MIDDLE POMERANIAN SCIENTIFIC SOCIETY OF THE ENVIRONMENT PROTECTION
ŚRODKOWO-POMORSKIE TOWARZYSTWO NAUKOWE OCHRONY ŚRODOWISKA

Annual Set The Environment Protection
Rocznik Ochrona Środowiska

Volume/Tom 19. Year/Rok 2017 ISSN 1506-218X 211-229

Vegetation and Birds Species Changes in Meadow Habitats in Polesie National Park, Eastern Poland

Mariusz Kulik[*]*, Ryszard Baryła*[*]*, Danuta Urban*[*]*,*
Grzegorz Grzywaczewski[*]*, Andrzej Bochniak*[*]*,*
Andrzej Różycki[**]*, Ewelina Tokarz*[*]
[*]*University of Life Sciences, Lublin*
[**]*Polesie National Park*

1. Introduction

Grasslands are one of the semi-natural ecosystems that require human activity and quickly degrades as a result of land use changes. Many agricultural lands, including grassland, are excluded from use (Harkot et al. 2011). Development of meadow communities depends upon flora composition (Nekrošienė & Skuodienė 2012), which is also one of the most sensitive indicators of landscape changes (Jutila 2003). Disturbance of the habitat conditions through regulating the hydrologic regime as well as limiting the intensity of use or its abandonment lead to changes in the species composition and range of the area covered by plant communities (Czyż et al. 2013, Myśliwy & Bosiacka 2009, Nekrošienė & Skuodienė 2012). The method and intensity of grassland use have an impact on the persistency and floristic diversity of that communities. The lack of use of meadows and pastures leads to their fast degradation (Stypiński & Grobelna 2000) and frequently irreversible habitat changes (Kozłowska & Burs 2013, Kulik 2014). Changes in grassland flora, mainly under the impact of too intensive livestock grazing and hay harvesting, can also be observed (Shushpannikova 2014).

These changes affect not only the vegetation cover but also birds. Many bird species that inhabit wet meadows, in particular, constitute one of the most endangered ecological groups in the whole of Europe. The

main threat is posed by changes in the humidity of habitats and abandonment of use (Chylarecki et al. 2006, Langgemach & Bellebaum 2005, Ławicki et al. 2011, Pehlak & Lohmus 2008, Vickery et al. 2001, Watkinson & Ormerod 2001). In the Lublin Region, for example, meadows and pastures are the habitats for about 20% of 213 breeding bird species, including those that are vulnerable and endangered (Grzywaczewski & Cios 2012). One of the areas, where the changes in land use were observed, is Polesie National Park in Eastern Poland.

The aim of the study was to: (1) identify the vegetation and bird species in the study area and compare it with the data collected 17 years ago, (2) analyse the changes in plant communities and bird species depending on grassland management and habitat as well as (3) analyse the climate and habitat changes based on Ellenberg's indicators.

2. Material and methods

2.1. The study area

Zienki Meadows are situated in Polesie National Park, Eastern Poland. The meadow complex discussed (51˚27-29' N; 23˚6-9' E), covering approx. 650 ha. The area encompasses the easternmost enclave of the Wieprz River catchment (Piwonia basin) and adjoins the western part of the Bug River catchment (Włodawka basin). The meadow complex has natural borders: in the north, it adjoins a natural mineral soil elevation, the so-called Włodawa Ridge; a forest complex in the west; a peat bog with Lake Moszne in the south; and a watershed on mineral soils in the east (Baryła & Urban 1999). The site encompasses vast natural basins of glacial origin, former bogs and peat bogs of varying humidity.

2.2. Field study

Previous research studies were carried out in 1996 and 2013 on Zienki Meadows. In that study, only complexes with the same phytosociological relevés in 1996 (marks as 7-302) and 2013 (marks as 7a-302a) were taken into account. The plant communities were classified using the Braun-Blanquet (1964) method, with 48 phytosociological relevés established each year on area of 25 m^2. Phytosociological taxonomy was based on Matuszkiewicz (2008), and the species names were provided according to Mirek et al. (2002).

Investigations concerning birds were conducted in the breeding period from mid-April to mid-July in the same periods as the vegetation cover; observations concerning the absence of certain bird species in the second period (2013) were confirmed over a period of several years (2009-2015). The observations, carried out in the morning from sunrise to 9-10 am, consisted of walking in the study area and recording the individual bird species and identifying their breeding distribution. Besides, dusk and night-time inspections were carried out to record species active at this time of day. Changes in bird species over a period of 17 years are presented in the overall table.

2.3. Data analysis

The pragmaTax program was used to carry out the numerical classification for all relevés based on the quantitative share of the species. The Weighted Pair Group Method of Arithmetic averages (WPGMA) was used. A comparison of the dendrograms obtained in the classification made it possible to include groups of relevés at alfa scale 0.5, similar in terms of community species composition. Changes of the climatic and edaphic conditions were assessed using ecological indicator values by Ellenberg et al. (1992). Climatic (L – light, T – temperature, K – continentality) and edaphic (F – moisture, R – reaction, N – nitrogen content) indicators were taken into account. Obtained results of ecological indicator values for every relevés were put to the ANOVA analysis complemented by the Tukey test ($p<0.05$) to estimate significant changes in study years for all plant communities and for the predominant *Arrhenatheretum elatioris* association and *Deschampsia caespitosa* community. The multidimensional Principal Component Analysis (PCA) was used to identify patterns occurring in the dataset. PCA helped determine which indices result in the greatest variance in the communities, and facilitated the visualisation of changes that occurred in the particular years of the investigation. Due to the identical scale of the indices examined, the PCA was based on a covariance matrix. The software used to carry out the analysis was Statistica v. 10.

