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White stork (*Ciconia ciconia* L.) as an indicator of natural environment status in agricultural areas, illustrated with an example of Masurian Landscape Park

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Abstract

The paper presents the results of a 5-year study on the population size of the white stork (*Ciconia ciconia* L.) as one of the indicator species used to assess a biodiversity level in agricultural areas. The study was carried out in Masurian Landscape Park situated in Warmińsko-Mazurskie Voivodeship. The results demonstrated that the white stork population size was closely linked to agricultural areas, in particular, the extensively managed permanent grassland. In the years 2014–2018, even if minor changes were observed in the land use structure, the white stork population size showed a slight upward trend within the study area. In order to maintain this status, efforts should be made to preserve open landscapes (first and foremost – meadows and pastures), which are preferred feeding grounds of white stork. Consequently, potential decision as regards afforestation and housing should be made considerably.

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1. INTRODUCTION

Numerous valuable natural habitats and plant and animal species, including birds in particular, which inhabit them, are closely linked to the agricultural landscape. In Poland, 20 to 40 bird species normally nest on a randomly selected square kilometre of the agricultural landscape, and the total number of nesting pairs usually ranges from 40 to 100. Throughout the country, approx. 100 breeding bird species are linked to the agricultural landscape. Out of nearly 280 endangered bird species throughout Europe, as many as 60% are birds that inhabit agricultural areas [Chylarecki P., 2003].

It is therefore essential to maintain the agricultural function of these areas while preserving their natural resources. The most frequently indicated factors that adversely affect the population size of birds inhabiting agricultural areas include the decrease in permanent grassland area, an increase in fertilisation levels, land consolidations, land drainage operations, an increase in the percentage of cultivated winter crops, pesticides, mechanisation, and an increase in livestock density [Chylarecki P., 2003; Butler S. J. et al., 2007; Newton I., 2004].

2. THE AIM, PURPOSE AND SCOPE OF THE RESEARCH

The aim of the study was to analyse changes in the white stork population size in rural communes located within the Masurian Landscape Park boundaries in the context of agricultural areas found there. The study was conducted in the years 2014–2018. The methodology of field work involves searching for white stork nests in the Masurian Landscape Park. The bird census was supplemented with the information on the colonisation status and the number of nestlings at an age close to that of acquiring the ability to fly. In order to increase efficiency in detecting the nests, two inspections were carried out. During the first one (from 10th April to 10th May), nests were located, while the second inspection (from 1st July to 25th July) determined the final manner of nest occupation [Chylarecki P. et al., 2015]. In total, from 103 nests in 2014 to 138 nests in 2018 were inspected (Fig. 1).

3. BIRDS OF THE AGRICULTURAL LANDSCAPE

Poland is of particular importance to 106 bird species nesting in the European Union countries as it sustains more than 5% of the Union's breeding population, which is particularly noticeable in rural areas [Biaduń W. et al., 2016].

One of the indicators of biodiversity status in agricultural rural areas in the European Union is the Farmland Bird Index (FBI), that is, an index of the population size of common agricultural landscape birds [Butler S. J. et al., 2010; Tryjanowski P. et al., 2011; Stjernman M. et al., 2013; Dynowska M., Ciecierska H., 2013]. The FBI is an aggregated index of changes in the status of 22 populations of common agricultural landscape birds closely related to habitats in agricultural use (white stork, common whitethroat, Northern lapwing, Eurasian hoopoe, barn swallow, crested lark, red-backed shrike, European stonechat, European serin, common linnet, Eurasian tree sparrow, ortolan bunting, Western yellow wagtail, whinchat, corn bunting, common kestrel, black-tailed godwit, Eurasian skylark, common starling, meadow pipit, yellow hammer, and European turtle dove). It is calculated as the geometric mean of the population number of the above-mentioned species [Gregory R.D. et al., 2005]. In Poland, in 2017, the lowest FBI level was reached for the entire 18-year period under monitoring. For the first time, the index value dropped to only 80% of the value obtained by it in the reference year, that is, 2000. Therefore, the fact that the situation of the birds associated with the agricultural landscape has, for a long time, been unfavourable and constantly deteriorating is confirmed once again. This is even more worrying when we consider that strong downward trends have also been noted for several field species not included in the FBI [Chodkiewicz T. et al., 2018].

