niskiej produktywności lub z mniej wydajnymi systemami rolniczymi. Potrzeba rozwoju metod rolniczych przyjaznych środowisku, Dyrektywa Siedliskowa i wdrażanie Konwencji o różnorodności biologicznej stworzyły klimat, w którym ochrona rzadkich ras bydła, takich jak Kerry, może być promowana.

Introduction

At first, it may seem difficult to find similarities between National Park needs in Ireland with those in Poland. This is particularly so when related to the subject of this workshop which focuses on the potential use of large herbivores in vegetation management. In Ireland, it is generally recognised that there is a need to reinstate lost woodland whereas in Poland and here in the Biebrzanski Park, the need is to slow or prevent the encroachment of woodland onto open sedge dominated communities on peat land soils. Nevertheless, similarities do exist, especially in the management of some vegetation communities of low species diversity such as *Molinia caerulea* dominated swards in upland peat lands in Ireland and areas of *Phragmities australis* in the Polish situation. These similarities form the substance of this presentation and it is hoped that the work undertaken in Ireland may add confidence to the National Park Service in Poland in the use of large herbivores, especially that of using native breeds of cattle. The differences between the two countries are of course also helpful, in that they may provide new perspectives in the way that their National Parks may be managed.

General Conservation Strategy

It is obvious that National Parks do not exist in isolation; rather they are part of an integrated economic, social and environmental context that involves all human endeavors. This is recognised by numerous international conventions and conservation agencies. It has been given particular emphasis by the Convention on Biodiversity in its report that advocates "An Ecosystem Approach". This concept was deliberated and given structure at a special workshop in Lilongwe, Malawi in January 1998. It identified 12 complementary and interlinked principles and recognises that humans are an integral component of any ecosystem. Thus, it recognises that consideration of past and present human impacts, is an essential step in establishing effective management structures for National Parks.

Other key ecosystem management requirements are:

the recognition of differing scales and patterns in time and space;
the need to manage on a water-catchment or river-basin basis;
that soil and in certain circumstances site management, may be necessary;
that fire, natural or human initiated, is frequently an important factor;
the identification of "key-stone" species and processes;
the consideration of the re-introduction of lost species;
the recognition of predator, parasite and pathogen impacts and management.

Cattle Husbandry

Cattle husbandry has had a long and profound impact on nearly all aspects of Europe's countryside, including that of Ireland's. The introduction of cattle to Ireland was early and may have predated even the Neolithic (Kelly, 1997 and Woodman *et al*, 1997). The impact of this long history of cattle and associated vegetation management have been key agents influencing nearly all extant plant and animal communities, no matter how natural they now appear. Kerry cattle, a relatively small dairy breed, are the last significant and recognizable land race of cattle remaining in Ireland today. They echo this long history. Their total population is probably less than 800, only 431 animals including 47 bulls are recorded in the 1996 pedigree herd book. It is understood that the situation for Poland's native breeds is similar, especially for the Czerwona Polska and marsh or Zuawka breeds. The National Parks and Wildlife Service of Duchas, The Heritage Service of Ireland, is a main player in conserving the Kerry cattle breed. Mainstream agriculture, where one would expect involvement, has shown little interest in the breed in recent decades, although it is only 50 years since they formed an important component of the dairying sector.

Kerry cattle are closely related to Welsh black, white park cattle, highland cattle and a number of other West European breeds, especially those of Britain (Alderson, 1978 and MacHugh *et al*.1998). Like these other breeds, Kerry cattle are today generally associated with areas of less favorable range conditions or with management systems that are less intensive than that used with more modern, mainly European continental breeds. In the need to develop more environmentally sound and sustainable methods of agriculture, the EU reform of the Common Agricultural Policy (CAP), EU directives such as the Habitats Directive and the implementation of the UN Convention on Biodiversity have provided a new context in which the conservation of rare breeds, including the Kerry, can be advanced. These new perspectives provide specific opportunities for the reinstatement of the Kerry and minority breeds into aspects of mainstream agriculture. These include areas of dairying, extensive cattle husbandry and their use in nature conservation. The realisation of these opportunities would require that the numbers of Kerry cattle and other minority cattle breeds increase many-fold more than they are today, thus securing their long-term conservation.