3. Results and discussion

Phytosociological studies conducted in 1996 as part of the Polesie National Park Conservation Plan revealed the great diversity of habitats and plant communities in the area. Several communities were distinguished: from *Phragmitetea* class wetland communities to dry and poor habitat communities of the *Koelerio glauca-Corynopheretea canescentis* class. *Alopecurus* meadows (*Alopecuretum pratensis*) growing in more humid habitats and the *Poa pratensis-Festuca rubra* community in fresh habitats predominated in the analysed area. Tall oat-grass meadows (*Arrhenatheretum elatioris*), occurring in habitats on more fertile mineral soil and formerly used mainly as arable fields, were also frequently recorded (Baryła & Urban 1999). These communities were characterised by poor floristic diversity because their species composition was based on mixes of grasses with legumes sown in the past after the regulation of hydrologic conditions. Tall oat-grass meadows were the most stable plant communities, with the greatest floristic diversity. 85% of these meadows did not change; their species composition changed only slightly. These meadows were located in dry habitats on mineral soils, located close to agricultural farms and systematically used. The share of these meadows actually increased because it replaced the *Poa pratensis-Festuca rubra* community, *Arrhenatherion* representing the same alliance and a community with *Agrostis capillaris* (Fig. 1). The persistence of tall oat-grass meadows is linked with the occurrence of high plants, including *Arrhenatherum elatius*, which is indirectly shown by the largest light index among the dominant communities (7.58); these meadows are also characterised by the lowest soil humidity index (5.19; Fig. 2). Climate changes were observed based on the changes in the species composition of these meadows in the study period linked with the light and temperature indices (Fig. 4). Xerothermic species had a greater share in the sward. Based on the calculated Ellenberg's indicators (1992), a significant reduction of soil acidity (6.65 > 6.36) and trophism (6.23 > 5.59) was observed. This could result from the extensification of meadow use in these habitats, particularly linked with the reduction or complete lack of mineral fertilisation.

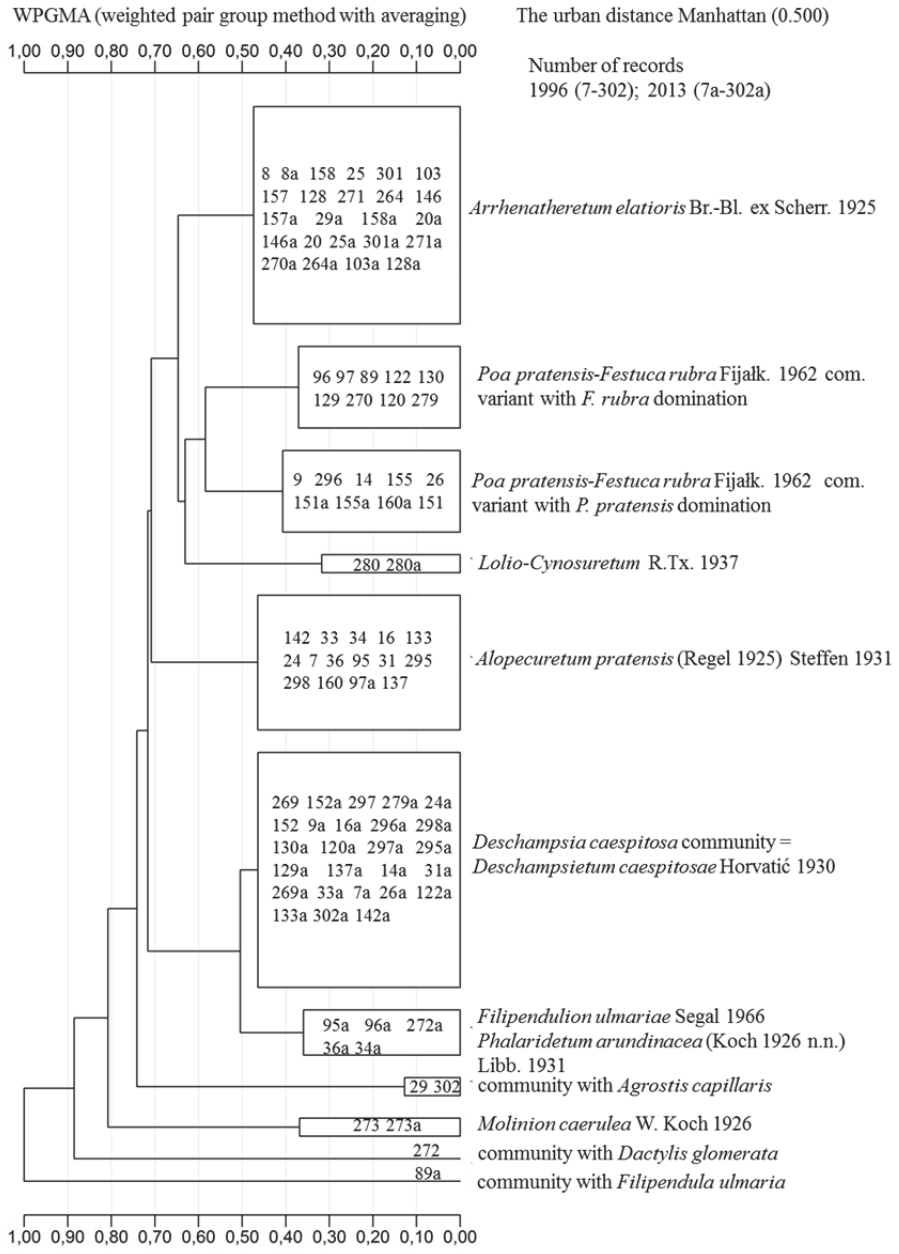

Fig. 1. Classification of the meadow plant communities
Rys. 1. Klasyfikacja łąkowych zbiorowisk roślinnych

The floristic composition of tall oat-grass meadows undergoes constant transformations and their restoration is limited by the existing use. It should be added that fresh meadows are one of the habitat types protected within the framework of the Nature 2000 network due to the presence of species of European importance (Klarzyńska & Kryszak 2015). In the last 25 years, in some European countries, including Poland, we have been observing a gradual disappearance of meadows from the *Arrhenatherion* alliance (Kucharski 2014, Vintu et al. 2011, Weigelt et al. 2009).

