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Changes in Agri-environmental Practices Pose a Threat to the Herpetofauna: a Case Study from Besaparski Ridove Special Protection Area (Natura 2000), Southern Bulgaria

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Abstract: After 2007, the Bulgarian farmers have started benefiting from the newly available agro-environmental schemes through the European Union, which have promoted significant landscape changes. However, the impact on the local environment and the herpetofauna is yet to be determined. This has prompted us to undertake a comparative study on the changes in the area of habitats in a biodiversity hotspot, Besaparski Ridove Special Protection Area, between 2006 and 2010. We mapped 584 new exact localities of 25 species of herptiles from this site, doubling the previously known localities. Herptiles were detected in 85% of the squares of the 2×2 km UTM grid. Pastures and natural grasslands have decreased by roughly 9%, on account of the increase of non-irrigated and permanently irrigated arable lands; open pastures have decreased by 51%. The most important habitats for the herpetofauna include water bodies, various kinds of pastures and natural grasslands (*Chao1* index for expected diversity of species per habitat ≥ 12). Industrial or commercial units and permanently irrigated lands are the least viable habitats (*Chao1* ≤ 5). Inevitably, loss of suitable habitats through agriculture negatively impacted species, including those of high conservation value: e.g. *Elaphe sauromates, Testudo hermanni* and *Eryx jaculus*. Therefore, the conservation of species and habitats might need re-assessment and more stringent national criteria than those enacted by the reformed Common Agricultural Policy (2014-2020).

Keywords: NATURA 2000, herpetofauna, Amphibia, Reptilia, habitat loss, agri-environmental schemes

Introduction

The increase of the European Union's territory and its common market are amongst the strongest driving forces of agricultural expansion and intensification throughout the continent; however, agriculture has been established amongst the main causes of biodiversity loss and ecosystem degradation (Henle *et al.* 2008; Carvalheiro *et al.* 2013). After Bulgaria joined the EU in 2007, new legislative and financial mechanisms became available to influence the capacity for long-term preservation of biodiversity on a national level, such as the Natura 2000 network, the agri-environment payments under the Rural Development Programme (RDP), and the Common Agricultural Policy (CAP). Agri-environment schemes are more likely to deliver substantial benefit if: (i) they are implemented with clear guidance to land managers, and (ii) they are located in landscapes with high levels of biodiversity. Greater biodiversity on farmlands is likely to increase the provision of a range of ecosystem services, which, in turn, should buffer agricultural land against likely future environmental changes (Whittingham 2011). The design and implementation of agri-environmental schemes should be governed by precise conservation and/or ecosystem service goals, although these are not necessarily mutually exclusive (Scheper *et al*. 2013). For example, meta-analyses suggest that in complex grassland landscapes agri-environmental management may help preserve farmland biodiversity but in complex croplands it is not a very effective tool for this purpose (Batáry *et al*. 2011). Kleijn *et al*. (2006) indicate that the examined schemes for five west European countries primarily benefit common species and have limited usefulness for the conservation of endangered and uncommon species of farmland wildlife.

Besaparski Ridove Special Protection Area (SPA), which is part of Natura 2000 network, is amongst the territories affected by the agri-environmental schemes in Bulgaria. It comprises a hilly formation on the boundary between the lowland Maritza River Valley and the Rhodopes Mountain, situated in the south of the country. Although the SPA is relatively small in size, it is of known conservation importance for a range of rare and protected avian species (Demerdzhiev 2014, Demerdzhiev *et al*. 2014), endemic plants in scrub and grassland habitats (Tzonev *et al*. 2014) and the site of discovery of new torymid wasps (Stojanova 2014).

Among the predominant types of habitats in this SPA are pastures and natural grasslands (ca. 50% of the area). Globally, pastures are amongst the most threatened habitats, subjected to multiple anthropogenic pressures. Worldwide, 21% of grasslands are abandoned, while 17% are affected by intensification (plowing up); 44% have an unchanged management (Peart 2008). However, major problems for pastures are conversion into arable lands or desertification as a result of intensive grazing by livestock (White *et al*. 2000; Peters *et al*. 2006). The plowing of pastures is a fundamental problem of national importance and has been identified as the second greatest threat for these habitats (Tzonev, Gusev 2013). The loss of grasslands and pastures and the consecutive fragmentation cause extinctions of unknown number of populations and species, changes in the structure and function of ecosystems, depletion of environmental services, and decline in human well-being (White *et al.* 2000; Zavaleta, Hulvey 2004). The ecological and economic values of pastures have been recognized lately, i.e. some developed countries have reverted low-quality farmlands and associated wetlands into more extensive grasslands, forests, or areas of conservation uses (Wood *et al.* 2000).

Grasslands and pastures are amongst the most important habitats for the herpetofauna in Bulgaria and, in general, they support high species diversity in different parts of the country (e.g., Vitosha Mountain, Tzankov *et al.* 2014; Ponor Mountain, Popgeorgiev *et al.* 2014; Pustrina Hill, Sakar Mountain, Eastern Rhodopes Mountain, unpublished data). However, the effects of agricultural practices on the herpetofauna in Bulgaria have not been considered.

Until recently, the herpetofauna of Besaparski Ridove SPA has not been studied in detail. As part of a broader project, Popgeorgiev *et al*. (2010) provided the first comprehensive review for the territory of this SPA through a literature overview and up-to-date personal information on species composition and localities, adding five new species of amphibians and four species of reptiles, and bringing the total to 24 species (8 amphibians and 16 reptiles).

The present study extends the work of Popgeorgiev *et al.* (2010) through providing a substantial number of additional observations and extended analyses on the herpetofaunal distribution in this SPA. It is the first in-depth analysis of the effects of the agricultural changes (especially agrarian intensification) on the herpetofauna after Bulgaria joined the EU.

This study aimed to:

– Update the map of the distribution of the amphibians and reptiles on the territory of Besaparski Ridove SPA on a 2×2 km UTM grid;

– Identify the areas of destroyed pastures;

– Identify specific relationships between species and habitat use;

– Identify the amphibian and reptile species associated with pastures;

– Identify key habitats with highest species diversity;

– Estimate the width of the spatial niches of the different species;

– Identify the most vulnerable species;

– Propose conservation measures beneficial to rare and valuable species.