4. THE WHITE STORK – CHARACTERISTICS OF THE SPECIES

The white stork population number in Europe amounts to 224–247 thousand pairs, of which 154–164 thousand pairs nest in the EU. The largest populations are found in Poland (51.7–53.9 thousand pairs), Ukraine (26.2–32.4 thousand pairs), and Belarus (21.3–21.5 thousand pairs), while the smallest ones are found in Denmark and Montenegro (one pair in each country) [The IUCN Red List..., 2015]. In Poland, in 2004, most white storks (results of the latest white stork count have not been published yet) inhabited the areas located to the east of the Vistula river, including Warmińsko-Mazurskie Voivodeship where nesting of approx. 20% of the domestic population was noted [Sikora A. et al., 2008]. The species diversity of the birds was significantly higher in occupied areas than in the areas unoccupied by white stork pairs. This diversity was always higher in the white stork's areas characterised by a higher breeding success in the period of 2005–2008. The percentage of meadows

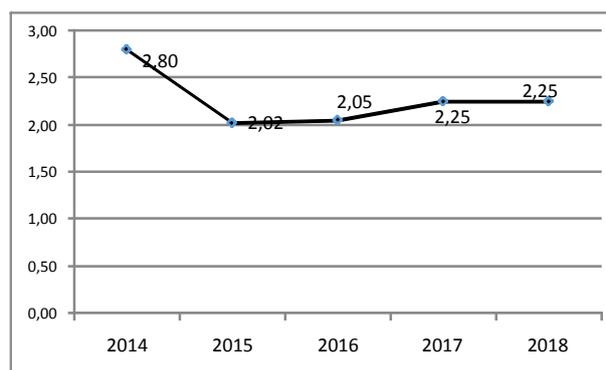


Figure 1. The white stork breed rearing within the Masurian Landscape Park boundaries. Source: Own elaboration.

and pastures was clearly higher in the occupied than in the unoccupied areas. This confirms the hypothesis that the white stork is an indicator of the agricultural landscape biodiversity [Tobółka M., 2015].

The white stork builds nests almost exclusively within human settlements. Only few pairs establish nests at a distance of more than 500 m from inhabited settlements. The birds feed mainly on permanent grasslands, papilionaceous crop cultivations, boundary strips as well as in shallow rivers, oxbow lakes, drainage ditches, fish ponds, and on swamps. White storks rarely search for food on arable land; if so, it is most frequently during the ploughing and other field work. The number of local breeding pairs is usually positively correlated with the area of permanent grassland [Chylarecki P. et al., 2015; Czajkowski M. et al., 2014; Chylarecki P. et al., 2018; Tryjanowski, Grzywaczewski, Zbryt, 2018]. One of the negative factors affecting the white stork population size is the change in the land use pattern, particularly afforestation and the disappearance of permanent grassland. A study by Sikora A. et al. [2008] shows that afforestation operations in the vicinity of white stork colonies may have an adverse effect on the parameters of the birds' individual adaptation. A decrease in the area of feeding grounds due to afforestation may therefore translate into the necessity of increased efforts to find the same amount of food for nestlings.

An example of both long- and short-term decrease in the white stork population number is the region of Żuławy Wiślane, which was associated with nothing else than habitat changes. Before 1945, the percentage of grassland in the Vistula river delta amounted to approx. 35%. The dramatic deterioration of habitat conditions was due to the flooding of Żuławy by Nazi German troops in March 1945. Water covered 70% of the region area, including all lower-lying areas with the highest percentage of grassland. Drainage of these areas lasted for five years, and the total grassland area has decreased as a result of overgrowth or the conversion into arable land. Despite the gradual increase in the percentage of grassland, traditional meadow-based farming in the region has been

abandoned. Unfavourable habitat changes in the region of Żuławy intensified in the 1950s due to the preference for large-scale cultivation of wheat, sugar beet and rape. The further decrease in grassland areas in this region intensified to reach a level of 13% in 2010 [Sikora A., 2017]. According to Zbryt A. et al. [2014] who monitored the white stork population within the Natura 2000 site of 'OstojaWarmińska' in Warmińsko-Mazurskie Voivodeship, despite the stability of the white stork population, the recent several years have observed rapid adverse changes in the land use, involving *inter alia* the support for corn and rape cultivation which, consequently, may result in a change to this species' population number. In this context, it is important, among other things, to support cattle breeding, as the very presence of this type of agricultural farms has a positive effect on the occurrence of white storks.

Over recent decades, the white stork population size in Poland has fluctuated indicating, however, an upward trend (Fig. 2). In 1974, the domestic population number for the white stork was estimated at 33.9 thousand pairs; later on, in 1984, it slightly decreased to a level of 30.5 thousand pairs, and after a decade, it increased to 40.9 thousand. The upward trend continued, and in 2004, the population number reached a level of approx. 52.5 thousand pairs [Chylarecki P. et al., 2018].

