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Effects of the Common Agricultural Policy on the Coverage of Grassland Habitats in Besaparski Ridove Special Protection Area (Natura 2000), Southern Bulgaria

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Abstract: In Bulgaria, an EU member state since 2007, semi-natural grasslands are still widespread but their area has decreased significantly in the last decades mainly due to their turnover into arable lands. We examined the changes in the cover and configuration of grassland habitats resulting from the Common Agricultural Policy implementation on the territory of Besaparski Ridove Special Protection Area between 2006 and 2010. There was a significant increase in the cover of arable lands, vineyards and orchards, and loss of natural and semi-natural grasslands. The most substantial land cover changes were the increase of arable lands (av. 33 ha per 4.84 km^2 sampling plot) and the loss of the natural grasslands (av. 30 ha per 4.84 km^2 sampling plot). There were also significant shifts found in the grassland configuration in terms of increased landscape complexity. We make recommendations for implementation of appropriate Agri-environmental schemes (AES) to avoid further loss of biodiversity and valuable grassland habitats within Natura 2000 in Bulgaria.

Keywords: Agri-environment schemes, biodiversity conservation, semi-natural grasslands, protected area management

Introduction

Management of agricultural lands is a major driver of biodiversity alterations in anthropogenic landscapes (Wrbka *et al.* 2008). Two main categories of farmland exist: unplowed semi-natural grasslands (usually used as pastures) and arable lands (Wretenberg *et al.* 2007). The semi-natural grassland is non-arable land with grazing regime and it is maintained in this condition for prolonged period of time. Farmlands include all arable lands (regularly or not regularly plowed). Grasslands, sheltering a characteristic and diverse flora and fauna with many rare and threatened species, are amongst the most threatened habitats by agricultural intensification due to habitat loss, degradation and fragmentation (Hannah *et al.* 1995, Tscharntke *et al.* 2005). Intensive management of arable lands generally consists of different practices, often used in conjunction, such as drainage, plowing and reseeding, use of fertilizers, intensive mowing and grazing and use of pesticides (Maccracken, Tallowin 2004). The environmental impacts from agricultural intensification in 20th century are well documented: these include detrimental changes to biodiversity, landscape, natural resources such as soil and water, and the rural economy (Buckwell, Armstrong-Brown 2004). The area of grasslands is decreasing consistently in northern (Pärt, Söderström 1999), western (Tucker, Heath 1994, Fuller *et al.* 1995) and eastern European countries (Meshinev *et al.* 2005): a total of 4 million ha of grasslands have been converted to arable lands in the last 20 years (Carlier *et al*. 2009). Grassland substitution by agricultural

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intensified lands is resulting in simplified systems (Maccracken, Tallowin 2004) and has been associated with a substantial decline in biodiversity (Wilson *et al.* 1999, Stoate *et al.* 2001, Jongman 2002). For instance, 76% of bird species of the natural and semi-natural European steppe habitats suffer from population decline (Suarez *et al.* 1997) and 97% of semi-natural lowland meadows have been lost since the 1930s in England and Wales (Maff 2000). In general, the changes that have been identified as being most detrimental to biodiversity include: (i) loss of habitat diversity at the farm and landscape-scales resulting from business rationalization, (ii) changes in crop type and structure, (iii) direct effects of pesticides on flora and invertebrates, (iv) indirect effects of pesticides, including the removal of plant and invertebrate material from the food chain, and (v) use of inorganic nitrogen to promote grass productivity at the expense of broad-leaved flora (Buckwell, Armstrong-Brown 2004). However, the impacts of agricultural intensification have not fallen on biodiversity alone. The key features associated with intensification from the landscape viewpoint are the expansion of monocultures, the loss or fragmentation of field-boundary features and woodlands when usually only little fragments of natural grasslands remain among the arable lands and they are overgrazed (Browder *et al.* 2002), improvement or overgrazing of extensive grazing land, and drainage and canalization of rivers (Buckwell, Armstrong-Brown 2004). As a logical measure, many grassland habitats are of special conservation concern in the European Union (EU) under the Habitat Directive (Directive 92/43/EEC). The Natura 2000 network is the main tool of the Habitat Directive for European biodiversity conservation. As farmlands cover over 50% of the EU (EEA 2010), the Common Agricultural Policy (CAP) plays an extremely important role in influencing how land is managed and environmental objectives are achieved. The CAP is also the main financial instrument available for achieving ambitious environmental goals, representing roughly 40% of the EU budget. The CAP sits under Heading 2 of the EU budget, named "Preservation and management of natural resources", and should therefore significantly contribute to halting biodiversity declines and enhancing environmental quality (Boccaccio *et al.* 2009). However, agricultural intensification over recent decades, partly driven by the CAP, has led to a widespread and significant decline of farmland biodiversity across the EU (Donald *et al.* 2006; Luoto *et al.* 2003; Reidsma *et al.* 2006). Although the policy incentive to over-produce was largely removed as part of the 2003 CAP reforms, a clear need to improve the environmental policy performance across the EU still remains (Buckwel, Armstrong-Brown 2004).