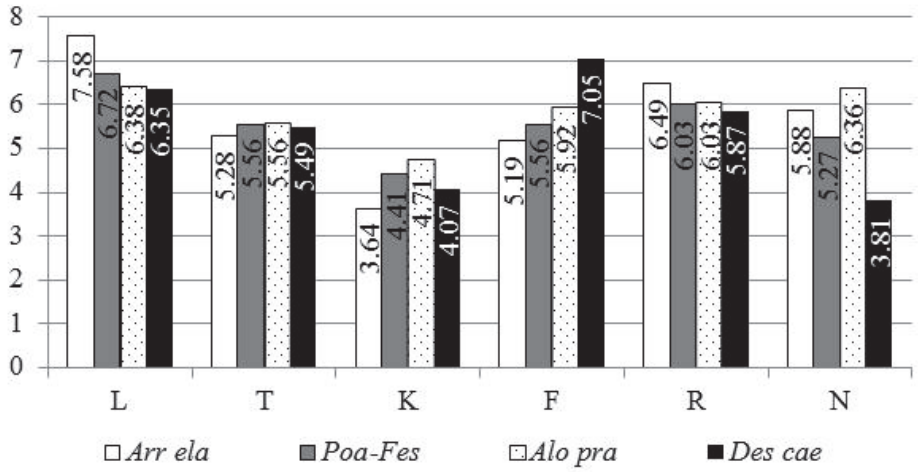

Fig. 2. Ellenberg's indicators (1996-2013) of dominant plant communities (L – light, T – temperature, K – continentality, F – soil moisture, R – acidity, N – trophism)
Rys. 2. Wskaźniki Ellenberga (1996-2013) dominujących zbiorowisk roślinnych (L – światło, T – temperatura, K – kontynentalizm, F – wilgotność gleby, R – kwasowość, N – trofizm)

The *Molinia* meadow and fertile *Lolio-Cynosuretum* pasture were also among the communities that did not change in the analysed period. The former needs to be mowed once a year, at a late date (Kulik 2014), and such extensive meadow management was conducted in most of the area of this complex. The latter community requires systematic grazing, which is rare not only in the Polesie National Park, but also throughout Europe. Grazing was conducted in this pasture in the years 1996-2013,

which significantly contributed to the stability of this community. It should be noted, however, that these were isolated grasslands.

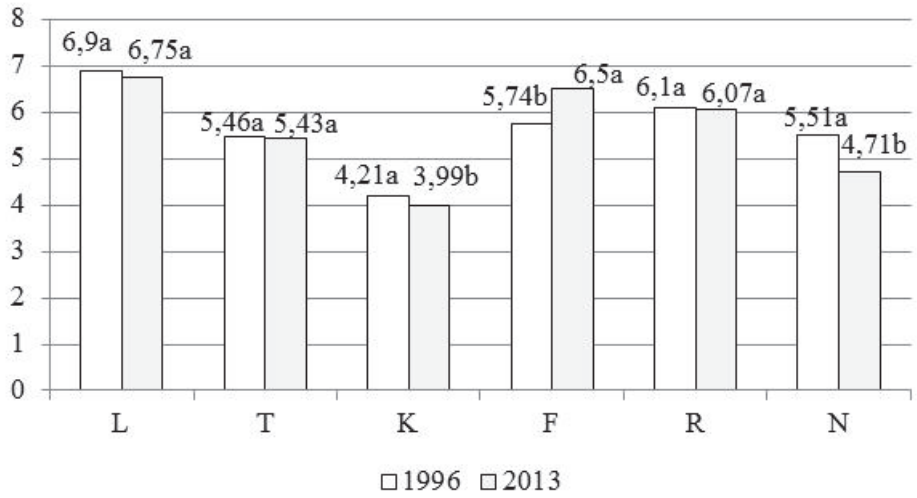

Fig. 3. Changes of Ellenberg's indicators mean values of all meadow communities (L – light, T – temperature, K – continentality, F – soil moisture, R – acidity, N – trophism; different letters indicate significant differences $p<0.05$)
Rys. 3. Zmiany średnich wartości wskaźników Ellenberga wszystkich zbiorowisk roślinnych (L – światło, T – temperatura, K – kontynentalizm, F – wilgotność gleby, R – kwasowość, N – trofizm; różne litery oznaczają istotne różnice $p<0.05$)

