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THE USE OF EXTENSIVE SHEEP GRAZING AS A METHOD OF ACTIVE PROTECTION WITHIN NATURA 2000 SELECTED HABITATS[1]

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Summary. When there is sustainable development, active protection of Natura 2000 habitats should be an integral part of the complex issues of landscape conservation. Ensuring the sustainability of basic natural processes and the development of the spatial interrelationships between natural habitats determines the effective conservation of resources and values of biodiversity in Natura 2000 sites. The introduction of free sheep grazing in the Kózki nature reserve (the river Bug valley, eastern Poland) may contribute to protecting the psammophilous grasslands as well as promoting the farming of native sheep breed Świniarka. The active way of nature conservation, taking into account the use of the Natura 2000 habitats, allows the optimization of economic activities with conservation.

Key words: Natura 2000 sites, active habitat protection, extensive sheep grazing, landscape, biotic diversity, soil, enzymatic rates

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INTRODUCTION

Natura 2000 is a major European program aimed to contribute to the implementation of one of the main objectives of the sustainable development of the European Union [Makomaska-Juchiewicz and Tworek (ed.) 2003, Weigle 2004, Chmielewski (ed.) 2006]. Ensuring the proper condition of the Natura 2000 habitats is one of the most important tasks of nature protection in Poland, resulting from the EU habitats directive [Directive 1992] and is important from the standpoint of maintaining the characteristic features of the landscape heritage of the region [Chmielewski (ed.) 2006].

The Natura 2000 sites are not strictly protected areas. They are reclaimed areas and the fundamental condition that must be met here is the protection of biodiversity in terms of sustainable use of natural resources [Chmielewski 2006]. The conservation way to protect nature, based on more or less isolated areas protected from human activity, is replaced by the active shaping of the environment, which allows optimization of economic and protective actions [Ryszkowski 2004]. Among the various possible ways of active protection of nature, Mroczkowski [2011] points out that sheep grazing can have a positive impact on the functioning of the landscape and biodiversity of protected areas, including valuable floristic diversity of plant communities.

The reactions of ecological systems to active protection are often very specific, have their individual character, and the results obtained are not always fully consistent with the expected ones. When it comes to poor ecosystems and those long remained in the stage of degradation, obtaining the desired effect is burdened with a high degree of uncertainty and can be very costly [Chmielewski (ed.) 2006].

The aim of this article is to review the theoretical aspects of active protection of the Natura 2000 habitats, with particular emphasis on the role of free grazing in the protection of grassland habitat diversity and the role of enzyme tests in the assessment of the quality of these habitats. The article also presents problems of the active grassland habitats, for example nature reserve Kózki, located in the Natura 2000 sites and in the valley of the river Bug.

THEORETICAL ASPECTS OF THE ACTIVE PROTECTION OF THE NATURA 2000 NATURAL HABITATS

The active protection of the Natura 2000 habitats should be an integral part of the complex issues of landscape conservation [Chmielewski (ed.) 2006]. Without considering the scale of landscape, protection of habitats and species diversity of the country will not be effective [Chmielewski 2001, Żarska 2005, Chmielewski (ed.) 2006].

The issues of the active protection of the Natura 2000 habitats have the following main aspects:

– the subject aspect – physiographic, ecological, sozological and landscaping conditions;

– the spatial aspect – (external and internal pressures and measures for their mitigation);

– the time aspect – (duration of treatment and durability of the obtained protective effects);

– the legal aspect (legal conditions of active protection);

– the conflict aspect – active protection as a source of spatial and social conflicts [Chmielewski (ed.) 2006].

The main meaning of the subject aspect is order. All physiographic, ecological, sozological and landscape structures are interrelated. They form a complex system of structures, processes and phenomena that is extremely difficult to be studied, designed or developed [Kowalkowski 1999, Ryszkowski 2004, Chmielewski (ed.) 2006]. Objectivity and full characterization of environmental processes require long-term monitoring [Majer 2007]. The spatial aspect is related to the need for active protection of habitats both within the Natura 2000 (internal actions) and in their environment (external actions), due to the diffusion migration of anthropogenic pollution, as well as fauna and flora because of their ability to move and carry out major natural linkages in space [Kurnatowska 2002, Mackenzie 2005]. The time aspect – stability of the active effects depends on the nature conservation of natural and anthropogenic conditions. Both can stimulate or reduce the effects of protective measures [Baranowski 2000]. The legal aspect covers the legal standards for the protection of nature and landscape [Żarska 2005, Chmielewski 2006]. Implementation of the Natura 2000 conservation is hindered by law variability and its ambiguity [Chmielewski (ed.) 2006]. Chmielewski [2011] points out that both the nature conservation act as well as various studies of an environmental strategy and programs, the problem of conservation and landscaping is still marginally considered. The conflict aspect is often spatial, infrastructure and economic. It is the result of poor information policy and bad organization of the active implementation of the Natura 2000 habitats [Baranowski 2000, Chmielewski (ed.) 2006].