Bulgaria is a relatively new EU member state (joined in 2007). Semi-natural grasslands are still widespread in the country (Meshinev *et al.* 2005) but their area has decreased significantly in the last decades: from ca.18,000 km^2 in the beginning of 20th century (16% of the territory of the country) (Ganchev *et al.* 1964), to ca. 8500 km^2 nowadays (EEA 2010). The main reasons for the decrease of this type of habitat are linked to the intensification in agriculture through the CAP and the turnover of grasslands into arable lands (Demerdzhiev 2007). Precisely the conversion of grasslands into arable lands has led to decrease in populations of many species of birds throughout Europe and in Bulgaria (Spasov 2008). Additionally, the loss of habitat heterogeneity is supposed to be an important engine of biodiversity decline. Common trend in all Western European countries is the long-term sharp decline in the populations of farmland birds and high level of intensification of farming (agrochemical, mechanical, etc.). As a response to the negative effects of intensification in agriculture, the EU applies agri-environmental schemes (AES) (Kleijn, Sutherland 2003). The aim is to encourage farmers to use more expensive and less profitable farming methods which conserve the biodiversity and environment (Stoate *et al.* 2009). Comprehensive changes in agricultural policy have also a big potential to change the unfavourable condition of the biodiversity nowadays in farmlands. Although the CAP implementation in Bulgaria has a key role on biodiversity, there is a poor knowledge on the effects of CAP on the cover and landscape configuration of the semi-natural grasslands in the country. Some case studies proved that extensively managed pastures shelter higher bird diversity than abandoned or intensive pastures and that there is a positive relation between habitat heterogeneity and bird diversity (Nikolov 2009, Nikolov *et al.* 2011). Similar results were demonstrated for vascular plants, where pastureland abandonment led to an increase in vegetation height and the richness of mesophytes and leafy plants, and red-list species, while grazed plots had higher total species richness, more xerophytes, rosette forming and spring-flowering species (Vassilev *et al.* 2011). To co-interact the negative aspects of CAP through industrialized and intensified agriculture on landscape and biodiversity, there is an urgent need for evaluation and improvement of CAP in Bulgaria, and further development of agri-environmental schemes (AES) providing

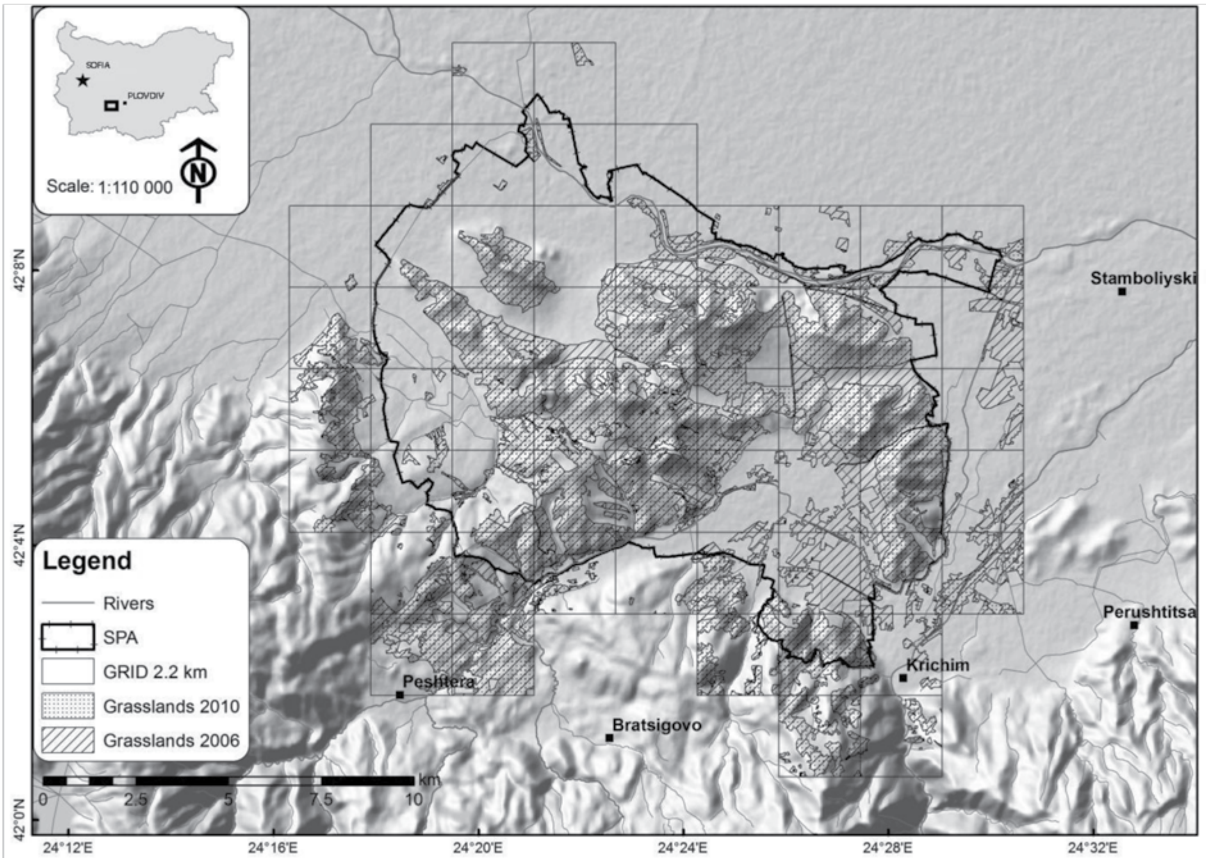

Fig. 1. Map of Besaparski Ridove Special Protection Area

subsidies to farmers for environmentally friendly agricultural practices.

