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DEVELOPING METHODS FOR TARGET SPECIES AND PRIME BUTTERFLY AREAS SELECTION CRITERIA IN SERBIA

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Important biogeographical determinants which are responsible for the faunistic richness of Serbian butterflies are pointed out. The most important ways of anthropogenic pressures to the fauna are specified. Target species selection criteria were applied for the selection of Serbian butterfly species. General criteria for the selection of the PBA have been applied. The special criteria for the selection of PBA have been defined. From 50 potential PBAs, 40 have been selected on the basis of the field work results.

Key words: Butterflies, Target Species, Prime Butterfly Areas, Serbia.

INTRODUCTION

Together with the process of natural extinction, anthropogenic pressure is a very significant factor in species extinction. Man is causing the lost of habitats and the reduction of the populations by contamination of the environment, climatic changes (with the arrival of invasive

species) and over-exploitation. In the small, fragmented and isolated populations, loss of genetic diversity is occurring due to inbreeding. Genetic diversity is the key factor in conservation biology, because populations must have the potential for adaptation to environmental changes. The size of the population is the main determinant in genetic diversity for all loci and traits in the small populations and for the species that are important for conservation (Milankov 2007).

The sustained use of biodiversity, which is demonstrated through the concept of sustained development (Agenda 21, Chapter 15: Preserving of biological diversity), is the primary approach in the strategy for the preservation of biodiversity. Evolutionary (im)balance is a plausible model for the survival of small populations. A precondition for the introduction of the small, fragmented and isolated populations is broad knowledge about national diversity. The most rational approach for practical and direct supervision of small populations is on both the national and, especially, the local level.

Because of the well-known historical situation in Serbia, the first papers about butterflies of Serbia were published at the end of the 19th century. Sanitary colonel of that time, Dr Radmilo Lazarević (1846 – 1899), educated in Vienna, published three papers in Serbian about the butterflies of Belgrade and surroundings in the "Voice of the Serbian Royal Academy". The first faunistic list of Serbian butterflies was provided by Gradojević (1931). In this paper, 168 species were named, including some from Macedonia, and 150 from Serbia. Since then, during the past seven decades, knowledge about Serbian butterfly fauna has significantly grown owing to the activity of foreign and local lepidopterologists. Today, the presence of 193 species in Serbia is verified. This fact aligns Serbia with faunistically rich countries in Europe. Serbia is one of the few countries that had not published a National Fauna of Butterflies. Now, however, conditions for publication are in place.

Because of evident anthropogenic pressure, demand for the protection of Serbian butterflies has arisen. Jakšić (1999) classified all butterfly species in Serbia according to the Classic IUCN categorisation, and also proposed 35 species for the National Red List. Van Swaay and Warren (1999), according to European criteria, used 19 specimens from that list which were specified as extremely endangered taxa, and which needed

obligatory protection. Further contribution was provided by Jakšić (2003a) in the publication "Red Data Book of Serbian Butterflies". The most important areas for butterfly preservation are partially protected through national legislation. In another act, protection is planned for these areas by the pilot project "Prime Butterfly Areas in Europe" (Van Swaay & Warren 2003).

THE CONCEPT OF TARGET SPECIES

While the protection of ecosystems has an intrinsic significance for the preservation of environmental processes as ecological and evolutionary processes, the species are considered the basic natural units which constitute the basis for protection politics and protection management Although management at the ecosystem level is necessary, it is not enough for biodiversity protection. Management at the ecosystem level can serve the majority of species of that particular ecosystem, but it is possible that different species can demand different optimal habitat conditions. In this way, the management can be far from perfect (Kremen 2000). Therefore, the species level is a much more appropriate basic unit for the development of the Pan European Ecological Network. Data on endangered status and plant and animal species distribution within Europe comprise the basis of this network's creation.