Conservation of Kerry Cattle

The UN Convention on Biodiversity and its advisory scientific agency SUBSTTA have identified the importance of conserving indigenous agricultural resources as entities worth conserving in their own right but most importantly, within an *in situ* context, in which an integrated approach is considered essential. Consequently, Kerry cattle require a twin-track approach to their conservation;

As a dairy breed, to be managed within the context of the dairy industry so that an adequate population in which the dairy attributes of the breed may be maintained.

As a cattle breed that can utilize extensive pasturage, especially in areas where the quality of the vegetation is of lower quality than that usually found on manured pasture such as that in the uplands. The situation already exists where the de-stocking of sheep in upland areas will require an appropriate large herbivore capable of grazing *Molinia caerulea* and other rough grasses and preventing further spread of bracken *Pteridum aquilinum*. Kerry cattle and their crosses with appropriate breeds, such as highland cattle as described below, have the potential to do this.

The use of the Kerry as a dairy breed

As the basic capacity of the Kerry is that of a dairy breed, it is difficult to consider how any meaningful conservation effort for the breed could be undertaken without addressing their promotion as such. This requires considerable focused effort, as present day dairy stock and their associated management are orientated towards producing relatively greater volumes of milk per lactation than those presently available from the Kerry. Few Kerry cows are milk-recorded and selection for increased milk production in the breed is presently limited. An initiative to increase the number of Kerry cows in recorded milk-production is therefore necessary. Whether this is to be achieved through promoting small numbers of Kerry cows in many herds or having larger numbers in a few herds is debatable, the essential need is to encourage the dairy sector to accept Kerry cattle into their herds. The same will apply to minority Polish breeds. Incentives to do this are required. One approach, initiated by the Irish National Parks, is the use of 'mettayage'. This ancient French system of crop sharing was recently successfully used in Africa to provide cow/heifers to family farms where capital was limited. This approach involves the 'free' loan of cows/heifers in exchange for the undertaking by the borrower to lend a similar number of stock to another, similarly committed farmer. This would allow a limited stock to grow exponentially at little or no cost to either the farmer or donor. Under the Rural Environmental Protection Scheme (REPS) funded by the EU and operated by the Irish Government Department of Agriculture, Food and Rural Development, financial incentives to keep Kerry cattle presently exist for those farmers who participate in the Scheme. Additional incentives to milk and record the performance of Kerry cows would be most helpful. It has been suggested that what Kerry cows lack in milk volume production is partially compensated for by the quality of their milk, exploring this aspect of the Kerry is an additional priority, providing information that could be used to promote its milk. An economic audit including the wider aspects of environmental costs and benefits of the use of the Kerry in dairying could also provide additional supporting information for this or other minority milk breeds. Their use in grain-less, grass only or 'organic" milk production maybe one area where such information might be supporting. Combined, these less generally recognised values of the Kerry may encourage more mainstream dairy farmers to participate in their use.

The use of the Kerry in beef production

Any effective conservation strategy for the Kerry breed will require that all aspects of its production be considered. The orientation of the Kerry to dairying would seem at the outset, to make it a less than ideal candidate breed for beef production. However, its size and the quality of its meat suggest that it may have a role in quality beef production, especially for certain niche markets, now that traceability in beef production is required. Again, the ability of the breed to thrive on less favorable pastures or where winter fodder supplementation is limited makes the breed attractive. While the numbers of the breed are below those required to secure their long term survival it is difficult to consider their use as a dam breed in any cross breeding program. Nevertheless, their dairy status would also make them a good candidate for crossing with a number of beef breeds. Initial steps to explore this on a limited scale using highland cattle as sires was undertaken in 1996 and following years at Killarney National Park. The resulting first crosses were used in extensive upland summer/autumn pastures and over-wintered without supplementary feeding on conserved pasture. This cross has similarities to that of other hardy crosses known as 'blue blacks' traditionally produced in Ireland for out-wintering in Scotland. The establishment of an identifiable cross that has marketable value based upon the Kerry would further enhance the value of the breed. The use of the Kerry in such controlled crossing may provide additional value to the breed provided that it does not undermine the genetic integrity of the breed. Their long reproductive life facilitates this.

