IMPACT OF THE LAND COVER CHANGE ON THE ABUNDANCE OF FARMLAND BIRDS

Nándor Csikós[1]

[1]*Department of Physical Geography and Geoinformatics, University of Szeged, H-6722 Szeged, Egyetem utca 2, Hungary*
e-mail: csikos@geo.u-szeged.hu

Abstract

The European landscape has been changed in the last decades and this process has different characteristics with different drivers in West and Central East Europe. In this study I analysed the land cover and land use change in two study areas (Hungary, Schleswig-Holstein) and its impact on the abundance data of a representative bird species of European agrarian landscapes, the Eurasian skylark. Generalized Linear Models were used to estimate the land cover effects in R Statistics software. ArcGis 10.3 were used for the spatial data analysis. Arable lands and pastures are habitat areas, while the forests, built up areas and water surfaces are the non-preferred areas of the skylark. According to our findings, the different changes of preferred and non-preferred land cover categories have strong effect on the population of the skylark in country and European scale.

Introduction

The land use and land cover (LULC) of the European landscape have been changed dramatically in the last decades. There are different drivers of the change in West- and Central East Europe, which have effect on the farmland bird fauna [1] abundance. In West Europe (in this case Germany) the main driver was the support of the renewable energies, because the members of the European Union have set up its own climate protection objectives [2,3]. The biogas energy production has the highest impact on the LULC change, because the feeding of the biogas power plants requires lots of material, such as manure and energy crops. In the beginning of the 2000s, Germany has been introduced the new energy law, which support the transformation of the agricultural landscapes into energy landscapes. These changes reshaped the land use, landscape structure, landscape pattern which had strong impact on biodiversity[4–8].

In the Central and East European (CEE) countries, the common agricultural policy of the EU and the land privatisation in the 1990s caused dramatic landscape changes[1,9,10]. In Hungary and other CEE (post- socialist) countries have lands with low soil quality and poor agro-ecological conditions have been abandoned. The land abandonment leads to the arable lands transformations into non cultivated lands, and spontaneous and fast reforestation of grasslands[1,11].

Most of the researches are focusing on parcel scale studies and analysing the land use / crop structure and the abundance of the agricultural fauna. The abundance data of the Eurasian skylark were used to analyse the impact of the LULC change on the agrarian fauna, because this species is one of the most characteristic farmland birds of the European agricultural landscapes. To announce the relationship between the abundance decline of this bird species and regional land cover change in Europe, it is important to identify the skylark preferred and non-preferred land cover types.

In this study I used the EU Corine Land Cover databases as land cover dataset. The Eurasian skylark's abundance data of the Hungarian Common Bird Monitoring database and the ornithological working group of Schleswig-Holstein and Hamburg have been accounted. The following are the objectives of this study: (1) analyse the relationship between the Eurasian

skylark abundance and the LULC categories based on my previous researches, (2) compare the proportion of LULC categories in the study areas and (3) to analyse the LULC categories and LULC change effect on the abundance of the skylark.

Materials and Methods

The basis of my research is the two study areas: At first Hungary, which is located in the Carpathian Basin in Central Europe. The elevation ranges from 77 m to 1014 m. The most common land cover type is agricultural area (61%). The second study area is Schleswig-Holstein Federal state of Germany. This region is surrounded by the Baltic Sea, Denmark and the North Sea. The climate is humid with an average annal temperature of 8.6 °C and mean annual precipitation 878 mm. The main land cover type is also agricultural land (41.5%).

Medium-scale land cover data for the two study areas were extracted from the Corine Land Cover database. It has a scale of 1:100000 and 44 classes of land cover, which 37 are relevant in Germany and 28 in Hungary[12].

The relationship analysis between the Eurasian skylark abundance data and the LULC categories was conducted based on ornithological datasets. In Hungary the Hungarian Common Bird Monitoring Database contains the abundance data and the details of the survey is in the work of Szép & Nagy (2001)[13]. In Schleswig-Holstein, the skylark data were collected by the Ornithological Working Group of Schleswig-Holstein and Hamburg. More details about the survey can be found in the work of Südbeck et. al 2005[14,15].