The biggest changes were observed in *Alopecurus* meadows that, in 1996, showed a predominance of *Alopecurus pratensis* and a large share of *Poa pratensis, Festuca rubra* and characteristic species of the *Molinietalia* order (*Lysimachia vulgaris, Lythrum salicaria, Deschampsia caespitosa*). Between 10 and 15 plant species were recorded in this community. After 17 years, most patches of this community (71%) transformed into communities with the predominance of *Deschampsia caespitosa*. Some *Alopecurus* meadows (21%), located in the proximity of waterlogged habitats under active protection of the Polesie National Park, transformed into floristically poor *Phalaris* meadows or herbaceous meadows of the *Filipendulion ulmariae* alliance (Fig. 1, 5). *Phalaris* meadows are characterized by predominance of *Phalaris arundinacea*

and usually the poorest species richness is observed in patches corresponding to the *Phragmitetea* class (Czyż et al. 2013). On the other hand, these meadows have an enormous significance for avifauna and mammal fauna (Wyłupek et al. 2015). Thus, *Alopecurus* meadows disappeared from the landscape of this complex in a very short period of time. It should be noted that the persistence of these meadows depends largely on their systematic use and optimum humidity conditions. The disappearance of that meadows was linked with the absence or very late date of mowing. After 1998, only a few fragments of this meadow complex were mowed, which limited the invasion of herbaceous and, subsequently, thicket communities. Systematic management was not introduced until 2009, but it was limited to mowing only once a year at a late date, which contributed to the continuously increasing share of *Deschampsia caespitosa.* In the years 2009-2013, about 40% of the meadow area in this complex was used systematically.

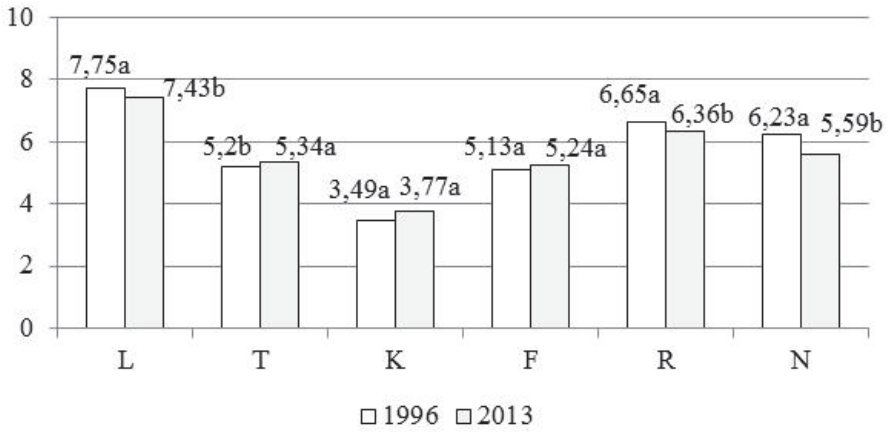

Fig. 4. Changes of Ellenberg's indicators mean values of *Arrhenatheretum elatioris* association (explanations like in Fig. 3)
Rys. 4. Zmiany średnich wartości wskaźników Ellenberga zespołu *Arrhenatheretum elatioris* (objaśnienia jak w Rys. 3)

Another example of meadows mowed for hay in the first period, but later transformed, was the *Poa pratensis-Festuca rubra* community represented by two variants: the more humid variant, with the predominance of *Poa pratensis*, and the drier variant, with *Festuca rubra* (Fig. 1,

5). During the 17-year study period, the species composition changed significantly in 84% of the meadows. Most of them (50%) transformed into *Deschampsia caespitosa* communities. Tussocks of this species can be safe sites for seedling recruitment in the succession of floristically rich wet meadows (Kostrakiewicz-Gierałt 2014). However, in this case, *D. caespitosa* predominates, which prevents the restoration of the original plant communities. Changes in the more humid variant with *P. pratensis* primarily resulted from the lack of mowing, while in the case of the drier variant, an additional reason was the increased humidity of the habitat due to the active protection measures conducted by the Polesie National Park. The groundwater level in the part of the meadow complex increased by 7 to 70 cm under conditions of precipitation volume similar to the previous period (Kulik & Baryła 2010). This is confirmed by the highest humidity index for the *D. caespitosa* community (7.05) among the dominant plant communities (Fig. 2). Due to the increased humidity, some *Poa-Festuca* meadows transformed into herbaceous meadows of the *Filipendulion ulmariae* alliance (Fig. 1). Only 16% of these meadows (variant with *P. pratensis*) did not change significantly. It resulted from the systematic mowing, often twice a year, which prevented the propagation of *D. caespitosa* occurring in the sward. *Poa-Festuca* meadows are Natura 2000 habitats (6510-2) but, according to Korzeniak (2012), these habitats only include floristically rich meadows whose species composition is similar to psammophilous grassland. However, cultivated meadows, with a predominance of grasses with a high fodder value, may not be included in this habitat. Such meadows with a large share of grasses and a small share of dicotyledons develop in more humid habitats (Klarzyńska & Kryszak 2015).

Principal Component Analysis shows that the first two components account for 82.6% (and the first for 62.3%) of the total variance of data. Figure 5 shows the share of the particular Ellenberg indicators (1992) in the structure of the principal components. It should be noted that climatic indicators underwent smaller changes (Fig. 3). Significant changes were recorded only in the case of the continentality index (4.21 > 3.99), which was manifested by the reduced cover of continental species. The most significant factors differentiating the data set under study are trophism (positive impact on first component) and soil humidity (negative impact on first component). The first study period was charac-

terised by a significantly lower soil humidity index (5.74) in comparison with the second period (6.50). The appearance or increase in the cover of humid habitat species resulted from the protective measures that had been conducted in the Polesie National Park. These measures consisted of reducing the drainage of water from the analysed meadow complex, which caused an increase of water retention and increase of humidity. This, in turn, led to the reduced intensity of the organic soil muck-formation process and reduced soil trophism, which was confirmed by the significantly lower trophism indices in the second study period (5.51 > 4.71; Fig. 3).

The lack of mineral fertilisation was an important factor that could have contributed to the reduced soil trophism. The smallest variance of the results was found for soil acidity, temperature and light indices. Fig. 5 also shows the distribution of dominant plant communities in the coordinate system determined by the first two principal components.