Kerry Cattle in Conservation Management

In 1993 the first tentative steps were taken by National Parks in Ireland to see if habitat restoration could be undertaken on a systematic basis. Of primary interest was the need to see if cattle grazing could facilitate the restoration of upland habitats including that of the red deer *Cervus elaphus,* the mountain hare *Lepus timidus* and red grouse *Lagopus lagopus* in Killarney National Park in the South-west of the country. This approach followed upon the results of research that showed that there were major differences in the way that different species of large herbivore fed. These differences suggested that one type of herbivore could facilitate another through complementary use of the available vegetation. It was anticipated that the cattle, which are relatively unselective roughage feeders, could remove dominant grasses such as that of purple moor grass *Molinia caerulea* in the upland areas thus improving conditions for soft grasses and dwarf shrubs such as heather *Caluna vulgaris* and blue berry *Vaccinium myrtilis*. These dwarf shrubs are important food and cover species used by remnant, once larger populations of hare and grouse. The red deer too were expected to benefit from the year-round growth of soft grasses. This use of cattle in habitat restoration has more recently been reported by Bokdam, 2002 and Van Wieren, 1998 amongst others. Broad-scale practical initiatives such as the Grazing Animal Project (GAP) in the United Kingdom and La Canada, (The European Forum on Nature Conservation and Pastoralism) have proven effective and indeed a necessary approach to many of Europe's nature conservation sites, including National Parks. They also have the added objective of supporting pastoralism as a culturally important way of life in many parts of Europe.

Although the relative non-selective feeding behavior of cattle is seen as being far preferable to that of the sheep that have had access to most upland areas in Ireland, both positive and negative effects were expected with a change to cattle. Impacts varied depending upon cattle density, season and duration of grazing and the site's vegetation composition and structure. The Irish experience is that the use of 0.5-1.0 head of cattle per ha on a summer-autumn basis was effective in reducing the *Molinia.* Some perceived negative effects were localized poaching of the ground especially on areas of deep peat and along streams. However, such bare areas could provide opportunities for specialized plants and invertebrates. Whilst the initial impact by the cattle was obvious, changes in the vegetation's structure was slower and it seems that 10 or more years may be required for these changes to become established. Year-round grazing required a hardier type of cattle than the dairy Kerry. Crossing with the distinctive Highland cattle, probably once common in Ireland, produced a hardy type that was not only recognised as a good beef type by the country's farming organisations but was also easier to handle, especially in the more extensive conditions associated with year-round grazing.

In earlier times unenclosed cattle were tended by herders. In present times, control necessitates other methods either through being extensive or free ranging or by the use of electric fencing. Temporary electric fencing was found to be both effective and practical.

Strategy for Sustained Management

The primary conservation goal for endangered breeds such as the Kerry cattle must be to increase their numbers in ways that are consistent with maintaining their special traits whilst avoiding inbreeding depression, perhaps even increasing their genetic variation. The most logical context for this to take place is to promote their value. In the case of the Kerry cattle, value may be sought directly within the breed for the products they produce and in their use in nature/cultural conservation. While frequently dismissed, even derided by mainstream agriculture, (commonly refereed to as being a 'poor man's cow') of giving too little milk, having low beef value, difficult to handle or being too small etc. Such perceptions are easy to

understand within the very competitive and production orientated environments of present day agriculture which has not until recently had to pay much attention to the hidden costs of environmental degradation and biodiversity loss. It is also, given the economic and social difficulties endured by farmers in the past, understandable that links with difficult times are actively forgotten. The fact that Kerry cattle and other old breeds were once the mainstay of agriculture for hundreds if not thousands of years, raises the fundamental questions of what their inherent values that have allowed them to be used for so long were and how their traits may now be exploited. From the work that has been done so far in the Killarney Park, it is clear that local ancient breeds such as the Kerry are well adapted to local conditions. This local breed may better suit the management needs of the Park for summer grazing though hardier cattle as developed in the cross breeding program mentioned above, are needed for exposed sites and for year-round grazing of upland areas.