In this study, we examined the shifts in the landscape cover in a Special Protection Area (SPA) of Natura 2000 network in Bulgaria resulting from the CAP implementation in the country as a national-level model. More precisely, our study was focused on the changes in the cover (habitat loss) and configuration (landscape complexity) of grasslands. Since grasslands provide valuable habitats for many bird species and other vertebrates, we suggest adequate measures to avoid further loss of biodiversity.

Methods

Study area

For the aim of the study, we selected Besaparski Ridove SPA due to its rich biodiversity (Angelova *et al.* 2008) and relatively wide cover of grasslands (Tzonev *et al.* 2014), its proximity to a big town (Plovdiv) and our observations of a rapid trend of semi-natural grasslands conversion to arable lands (Demerdzhiev 2007). The study area (N42.109351 E24.388577) is located on the south-western part of the Thracian Lowland and covers about 152.9 km^2, with elevations between 350 and 536 m (Fig. 1). The region is characterised with plane to hilly relief and the climate is transitional continental with soft winters and hot summers. Besaparski Ridove area is relatively dry, with few constant surface water resources and low yearly precipitation between 500 and 800 mm/m^2. Soils are alluvial. Eroded and karst hills with almost no vegetation are specific to the SPA. In terms of natural and semi-natural vegetation cover, the area is dominated by grasslands (Tzonev *et al.* 2014), dominated by calciphilous and thermophilous species as Bluestem (*Dichantium ischaemum* L.), Scented grass (*Chrysopogon gryllus* L.) and Needle grass (*Stipa capillata L.)* (Kopralev 2002). *F*orests cover under 6% of the SPA's territory (Dimitrov, Petrova 2014) and consist mainly of Downy oak (*Quercus pubescens* Willd.), Live oak (*Quercus virgiliana* Ten.), Hungarian oak (*Quercus frainetto* Ten.), Common oak (*Quercus daleschampii* Ten.) and Manna ash (*Fraxinus ornus* L.). Shrubby vegetation is represented mainly by the Christ's Thorn (*Paliurus spina-christi* L.), Cade juniper (*Juniperus oxycedrus* L.) and Oriental Hornbeam (*Carpinus orientalis* L.) (Kopralev 2002).

The study area is split in 57 sample plots with grid size 2.2 × 2.2 km based on a standard grid, which expands the study area over the size of the

Table 1. Land cover types based on the united Corine Land Cover Classes

Land Cover Types	Corine Land Cover Classes	CLC Code
Urban	Continuous urban fabric surfaces	1.1.1.
	Discontinuous urban fabric	1.1.2.
	Industrial or commercial units	1.2.1.
	Sport and leisure facilities	1.4.2.
Stone pit	Mineral extraction sites	1.3.1.
Arable land	Non-irrigated arable land	2.1.1.
	Permanently irrigated land	2.1.2.
	Land principally occupied by agriculture, with significant areas of natural vegetation	2.4.3.
Orchard and Vineyard	Vineyards	2.2.1.
	Fruit trees and berry plantations	2.2.2.
SemiNat_Grass	Pastures	2.3.1.
Forests	Broad-leaved forest	3.1.1.
ConiMix_forests	Coniferous forest	3.1.2.
	Mixed forest	3.1.3.
Nat_Grass	Natural grassland	3.2.1.
Transitional	Transitional woodland shrub	3.2.4.
Wetlands	Beaches, dunes, and sand plains	3.3.1.
	Water courses	5.1.1.
	Water bodies	5.1.2.

Table 2. Description of analysed grassland landscape metrics in Besaparski Ridove SPA. Metrics are generated and calculated in Patch Analyst 5

Landscape parameter	Acronym	Measure type
Area weighted mean shape index	AWMSI	The sum of each patch's perimeter, divided by the square root of patch area for each class, and adjusted for circular standard divided by the number of patches.
Mean shape index	MSI	Sum of each patches perimeter/area ratio divided by number of patches (m/ha)
Mean perimeter – area ratio	MPAR	Sum of each patch's perimeter divided by the square root of patch area for each class, and adjusted for circular standard (for polygons), divided by the number of patches.
Mean patch fractal dimension	MPFD	Another measure of shape complexity:mean fractal dimension approaches one for shapes with simple perimeters and approaches two when shapes are more complex.
Area weighted mean patch fractal dimension	AWMPFD	Measure of shape complexity adjusted for shape size.
Total edge	TE	Perimeter of patches (m)
Edge density	ED	Amount of edge relative to the landscape area (m/ha)
Mean patch edge	MPE	Average amount of edge per patch (m/patch)
Mean patch size	MPS	Average patch size (ha)
Number of patches	NumP	Total number of grassland patches in the landscape (count)
Median patch size	MedPS	The middle patch size, or 50th percentile (ha)
Patch size coefficient of variation	PSCoV	Coefficient of variation of patches (ha)
Patch size standard deviation	PSSD	Standard Deviation of patch areas (ha)
Landscape area	TLA	Sum of areas of all patches in the landscape (ha)
Class area	CA	Sum of areas of all patches belonging to a given landscape class (in our case – grasslands) (ha)