According to Franklin [1997], the active nature conservation should include the following tactical elements of implementation:

– incorporation of knowledge about habitat conditions and prospects of landscape ecology;

– ecological consequences of protective actions;

– use of geographic information system GIS;

– the inclusion of the species composition of plant communities with its diversity to assess the functioning of the ecosystem;

– integration of environmental management approaches in the diversity of spatial and time scales;

– identifying the perspectives of development dynamics of the ecosystem, including their association with global changes;

– implementation of adaptive management based on evolutionary ecosystem;

scientifically designed, reliable, continuous monitoring of the ecosystem.

Forecasting the effects of changes in the environment that will occur under the influence of the system of active protection of habitats is a very difficult task because you can not always predict them [Mayer 2007]. Wätzold [2006] advocates the use of indicators for quantifying the environmental impacts of the proposed treatment plan. According to Ryszkowski [2007], predicting the environmental effects of conditioned changes in landscape structure caused by treatments of the living resources of the active protection of nature was made possible by the system analysis and development of forecasting models. The analysis of the multifunctionality of landscapes [Ryszkowski 1998, 2007], proposals for indicators to monitor changes in landscape characteristics [Fischer and Magomedow 2004, Wätzold 2006, Bielińska 2008], an integrated analysis of the costs and effects of nature [Gutman 2002, Chmielewski 2006] are important elements of the management of the Natura 2000 areas, broadening the reach of landscape ecology in terms of both theoretical analysis and methods of conservation projects.

ENZYME TESTS AS DIAGNOSTIC INDICATORS OF LANDSCAPE CONDITION AND TRANSFORMATIONS

The functioning of the landscape is a continuous circulation of matter and energy flow that occurs between elements of the landscape [Fischer and Magomedow 2004]. The most active components of the landscape, determining its quality are soil microorganisms. The indicator of their metabolic ability are enzymes secreted into the soil environment [Bandick and Dick 1999, Kieliszewska-Rokicka 2001, Bielińska 2007]. The changes in the circulation of matter and energy flow through the elements of landscape, caused by environmental factors determining the enzymatic processes, reflect changes in the specific capacity of the soil complex [Bielińska *et al*. 2008].

In order to know and clarify the potential drift habitat in the ecosystem, under the influence of active protection, it is necessary to choose communicative indicators of the long-term changes in habitat conditions [Kowalkowski 2002, Wätzold 2006, Bielińska *et al*. 2008]. Enzymatic indicators provide information on the state (quality) of the natural environment as well as the nature of the changes. The indicators allow monitoring and identifying long-term trends [Domżał and Bielińska 2007]. The main advantage of biological methods to assess the functioning of the landscape, based on enzymatic assays, is not only the ability to perform serial studies, but above all, the ability to express a summary of numerous factors, and impact assessments which are impossible to determine the parameters in other ways, such as components of cellular metabolism [Kieliszewska-Rokicka 2001]. Biochemical processes occurring in the soil play an important structural and functional role in the dynamics of plant nutrient cycle and may significantly affect their growth and development. Simultaneously, changes in soil enzyme activity reflect the environmental problems that affect both the soil and plants [Bielińska 2007].

In the world literature there are no reports on the use of enzymatic methods for the analysis of the structure and functioning of landscapes. In Poland, research in this area is led by Bielińska and her colleagues [Bielińska 2007, Bielińska *et al*. 2008]. The research shows that the enzyme tests allow a reliable assessment of the functioning of the landscape [Bielińska 2007].