The experience gained from these initiatives, especially in the use of cattle in habitat management in Ireland, suggests that attention to the following points can beneficial:

taking a step-by-step approach;
establishing a network of trial and demonstration sites in different areas;
recognizing that there are different scales of time and space for each situation;
establishing permanent sampling sites to record ecological change through effective monitoring procedures;
effectively informing the public through 'flagship' projects and demonstrations;
taking an interdisciplinary, intersectoral and holistic approach.

In the Irish context, the conservation of the rare and threatened Kerry cattle has been provided with new opportunities through their compatible role in habitat management. Similar opportunities have been found for other breeds and species in other European countries and it seems that the dual objectives of breed conservation and habitat-management are mutually supporting and worthy of further development.

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Involvement of grazers in conservation management of the Beka reserve

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Streszczenie
*Rezerwat Beka znajduje się w północnej Polsce, w pobliżu Gdańska, w granicach ostoi ptaków IBA – Zatoka Pucka i Nadmorskiego Parku Krajobrazowego. Rezerwat to około 200 ha głównie podmokłych łąk halofilnych (*Juncetum gerardi*), trzcinowisk, zbiorowiska* Scirpetum maritimi *oraz zarośli wierzbowych. Coroczne zimowe zalewy słabo zasolonymi wodami Zatoki Puckiej sprzyjają utrzymywaniu się słonaw. Po utworzeniu rezerwatu zabroniono prowadzenia wypasu lub jakiejkolwiek innej działalności rolniczej na tym terenie. Wkrótce łąki halofilne zaczęły zarastać trzciną, co miało negatywny wpływ na liczebność gnieżdżących się na tam siewkowców. Mając w zarządzie teren rezerwatu OTOP rozpoczął letnie wykaszanie trzciny oraz wypas przy użyciu bydła i konika polskiego. Mieszany wypas pozwala na uzupełnianie się efektów: konie pasą się na roślinności zdeptanej przez bydło i wykorzystują fragmenty łąki, których ono nie wykorzystuje, bydło natomiast w przeciwieństwie do koni wybiera trzcinę jeżeli alternatywą jest roślinność halofilna lub turzyce. Wiosną 2002 roku odnotowano znaczny wzrost liczebności lęgowych czajek, natomiast liczebność lęgowego biegusa zmiennego została utrzymana na tym samym poziomie. Bardzo istotnym elementem projektu jest współpraca z rolnikami.*

Introduction

The Beka reserve is located near Gdansk (northern Poland) within the borders of the Important Bird Area (IBA) – 'Puck Bay' and Nadmorski Landscape Park. The reserve (200 ha) covers mostly salt and brackish marsh habitats (*Juncetum gerardi*), reed beds, *Scirpetum maritimi* community and Willow (*Salix)* scrubs. Brackish flooding water from the Puck Bay inundates the reserve during winter and creates appropriate conditions for the development of salt marsh plant communities. The key bird species are breeding waders, especially Dunlin, which is nearly extinct in Poland. After the establishment of the reserve, grazing and other farming activities were not allowed any more within the area. In a very short time, the salt marsh became invaded by reed. The succession had a significant, negative impact on the number of breeding waders. Other factors like raptor pressure, tourism, and recreation may also have a negative impact. OTOP has carried out various protection measures in the Beka reserve to stop the Reed invasion and improve the habitat conditions for breeding waders. The management is based on an agreement between OTOP and the Gdansk Nature Conservation Authority. Apart from summer reed cutting, OTOP provides mixed grazing with cattle and horses (tarpons).