The community with *D. caespitosa* has higher values of the soil acidity index, while the *Arrhenatheretum elatioris* and *Alopecuretum pratensis* communities have higher values of the trophism indices. Phytosociological relevés of the *Poa pratensis-Festuca rubra* community are located neutrally in relation to the first principal component, and they show a tendency to be heliophytic – influence on the second principal component (Fig. 5).

Vegetation changes also affect birds changes. In the first study period, 73 bird species were found, while in the second period, the number of species increased to 78 (Table 1). Though the small increase in the number of species, negative changes were observed for two endangered *Charadriiformes* species in Poland and Europe: the black-tailed godwit *Limosa limosa* and the common redshank *Tringa totanus* (Beintema et al. 1991, Chodkiewicz et al. 2015). The withdrawal of these two bird species could have been caused by the changes that occurred in wet meadow habitats, including the transformation of *Alopecurus* meadows into *Deschampsia* meadows. Both the black-tailed godwit and redshank inhabit waterlogged open meadows, pastures or peat-bogs (Lewartowski & Piotrowska 1987, Świętochowski 2009). The appearance of large areas of more humid meadows dominated by the high tussocks of *Deschampsia caespitosa* was probably one of the reasons for the withdrawal of these *Charadriiformes* species from this complex.

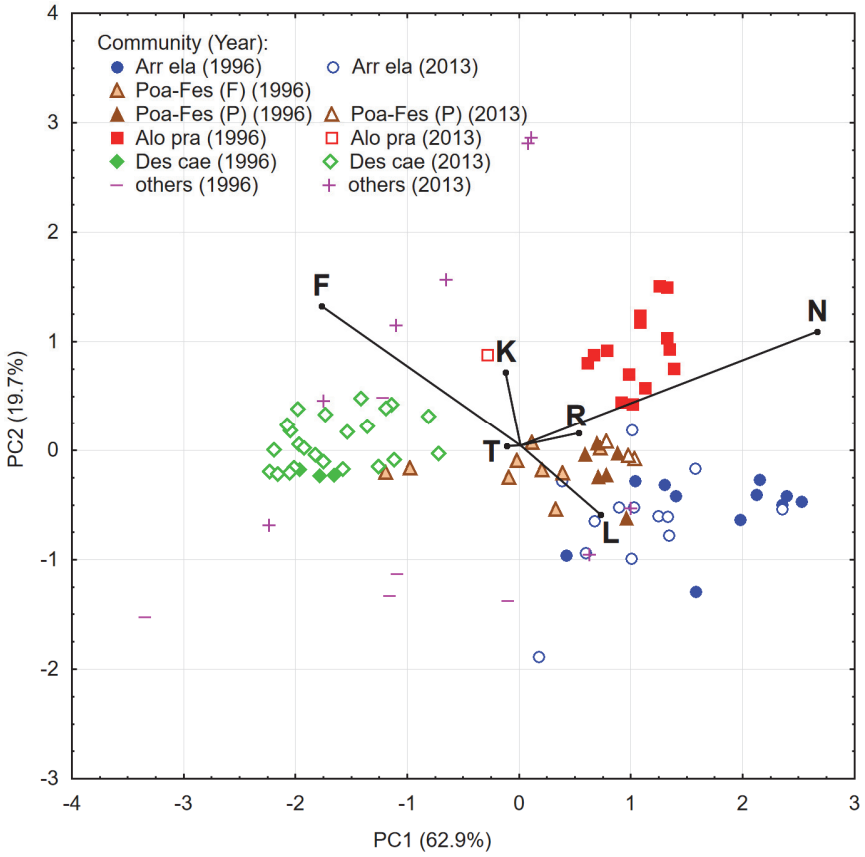

Fig. 5. The share of Ellenberg indices in principal components and distribution of plant communities (explanations like in Fig. 2)
Rys. 5. Udział wskaźników Ellenberga w składowych głównych oraz rozmieszczenie zbiorowisk roślinnych (objaśnienia jak w rysunku 2)

Table 1. List of bird species observed on "Zienkowskie Meadows"
Tabela 1. Lista gatunków ptaków obserwowanych na Łąkach Zienkowskich

Groups	Bird species	The main reasons for changes
bird species observed only in the first period	*Circus pygargus*, *Corvus cornix, C. frugilegus*, *Erythrina erythrina, Fulica atra*, *Limosa limosa*, *Tetrao tetrix*, *Tringa totanus*	transformation of *Alopecurus* meadows into meadows with the dominance of *Deschampsia caespitosa*, a high tussock grass species
bird species observed in both periods	*Accipiter gentilis*, *A. nisus*, *Acrocephalus palustris*, *A. schoenobaenus*, *A. scirpaceus*, *Actitis hypoleucos*, *Alauda arvensis*, *Anas crecca*, *A. platyrhynchos*, *A. querquedula*, *A. strepera*, *Anser anser*, *Ardea alba*, *Aythya ferina*, *A. fuligula*, *Buteo buteo*, *Calidris pugnax*, *Chlidonias hybrida*, *Ch. leucopterus*, *Chroicocephalus ridibundus*, *Ciconia ciconia*, *C. nigra*, *Circus aeruginosus*, *Clanga pomarina*, *Corvus corax*, *Crex crex*, *Cuculus canorus*, *Dendrocopos major*, *D. medius*, *Dryocopus martius*, *Emberiza citrinella*, *E. schoeniclus*, *Falco columbarius*, *F. subbuteo*, *Fringilla coelebs*, *Gallinago gallinago*, *Gallinula chloropus*, *Garrulus glandarius*, *Grus grus*, *Haliaeetus albicilla*, *Hirundo rustica*, *Lanius collurio*, *L. excubitor*, *Linaria cannabina*, *Locustella luscinioides*, *Luscinia luscinia*, *Motacilla flava*, *Oriolus oriolus*, *Phasianus colchicus*, *Phylloscopus collybita*, *P. trochilus*, *Porzana porzana*, *Rallus aquaticus*, *Saxicola rubetra*, *Sturnus vulgaris*, *Sylvia atricapilla*, *S. borin*, *S. communis*, *Tachybaptus ruficollis*, *Tringa erythropus*, *T. glareola*, *T. ochropus*, *Turdus merula*, *Upupa epops*, *Vanellus vanellus*	mosaic character of habitats diversity of plant communities diversity of habitat humidity preservation of extensive use involving mowing (very rarely pasture) in some parts of the area
bird species observed only in the second period	*Anthus pratensis, A. trivialis, Ardea cinerea, Chlidonias niger, Clanga clanga, Delichon urbicum, Gallinago media, Larus cachinnans, Locustella fluviatilis, L. naevia, Phalacrocorax carbo*	raising of the groundwater level and increase of humidity appearance of isolated shrubs due to the extensification of meadow management