In the theory and practice of species protection, there are two primary strategic approaches: protection on the basis of target species and protection on the basis of a characteristic target species group. Within the scope of the first approach, there are several models which represent the way to get to the target species. There are summarily represented below.

1. Umbrella species. This model was promoted by Wilcox (1984). The concept is that the protection of one important species provides protection for all species in that habitat, under the shelter (the "umbrella") of this species.

2. Keystone species model, promoted by Bond (1995). The presence of key species enriches the ecosystem functions. Their significance in the ecosystem is much greater than their abundance, while their removal from the ecosystem results in the loss of

biodiversity. Key species may be divided into habitat modifiers, predators and herbivores.

3. Flagship species model, promoted by Western (1987). The cult species is the one selected to represent the conditions of a disturbed environment which needs protection efforts. This species is chosen because of its endangered status, appeal, and mostly because it represents a traditional, cultural, religious, historical, national or other symbol of the environment of the given civilization.

4. Indicator species. The term bioindicators was first used by Clements (1920) who in this way marked any organisms which, by their presence or absence at that habitat, indicate the ecological condition of the habitat without any doubts. These species are particularly sensitive to environmental disturbance, and they may provide early warnings as to the health of the ecosystem. Hence they are extremely sensitive, and a reduction in their number signals the pollution of air, water, soil, food, etc.

Indicator species may also be endangered species, and in an ecological-biogeographical sense they are very often endemic and/or relict species. Naturally, not all of them have the same value and significance, and it is necessary to differentiate Tertiary relicts, glacial relicts, boreal relicts and xerothermous relicts (remains of steppe flora and fauna from the interglacial period). Many of these species may belong to two or three out of the four groups (umbrella species, keystone species, flagship species, and indicator species) at the same time.

METHODS

Swaay and Warren (2006) developed criteria for butterfly target species and Prime Butterfly Areas of Europe selection. During the selection of target species in Serbian butterfly fauna, on the basis of Swaay and Warren's article the following criteria were used:

Criterion 1: Species distributed in Europe, of European concern, listed in Appendix II or IV of the Bern Convention and/or the Habitats Directive. Species is recorded as threatened in the Red Data Book of European Butterflies (Van Swaay & Warren 1999).

Criterion 2: Species is restricted to Balkan Peninsula. Range Affinity 4 in Van Swaay & Warren (1999). Species is recorded as Endangered (E) or Rare (R) in the Red Data Book of Serbian Butterflies (Jakšić 2003a).

Criterion 3: Species is restricted to Balkan Peninsula and very restricted in Serbia (3 – 5 localities). Range Affinity 4 - 2 in Van Swaay & Warren (1999). Species is recorded as Endangered (E) in the Red Data Book of Serbian Butterflies (Jakšić 2003a).

Table 1. - Criteria for selection of Target species in Serbia.

No.	SCIENTIFIC and SERBIAN NAME OF THE SPECIES	HABITATS DIRECTIVE 92/43/EEC		CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS, Bern, 1979 (Annex II)	CITES	DECREE ON PROTECTION OF NATURAL RARITIES (in Serbia), 1993	PAN-EUROPEAN ECOLOGICAL NETWORK	CARPATHIAN LIST OF ENDANGERED SPECIES
		Annex II	Annex IV					
	Order **LEPIDOPTERA** Superfamily **HESPERIOIDEA**							
	Family **HESPERIIDAE**							
1	*Spialia phlomidis* (Herrich-Schäffer, 1845) Srebrna hesperida							
2	*Pyrgus andromedae* (Wallengren, 1853) Alpijska hesperida							
3	*Thymelicus acteon* (Rottemburg, 1775) Travar							
	Family **PAPILIONIDAE**							
4	*Zerynthia polyxena* (Denis & Schiffermüller, 1775) Uskršnji leptir		x	x		x	x	CR
5	*Parnassius mnemosyne* (Linnaeus, 1758) Mnemozine		x	x		x	x	EN