3.1 The white stork in the Masurian Landscape Park

The Masurian Landscape Park was established by virtue of Resolutions of the Voivodeship National Councils in Suwałki on 5 December 1977 and in Olsztyn on 8 December 1977.¹ The Park with an area of 53,655 ha is located in Warmińsko-Mazurskie Voivodeship in the following administrative units: MrągowskiPoviat (communes of Piecki, Mikołajki, and Mrągowo), PiskiPoviat (Ruciane-Nida, Pisz, and Orzysz), and SzczycieńskiPoviat (Świętajno). The total area of the agricultural land is 8,100 ha, which accounts for 17% of the Park area. As regards agricultural land, meadow communities of the Molinio-Arrhenatheretea that are found on extensive mid-forest meadows as well as waterlogged grassland are particularly valuable from the environmental perspective, including in the context of protection and preservation of white stork population. Unfortunately, the number of small- and medium-sized agricultural farms has been on the decrease since 2000, and due to the overall structural changes in land use, the number of large-sized farms has been increasing.²

¹ Resolution No VIII/31/77 of the Voivodeship National Council in Suwałki on 5 December 1977, on the establishment of the Masurian Landscape Park (Journal of Laws of the VNC in Suwałki, No 8, item 36)
² Resolution No X/38/77 of the Voivodeship National Council in Olsztyn on 8 December 1977, on the establishment of the Masurian Landscape Park (Journal of Laws of the VNC in Olsztyn, No 11, item 51)
² Protection Plan for the Masurian Landscape Park until 2032. Appendix No 1 to Resolution No XIX/368/12 of the Warmińsko-Mazurskie Voivodeship Assembly on 28 August 2012, Krutyń, March 2012

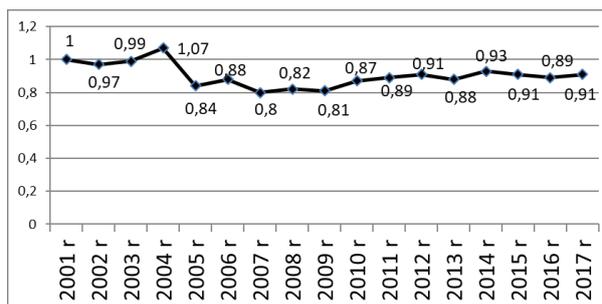


Figure 2. Changes in the white stork (*Ciconia ciconia* L.) population size in Poland. Source: Own elaboration based on: <http://monitoringptakow.gios.gov.pl/baza-danych>

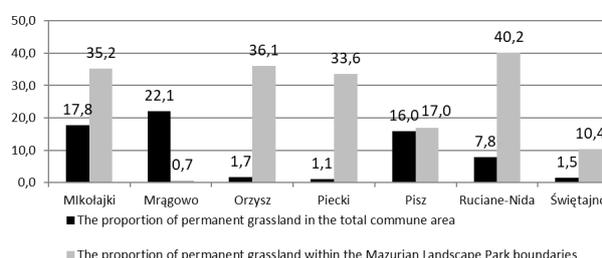


Figure 3. The proportion of permanent grassland in the total area of communes located within the Masurian Landscape Park boundaries and in the total area of agricultural land (ha). Source: Own elaboration

The largest acreage of permanent grassland is found within the communes of Mrągowo, Mikołajki, and Pisz, while the smallest one in the commune of Piecki (Fig. 2). The situation is slightly different when we analyse the percentage of meadows and pastures within the Masurian Landscape Park boundaries. In this case, the largest proportion of permanent grassland is found in the communes of RucianeNida, Piecki, and Pisz (Fig. 3).

As it could be assumed, the land use structure and the related access to food resources have determined the location of white stork nests (Fig. 4). Their greatest density was found in the communes of Ruciane Nida (80 nests), Piecki (30), Pisz (12), and Orzysz (11). In the remaining communes, despite the permanent grassland occurring there, the number of white stork nests ranged from 0 in the commune of Świętajno to 4 in the commune of Mikołajki (Fig. 4).

In the years 2014–2018, all the white stork nests and the newly-established breeding platforms located within the Masurian Landscape Park boundaries were inspected. It was found that for the inhabited nests, the situation was stable since only slight differences in their population size had been noted in particular years. A slightly different situation was observed for the nests uninhabited by birds, whose number increased over 5 seasons from 19 to 41, similarly as in the case of the above-mentioned