Grazing

It appeared that grazing was a very useful conservation tool in the Beka reserve conditions. Grazing provided very short vegetation, which was very suitable for breeding Dublin and Lapwing. In the spring 2002, there was a significant increase in the number of breeding Lapwing. The abundance of breeding Dublin was maintained.
There are a few advantages of using mixed grazing:

Cattle	Horses
Prefer to graze on reeds if there are only salt rushes and sedges as an alternative Are not afraid to enter reedbeds	Graze on vegetation trampled by cattle Graze on patches of grass omitted by cattle Prefer to graze more on salt rushes than on reeds

Feasibility

OTOP was faced with many economical and sociological problems during the implementation of grazing in Beka reserve. The local farmers regarded Beka reserve as an unsuitable pasture

for dairy cows. Besides they can rent land near their home village for a very low price. And they remember the time, when grazing was prohibited on the reserve after its establishment. OTOP decided to solve the problem by co-operating with farmers. The warden of the reserve developed good contacts with farmers and now he is known by most of them. Building up a good relationship is not easy and requires time and energy. Farmers do not like to talk much about biodiversity, birds and plants. Their interest is farming. Therefore wardens should have an elementary basic knowledge of farming and the various kinds of problem farmers are faced with.

Conclusions

Mixed grazing is worth considering in very rough pasture condition. Cattle and horses supplement each other, providing very suitable habitat for waders. There is a need to treat farmers as a partner and to develop proposition of joined projects, talking not about wildlife values of the place but about measurable benefits they can achieve from such kind of collaboration.

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Limiting bush encroachment at Biebrza marsh by Konik/Tarpan grazing.

Marek Borkowski

Streszczenie

Światowe wartości przyrodnicze Bagien Biebrzańskich związane są z występowaniem otwartych torfowisk niskich. Wskutek sukcesji roślinnej, obniżenia poziomu wody, zaniechania tradycyjnej gospodarki rolnej dochodzi do zakrzaczania - utraty wartości tych obszarów. Spróbowałem przeciwdziałać niekorzystnym zmianom przez hodowlę Konika Polskiego. Wykorzystałem jego specyficzną dietę (m.in. gatunki drzew, krzewów kolonizujących bagna), małą masę ciała, odporność na choroby i warunki klimatyczne. Zgromadziłem zasadnicze i oryginalne doświadczenia dotyczące prowadzenia stada, dostosowania wypasu do pór roku, poziomu wody, pogody, etc. Program zapoczątkowany został ponad 20 lat temu. Wynaleziona na podstawie wypraw studialnych do obszarów podmokłych Eurazji (od Pacyfiku po Atlantyk) i doświadczeń miejscowych, nowa technika czynnej ochrony przyrody, wprowadzona w życie na Bagnach Biebrzańskich, wzbudziła po latach zainteresowanie na zachodzie Europy i rozprzestrzeniła się po wielu rezerwatach naszego kontynentu, stanowiąc oryginalny wkład Polski w europejski rozwój tej dziedziny. W ostatniej edycji konkursu Eurosite'u na najlepiej czynnie chroniony rezerwat sieci Natura 2000 obejmującej WSZYSTKIE cenne przyrodniczo tereny EU zwyciężył Redgrave-Lopham Fen (GB) chroniący torfowisko niskie przy pomocy stada Koników Polskich składającego się z naszych zwierząt przybyłych znad Biebrzy i kilku pokoleń ich potomków. Prócz ochrony wartości terenów podmokłych, hodowla Konika Polskiego przyczynia się do zachowania tej nielicznej (a najbliższej oryginalnemu, dzikiemu koniowi Europy) rasy rodzimej. Podjęte jeszcze przed powołaniem Biebrzańskiego Parku Narodowego starania o kontynuowanie eksperymentu również na gruntach Skarbu Państwa (co było założeniem przedsięwzięcia) w końcu uwieńczone zostały pewnym sukcesem. Na podstawie rocznej umowy z dyrekcją wprowadziłem na tereny państwowe stado 20 sztuk. Pozwoliło to pokazać, że Konik Polski może samodzielnie żyć w stanie wolnym, bez płotów i dokarmiania nawet w trakcie zimy - precedens na skalę europejską. Miejmy nadzieję, że te osiągnięcia i uzyskana wiedza nie zostaną zaprzepaszczone.