No.	SCIENTIFIC and SERBIAN NAME OF THE SPECIES	HABITATS DIRECTIVE 92/43/EEC		CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS, Bern, 1979 (Annex II)	CITES	DECREE ON PROTECTION OF NATURAL RARITIES (in Serbia), 1993	PAN-EUROPEAN ECOLOGICAL NETWORK	CARPATHIAN LIST OF ENDANGERED SPECIES
		Annex II	Annex IV					
6	*Parnassius apollo* (Linnaeus, 1758) Apolon		x	x	x	x	x	CR
	Family **PIERIDAE**							
7	*Leptidea morsei* Fenton, 1881 Fruškogorski belac	x	x					
8	*Euchloe ausonia* (Hübner, 1804) Čipkasti belac							
9	*Colias myrmidone* (Esper, 1780) Zanovetak	x	x			x	x	EN
10	*Colias caucasica* Staudinger, 1871 - Kavkaski poštar							
	Family **LYCAENIDAE**							
11	*Lycaena dispar* (Haworth, 1802) Veliki dukat	x	x	x			x	EN
12	*Pseudophilotes vicrama* (Moore, 1865) Dušicin plavac							
13	*Pseudophilotes bavius* (Eversmann, 1832) Zagasiti plavac							
14	*Scolitantides orion* (Pallas, 1771) Žednjakov plavac						x	EN
15	*Glaucopsyche alexis* (Poda, 1761) Zelenotrbi plavac							
16	*Maculinea arion* (Linnaeus, 1758) Veliki pegavac		x	x			x	EN
17	*Maculinea alcon* Denis und Schiffermüller, 1775 Mali pegavac						x	EN

No.	SCIENTIFIC and SERBIAN NAME OF THE SPECIES	HABITATS DIRECTIVE 92/43/EEC		CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS, Bern, 1979 (Annex II)	CITES	DECREE ON PROTECTION OF NATURAL RARITIES (in Serbia), 1993	PAN-EUROPEAN ECOLOGICAL NETWORK	CARPATHIAN LIST OF ENDANGERED SPECIES
		Annex II	Annex IV					
18	*Vacciniina optilete* (Knoch, 1781) Borovničar						x	EN
19	*Aricia anteros* (Freyer, 1838) Alpijski plavac							
20	*Polyommatus eroides* (Frivaldszky, 1835) Planinski plavac	x	x				x	
	Family **NYMPHALIDAE**							
21	*Brenthis ino* (Rottemburg, 1775) Inova sedefica							
22	*Boloria (Proclossiana) eunomia* (Esper, 1799) Staroplaninska sedefica							
23	*Boloria (Clossiana) titania* (Esper, 1793) Titania							
24	*Nymphalis xanthomelas* (Esper, 1781) Žutonogi mnogobojac							VU
25	*Nymphalis vaualbum* (Denis und Schiffermüller, 1775) Mrki mnogobojac	x	x					VU
26	*Euphydryas maturna* (Linnaeus, 1758) Žuti šarenac	x	x	x			x	EN/VU
27	*Euphydryas aurinia* (Rottemburg, 1775) Močvarni šarenac	x		x			**x**	EN/VU
28	*Melitaea arduinna* (Esper, 1783) Frejerov šarenac							
29	*Melitaea aurelia* (Nickerl, 1850) Zlatni šarenac							