territory of the SPA (Fig. 1). We used a 2.2 km grid size, which is consistent with the distribution and nearest neighbour distance of the breeding Rough-Legged buzzards (*Buteo rufinus* Cretzschmar, 1927) in this SPA (Demerdzhiev *et al.* 2014) and ensures a good approach to assess changes in grassland habitats over the study period. Additionally it allows to include some adjacent areas outside the SPA in the analysis in order to avoid bias since the effect of grassland fragmentation and loss spreads beyond SPA borders.

Land cover analysis

To assess the impact of the Common Agricultural Policy (CAP) on the cover of grasslands in the SPA we built digital maps and compared the land cover between 2006, when the CAP was still not operating, and 2010, when the CAP has operated for 4 years. First we built a digital map of the habitats within the study area for 2006 based on publicly available aerial photos with scale 1:5000. We assigned different polygons to land cover types (i.e. habitats) according to Corine Land Cover (CLC) classes (EEA 2006). Additionally, CLC classes with similar characteristics were united in groups of land cover types for the purpose of the analysis (Table 1) . Then we used the GIS map for 2006 as a template to build the digital map for 2010 by accounting the land cover changes during the studied period. Because there were no available high resolution aerial photos for 2010, we mapped all territories that were plowed in 2010 in the field by using the track function of a hand-held GPS device (Garmin E-trex, accuracy ±10 m). Changes in land cover in 2010 were validated using Google Earth images referent to 2010 (Google Earth 2010). The data processing and mapping were done with software ArcGIS 9.2 (Esri 2011). Mapping of the plots was completed with accuracy 1:1000.

Fragmentation analysis was performed with Patch Analyst 5 (Rempel *et al*. 2012). Only the grassland polygons referent to 2006 and 2010 respectively were used in the analysis. The polygons (patches) were initially dissolved to aggregate bordering polygons. Once dissolved the polygons were disintegrated to single polygons using Multipart-to-Single-Part Tool in ArcGIS 9.2 (Esri 2011). Finally the polygons were analyzed with Spatial Statistic analyses of Patch Analyst 5 (Rempel *et al.* 2012). Indices used are presented in Table 2.

For analysis of land cover changes we used a cell unit of 2.2 × 2.2 km in UTM grid. We calculated habitat diversity at the cell level for both 2006 and 2010 using the Shannon diversity index (Shannon 1948).

Shifts in habitat cover data between 2006 and 2010 were investigated by Wilcoxon matched pairs test. Correlations were tested by Spearman Rank Correlation Coefficient. All analyses were computed in STATISTICA 7.0 (StatSoft 2004).

Results

We identified 10 land cover types based on the CLC Classes and we found a significant difference in the area of four habitat types between 2006 and 2010 (Table 3). The area of the "arable lands" and "vineyards and orchards" increased while the cover of "natural" and "semi-natural grasslands" decreased. The area of all other habitat types did not significantly change within the studied period. The most substantial shifts were found in the area of "arable lands" and the area of "natural grasslands". "Arable lands" increased on average ca. 33 ha per 4.84 km^2 sampling plot and "natural grasslands" decreased on average ca. 30 ha per 4.84 km^2 sampling plot. The increase of "arable lands" was mostly related to reduction in the area of "natural grasslands" and to a lesser extent to reduction in the area of "semi-natural grasslands", while the increase in the area of "vineyards" was related only to the decrease in the area of the "natural grasslands" (Table 4). Increase of the area of "arable lands" also negatively affected the habitat diversity within the studied area (2006: r_s = -0.37, p<0.05; 2010: r_s = -0.58, p<0.05). Out of 15 analyzed landscape metrics of "grasslands", 11 demonstrated higher landscape complexity of "grasslands" in 2010 compared to 2006 (Table 5).

Discussion

We observed dramatic loss of "grasslands" for the purposes of agriculture caused by the intensification of agriculture and turnover of "natural" and "semi-natural grasslands" to "arable lands" and "vineyards and orchards", the main habitat types that significantly changed their area during the study period. Bulgaria joined the EU in 2007 and one of the policies in EU supporting the intensification of agricultural production is the CAP (Polakova *et al.* 2011). Additionally there is a common trend in many European countries for unifying small agricultural fields into expanded monocultures to permit the use of large machinery; however, field margins and other land cover types have been destroyed resulting in more homogenous landscape diversity (Brotons *et al.* 2004) and the fragmentation and turnover of natural habitats into agricultural lands which is the case in the present study. The CAP has already been

Table 3. Mean cover (±SE) of habitat types in 2006 and 2010 in Besaparski Ridove SPA. Only habitats with significant difference in the cover between 2006 and 2010 are shown. Comparisons were made by Wilcoxon matched pairs test. *: p<0.05, ***: p<0.001.