Materials and Methods

Study site

The study site consists of the hilly Besaparski Ridove SPA (BG0002057) located close to the city of Pazardzhik, 20–30 km west of the major city of Plovdiv, southern Bulgaria. The importance of the SPA for biodiversity is attested by the fact that this SPA encompasses an Important Bird Area (IBA), a Site of Community Importance (SCI) "Besaparski Vazvishenia" (BG0000254) and Protected Area "Ognyanovsko-Sinitevski Rid". The area of the SPA is approximately 14,765 ha.

The SPA is located in the south-western Thracian Plain, in the foothills of the Rhodopes

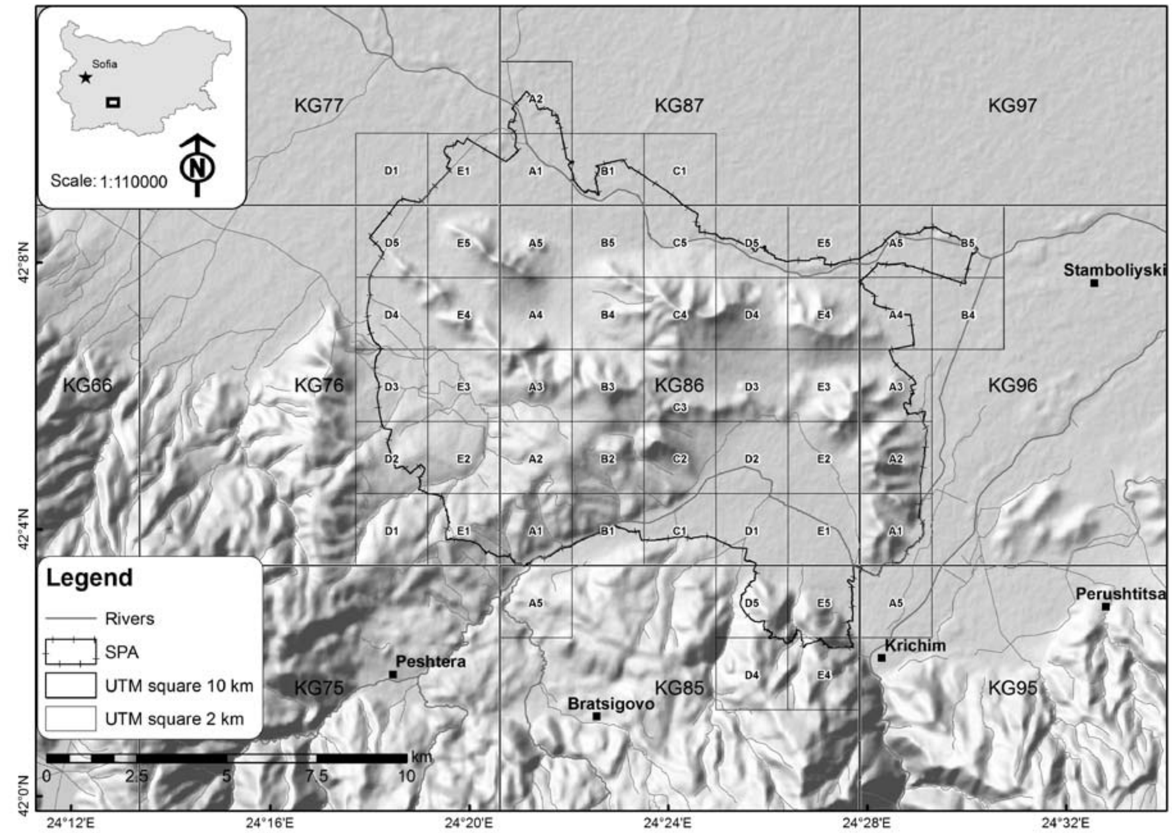


Fig. 1. Location of Besaparski Ridove SPA, including labeled cells in the 10×10 and 2×2 national UTM grid

Mountains, at elevations between 350–536 m a.s.l. (42°7'N–24°23'E; Fig. 1). The vegetation in around 90% of the territory is dominated by calciphilous and thermophilous communities of grasses and cultivated land, interspersed with separate patches of deciduous forests or admixture of coniferous and deciduous forests. The dominant grass species is the bread-grass (*Dichantium ischaemum* (L.) Roberty) that is extremely resilient to grazing, trampling, and erosion in particular. Scrub and short trees are found in a small percent of the territory, and only isolated patches of deciduous forests are present (Demerdzhiev 2007).

Inventory of herpetofauna

The authors gathered location data on the species of herpetofauna (classes Amphibia and Reptilia) and supplemented it with information provided by colleagues. In addition, we utilized the raw and published data presented in Popgeorgiev *et al*. (2010). Data were collected opportunistically during the active season (February–November), predominantly between 2007 and 2013, although limited published data exist as far back as 1900. The authors carried out more thorough sampling specifically to map the herpetofaunal distribution in Besaparski Ridove SPA in 2011. However, the overall sampling effort was uneven (temporally, spatially, number of investigators). Also, although all 2×2 UTM squares were visited, unfavorable weather conditions at times might have led to decreased herptile activity and thus lowered the detection rates.

We actively visually searched for species, focusing on suitable habitats and microhabitats (e.g. under rocks and logs). Anurans were also detected audibly. In addition, specifically for newts and amphibian larvae, we sampled wetlands and water bodies by setting funnel traps overnight and by seining using dip nets. Exact geographic coordinates of each identified individual were marked *in situ* using handheld GPS units (accuracy ±5 m; Garmin, Olathe, Kansas, USA); a limited number of locations were positioned through a publicly available, geographically referenced high-resolution satellite imagery from 2001-2013 (Google Earth 7; Google, Mountain View, California, USA).

Furthermore, we reviewed all available published and unpublished data for the herpetofaunal species in the SPA and its surroundings.

Mapping, analyses and software

For the purposes of mapping, we used the national 10×10 km UTM grid, sub-divided into a 2×2 km grid to provide greater detail of representation.

The territory of the study site includes 54 squares 2×2 km, 22 complete and 32 partial. Data from the literature were assigned to cells in the 2×2 km UTM grid; they were used only for mapping because of lack of sufficient details provided.