On the other hand, the active protection of wet habitats conducted by the Polesie National Park in recent years, based on retaining water by building of sluices and weirs, led to the appearance of the greater spotted eagle *Clanga clanga*, a species vulnerable to extinction in Poland and Europe. The greater spotted eagle occurs in bogs in the vicinity of wet forests and in the vast areas of waterlogged meadows and wetlands. Besides, the restrictions on the use of these meadows not only led to changes in the plant communities, but also triggered secondary succession which occurs faster in forest meadows or meadows located in the vicinity of forest ecosystems (Szydłowska 2010). Isolated low shrubs that appeared in these meadows and shrubs growing along drainage ditches became a favourable habitat for the common grasshopper warbler *Locustella naevia* that had not occurred on the complex of Zienki Meadows before (Table 1).

4. Conclusions

The phytosociological studies conducted on Zienki Meadows in the Polesie National Park revealed a great diversity of habitats and plant communities.

1. It was found that the greatest changes occurred in *Alopecurus* and *Poa pratensis-Festuca rubra* meadows. After 17 years, most of them transformed into meadows with the predominance of *Deschampsia caespitosa*. Some *Alopecurus* meadows, located in the proximity of waterlogged habitats under active protection of the Polesie National Park, transformed into floristically poor *Phalaris* meadows or herbaceous meadows of the *Filipendulion ulmariae* alliance.
2. Tall oat-grass meadows 6510 (*Arrhenatherum elatioris*) were found to be the most stable plant communities, with the greatest floristic diversity. However, based on Ellenberg's indicators, a significant reduction of soil acidity and trophism of the habitat was observed, possibly as a result of the extensification of meadow use in these habitats (reduction or lack of mineral fertilisation).
3. Soil humidity and trophism were the most significant factors differentiating the data set under study. The appearance of large areas of such humid meadows was probably one of the reasons for the withdrawal

of two endangered bird species in Poland and Europe: the black-tailed godwit *Limosa limosa* and the common redshank *Tringa tetanus*.

4. Vegetation changes resulted from the lack of mowing as well as increased humidity of the habitat due to the active protection measures conducted by the Polesie National Park. On the other hand, the mosaic character of habitats with diverse humidity, diversity of plant communities and extensive utilisation ensured the stable number of bird species observed in both periods of the study.

References

Baryła, R. & Urban, D. (1999). Directions in grass community changes due to reduction and renunciation the agricultural performance following the example of Poleski National Park meadows. *Folia Universitatis Agriculturae Stetinensis*, *Agricultura*, *197(75)*, 25-29.

Beintema, A.J., Thissen, J.B., Tensen, D., Visser, G.H. (1991). Feeding ecology of Charadriiform chicks in agricultural grass land. *Ardea*, *79*, 31-43.

Braun-Blanquet, J. (1964). *Plant sociology. The study of plant communities*. Ed. 3. Wien-New York: Springer Publishing, 865.

Chodkiewicz, T., Kuczyński, L., Sikora, A., Chylarecki, P., Neubauer, G., Ławicki, Ł., Stawarczyk, T. (2015). Ocena liczebności populacji ptaków lęgowych w Polsce w latach 2008-2012. *Ornis Polonica, 56*, 149-189.

Chylarecki, P., Matyjasiak, P., Gmitruk, K., Kominek, E., Ogrodowczyk, P. (2006). Breeding success of waders in the Bug and Narew valleys, E Poland. *Wader Study Group Bulletin, 111*, 24-25.

Czyż, H., Malinowski, R., Kitczak, T., Przybyszewski, A. (2013). Charakterystyka chemiczna gleb i szaty roślinnej użytków zielonych w dolinie ujścia Warty. *Rocznik Ochrona Środowiska*, *15*, 694-713.

Ellenberg, H., Weber, H.E., Düll, R., Wirth, V., Werner, W., Paulißen, D. (1992). Zeigerwerte von Pflanzen in Mitteleuropa. *Scripta Geobotanica*, *18*, 258.

Grzywaczewski, G., Cios, Sz. (2012). Biological diversity of birds in the Lublin region - significance for the region. In: *Biodiversity and Regional Development* (eds. Bojar W., Diniz F., Junkuszew A.). Toruń: Towarzystwo Naukowe Organizacji i Kierownictwa, 213-236.

Harkot, W., Lipińska, H., Wyłupek, T. (2011). Directions of land management changes on a background of natural conditions of agricultural production space in Lublin region. *Acta Scientiarum Polonorum Administratio Locorum 10(1)*, 5-16.