Introduction

Open marshland habitats are the natural values of global importance over 100.000 ha Biebrza Marsh (NE Poland). Aquatic Warbler *(Acrocephalus paludicola)* and Great Snipe *(Gallinago media)* are just two examples of species from Appendix I of EU Bird Directive - more numerous at Biebrza Marsh than in any area covered by the directive. For both species open marshland is essential.

Due to plant succession the open habitats are replaced by willow-alder-birch scrub. Over the last centuries, traditional management (mowing/grazing) was a factor limiting the bush encroachment, but this gradually disapeared after WWII. Although only on a small scale, the last bursts of such traditional management were still there to be studied up untill the 70's, giving a chance to learn from several generations knowledge.

Then, as an answer to the abundance of traditional management (and consequently natural habitat values), in the late 70's the idea of grazing by Konik/Tarpan horses was conceived. Specific diet, including seedlings, leaves, shoots, twiggs, bark, etc. of mentioned plant species was the main reason. Body size, local breed, resistance towards hard weather conditions, immunity, good character were also factors to take into account. Last but not least was a value of the rare breed, the nearest to original wild horse of Europe one may get nowadays.

Since the 70's several big wetlands in our climate zone where horses appear were visited to gain more knowledge - from Spanish Coto Donana in the west to Manchurian Zha Long in the east. At the same time experience of keeping and breeding horses was gathered in different Polish stables. Supplementary studies of particular breed of Konik were undertaken as well - both in the field as well as through literature.

The Konik experiment in the Biebrza Valley

The Konik experiment has begun just on small patches of marshland, I have bought or loaned from individual farmers - as there were several restrictions on buying land in Poland during the period of time mentioned. About one half of the marsh is privately owned with thousands

of locals having small plots; the other half is owned by the State and then was administrated by a Forestry Service (and now, for some years, by a National Park). Since the begining the aim of the program was to introduce the horses into the state owned part of the marsh.
The own financing (the purchase of horses but also the infrastucture, haymaking, etc.) and difficult conditions for any private or nongovernmental initiative at that time were factors limiting the size of experiment. However the first animals were put into the parts of Southern and Middle Basins of Biebrza Marsh and progressively more and more of the marsh was managed with more and more horses.
Due to the limited possibilities the management was concentrated in areas important for breeding of rare bird species, esp. Great Snipe, Corncrake or Aquatic Warbler. For the purposes of monitoring some plant species composition descriptions were undertaken - again with limited possibilities.
Through the years different techniques were used: from intensive fenced pasture to fenceless free roaming herd, from seasonal to all year round grazing. Over the years the original knowledge about limiting bush encroachment by Konik/Tarpan grazing was gathered. The most productive and less harmful ways of limiting plant succession were discovered.