To assess the changes in the cover types in the SPA, we compared the land covers in 2006 and 2010, using the two digital maps of the habitats within the SPA prepared by Dobrev *et al.* (2014): drawn based on detailed aerial photographs and verified (or improved) in the field. For our study, the land use types were equated to the CORINE Land Cover nomenclature; only pastures were further subdivided based on the amount of bush present.

Each observation with an exact geographic location was attributed to a respective habitat from the 2010 digital map of habitats.

The diversity of the used habitats by each species (niche range) was calculated by mean of the Shannon diversity index (*H';* Krebs 1998), calculated as:

$H' = -\Sigma(p_i \cdot \ln(p_i))$,

where p_i was defined as proportion of the locations of species "*i*" in the respective habitat to the total number of locations for all habitats.

Additionally, to measure the expected diversity of species per habitat, *Chao1* bias corrected index was calculated:

$Chao1 = S + F1 \cdot (F1 - 1) / (2 \cdot (F2 + 1))$,

where *S* was the species richness, *F1* was the number of singleton species (taxa represented by a single occurrence in that habitat) and *F2* the number of doubleton species.

Both indices were tested for statistically significantly correlations with *S* and abundance per habitat. The index with the higher score was chosen with priority respectively for presenting the species diversity per habitat ($r = 0.97$, $p < 0.001$ for *Chao1*; $r = 0.64$, $p < 0.001$ for *H'*).

To analyze the similarity between habitats based on species richness, the Bray-Curtis similarity index was calculated as follows:

$$d_{jk} = 1 - \frac{\sum_i |x_{ji} - x_{ki}|}{\sum_i (x_{ji} - x_{ki})}$$

where d_{jk} is the similarity in species composition between two habitats *j* and *k,* each defined by the number of specimens of species x_{ji} and x_{ki}.

The similarity matrix was visualized with a single linkage tree algorithm.

Data processing and mapping were done with software ArcGIS 10.1 (ESRI, Redlands, California, USA) and PAST 2.17 (Hammer *et al.* 2001).

Taxonomical framework

Taxonomy, identification, and species names are primarily in accordance with Stojanov *et al.* (2011). However, several recent revisions have affected the taxonomy of the Bulgarian herpetofauna but the implications of these taxonomic changes at the local/national level are unknown due to lack of sampling in the relevant regions.

1) *Hyla arborea* was split by Stöck *et al.* (2008) into *H. arborea* and *H. orientalis*.

2) *Bufo viridis* was split into *B. viridis* and *B. variabilis* (Stöck *et al.* 2006; where after generic name changes, *Pseudepidalea* and most recently *Bufotes* have affected the taxon; Frost *et al.* 2006, Dubois, Bour 2010).

3) Furthermore, the latest phylogeographical studies on *Natrix natrix* demonstrated a need for an updated taxonomic scheme (Kindler *et al.* 2013).

Therefore, we tentatively refer to these data as complexes, *H. arborea* (complex), *B. viridis* (complex), and *N. natrix* (complex), respectively.

4) In addition, the two subspecies of *Anguis fragilis* were elevated to species rank (*A. fragilis* and *A. colchica*; Gvoždik *et al.* 2010).

5) Triturus ivanbureschi replaces the previously recognized taxon *T. karelinii* in Bulgaria (Wielstra *et al.* 2013).

Results and Discussion

Herpetofaunal diversity and temporal/spatial distribution within the SPA

We collected a total of 992 records for 25 species (considering complexes) (10 amphibians and 15 reptiles) that occur in Besaparski Ridove SPA (Fig. 2). For 942 of these, exact dates were available; over 79% of the observations were collected between March–May (Table 1). Over 96% of the observations were between 2008–2011, with 584 (62%) of them are personal records obtained after the last publication (see Popgeorgiev *et al.* 2010; see Table 2).

Since the publication of Popgeorgiev *et al.* (2010), one new species has been recorded, i.e. *Pelobates syriacus*, based on a single record. Four other species have also been observed in only one 2×2 UTM square – *Salamandra salamandra*, *Rana graeca*, *Platyceps najadum* (their presence was not confirmed by this study), and *T. ivanbureschi*. In two squares we recorded *Testudo graeca* (one square previously unpublished) and *Zamenis longissimus*; in four – *Bombina variegata* and *Testudo hermanni*

Table 1. Distribution by month of the count of 942 dated records for amphibians and reptiles in Besaparski Ridove SPA

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Count	-	6	141	427	180	24	137	-	-	21	6	-

Table 2. Distribution by year of the count of 942 dated records for amphibians and reptiles in Besaparski Ridove SPA

Year	1905	1931	1968	1995	1996	2002	2007	2008	2009	2010	2011	2012	2013
Count	1	1	1	1	3	1	4	75	271	130	434	18	2

(three new squares). *Eryx jaculus* was recorded in five squares, three of which have not been previously published. The remaining species were found in over six UTM squares each.

Within the territory of the SPA, herptiles were detected in 46 (85%) of the 2×2 km squares (Fig. 3). Out of the eight squares without observations, only one is completely within the SPA; five of the seven partial squares fall almost completely outside of the study area, and therefore, the search effort there was minimal.

Within the SPA itself, the species diversity is unevenly distributed (Fig. 3), with the highest species diversity in UTM squares located at the periphery of the SPA – bordering the Rhodopes Mts and some areas in the Maritsa River Valley. The UTM square with the highest species number (16) falls within the Rhodopes from a geographic standpoint. The detailed sampling within the SPA suggests that the geographically unequal diversity across the landscape is a result of the high level of habitat fragmentation and the mosaic distribution of the majority of species.