Jutila, H.M. (2003). Germination in Baltic coastal wetland meadows: similarities and differences between vegetation and seed bank. *Plant Ecology 166(2)*, 275-293.

Klarzyńska, A. & Kryszak, A. (2015). Floristic diversity of extensively used fresh meadows (6510) in the Wielki Łęg Obrzański complex. *Acta Agrobotanica*, *68(2)*, 115-123.

Korzeniak, J. (2012). 6510 Extensively use hay lowland meadows (*Arrhenatherion*). In: *Monitoring of natural habitats. Methodical guidebook.* Part 3. (eds. Mróz W.). Chief Inspectorate of Environmental Protection, Warsaw, 79-94.

Kostrakiewicz-Gierałt, K. (2014). Are *Deschampsia caespitosa* (L.) Beauv. tussocks safe sites for seedling recruitment in the succession of wet meadows. *Polish Journal Ecology*, *62(4)*, 707-721.

Kozłowska, T. & Burs, W. (2013). Transformation of meadow communities due to the changes in soil moisture of meadow habitats. *Journal of Research and Applications in Agricultural Engineering, 58(4)*, 7-11.

Kucharski, L. (2014). Vegetation of oat-grass meadows in central Poland. *Steciana*, *18(3)*, 119-125.

Kulik, M. (2014). Changes of biodiversity and species composition of Molinia meadow depending on use method. *Polish Journal of Environmental Studies*, *23(3)*, 773-782.

Kulik, M. & Baryła, R. (2010). The changes of groundwater level at "Krasnoryki" meadow site in the Poleski National Park. *Teka Komisji Ochrony i Kształtowania Środowiska Przyrodniczego – OL PAN*, 7, 184-191.

Langgemach, T. & Bellebaum, J. (2005). Pradation und der Schutz bodenbrutender Vogelarten in Deutschland. *Vogelwelt*, *126*, 259-298.

Ławicki, Ł., Wylegała, P., Batycki, A., Kajzer, Z., Guentzel, S., Jasiński, M., Kruszyk, R., Rubacha, S., Żmihorski, M. (2011). Long-term decline of grassland waders in western Poland. *Vogelwelt*, *132*, 101-108.

Lewartowski, Z. & Piotrowska, M. (1987). Breeding birds in the valley of the Narew River. *Acta Ornithologica*, *23*, 215-272.

Matuszkiewicz, W. (2008). *Przewodnik do oznaczania zbiorowiska roślinnych Polski.* Warszawa: Wydawnictwo PWN, 536.

Mirek, Z., Piękoś-Mirkowa, H., Zając, A., Zając, M. (2002). *Flowering plants and pteridophytes of Poland a checklis*t. Kraków: Institute of Botany, Polish Academy of Sciences, 442.

Myśliwy, M. & Bosiacka, B. (2009). Disappearance of *Molinio-Arrhenatheretea* meadows diagnostic species in the Upper Płonia river valley (NW Poland). *Polish Journal of Environmental Studies*, *18(3)*, 513-519.

Nekrošienė, R. & Skuodienė, R. (2012). Changes in floristic composition of meadow phytocenoses, as landscape stability indicators, in protected areas in Western Lithuania. *Polish Journal of Environmental Studies, 21(3)*, 703-711.

Pehlak, H. & Lohmus A. (2008). An artificial nest experiment indicates equal nesting success of waders in costal meadows and mires. *Ornis Fennica, 85*, 66-71.

Shushpannikova, G. (2014). Formation and degradation of meadows under the impact of hay harvesting and grazing in the Vychegda and Pechora floodplains. *Russian Journal of Ecology*, *45(1)*, 33-37.

Stypiński, P. & Grobelna, D. (2000). Directions of succession of plant communities on the degraded and taken out from utilisation former grassland. *Łąkarstwo w Polsce, 3*, 151-157.

Świętochowski, P. (2009). Czynniki wpływające na sukces rozrodczy wybranych gatunków siewkowych *Charadriiformes* w strefie zalewowej doliny Biebrzy. *Dubelt*, *1*, 27-42.

Szydłowska, J. (2010). Charakterystyka florystyczna runi oraz ocena fitoindykacyjna warunków siedliskowych wybranych łąk śródleśnych. *Rocznik Ochrona Środowiska*, *12*, 299-312.

Vickery, J.A., Tallowin, J.R., Feber, R.E., Asteraki, E.J., Atkinson, P.W., Fuller, R.J., Brown, V.K. (2001). The management of lowland neutral grasslands in Britain: effects of agricultural practices on birds and their food resources. *Journal of Applied Ecology*, *38*, 647-664.

Vintu, V., Samuil, C., Rotar, I., Moisuc, A., Razec, I. (2011). Influence of the management on the phytocoenotic biodiversity of some Romanian representative grassland types. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, *39(1)*, 119-125.

Watkinson, A. & Ormerod, S. (2001). Grasslands, grazing and biodiversity: editors introduction. *Journal of Applied Ecology*, *38*, 233-237.

Weigelt, A., Weisser, W.W., Buchmann, N., Scherer-Lorenzen, M. (2009). Biodiversity for multifunctional grasslands: equal productivity in high-diversity low-input and low-diversity high-input systems. *Biogeosciences*, *6(8)*, 1695-1706.

Wyłupek, T., Ziemińska-Smyk, M., Czarnecki, Z. (2015). Floristic diversity and agricultural value of *Phalaridetum arundinaceae* (Koch 1926 n.n.) Lib. 1931 in the selected river valleys of the Zamość region. *Acta Agrobotanica, 68(2)*, 109-113.