The impact of the LULC categories on the abundance of skylark were carried out by Generalized Linear Models in R statistics. The details of the model can be found in my previous article Csikós & Szilassi (2020)[16]. I calculated the preferred and non-preferred land cover types' proportion in both study areas and compared them[16,17]. Finally, based on the CLC datasets I analysed the changes of the land cover types. The spatial analyses of the datasets were executed in ArcGis 10.3 software.

Results and discussion

Table 1 shows the results of the Generalized Linear Model, which describe the preferred and non-preferred land cover types of the skylark in both study area. The preferred land cover types are usually covered by low height and low ground cover density plants, which areas suitable for skylark. The non-preferred land cover categories are not suitable areas for skylark, because of the height and density of the plants and the composition of the land use types inside the category[11]. Regarding to the different preferred and non-preferred land cover categories, landscape changes and landscape structure, forced by different environmental, cultural and political drivers, have strong effect on the population of the skylark[1].

Table 1. Results of the Generalized Linear Models based on the study areas, which shows the preferred and non-preferred land cover types of the Eurasian skylark

Hungary		Schleswig-Holstein	
Non-preferred	**Preferred**	**Non-preferred**	**Preferred**
Construction sites	Non-irrigated arable land	Discontinuous urban fabric	Non-irrigated arable land
Green urban areas	Natural grassland	Mixed forest	Pastures
Fruit trees and berry plantations		Water bodies	Natural grassland
Complex cultivation patterns			Inland marshes
Broad-leaved forest			
Coniferous forest			
Inland marshes			

Based on the Table 1. results I calculated and visualised the proportion of the land cover types in both study area, the Figure 1. and explaining most of them. For example, the case of the pastures, in Schleswig-Holstein there are lot of pasture area (proportion and number of patches), because of the dairy production. Discontinuous urban fabric land cover category has higher proportion in Schleswig-Holstein. Complex cultivation patters also unusual land cover category in Schleswig-Holstein, but in Hungary it has a high number of patch, while there is a mixed structure of agriculture, where traditional and intensive farming stand side by side [9]. Because of the different climate conditions, Fruit trees and berry plantations category is rare in Schleswig-Holstein as the Mixed Forest category in Hungary because of the different climatic conditions of the study areas. Figure 2. visualize the spatial characteristics of the preferred and non-preferred land cover types in Hungary and Schleswig-Holstein.
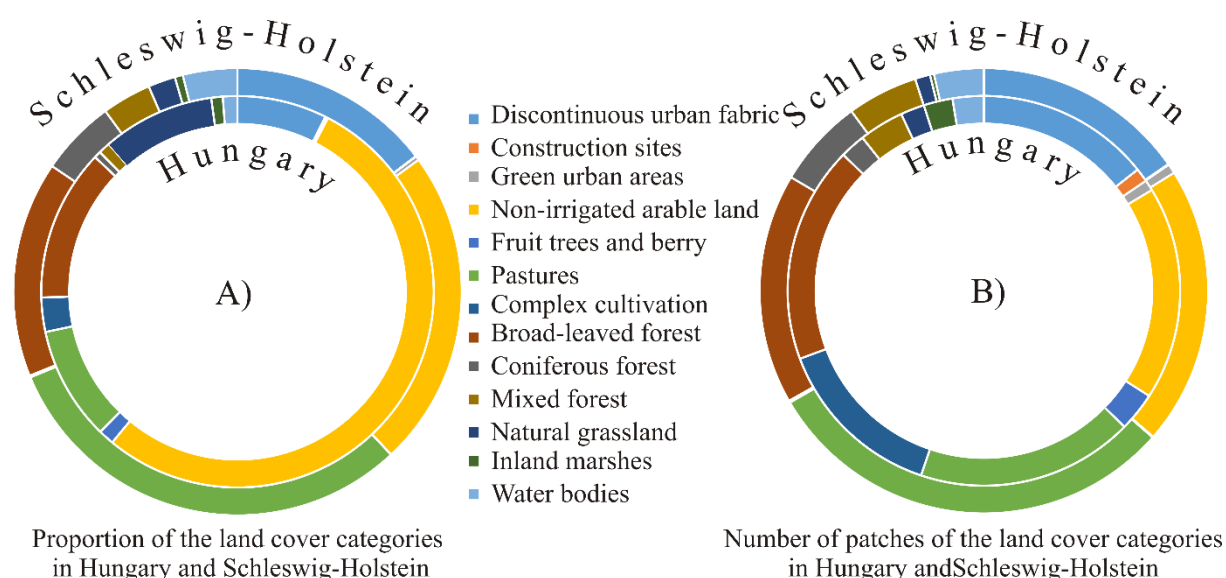