Intra-habitat distribution, habitat significance and dynamics

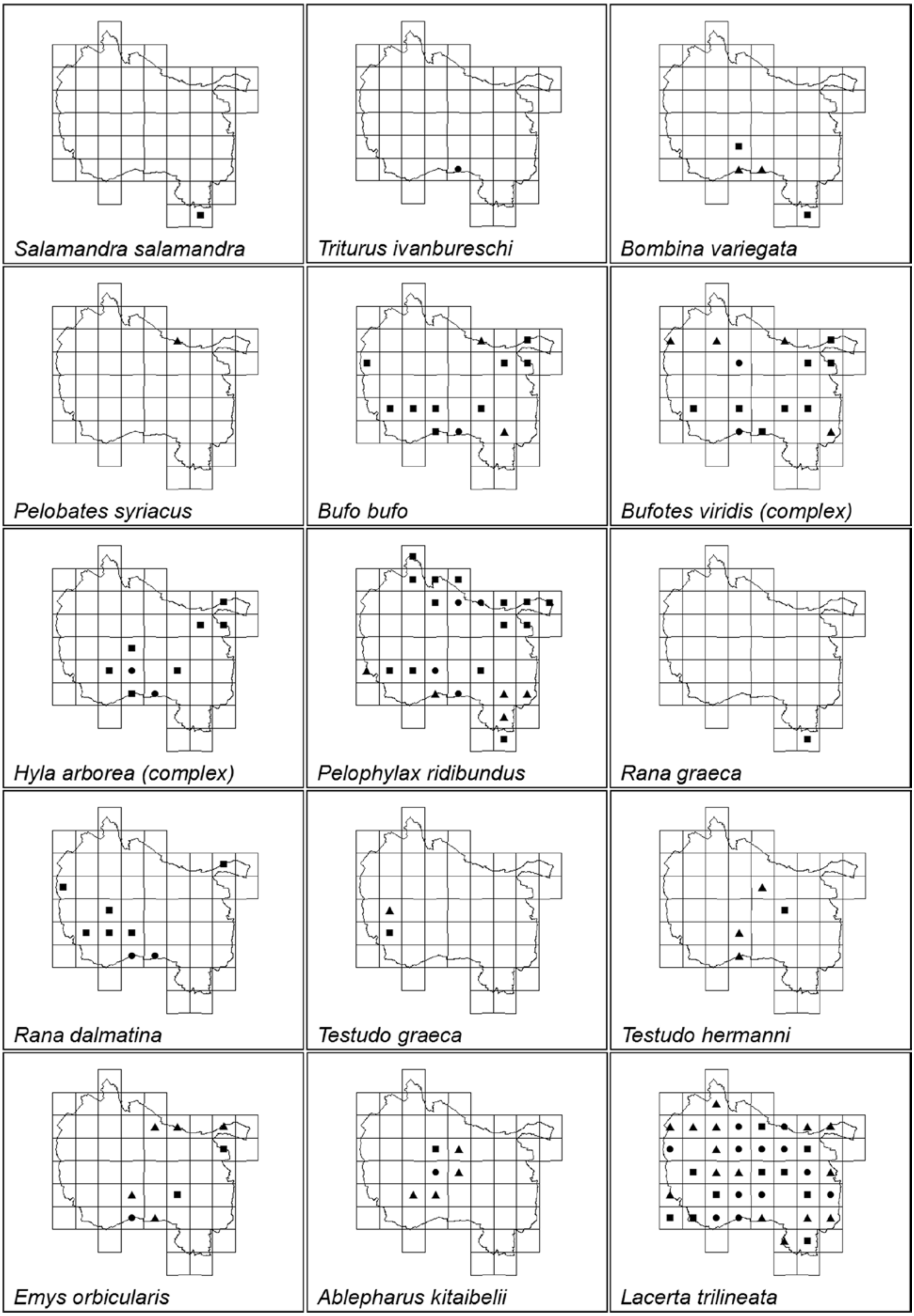
Twenty-two habitat types have been identified within the SPA (Table 3); 16 contained reptiles, and 12 of these – amphibians (Table 4). The six habitats without detected herpetofauna (see Table 3), likely support amphibians and reptiles, but their small overall area within the SPA (5.5–6.3%) and our lower sampling effort there possibly explain the lack of data.

We consider nine habitat types in the SPA to be of importance for the herpetofauna (*Chao1* > 6.00) because of their high naturalness and rich biodiversity. They contain 89% of the locations for the observed species and 100% of the species (Table 4). Considering the prevalent climatic conditions characterizing the study area and the widespread open and dry habitats, the highest species diversity falls within CORINE categories "5.1.2 Water bodies" and "5.1.1. Water courses". It is important to note, however, that the habitats belonging to "5.1.2 Water bodies" are highly restricted both in terms of surface area (0.74% of the overall area) and as an absolute number of water bodies (approximately 6–7); in addition, they exhibit a high degree of isolation from one another.

As a result of the analyses, pastures emerge as one of the most important habitats for the herpetofauna, especially for the reptiles. Five of these habitats ["Pastures (bare, with no bushes)"; "Pastures with bush-coverage < 25%"; "Pastures with bush-coverage 25–50%"; "Pastures with bush-coverage > 50%"; "Pastures with single trees"] fall in this category, in which 40% of the locations and 64% of the species have been recorded.

Although water bodies are vital for the reproduction of amphibians and also support an extensive diversity of reptile species, it is imperative that they are considered at the broader landscape level, in conjunction with the surrounding habitats. Many amphibians are terrestrial outside of their breeding season and larval stage, and depend on the conditions of nearby non-water habitats such as pastures.

An analysis of the change in the area of habitats between 2006 and 2010 shows alarming trends in a key habitat – "Pastures (bare, with no bushes)" (Table 3; see Dobrev *et al*. 2014 for a general overview of the effects of the Common Agricultural Policy on the cover of grassland habitats in a Natura 2000 site in Bulgaria). The area of this habitat has decreased by 51% (roughly 9% of the total area), at the expense of an increase of the areas of two habitats: "2.1.1. Non-irrigated arable lands" and "2.1.2. Permanently irrigated land" that have respectively increased by over 22% and 26% (roughly 5% and 3% of the total area). This dramatic decrease likely reflected on present species abundance and richness, as the pastures have two to three times higher index of species richness than the two types of arable lands (*Chao1*: 13 vs 6 and 4.5, respectively). A species of conservation importance that was severely impacted by the changes in land use is