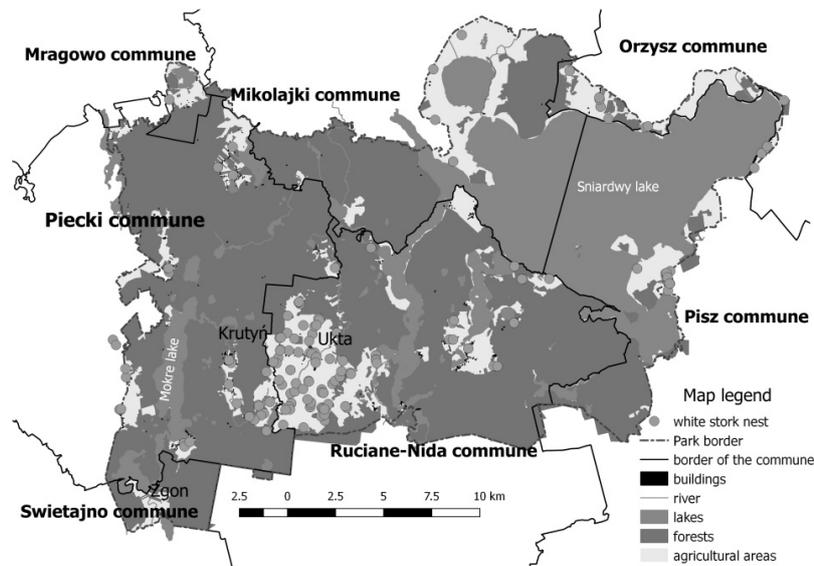


Figure 4. The distribution of the white stork nests within the Masurian Landscape Park boundaries. Source: Own elaboration.

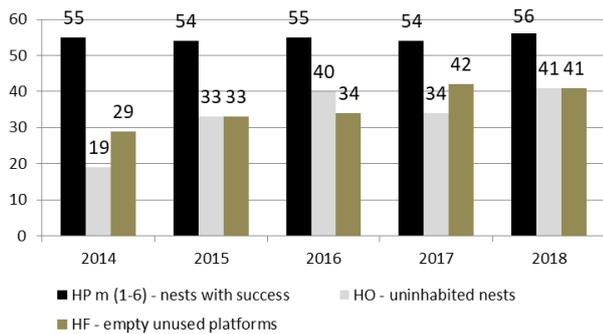


Figure 5. White stork’s breeding success within the Masurian Landscape Park boundaries. Source: Own elaboration.

breeding platforms (Fig. 5). This means that the white stork population in the Masurian Landscape Park is, as already mentioned, stable; however, it shows not upward trend, which may be due to the volume of food resources associated with open agricultural areas, particularly in the form of extensively managed permanent grassland. The stable (yet not optimal for the species concerned) situation concerning the white stork population is also confirmed by the observations of the reared broods (breeding success) (Fig. 5). Apart from the decrease in the number of reared nestlings between 2014 and 2015 (from 2.8 to 2.02), the pairs nesting in the Masurian Landscape Park rear a similar number of nestlings (an average of 2.27) with a slight upward trend from 2015 onwards. The decrease in the average number of reared nestlings, observed since 2015, may be due to several factors. The effects of hatching are primarily determined

by the condition of birds coming back from wintering grounds. The number of reared nestlings also depends on the nutritional and atmospheric conditions prevalent during the season. These effects overlap, and it is therefore difficult to assess, at least only by means of local research within the area of breeding sites, what the main reasons are for a particular year to be referred to as successful or not [Żurawlew P., 2011]. It appears, however, that the major factor contributing to a decrease in the number of reared nestlings during the period concerned was climate change. According to the data of the Institute of Soil Science and Plant Cultivation’s Agricultural Drought Monitoring System in Puławy,³ droughts have been noted in Poland in the growing season since 2015, which translated into food availability followed by the breeding success.

5. CONCLUSION

The white stork (*Ciconia ciconia* L.) is one of the 22 bird species comprising the so-called Farmland Bird Index (FBI), which is among the most important indicators of the environment condition and the biodiversity status in the agricultural rural areas. The region of Warmia and Mazury, including the Masurian Landscape Park, is an important white stork sanctuary in Poland as a whole. The study showed that the white stork population in the Masurian Landscape Park was stable in terms of both population size and the reared broods. It should be stressed, however, that this situation may undergo detrimental changes that have previously been observed in other regions of the country. Given the biology of this species, it is very important to preserve open spaces, in

³ <http://www.susza.iung.pulawy.pl/glowna/>

particular the extensively managed permanent grassland, and to inhibit the development of uncontrolled scattered housing, which results in the degradation of the landscape of open (agricultural) areas of the Park. In order to maintain the existing white stork population size, it is necessary to address the issue of afforestation of areas unsuitable

for agricultural production, and to halt the natural succession occurring in these areas. Farm owners should be encouraged to participate in the Agri-Environment-Climate Scheme, which is one of the most effective tools of the Common Agricultural Policy, aimed at the preservation of valuable natural resources in agricultural areas.

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