Suitability
The impact of horses on limiting willow and alder encroachment can be reasonably high if the animals are properly used - it is due to browsing and in addition also due to breaking young trees and branches in a process of the horses scratching. The size of the impact depends very much on the intensity and season of grazing. Of course willow and alder are not the only (nor even the first or the second) choice of the horses - but the knowledge of "when and where" helps to concentrate and direct their foodtake at unwanted species.
In all cases the encroachment of bush at the managed areas was stopped or slowed down and in all cases the number of breeding birds of key species was stabilised or even increased. In particular Konik/Tarpan grazing is an important management tool in the protection of the first nongovernmental nature reserve in the EEC - the Great Snipe lek near Budy. At the same time unmanaged plots nearby turn into a scrub, loosing those species mentioned that require open marsh habitat.
Because of Polish climate and soil conditions the essential point is to adjust the places and time of grazing to actual water level and weather conditions. Due to these variables (plus horses seasonal behaviour), strict dates/areas for putting animals into the marsh can not be stated. The autumn and especially winter grazing are the essential issues but they have to be played by ear and experience.
Nature conservationists from Western Europe carefully watched the effects of my Konik/Tarpan grazing at Biebrza Marsh. As a result the horses were asked to help with a problem of overgrowing in other countries. RSPB (the biggest nature conservation organization in Europe) decided to manage Minsmere (it's first and most respectable reserve) with horses born at Biebrza Marsh and their descendants.

Feasibility
In this situation of using several separated small pieces of land - keeping the horses in one place and then moving them to another was always a big issue. Different types of electric fencing were used. Having the horses wild enough to be self-sufficient in heavy conditions and at the same time tamed enough to be easily taken from one part of the marsh to the other - is a result of learning on several generations.
On the other hand the unfenced free roaming animals caused different problems in terms of monitoring. To find and then watch the horses on the flat, extensive marsh (also during a short snowy winter day) - a radio collar was the solution. To get to the herd on this vast area

covered by snow or water rough four- or six- wheel drive trucks were used, although sometimes the only way was to go on a horseback.
To run the program over the decades I breed the horses myself. In a situation of a narrow gene pool it caused some problems. All the animals have a full pedigree and long term selection of parents needs much imagination and breeding skills - as well theoretical as practical (different grazing regimes). Inbreeding factor matters as much as the quality of the offspring (both physical and psychological) and their help in bush maintaining.
Potential threats such as the attitude of locals and wolf predation did not appear to matter much after years. Moreover the scarce human population of the marsh is proud of the experiment and help in finding the herd or maintaining it safely (*e.g.* pulling horses out of a ditch by hand after accidentally falling in). Despite great interest by wolves in the horses and observed interactions between a pack and the herd not even a single foal has been lost so far - a group system of defence seems to work well.

Perspectives
Of course one of the limits of running and developing the Konik/Tarpan program is money. All the work so far is done by me & my family and has been financed from my pocket. Let's hope that after the Poland access to the EU an interest in nature protection of the marsh from both European society and authorities will help to back this management.
There is no doubt that open habitats are lost in Biebrza Marsh due to no management. Due to changes of farming there is only a little (and still diminishing) interest in grazing the marsh and in addition there is a shortage of primitive breeds able to do so. The well-established herd of Koniks/Tarpans does the job.
It is not just at this site too, since Koniks/Tarpans show their positive impact in several nature reserves in Western Europe (Netherlands, UK, France, Germany). The last edition of Eurosite award for the best managed Nature 2000 Site was won by Redgrave & Lopham Fen (Suffolk/Norfolk, UK), grazed by the horses born and reared at Biebrza Marsh (and their descendants). It is certain that Biebrza Marsh will be another Natura 2000 site when Poland join the EU.
My efforts to put Koniks/Tarpans into the state owned part of the marsh started well into the previous century. In the early 90's I managed to interest two forest divisions, administrating the marsh, into introducing the horses. The forest administration was then replaced by the new BNP authority.
Finally the long efforts to interest National Park administration in managing the marsh led to a sort of success, after all. A yearly agreement was signed and a herd of horses was introduced to state owned grounds as well as to the private ones. It set a precedent - the first unfenced free roaming horse herd in Europe since the original Tarpan was eliminated on the Ukrainian steppes in the XIXth century.
For such a long haul programme an understanding, good will as well as a positive and stable attitude by the authorities (at a national park administration and a central government level) is essential. This quarter of a century management just fulfils the nature protection statutory duties of a relatively new national park. The nature protection technique of limiting plant succession by a local Konik/Tarpan breed is a Polish chapter in a book of European nature conservation.