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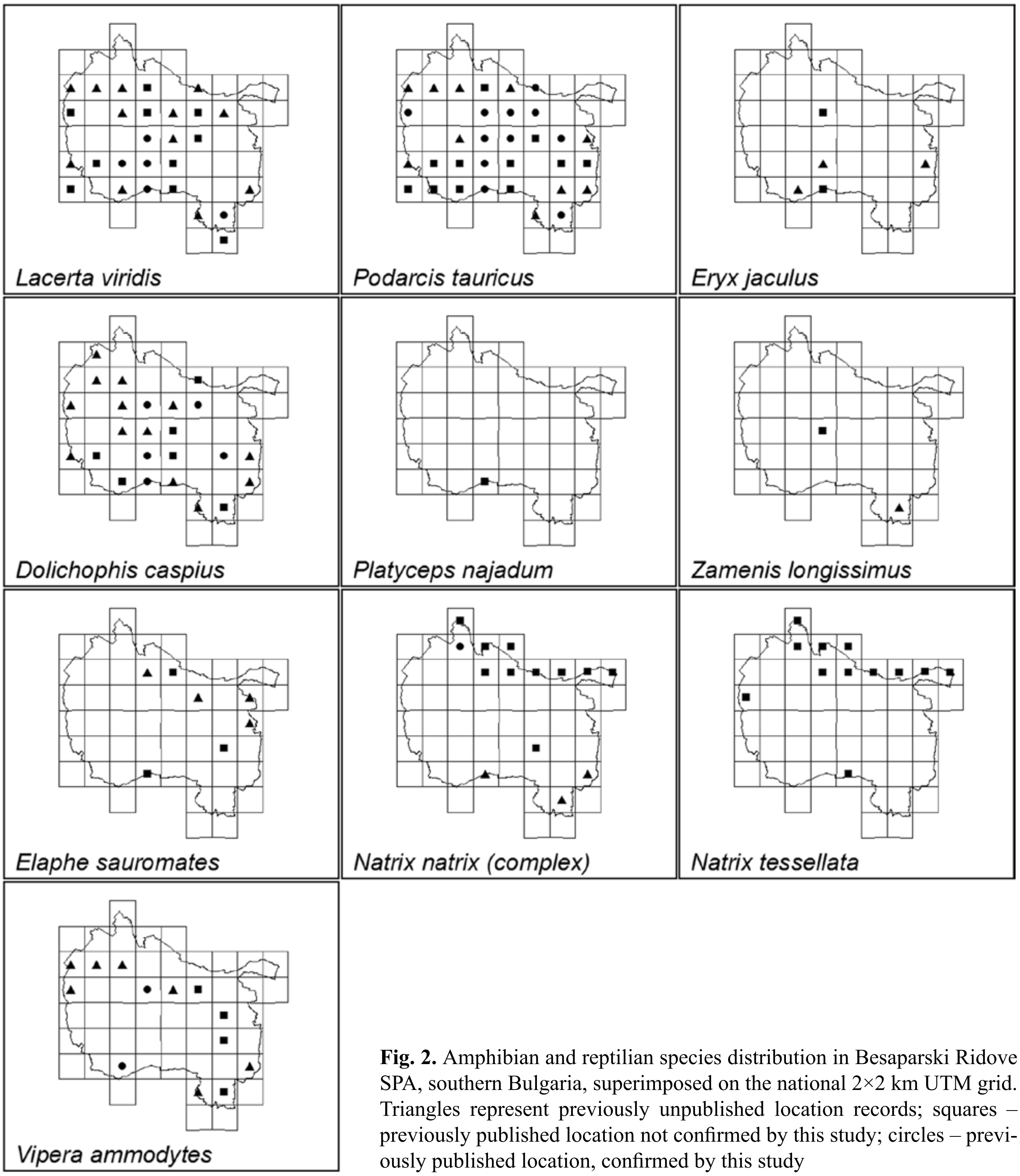

Fig. 2. Amphibian and reptilian species distribution in Besaparski Ridove SPA, southern Bulgaria, superimposed on the national 2×2 km UTM grid. Triangles represent previously unpublished location records; squares – previously published location not confirmed by this study; circles – previously published location, confirmed by this study

Elaphe sauromates, which hitherto has been located only in five locations, with single observations.

Ranges of herpetofaunal spatial niches

The habitats form several well-separated groups on the basis of the herpetofauna present within (Fig. 4). Well-defined groups are standing and flowing water bodies (because they concentrate all amphibian species) and habitats with low species diversity. The rest of the habitats exhibit relatively high species diversity and thus are of significance for the conservation of the herpetofauna in the region. Based on the specifics of their species composition, the different groups of habitats need to be considered as separate important conservation units, for which specific conservation strategies need to be employed.

Four reptile species can be classified as widespread based on the range of the spatial niches they occupy ($H' > 2$). These are *Lacerta viridis,*