Habitat type	**Cover (ha)**		
	2006	2010	**Z (n = 57)**
Arable lands	144.5±17.2	177.3±18.9	5.48***
Vineyards and orchards	14.3±3.3	16.0±3.3	2.20*
Natural grasslands	125.2±15.8	94.1±13.8	5.29***
Semi-natural grasslands	66.5±10.9	62.6±10.5	3.35***

Table 4. Spearman Rank Correlations between the shifts in the habitat cover within the studied area for the period 2006-2010. *: p<0.05, ns: p>0.05.

Shifts in habitat cover	**Natural grasslands**	**Semi-natural grasslands**
Arable land	-0.88*	-0.38*
Vineyards and orchards	-0.36*	-0.10 ns

Table 5. Means of landscape metrics (±SE) of grasslands in 2006 and 2010 in Besaparski Ridove SPA. Only metrics which differ between 2006 and 2010 are shown. Comparisons were made by Wilcoxon matched pairs test. *: p<0.05, **: p<0.01, ***: p<0.001.

Landscape parameter (metric)	**2006**	**2010**	**Z (n = 57)**
Mean perimeter – area ratio	3,089.23±1,474.07	12,934.31±7,418.68	2.62**
Mean patch fractal dimension	1.40±0.01	1.43±0.01	3.03**
Area weighted mean patch fractal dimension	1.31±0.01	1.32±0.01	2.02*
Total edge (m)	17,839.65±1,238.30	15,284.51±1,149.08	4.19***
Edge density (m/ha)	1.63±0.11	1.71±0.13	2.93**
Mean patch edge (m/patch)	3,589.81±439.95	3,121.19±398.30	2.10*
Mean patch size (ha)	49.85±9.81	39.62±8.23	3.63***
Median patch size (ha)	27.92±9.98	20.52±8.21	2.13*
Patch size standard deviation (ha)	51.53±7.06	44.17±6.62	3.76***
Landscape area (ha)	10,928.03±0.0	8,931.9±0.0	6.57***
Class area (ha)	191.72±17.23	156.7±16.61	5.57***

reported to stimulate fragmentation and the turnover of grassland habitats into arable lands through intensification of agricultural management and thus resulting in population decline of many species: e.g. farmland birds (Donald *et al.* 2001, 2006, Buenestado *et al.* 2008, Delibes-Mateos *et al.* 2009, Baldi, Batary 2011, Santana *et al.* 2013) and mammals (Sokos *et al.* 2013). Moreover, "natural" and "semi-natural grasslands" in the studied SPA that we identified shelter four types of protected non-forest habitats under the Habitat Directive (habitat codes 5210, 6210, 62A0 and 6220) (Tzonev *et al.* 2014). The habitat 62A0 "Eastern sub-Mediterranean dry grasslands" is the most widespread in the site and it also has an important role for the preservation of the populations of protected mammals (Nedyalkov, Koshev 2014), reptiles (Popgeorgiev *et al.* 2014), birds (Demerdzhiev 2014, Demerdzhiev *et al.* 2014), endemic and protected plants (Angelova *et al.* 2008). Amongst the main threats for this habitat is the plowing of grasslands (Tzonev *et al.* 2014). The large-scale plowing of areas that had been managed as pastures in recent decades and the turnover to agricultural lands resulted in a significant loss of valuable foraging habitats for raptors as well as many other species inhabiting grassland habitats (Nikolov *et al.* 2011, Demerdzhiev 2014). And although agricultural lands provide habitats for a range of species (e.g. Kleijn, Sutherland 2003, Herzon *et al.* 2014), the value of these territories is limited because of the constant disturbance several times per year and because of the simple structure of the vegetation, they support less species than the grasslands (Browder *et al.* 2002). Our results clearly demonstrate a substantial conversion of grassland habitats under the Habitat Directive (92/43/EEC) in agricultural lands in the studied SPA and fragmentation of these habitats by "arable lands" (out of 15 analyzed landscape metrics, 11 demonstrated higher landscape complexity in 2010 compared to 2006).Therefore, we confirm the negative consequences that the CAP may have on the biodiversity in a EU member state under inadequate implementation (Wrbka *et al.* 2008, Boccaccio *et al.* 2009, Nikolov *et al.* 2011). Hence, its design, coordination and implementation should be carefully considered and tested for sustaining biodiversity and associated ecosystem services through agriculture towards meeting the EU's biodiversity goals (Kleijn, Sutherland 2003). As a part of CAP and a response to the negative effects of intensification in agriculture the EU applied agri-environmental schemes (AES) (Kleijn, Sutherland 2003). The aim is to encourage farmers to accept more expensive and less profitable agricultural practices to conserve biodiversity and the habitats (Stoate *et al.* 2009, Polakova *et al.* 2011). An instrument to avoid negative effects of CAP, especially in Natura 2000 sites such is the case with the study area, AES meet a number of difficulties due to the direct transposition of the schemes to national legislation which cause negative effects in the natural habitats. Amongst the drivers for reduction and deterioration of the quality and quantity of natural and semi-natural grasslands, there are several problems with the national application of the CAP and AES: (i) Terms and rules concerning the schemes for single area payments (SSAP) and agri-environmental payments (AEP) in Bulgaria, which are not consistent with natural conditions and traditions of land use and included in laws, regulations and normative acts. (ii) Usage of different systems for management and control of grasslands in Natura 2000 network by responsible state institutions. Specifically, to control activities such as the land use in Natura 2000 sites, the Ministry of Environment and Waters uses cadastral maps. To manage and control the schemes for single area payments, the Ministry of Agriculture and Foods uses a map of the Land Parcels Identification System (LPIS). There are many cases where the two types of maps do not match; the cadastral maps have a number of significant gaps as well. (iii) In spite of the large area and the strong negative impact because of gaps in legislation, the agricultural activities of plowing of natural and semi-natural grasslands are not accepted as a plan, a program, a project or an investment proposal. Therefore, these activities are not considered as a subject of appropriate assessment and Environment Impact Assessment and the impact of their implementation on the environment is not evaluated adequately (Stefanova 2013).