Let's hope the knowledge will not be wasted.

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Session V: Research

Spatial explicit models in grazed landscapes

Harmke van Oene

Streszczenie

W pracy opisano model służący do analizy zależności roślina – roślinożerca i powiększenia tych zależności do skali krajobrazowej. Model ten można wykorzystać w prognozowaniu wpływu roślinożerności na rozwój roślinności. Jest to model ekosystemu posiadającego moduły: obiegu wegla i azotu w roślinach, glebowej materii organicznej i atmosfery. Rośliny konkurują o światło i azot. Dodatkowo, dołączono moduł dotyczący roślinożerności, który opisuje selektywne pobieranie pokarmu przez roślinożercę w przestrzennie zróżnicowanym obszarze. Przeprowadzono symulacje analizując wpływ zagęszczenia roślinożerców na dynamikę roślinności, wpływ zasobności gleby na maksymalne zagęszczenia roślinożerców oraz wpływ zagęszczenia roślinożerców na krajobraz. Krzywa maksymalnego zagęszczenia roślinożerców przybiera kształt odwróconego U wzdłuż osi charakteryzującej spadek zasobności gleby. Przy wyższej żyzności gleby konkurencja o światło staje się bardziej istotna. Roślinożerność wpływa na konkurencję roślin, promując wysokie, mniej smaczne rośliny i w efekcie redukując jakość i dostępność pokarmu, a co za tym idzie pojemność obszaru. W skali krajobrazu roślinożerność prowadzi do wzrostu zróżnicowania. Dalszy rozwój modelu bedzie związany z rozszerzeniem możliwości jego zastosowania. Przygotowywany jest moduł opisujący dynamikę populacji roślinożerców. Zostanie również dołączony moduł hydrologiczny uwzględniający wysycenie przestrzeni glebowej, wpływające na przepływ wody kapilarnej z głębszych warstw gleby. Pozwoli to na testowanie modelu dla różnych rodzajów gleby. Zastosowanie modelu dla innych typów ekosystemów zostało zmienione na wpływ globalnych zmian w akumulacji wegla i zróżnicowania gatunkowego roślin. Zmiany te czynią model przydatnym narzędziem do analizy wpływu działań ochronnych na zróżnicowanie krajobrazu, populacje roślinożerców, obieg azotu i zróżnicowanie gatunkowe roślin na skalę krajobrazową.

Abstract

Herbivore grazing is increasingly applied as a management tool to prevent the dominance of vegetation by tall grasses or trees. A model is described that is used to analyse plant-herbivore interactions and their scaling up to landscape level. The model can be used to predict effects of herbivory on vegetation development. The model is an ecosystem model including modules for carbon and nitrogen cycling through plants, soil organic matter and atmosphere. Plants compete for light and nitrogen. A herbivory module is included that implements selective foraging by a herbivore in a spatially heterogeneous area. Simulations were done to analyse the effects of herbivore density on vegetation dynamics, to analyse the impact of soil fertility on maximum herbivore density, and to analyse effects of herbivore density on landscapes. Two important points come forward from the model. Maximum herbivore abundance shows a hump-shaped curve along a soil fertility gradient. At higher soil fertility, light competition becomes more important. Herbivory interferes with plant competition, giving the tall, less palatable species a competitive advantage and thereby reducing the food quality and availability and hence the carrying capacity of the area. At a landscape scale, herbivory leads to increased heterogeneity.

Further model developments have been made that extend the model's application area. A module describing herbivore population dynamics is under development. A hydrology module is included that accounts for saturated and unsaturated soil compartments, allowing for capillary water flow from deeper layer. Therefore the model is suitable to be used at different soil types. Applications to other types of ecosystems have been directed to the effects of global change on carbon accumulation and plant species diversity. The complete set of developments make that the model is a suitable tool that can be used to analyse the effects of

management practices on landscape heterogeneity, herbivore populations, nitrogen cycling, and plant species diversity at a landscape level.

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