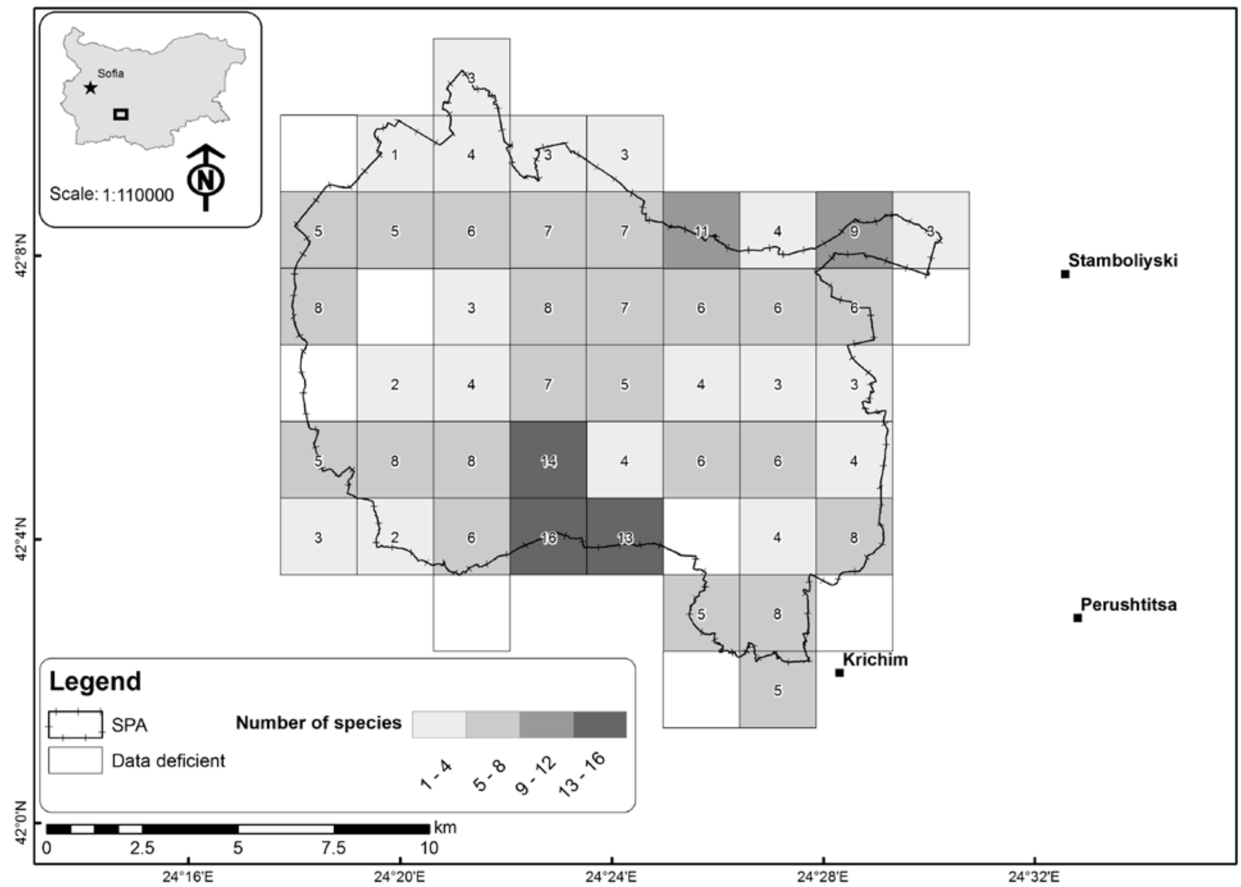

Fig. 3. Amphibian and reptile species richness in Besaparski Ridove SPA, southern Bulgaria, superimposed on the national 2×2 km UTM grid. Numbers indicate count of species per square, based on this study and published data

Dolichophis caspius, Lacerta trilineata and *Podarcis tauricus*, comprising 82% of all reptiles specimens found (52% of all observed specimens; Table 4). These particular species are also located in the "poorest" habitats: "1.2.1. Industrial or commercial units", "2.1.2. Permanently irrigated land", "3.3.3. Sparsely vegetated areas". Typical amphibians are *H. arborea* (complex) and *B. viridis* (complex) (*H'* = 1.7 and 1.4), which have lower counts compared to reptiles: only 3% of all observations (8.6% of amphibian observations).

The rest of the species are less common. From these, six species (predominantly amphibian) stand out because they have been observed in one habitat each with only one locality: *B. variegata, R. graeca, S. salamandra, P. syriacus, T. ivanbureschi* and *P. najadum*. The first three are found only in the "Rhodope" part of the SPA and are highly likely absent from the rest, due to the lack of species-specific suitable terrestrial and breeding habitats (e.g. small water bodies, broad-leaf forests). The other two amphibians suffer especially from lack of suitable water bodies for breeding.

Thus, measures must be taken to safeguard/improve the populations of at least two of those species, *B. variegata* and *T. ivanbureschi*. The highly limited number of breeding sites at the SPA suggests that a cost-effective action with high conservation impact for amphibians will be the artificial creation of small (ca. 100 m^2) pools around the SPA. For the other four species, the SPA falls on the border of their distribution.

Species with a potential to occur in the SPA

Lissotriton vulgaris, *B. bombina*, *A. colchica* and *A. fragilis* were found in the immediate vicinity of the study area. The lack of records for *L. vulgaris* is intriguing, especially given the suitable conditions and the intensive sampling in some breeding pools with specialized live traps. Interestingly, *T. ivanbureschi* has also been observed in only one pool, suggesting that issues for successful newt reproduction and (or) survival exist either with the suitability of the open water bodies or the surrounding terrestrial habitats. Seemingly suitable conditions exist for *B. bombina* in the SPA along the Maritza River, but even though males can be easily detected when calling, they might be present only in low numbers. The typical habitats for *A. fragilis* and *A. colchica*, broad-

Table 3. Changes in the areas of the twenty-two habitats, present in Besaparski Ridove SPA from 2006 to 2010, based on Dobrev *et al*. (2014). For this study, the raw results were used. Habitats with herptiles found are sorted by the difference in area between 2006 and 2010; habitats with no herptiles found are sorted by area in 2006. Total area is 14770.47 ha

Habitat	2006		2010		
	Area (ha)	% of total area	Area (ha)	% of total area	Difference (ha)
With herptiles found					
Pastures (bare, with no bushes)	2565.62	17.37	1246.51	8.44	-1319.12
Pastures with bush-coverage < 25%	689.76	4.67	628.05	4.25	-61.71
Pastures with single trees	510.23	3.45	499.75	3.38	-10.47
Pastures with bush-coverage 25–50%	481.27	3.26	477.49	3.23	-3.78
3.2.1. Natural grassland	3330.29	22.55	3327.19	22.53	-3.11
1.2.1. Industrial or commercial units	343.21	2.32	342.97	2.32	-0.24
5.1.2. Water bodies	109.26	0.74	109.14	0.74	-0.12
2.1.1. Non-irrigated arable land	2902.04	19.65	3711.29	25.13	809.24
2.1.2. Permanently irrigated land	1344.85	9.10	1809.45	12.25	464.60
Clusters of trees	50.85	0.34	56.29	0.38	5.34
3.2.4. Transitional woodland scrub	419.09	2.84	419.23	2.84	0.14
Forest	416.45	2.82	416.45	2.82	0.00
5.1.1. Water courses	284.89	1.93	284.89	1.93	0.00
1.3.1. Mineral extraction sites	255.86	1.73	255.86	1.73	0.00
Pastures with bush-coverage >50%	136.72	0.93	136.72	0.93	0.00
1.2.2. Road and rail networks and associated land	117.87	0.80	117.87	0.80	0.00
Subtotal	*13958.26*	*94.5*	*13839.15*	*93.7*	*-119.23*
With no herptiles found					
1.1.2. Discontinuous urban fabric	423.39	2.87	423.39	2.87	0.00
2.2.1. Vineyards	221.37	1.50	263.69	1.79	42.32
2.4.3. Land principally occupied by agriculture with significant areas of natural vegetation	19.15	0.13	25.75	0.17	6.60
2.2.2. Fruit trees and berry plantations	147.75	1.00	218.09	1.48	70.34
1.1.1. Continuous urban fabric	0.48	0.00	0.48	0.00	0.00
1.4.2. Sport and leisure facilities	0.03	0.00	0.03	0.00	0.00
Subtotal	*812.17*	*5.5*	*931.43*	*6.31*	*119.26*

leaf forests, have very limited distribution and are subject to strong anthropogenic pressures by means of fires and illegal logging. Although *A. fragilis* is the predominant species in the region, *A. colchica* is more likely to be found in the SPA because it is more thermophilous and a historic record (VI.1912) exists for this species from the nearby area of Krichimska koriya cited in Buresch, Zonkow (1933).