In addition, declaration of natural and semi-natural grasslands in Natura 2000 under the SSAP and Agri-environmental payments and their management is characterised with obscure and constantly changing rules, significant administrative burden and a lack of any forecast of the process. For that reason because of significantly lesser administrative burden, clear rules and profitability, and stimulation by SSAP, the farmers prefer to plow these territories and to plant it with annual crops. The problem even grows bigger as a consequence of the ineffective system of consulting for farmers (Stefanova 2013).

Considering the mentioned problems, reducing and deteriorating the quality of natural and semi-natural grasslands and to avoid further loss of biodiversity and valuable grassland habitats, we recommend the implementation of AES such as:

Adaptation of definitions for grasslands, the terms and rules to subsidise land used under SSAP and AEP which are included in laws, regulations and normative acts with natural conditions and traditions in the land use in the country (Stefanova 2013).

Unification of the management and control systems used by the state institutions into real land use based systems that also consider the conservation and sustainable use of grasslands in Natura 2000.

Amendment and supplementation of the environmental law and linked with it regulations and normative acts in order to create procedures requiring Environmental Impact Assessment and Appropriate Assessment for activities which consider plowing of Natura 2000 grasslands.

Optimization of the process of declaration and grassland management under SSAP and AEP, and reduction of the administrative burden and provision of forecast of the process (Stefanova 2013).

Creating of a constant grasslands layer in the LPIS which includes all meadows, pastures and other areas not included in a crop rotation in the last 5 or more years and declared under SSAP, Natura 2000 payments and AEP during the 2007–2013 program period.

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References

Angelova K., K. Metodiev and G. Popgeorgiev 2008. The natural heritage of the Bessapari Hills. Sofia (Bulgarian Biodiversity Foundation). (In Bulgarian).

Baldi A., P. Batary 2011. Spatial heterogeneity and farmland birds: different perspectives in Western and Eastern Europe. – *Ibis*, **153**: 875-876.

Boccaccio L., J. Hegarty and A. Brunner 2009. Through the green smokescreen. How is CAP cross compliance delivering for biodiversity? Brussels (BirdLife International).

Browder S. F., D. H. Johnosn, I. J. Ball 2002. Assemblages of breeding birds as indicators of grassland condition. USGS Northern Prairie Wildlife Research Center. Paper 201.

Brotons L., S. Manosa, J. Estrada 2004. Modeling the effects of irrigation schemes on the distribution of steppe birds in Mediterranean farmland. – *Biodiversity & Conservation*, **13**: 1039-1058.

Buckwell A., S. Armstrong-Brown 2004. Changes in farming and future prospects – technology and policy. – *Ibis*, **146** (Suppl. 2): 14-21.

Buenestado F. J., P. Ferreras, M. Delibes-Mateos, F. S.Tortosa, J. A. Blanco-Aguiar and R.Villafuerte 2008. Habitat selection and home range size of red-legged partridges in Spain. – *Agriculture, Ecosystems & Environment*, **126**: 158-162.

Carlier, L., I. Rotar, M. Vlahova and R. Vidican 2009. Importance and functions of grasslands. – *Not. Bot. Hort. Agrobot. Club*, **37**(1): 25-30.

Delibes-Mateos M., M. A. Farfan, J. Olivero, A. L. Marquez and J. M. Vargas 2009. Long-term changes in game species over a long period of transformation in the Iberian Mediterranean landscape. – *Environmental Management*, **43** (6): 1256-1268.

Demerdzhiev D. 2007. Besaparski Hills. – In: Kostadinova I.,M. Gramatikov (eds.): Important Bird Areas in Bulgaria and Natura 2000. Sofia (BSPB), 320-322 pp.