Figure 1. Proportion (A) and number of patches (B) of the land cover categories in Hungary and Schleswig-Holstein
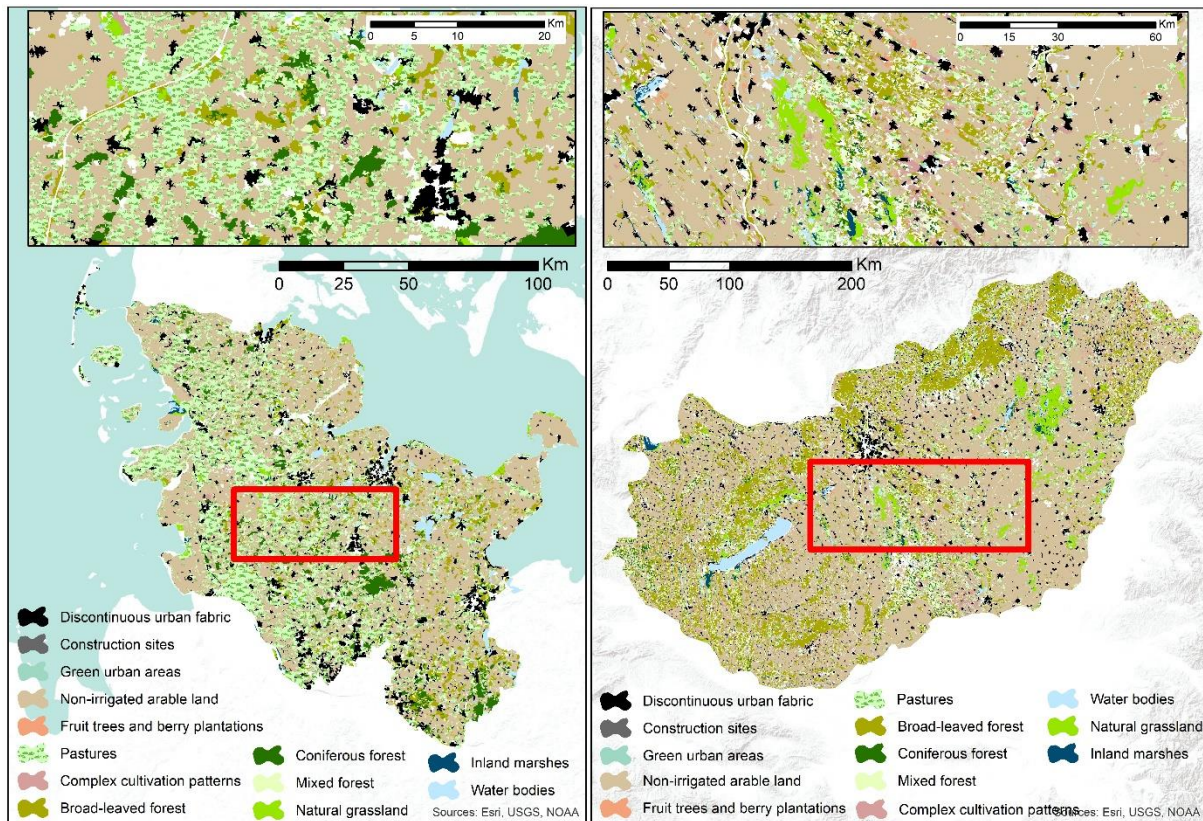
Figure 2. The spatial characteristics of the main land cover categories of Hungary and Schleswig-Holstein

Conclusion

In the last decades, the landscape change in Europe, which has an effect on the population of the agricultural fauna. The Eurasian skylark is an indicator species, so the changes in its population can predict the population changes of other farmland birds. Generalized Linear Models presents different land cover categories as preferred and non-preferred land covers. Landscape changes and landscape structure, influenced by different environmental, cultural and political drivers, have strong effect on the population of the skylark. In a European wide habitat modelling, we have to take under consideration that the certain regions have different environmental and cultural drivers in case of landscape change, which have specific effect on the population of the skylark.