Agri-environmental effects on land-use (2007–2013) and future prospects

New agri-environmental schemes and ecological legislation came into effect after 2007 with the joining of Bulgaria to the EU and greatly affected land use. Land cover changes, including loss of heterogeneity, that are negative for the biodiversity (and specifically amphibians and reptiles), are largely resulting from the application of the Common Agriculture Policy (CAP, 2007–2013) of the Union. More specifically, the negatives are resultant of rules and regulations for the "Single Area Payment Scheme" (SAPS) inconsistent with the natural conditions and traditions in land use in Bulgaria. Generally, the negative effect especially on reptiles and their habitats has the following dimensions:

Destruction of grasslands as a result of plowing and sowing with annual crops;

Destruction of field margins as a result of consolidation of agricultural land and the formation of large-scale monoculture blocks with annual crops;

Deterioration and damage to the structure of habitats due to removal of trees and shrubs, used for shelter and foraging.

These negative factors are due to regulations and requirements included in laws and normative acts, as well as discrepancies in the control and management of permanent grassland in the country, such as "Ordinance № 5 of 10 March 2010 on the conditions for eligibility

Table 4. Species vs. habitats (Shannon diversity index *H'* and Chao bias corrected index *Chao1*). Species names are composed of the first letter of the genus and the first three letters of the species name; "c" stands for "complex"

Species	5.1.2. Water bodies	5.1.1. Water courses	Pastures (bare, with no bushes)	3.2.1. Natural grassland	Pastures with bush- coverage < 25%	3.2.4. Transitional woodland scrub	Pastures with bush-coverage 25–50%	Pastures with bush coverage > 50%	Forest	Pastures with single trees	1.3.1. Mineral extraction sites	2.1.1. Non-irrigated arable land	1.2.2. Road and rail networks and associated land	Clusters of trees	1.2.1. Industrial or commercial units	2.1.2. Permanently irrigated land	Specimens	Habitats	*H'*
D. cas.			5	9	5	5	4		2	2		3	2		2	3	42	11	2.27
L. vir.	5		10	21	54	30	24	6	19	16	3	3		13	3	1	208	14	2.25
L. tri.	4	2	13	41	14	11	37	5	9	23	7	1			2	1	170	14	2.17
P. tau.	2	2	30	88	37	5	47	2	11	20	9	4		7	3	2	269	15	2.05
H. arb. c	7	1	1		1		1		1	2				1			15	8	1.71
E. sau.			1	1							1	1	1				5	5	1.61
B. vir. c	14			5	1	1	1	1			3						26	7	1.4
A. kit.			5		4		1							2			12	4	1.24
T. her.			1	1		2											4	3	1.04
V. amm.				42	3				1		3		1		1		51	6	0.72
P .rid.	44	25						1									70	3	0.72
N .tes.	1	1															2	2	0.69
T. gra.				1									1				2	2	0.69
Z. lon.					1									1			2	2	0.69
E. jac.			2				2										4	2	0.69
B. buf.	26	9				1											36	3	0.68
R. dal.	66	8				1		1		1							77	5	0.54
N. nat. c	1	6															7	2	0.41
E. orb.	59	6															65	2	0.31
B. var.	10																10	1	–
P. syr.	6																6	1	–
P. naj.			1														1	1	–
R. gra.		1															1	1	–
S. sal.		1															1	1	–
T. iva.	235																235	1	–
Specimens	480	62	69	209	120	56	117	16	43	64	26	12	5	24	11	7	1321		
Species	14	11	10	9	9	8	8	6	6	6	6	5	4	5	5	4			
Amphibians	7	6	1	1	2	3	2	3	1	2	1			1					
Reptiles	7	5	9	8	7	5	6	3	5	4	5	5	4	4	5	4			
Chao1	14.5	13	13	12	12	9.5	9.5	7.5	6.5	6	6	6	5.5	5.5	5	4.5			

for support of agricultural lands in payment schemes per area and of general and regional criteria for permanent pastures". According to Article 16 (1) of Ordinance № 5, eligible for payment are permanent pastures used for grazing or mowing, whether mowing is carried out for the extraction of silage or hay, or as a method of environmental protection, or for weed control, where 1) they have no more than 50 trees and / or shrubs per hectare higher than 50 cm (for Mountain pine and Juniper - regardless of height) that are not compactly arranged (with mosaic distribution).

For low-productivity pastures the maximum number of trees and / or shrubs per hectare is 75, and for support for Measure 213 (Natura 2000 payments