Demerdzhiev, A. D. 2014. Avifauna in Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria: conservation status and dynamics. – *Acta zoologica bulgarica*, **Suppl. 5**: 171-189.

Demerdzhiev D., V. Dobrev and G. Popgeorgiev 2014. Effects of habitat change on territory occupancy, breeding density and breeding success of Long-legged Buzzard (*Buteo rufinus* Cretzschmar, 1927) in Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria. – *Acta zoologica bulgarica*, **Suppl. 5**: 191-200.

Dimitrov M., D. Petrova 2014. Forest habitats in Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria: characteristics, status assessment and management recommendations. – *Acta zoologica bulgarica*, **Suppl.5**: 129-136.

Donald P. F., R. E. Green and M.F. Heath 2001. Agricultural intensification and the collapse of Europe's farmland bird populations. – *Proc. R. Soc. B,* **268**: 25-29.

Donald P. F., F. J. Sanderson, I. J. Burfield and F .P. J. van Bommel. 2006. Further evidence of continent-wide impacts of agricultural intensification on European farmland birds, 1990-2000 – *Agriculture, Ecosystems & Environment*, **116**: 189-196.

EEA [European Environmental Agency] 2010. Corine Land Cover 1990 raster data – version 13 (02/2010). Available at: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-1990-raster. Accessed 24 October 2010.

Esri 2011. ArcGIS Desktop: Release 9.2. Redlands. CA (Environmental Systems Research Institute).

Fuller, R.J., R.D. Gregory, D.W. Gibbons, J.H. Marchant, J.D. Wilson, S.R. Baillie and N. Carter 1995. Population declines and range contractions among lowland farmland birds in Britain. – *Conservation Biology*, **9**: 1425-1441.

Ganchev, I., I. Bondev and S. Ganchev 1964. Vegetation of meadows and pastures in Bulgaria. Sofia (BAS).

Google Earth 2010. Bessaparski Hills. N42.103004 N E24.403644. Google Earth 28.07.2010.

Hannah, L., L.J. Carr and A. Lankerani 1995. Human disturbance and natural habitat: a biome level analysis of a global data set. – *Biodiversity & Conservation*, **4:** 128-155.

Herzon, I., R. Marja, S. Menshikova and A. Kondratyev 2014. Farmland bird communities in an agricultural landscape in Northwest Russia: seasonal and spatial patterns. – *Agriculture, Ecosystems & Environment*, **183**: 78-85.

Jongman, R. G. H. 2002. Homogenisation and fragmentation of the European landscape: ecological consequences and solutions. – *Landscape and Urban Planning*, **58**: 211-221.

Kleijn D., W. J. Sutherland 2003. How effective are European agri-environment schemes in conserving and promoting biodiversity? – *Journal of Applied Biology*, **40**: 947-969.

Kopralev I. 2002. Geography of Bulgaria. Physical and socio-economical geography. Sofia (ForCom). 760 p. (In Bulgarian).

Luoto M., S.Rekolainen, J. Aakkula and J.Pykala 2003. Loss of plant species richness and habitat connectivity in grasslands associated with agricultural change in Finland. – *Journal of the Human Environment*, **32**: 447-452.

Maccracken D. I., J. R. Tallowin 2004. Swards and structure: the interactions between farming practices and bird food resources in lowland grasslands. – *Ibis*, **146** (Suppl.2): 108-114.

Maff 2000. Towards Sustainable Agriculture: A Pilot Set of Indicators. London (MAFF Publications). 74 p.

Meshinev, T., I. Apostolova, G. Georgiev, V. Dimitrov, A. Petrova and P. Veen 2005. Grasslands of Bulgaria. Final report on the National Grasslands Inventory Project – Bulgaria, 2001–2004 (PINMATRA/2001/020). Sofia (Dragon 2003 Publishers).

Nedyalkov N. P., Y. S. Koshev 2014. Small mammals (Erinaceomorpha, Soricomorpha, Rodentia, Lagomorpha) in Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria: species composition, distribution and conservation. – *Acta zoologica bulgarica*, **Suppl. 5**: 201-212.

Nikolov, S. C. 2010. Effects of land abandonment and changing habitat structure on avian assemblages in upland pastures of Bulgaria. – *Bird Conservation International,* **20**: 200-213.

Nikolov, S. C., D. A. Demerdzhiev, G. S. Popgeorgiev and D.G. Plachiyski 2011. Bird community patterns in sub-Mediterranean pastures: the effects of shrub cover and grazing intensity. – *Animal Biodiversity & Conservation*, **34** (1): 11-21.

Part, T., B. Soderstrom 1999. Conservation value of semi-natural pastures in Sweden: contrasting botanical and avian measures. – *Conservation Biology,* **13***:* 755-765.

Poláková J., G. Tucker, K. Hart, J. Dwyer and M. Rayment 2011. Addressing biodiversity and habitat preservation through measures applied under the Common Agricultural Policy. Report Prepared for DG Agriculture and Rural Development, Contract No. 30-CE-0388497/00-44. London (Institute for European Environmental Policy), 313 p.