Zmiany szaty roślinnej i gatunków ptaków w siedliskach łąkowych w Poleskim Parku Narodowym, wschodnia Polska

Streszczenie

Celem badań była ocena szaty roślinnej i gatunków ptaków oraz porównanie wyników z danymi zebranymi 17 lat wcześniej, analiza zmian zbiorowisk roślinnych i gatunków ptaków w zależności od siedliska i gospodarki na użytkach zielonych, a także analiza zmian klimatycznych i siedliskowych na podstawie obliczonych ekologicznych liczb wskaźnikowych Ellenberga. Badania zostały przeprowadzone w latach 1996 i 2013 na Łąkach Zienkowskich w Poleskim Parku Narodowym, we wschodniej Polsce. Analizowany kompleks łąkowy (51˚27-29 'N; 23˚6-9' E), obejmuje powierzchnię ok. 650 ha i oddzielony jest naturalnymi granicami: od północy przylega on do naturalnego wyniesienia mineralnego, tzw. Garbu Włodawskiego, od zachodu otacza go kompleks leśny, od południa torfowisko z Jeziorem Moszne, a od wschodu mineralne wyniesienie wododziałowe. Zbiorowiska roślinne zostały zaklasyfikowane według metody Braun-Blanqueta. Badania dotyczące ptaków prowadzono w okresie lęgowym od połowy kwietnia do połowy lipca w okresach analogicznych do badań szaty roślinnej. Obszar badań charakteryzował się dużą różnorodnością siedlisk i zbiorowisk roślinnych. Największą stabilnością odznaczały się łąki rajgrasowe, które należą do jednego z typów cennych siedlisk przyrodniczych chronionych w ramach sieci Natura 2000 (6510). Te łąki świeże charakteryzowały się największą różnorodnością florystyczną, ale wskaźniki Ellenberga pokazały istotne zmniejszenie kwasowości gleby i trofizmu tych siedlisk w ciągu 17 lat. Zmiany te mogły być spowodowane ekstensywnym użytkowaniem łąk (zmniejszenie lub brak nawożenia mineralnego). Z kolei największe zmiany zaobserwowano na łąkach z *Alopecurus pratensis* i *Poa pratensis-Festuca rubra*. Większość z nich przekształciła się w łąki z dominacją *Deschampsia caespitosa*. Pojawienie się dużych powierzchni łąk bardziej wilgotnych mogło być prawdopodobnie jedną z przyczyn wycofania się dwóch zagrożonych wyginięciem w Europie ptaków: rycyka *Limosa limosa* i krwawodzioba *Tringa tetanus*. Wilgotność gleby i trofizm były bowiem czynnikami, które w największym stopniu wpływały na uzyskane dane. Z drugiej strony mozaikowaty charakter różnych siedlisk, zróżnicowanie zbiorowisk roślinnych i ekstensywne użytkowanie wpływało na stabilną liczbę gatunków ptaków w obydwu okresach badawczych. Czynna ochrona siedlisk podmokłych, która jest prowadzona w ostatnich latach przez Poleski Park Narodowy, przyczyniła się

do pojawienia się orlika grubodziobego *Clanga clanga*, ptaka, który jest zagrożony wyginięciem w Europie. Ponadto pojedyncze, niskie krzewy, pojawiające się na tych łąkach oraz krzewy, rosnące wzdłuż rowów melioracyjnych stały się korzystnym siedliskiem dla świerszczaka *Locustella naevia*, ptaka, który wcześniej nie występował na tym terenie.

Abstract

The aim of the study was to estimate the vegetation and bird species and compare it with the data collected 17 years ago, analyse the changes in plant communities and bird species depending on grassland management and habitat as well as analyse the climate and habitat changes based on Ellenberg's indicators. Studies were carried out in 1996 and 2013 on Zienki Meadows in Polesie National Park, Eastern Poland. The meadow complex discussed (51˚27-29' N; 23˚6-9' E), covering approx. 650 ha, has natural borders: in the north, it adjoins a natural mineral soil elevation, the so-called Włodawa Ridge; a forest complex in the west; a peat bog with Lake Moszne in the south; and a watershed on mineral soils in the east. The plant communities were classified using the Braun-Blanquet method. Investigations concerning birds were conducted in the breeding period from mid-April to mid-July in the same periods as the vegetation cover. The study area is characterized by the great diversity of habitats and plant communities. The most stable were tall oat-grass meadows, which are one of the habitat types protected within the framework of the Nature 2000 network (6510). That fresh meadows were characterized by the greatest floristic diversity, but Ellenberg's indicators showed a significant reduction of soil acidity and trophism of that habitat during 17 years. These changes could have been caused by extensification of meadow use (reduction or lack of mineral fertilisation). The biggest changes in *Alopecurus* and *Poa pratensis-Festuca rubra* meadows were observed. Most of them were transformed into meadows with the predominance of *Deschampsia caespitosa*. The appearance of large areas of such humid meadows was probably one of the reasons for the withdrawal of two endangered bird species in Europe: the black-tailed godwit *Limosa limosa* and the common redshank *Tringa tetanus*. The most significant factors differentiating the data set were soil humidity and trophism. On the other hand, a mosaic character of different habitats, diversity of plant communities and extensive utilisation ensured the stable number of bird species in both study periods. The active protection of wet habitats conducted by the Polesie National Park in recent years led even to the appearance of the greater spotted eagle *Clanga clanga*, a species that is vulnerable to extinction in Europe. Moreover, isolated low shrubs that appeared in

these meadows and shrubs growing along drainage ditches became a favourable habitat for the common grasshopper warbler *Locustella naevia* which had not occurred in this area before.

Słowa kluczowe:
gatunki ptaków, wskaźniki Ellenberga, łąka, zmiany szaty roślinnej

Key words:
bird species, Ellenberg's indicators, meadow, vegetation changes