Because of the role of microorganisms in maintaining and restoring soil fertility, assessing the impact of anthropogenic stressors associated with agricultural human activity on their development and activity in the soil, became in many countries one of the elements to be checked by the monitoring of the environment [Domżał and Bielińska 2007]. It is worth noting that most of the information in literature is related to the departure of such an indicator of a laboratory experiment, without sufficient account of both the protective mechanism that occurs in natural soils and microorganisms and enzymes to protect against the influence of environmental stress, and current habitat conditions that determine changes in the system and the functioning of soil landscape.

The soil plays a fundamental role in shaping the conditions of existence of ecosystems. Soil quality assessment is not easy due to the complexity and variability of the soil environment as well as chemical, physical and biological conditions. Furthermore, the fact of overlapping in soil caused by anthropogenic and natural factors and the ability of soils to self-regulation of these changes significantly impedes their analytical and interpretive substantiation. A significant role is played by changing conditions related to the buffer capacity of the sorption complex, and the retention and accumulation of elements in the soil [Domżał and Bielińska 2007]. Specific soil processes, mainly related to microbes and enzymes secreted by them, are dynamic and the direction of these processes is the result of many biotic and abiotic factors shaping the balance of ecosystems [Bielińska *et al*. 2008]. All the changes of nutrients occurring in the soil enzymes are stimulated by conditioning their transition into forms available for microorganisms and plants as a source of energy and nutrients. Changes in soil enzymatic activity is the earliest sign of change of intensity of life processes in the environment, which stems from the fact that many chemical compounds take on the toxic or mutagenic characteristics after metabolic transformations occurring in living organisms [Hübner 2002].

The previous studies on soil enzymatic activity was mainly devoted to crop production. The national and world literature lacks information on the impact of grazing livestock in the metabolic activity of microorganisms in protected habitats. The study of biochemical processes occurring in the soil under the influence of grazing sheep contribute to a better understanding of animal production linkages with the environment and enable an assessment of the production functions in protecting and shaping the landscape ecological system [Bielińska and Gruszecki 2011].

KÓZKI NATURE RESERVE

The Bug river valley is regarded as an ecological corridor of European importance. The protection of its structure and biodiversity is of particular importance for the European Union [Faliński *et al*. 2000, Landsberg 2002, Chmielewski and Chmielewski 2006]. The basic condition for sustainable natural resource management in the Natura 2000 areas is the harmonization of economic activity with the protection of nature and landscape [Chmielewski 2001, 2011].

Stopping the use of the sward after creating nature reserve Kózki, located within the Landscape Park within the Natura 2000 sites: PLH 140011 and PLB 140001 (Fig. 1), has become the cause of secondary succession of psammophilous grasslands. The succession is manifested with impoverishment of biodiversity and changes in soil condition [Bielińska and Gruszecki 2010].

The processes of plant succession in the river valley are also accelerated by an increase in trophic habitats, caused by air pollution (mainly in the 70s and 80s of the twentieth century), a high contamination of the Bug flood waters, windblown nutrients and organic matter in the sandy habitat of the surrounding fields.

According to the hierarchy of the National Framework Programme [2005], research on soil quality and biodiversity in protected areas belong to the strategic research area (Area 2. Environment: Community priorities and Polish priorities: soil and water protection, protection of biodiversity). Preserving the diversity of ecosystems, species of flora and fauna (including crops and breeding animals) is a prerequisite for the protection of biotic diversity [Mackenzie *et al*. 2005]. Loss of biotic diversity is one of the major problems of the modern world [Ryszkowski 2007]. The secondary plant succession and encroachment of woody vegetation, observed in the Kózki nature reserve, cause changes in the landscape, the disappearance or fragmentation of valuable habitats, and consequently the withdrawal of rare species of fauna.

Land ecosystems are characterized by a specific dependence of plant and animals with the entire landscape [Piekut and Pawluskiewicz 2005, Chmielewski 2011].

One of the main functions of livestock production is to protect agricultural landscape [Piekut and Pawluskiewicz 2005]. The introduction of extensive sheep grazing contributes to biodiversity conservation of habitats in protected areas [Rogalski *et al*. 2001, Mroczkowski 2011]. Grazing sheep is stimulating the development of pasture sward as a result of its selective collection, soil and sod treading, leaving droppings [Mroczkowski 2006].