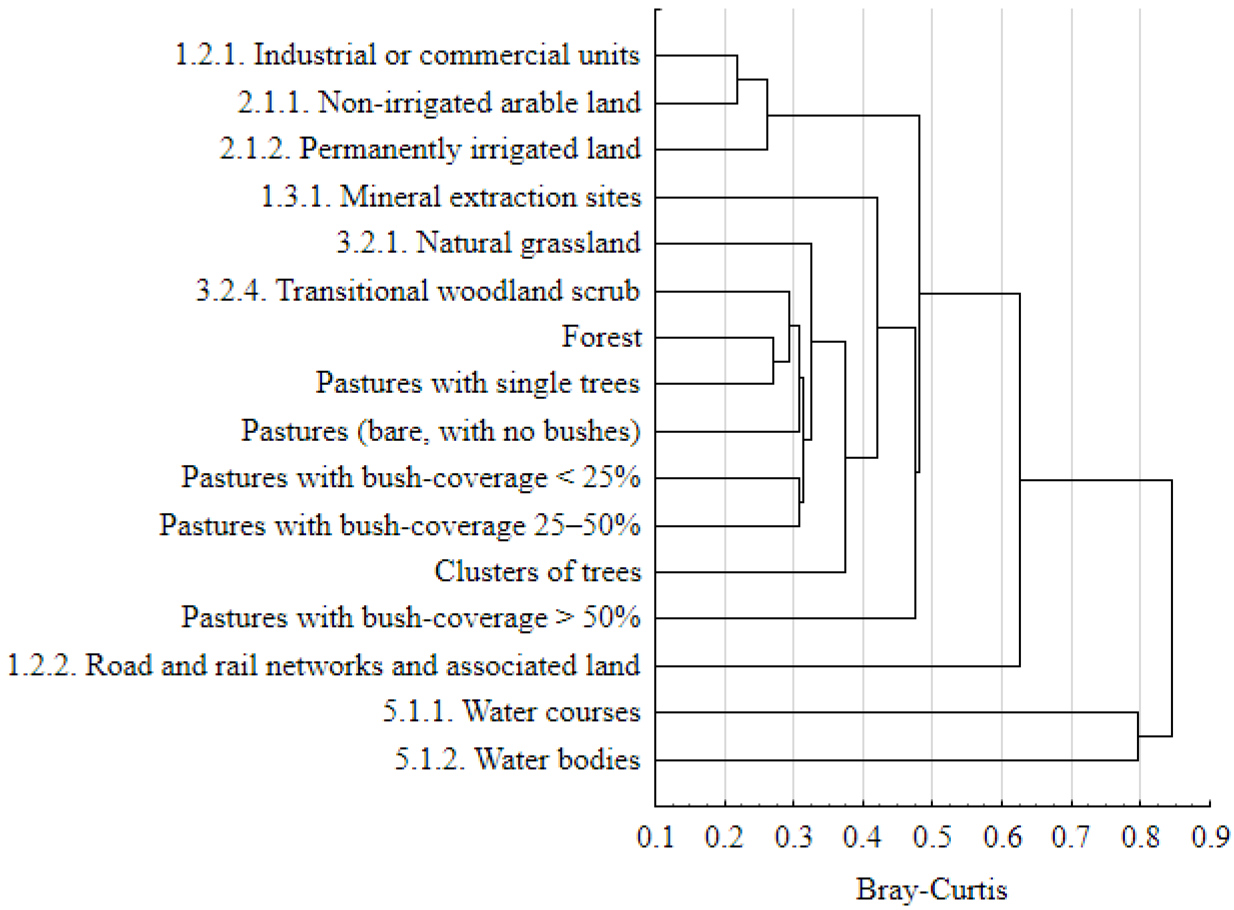

Fig. 4. Habitats interrelationships based their herpetofauna species composition expressed as Bray-Curtis similarity index

and payments linked to Directive 2000/60/EC) and Measure 214 (Agri-environment payments) under the Rural Development Programme (RDP) 2007–2013, eligible are permanent pastures in which no more than 25% of the area of agricultural land is occupied by a mosaic of trees, shrubs, rocks and other permanently unsuitable for support areas according to Article 15 (1) of the Ordinance № 5, which are with a single area less than 100 m^2. However, to receive the high value of the SAPS payments, farmers removed trees and especially shrubs, but simultaneously received additional payments under Measures 213 and 214 of the RDP. At the same time, although the removal of the tree and shrub vegetation damages the habitats of species and often the natural habitats (especially sub-Mediterranean grasslands and semi-natural dry grassland–shrub communities on limestone), it is not sanctioned by the structures of the Ministry of the Environment and Water (MoEW).

Another significant set of factors leading to destruction of habitats for reptiles are the inconsistencies and gaps in the systems for management and control. In particular, to control activities, including land use within Natura 2000 sites, MoEW uses the cadastral map of the country. Under this system, a large percentage of grasslands, formed in the last 7 or more years as a result of fallowing are recorded with a permanent usage category “Arable land”. Due to gaps in legislation, the conversion of these grasslands is not considered as a plan, program, project or investment proposal, and thus their cultivation (plowing) is not subject to Appropriate Assessment. Therefore, despite the enormous areas and the highly negative impact on habitats of conservation priority species, this is not sanctioned by the MoEW. The land management and control of activities in Natura 2000 sites are not based on actual conditions but on outdated documentary basis. Meanwhile, according to the system for identifying agricultural parcels (Land Parcel Information Systems, LPIS) on whose basis the areas for support are identified and verified, these lands are eligible for payments as permanent pastures. However, due to the significantly smaller administrative burden, the clear rules and the profitability, and stimulated by the SAPS, farmers prefer to plow these areas and plant them with annual crops.

However, to a great extent the long-term conservation of grasslands is dependent on the future development of agricultural practices and grazing intensity (Henwood 1998; Curtin, Western 2008); this will directly impact all associated biodiversity. As of 2014, the new 'greener' reformed CAP for 2014–2020 was enacted by the EU; almost 40% of EUs budget will affect the management of ½ of its territory. Although the originally suggested revisions of the new CAP promoted a much 'greener' policy, the resultant set of measures are much less stringent when dealing with biodiversity protection and fail to fulfill the target to "maximize areas […] covered by biodiversity-related measures under the CAP" (Pe'er *et al*. 2014). The analysis on the reformed CAP carried by Pe'er *et al*. (2014) further suggests that without extra steps by each member state of the EU, the agricultural reform will fail to protect farmed and grassland ecosystems.

Conclusions

The destruction of almost half of the pastures in the SPA is a serious threat that has inevitably negatively impacted a number of species strongly associated with this habitat. Some of the species are of high conservation value: *E. sauromates, T. hermanni* and *E. jaculus*.

Agri-environmental measures should be properly devised and controlled in order to benefit both agriculture and biodiversity. The future successful conservation of agriculture-dependent species and habitats both in Besaparski Ridove SPA and nationwide might need re-evaluated and more stringent national criteria than those enacted by the reformed CAP (2014–2020).

A serious threat exists for species related to aquatic habitats, especially in terms of the number and volume of standing water bodies that have been reduced to a critical minimum. One of the key species to be protected – *T. ivanbureschi* – is present in only one locality.

Future studies should be conducted that focus on assessing the degree of fragmentation of the herpetofaunal species and their habitats in Besaparski Ridove SPA.

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