Acknowledgements

References

1. Tryjanowski, P.; Hartel, T.; Bldi, A.; Szymański, P.; Tobolka, M.; Herzon, I.; Goławski, A.; Konvička, M.; Hromada, M.; Jerzak, L.; et al. Conservation of farmland birds faces different challenges in Western and Central-Eastern Europe. *Acta Ornithol.* **2011**, *46*, 1–12.
2. EU Directive 2009/28/EC of the European parliament and of the council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. *Off. J. Eur. Union* **2009**, *52*.

3. EC (European Commission) Optimal use of biogas from waste streams. An assessment of the potential of biogas from digestion in the EU beyond 2020 - European Commission Available online: https://ec.europa.eu/energy/en/studies/optimal-use-biogas-waste-streams-assessment-potential-biogas-digestion-eu-beyond-2020 (accessed on May 9, 2018).

4. Scheftelowitz, M.; Becker, R.; Thrän, D. Improved power provision from biomass: A retrospective on the impacts of German energy policy. *Biomass and Bioenergy* **2018**, *111*, 1–12.

5. Lüker-Jans, N.; Simmering, D.; Otte, A. The impact of biogas plants on regional dynamics of permanent grassland and maize area—The example of Hesse, Germany (2005–2010). *Agric. Ecosyst. Environ.* **2017**, *241*, 24–38.

6. Laggner, B.; Orthen, N.; Osterburg, B.; Röder, N. Ist die zunehmende Biogasproduktion die alleinige Ursache für den Grünlandschwund in Deutschland? – eine Analyse von georeferenzierten Daten zur Landnutzung. *Raumforsch. Raumordn.* **2014**, *72*, 195–209.

7. Schleupner, C.; Link, P.M. Potential impacts on important bird habitats in Eiderstedt (Schleswig-Holstein) caused by agricultural land use changes. *Appl. Geogr.* **2008**, *28*, 237–247.

8. Brandt, K.; Glemnitz, M. Assessing the regional impacts of increased energy maize cultivation on farmland birds. *Environ. Monit. Assess.* **2014**, *186*, 679–697.

9. Báldi, A.; Faragó, S. Long-term changes of farmland game populations in a post-socialist country (Hungary). *Agric. Ecosyst. Environ.* **2007**, *118*, 307–311.

10. Szép, T.; Nagy, K.; Nagy, Z.; Halmos, G. Population trends of common breeding and wintering birds in hungary, decline of long-distance migrant and farmland birds during 1999–2012. *Ornis Hungarica* **2012**, *20*, 13–63.

11. Gil-Tena, A.; De Cáceres, M.; Ernoult, A.; Butet, A.; Brotons, L.; Burel, F. Agricultural landscape composition as a driver of farmland bird diversity in Brittany (NW France). *Agric. Ecosyst. Environ.* **2015**, *205*, 79–89.

12. EEA and ETC-TE CLC Update CLC 2000 Project. Technical Guidelines. Final Version Available online: http://land.copernicus.eu/user-corner/technical-library/techrep89.pdf (accessed on May 9, 2018).

13. Szép, T.; Nagy, K. The GIS UTM Quadrants based Hungarian Bird Monitoring database of the BirdLife Hungary. *Természetvédelmi Közlemények* **2001**, *9*, 31–37.

14. Südbeck, P.; Andretzke, H.; Fischer, S.; Gedeon, K.; Schikore, T.; Schröder, K.; Sudfeldt, C. *Methodenstandards zur erfassung der Brutvögel Deutschlands*; 2005; ISBN 300015261X.

15. Brendt, R.K.; Koop, B.; Struwe-Juhl, B. *Vogelwelt Schleswig-Holsteins*; 2nd ed.; Wachholz Verlag: Neumünster, 2005;

16. Csikós, N.; Szilassi, P. Impact of Energy Landscapes on the Abundance of Eurasian Skylark (Alauda arvensis), an Example from North Germany. *Sustainability* **2020**, *12*, 664.

17. Szilassi, P.; Csikos, N.; Galle, R.; Szep, T. Recent and Predicted Changes in Habitat of the Eurasian Skylark Alauda arvensis Based on the Link between the Land Cover and the Field Survey Based Abundance Data. *Acta Ornithol.* **2019**, *54*, 59.