The results of field studies aimed at defining the consequences of grazing showed that a larger number of birds prey on graving surfaces, compared with a control surface. In these studies, they also observed a greater number of species on the surface. Species interested in preying were swallows (*Hirundinidae*), especially the Barn Swallow (*Hirundo rustica*) and the Common House Martin (*Delichon urbicum*), *Corvidae* – mainly the Common Magpie (*Pica pica*). What is particularly interesting are observed opportunistic feeding sessions performed by the White Stork (*Ciconia ciconia*) winning food in the course of the lengthy sessions of the movement of the herds of grazing sheep Świniarka [Kitowski *et al*. 2011].

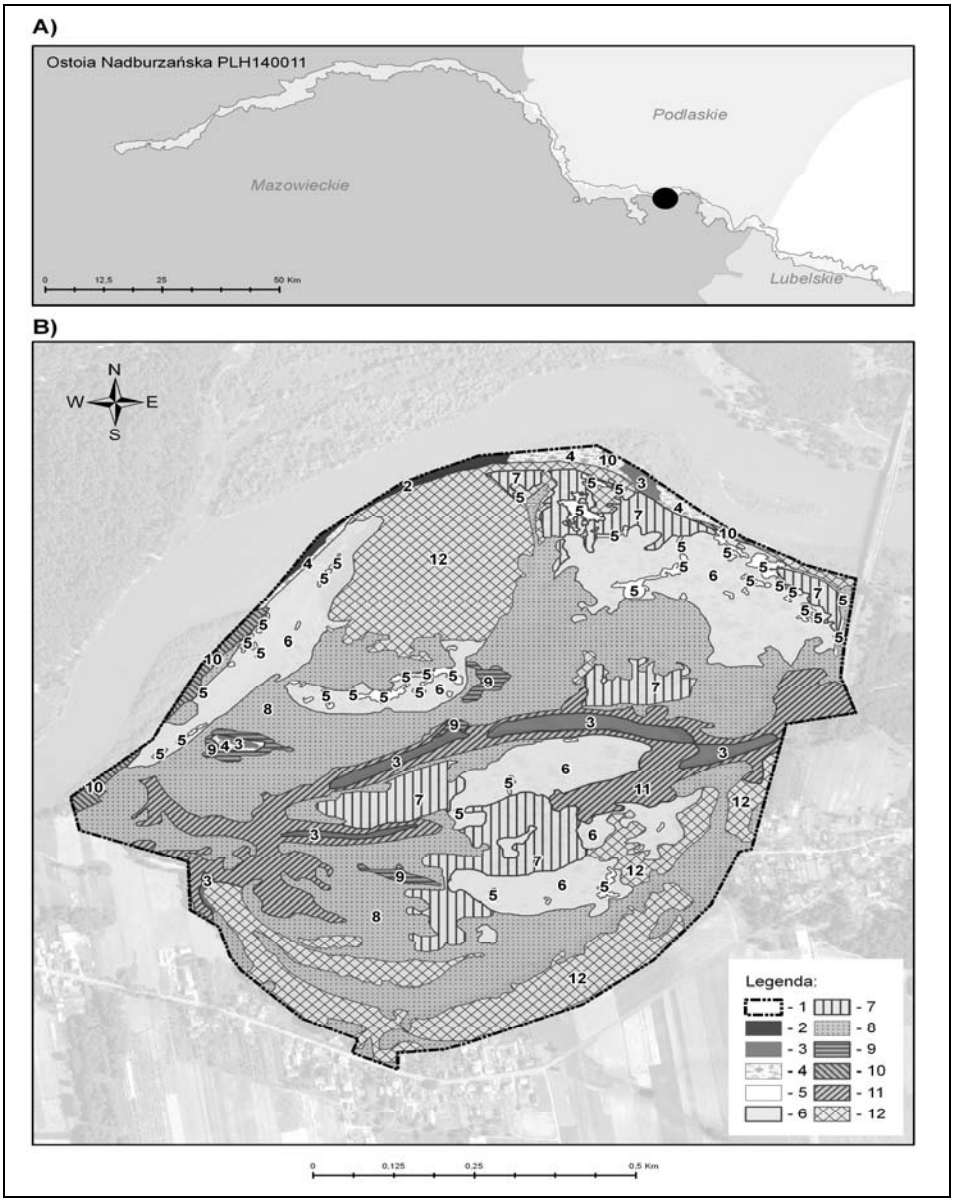

Fig. 1. Location of the study area on the background of the Natura 2000 site *Ostoja Nadbużańska* (A) and the map of land cover forms in nature reserve Kózki (B):; 1 – the boundary of the Kózki nature reserve, 2 – the Bug river within the reserve, 3 – oxbow lakes, 4 – rushes, 5 – sand dunes, 6 – psammophilous grasslands, 7 – psammophilous grasslands with meadow communities, 8 – meadow communities, 9 – scrub communities, 10 – floodmeadows, 11 – alder meadows, 12 – other forest communities (acc. to aerial photographs from 2006 – Szymon Chmielewski, 2011)