Popgeorgiev, G. S., N.D. Tzankov, Y.V. Kornilev, D.G. Plachiyski, B. Y. Naumov and A.Y. Stoyanov 2014. Changes in agri-environmental practices pose a threat to the herpetofauna, a case study from Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria. – *Acta zoologica bulgarica*, **Suppl. 5**: 157-169.

Reidsma, P., T. Tekelenburg, M.van den Berg and R.Alkemade 2006. Impacts of land-use change on biodiversity: an assessment of agricultural biodiversity in the European Union. – *Agriculture, Ecosystems & Environment*, **114**: 86-102.

Rempel, R. S., D. Kaukinen and A.P. Carr 2012. Patch Analyst and Patch Grid. Ontario, (Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research).

Santana J., L. Reino, C. Stoate, R. Borralho, C. R. Carvalho, S. Schindler, F. Moreira, M. N. Bugalho, P. F. Ribeiro, J. L. Santos, A. Vaz, R. Morgado, M. Porto and P. Beja 2013. Mixed effects of long-term conservation investment in Natura2000 farmland. – *Conservation Letters*, **7**: 1-10.

Shannon, C. E. 1948. A mathematical theory of communication. – *The Bell System Techincal Journal*, **27**: 379-423, 623-656.

Sokos C. K., A. P.Mamolos, K. L. Kalburtji and P. K. Birtsas 2013. Farming and wildlife in Mediterranean agroecosystems. – *Journal for Nature Conservation*, **21**: 81-92.

Spasov, S. 2008. The state of Bulgaria's common birds. Sofia (Bulgarian Society for the Protection of Birds).

StatSoft 2004. STATISTICA 7.0. Data analysis software. Tulsa, USA (StatSoft Inc.). Available at: http://www.statsoft.com/

Stefanova, V. 2013. Definition of permanent pastures and agricultural land of high natural value. Report of thematic working group 2 ofNational rural network. Sofia (NRN), 28 p. Available at: http://www.nsm.bg/

Stoate C., N.D. Boatman, R.J. Borralho, C.R. Carvalho, G.R. de Snoo and P. Eden 2001. Ecological impacts of arable intensification in Europe. – *Journal of Environmental Management*, **63**: 337-365.

Stoate C., A. Báldi, P. Beja, N. D. Boatman, I. Herzon, A. Van Doorn, G. R. de Snoo, L. Rakosy and C. Ramwell 2009. Ecological impacts of early 21st century agricultural change in Europe – a review. – *Journal of Environmental Management*, **91**: 22-46.

Suarez, F., C. Martinez, J. Herranz and M. Yanes 1997. Conservation status and farmland requirements of pin-tailed sandgrouse *Pterocles alchata* and black-bellied sandgrouse *Pterocles orientalis* in Spain. – *Biological Conservation* **82**: 73-80.

Tilman D., J. Fargione, B. Wolff, C. D'Antonio, A. Dobson and R. Howarth 2001. Forecasting agriculturally driven global environmental change. – *Science*, **292**: 281-284.

Tscharntke T., A.M. Klein, A. Kruess, I. Steffan-Dewenter and C. Thies 2005. Landscape perspectives on agricultural intensification and biodiversity – ecosystem service management. – *Ecological Letters*, **8**: 857-874.

Tscharntke T., J. Clough, T.C. Wanger, L. Jackson, I. Motzke, I. Perfecto, J. Vandermeer and A.Whitbread 2012. Global food security, biodiversity conservation and thefuture of agricultural intensification. – *Biological Conservation*, **151**: 53-59.

Tucker G. M., M. F. Heath 1994. Birds in Europe: their conservation status. BirdLife Conservation Series No 3. Cambridge, UK (BirdLife International).

Tzonev R., C. Gussev and G. Popgeorgiev 2014. Scrub and grassland habitats of Besaparski Ridove Special Protection Area (Natura 2000), southern Bulgaria: distribution and assessment of their conservation status. – *Acta zoologica bulgarica*, **Suppl. 5**: 137-142.

Vassilev, K., H. Pedashenko, S. C. Nikolov, I. Apostolova and J. Dengler 2011. Effect of land abandonment on the vegetation of upland semi-natural grasslands in the Western Balkan Mountains, Bulgaria. – *Plant Biosystems*, **145** (3): 654-665.

Wilson J. D., A. J. Morris, B. E. Arroyo, S. C. Clark and R.B. Bradbury 1999. A review of the abundance and diversity of invertebrate and plant foods of granivorous birds in northern Europe in relation to agricultural change. – *Agriculture, Ecosystems & Environment,* **75**: 13-30.

Wrbka T., S. Schindler, M. Pollheimer, I. Schmitzberger and J. Peterseil 2008. Impact of the Austrian Agri-Environmental Scheme on diversity of landscapes, plants and birds. – *Community Ecology*, **9**(2): 217-227.

Wretenberg J., A. Lindstrom, S. Svensson and T. Part 2007. Linking agricultural policies to population trends of Swedish farmland birds in different agricultural regions. – *Journal of Applied Ecology,* **44:** 933-941.