The development of civilization generating changes in the methods and uses of animals and the impact of grazing on soil environment indicates the need to assess soil quality across the landscape. Comprehensive characterization of the functioning of soils in the landscape can be the basis for better understanding of cause and effect relationships between landscape transformations and changes in the observed components of the ecosystem under the influence of grazing sheep. It will also allow to assess both compliance with the use of selected habitat features and natural determinants, and resistance to degradation of the environment and the ability to regenerate. This will facilitate the selection of treatments associated with the active protection and restoration of habitats in the Natura 2000 sites.

The research by Bielińska and Gruszecki [2011] showed that the introduction of extensive grazing of sheep into the Kózki nature reserve received such an increase in soil enzymatic activity, regardless of the type of habitat. The introduction of a limited number and time, free sheep grazing in the Kózki nature reserve area can contribute to the conservation of psammophilous grasslands, and also to the promotion of indigenous sheep breed Świniarka. This breed is covered by a program of protection of genetic resources. The adverse effect of secondary succession of plants on enzymatic activity and chemical properties of soil indicates the need to protect valuable and rare vascular plants of sandy habitats [Bielińska and Gruszecki 2010, 2011]. Adaptation of sheep and a cast of area and period of grazing to the requirements of biodiversity conservation and landscape psammophilous habitat requires precise control.

CONCLUSIONS

1. In sustainable development conditions, the active protection of the Natura 2000 habitats should be an integral part of the complex issues of landscape conservation.

2. Ensuring the sustainability of basic natural processes and the development of the spatial interrelationships between natural habitats determines the effective conservation of resources and values of biodiversity in the Natura 2000 sites.

3. In order to know and clarify the potential drift habitat in the ecosystem, under the influence of active protection, it is necessary to choose communicative indicators of the long-term changes in habitat conditions.

4. The active way of nature conservation, taking into account the use of the Natura 2000 habitats, allows the optimization of economic activities with conservation.

5. The unfavourable conversion of protected habitats within nature reserve Kózki, including intense processes of secondary succession, demonstrated the need to restore free sheep grazing with a limited stock.

6. The introduction of sheep grazing in the Kózki nature reserve area resulted in suppression of the unfavourable processes of succession of trees and

shrubs in the protected psammophilous grasslands. On the other hand, it resulted in the increase in the number of species of birds preying there, and could also contribute to the promotion of sheep farming and breeding of native breed Świniarka.

7. A basic strategy for active protection of habitats in the Natura 2000 sites should be a holistic concept of landscape systems.

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WYKORZYSTANIE EKSTENSYWNEGO WYPASU OWIEC
JAKO METODY CZYNNEJ OCHRONY WYBRANYCH SIEDLISK NATURA 2000

Streszczenie. W warunkach zrównoważonego rozwoju, czynna ochrona siedlisk Natura 2000 powinna stanowić integralną część kompleksowo ujmowanej problematyki ochrony krajobrazu. Zapewnienie trwałości podstawowych procesów przyrodniczych oraz rozwijanie wzajemnych powiązań przestrzennych między siedliskami przyrodniczymi, warunkuje skuteczne zachowanie zasobów i walorów różnorodności biologicznej na obszarach Natura 2000. Wprowadzenie swobodnego wypasu owiec na teren rezerwatu przyrody Kózki (dolina Bugu, Polska wschodnia) może przyczynić się do ochrony muraw psammofilnych oraz promocji chowu i hodowli owiec rodzimej rasy świniarka. Aktywny sposób ochrony przyrody, uwzględniający użytkowanie siedlisk Natura 2000, pozwala na optymalizację działań gospodarczych z ochronnymi.

Słowa kluczowe: obszary Natura 2000, czynna ochrona siedlisk, ekstensywny wypas owiec, krajobraz, różnorodność biotyczna, gleby, wskaźniki enzymatyczne