No.	SCIENTIFIC and SERBIAN NAME OF THE SPECIES	HABITATS DIRECTIVE 92/43/EEC		CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS, Bern, 1979 (Annex II)	CITES	DECREE ON PROTECTION OF NATURAL RARITIES (in Serbia), 1993	PAN-EUROPEAN ECOLOGICAL NETWORK	CARPATHIAN LIST OF ENDANGERED SPECIES
		Annex II	Annex IV					
30	*Apatura metis* (Freyer, 1829) Paninski prelivac			x				
31	*Esperarge climene* (Esper, 1783) Timočki rešetkar							
32	*Lopinga achine* (Scopoli, 1763) Draganin okaš		x	x			x	EN
33	*Coenonympha gardetta* (Prunner, 1798) Alpijska cenonimfa							
34	*Erebia manto* (Denis und Schiffermüller, 1775) Prokletijska erebija							
35	*Erebia orientalis* Elwes, 1909 Samotna erebija							
36	*Erebia medusa* (Denis und Schiffermüller, 1775) Prolećna erebija							
37	*Erebia alberganus* (Prunner, 1798) Staroplaninska erebija							
38	*Erebia rhodopensis* Nicholl, 1900 Rodopska erebija							

PRIME BUTTERFLY AREAS (PBA) IN SERBIA: DEFINITION AND CRITERIA FOR SITES SELECTION

The framework for the selection of a target species of butterflies in Serbia is based on the EU Habitats Directive 92/43.EEC. In Annex II and Annex IV of this document there are specially defined criteria for the selection of target species. This Directive is still not incorporated

into national legislation in Serbia, but present legislation concerning this problem is based on the same principles (Anonymous 1993). In practice, these principles have a long tradition in Serbia and are based on biogeographical-ecological criteria which were established by Matvejev (1962).

Biodiversity is protected either indirectly within the protected areas or directly through the protection of the species. The list of protected natural values includes 5 National Parks, 10 Nature Parks, 14 Landscapes of Outstanding Features, 72 Nature Reserves and Special Nature Reserves, 287 Natural Monuments etc. This list also includes the areas under international protection. Stari Ras – Sopoćani, Dečani, Pećka patrijaršija, Gračanica, Crkva Bogorodice Ljeviške are under UNESCO protection as Natural and Cultural Heritage of Mankind. Golija-Studenica has the status of Biosphere Reserve. Ramsar areas include Obedska bara, Ludoško jezero, Carska bara (Stari Begej), Slano Kopovo and 35 Important Bird Areas. Work on the Important Plant Areas in Serbia is in progress; the basic plan is the protection of 59 areas on this basis. Prokletije and Šar-planina Mountains are recommended for the Balkans Peace Park Project. This initiative is expected to provide the protection of the territories within the boundaries of Serbia, Montenegro and Albania (Marinčić 2003). There are also numerous areas protected on the basis of the Important Bird Areas program. In Serbia, 61 areas are recommended as Emerald areas. UN (UNMIK) administration provided protection of the Prokletije of Metohia at the rank of National Park. According to the national legislation, the list of protected species includes 427 animal species and 251 plant species. Among them are 7 butterfly species which are declared as Natural Rarities (Anonymous 1993).

The Natura 2000 program is based on the Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) network of the EU member countries, established by the Bird Directive (79/409/EEC) and Habitats Directive (92/43/EEC) provided by the Council of Europe.

Information about target species has the key role in the identification of areas with species of significance and may contribute to the identification and development of a coherent system of key areas. Recently, several initiatives were started for the identification of the

most important (prime) areas in Europe for the different groups of target species. Projects have been realized through international cooperation. The first published results regarded birds ("Important Bird Areas" - IBA) and butterflies ("Prime Butterfly Areas" - PBA), while the projects for the herpetofauna ("Important Herpetofaunal Areas" - IHA), dragonflies ("Important Dragonfly Areas" - IDA), plants ("Important Plant Area"- IPA) and mushrooms („Important Mushroom Areas" - IMA) are still in progress. Preliminary results are showing very high correspondence between IBA areas and other taxonomic groups' significant areas (Brooks 2004). Other similar projects, like the Large Carnivore Initiative Europe – LCIE and the Large Herbivore Foundation – LHF, consist of initiatives related to general species-groups.

Prime Butterfly Areas are an initial selection of important butterfly areas, focusing on target species that are conservation priorities across this diverse region. A Prime Butterfly Area is a natural or semi-natural site exceptionally rich in fauna, particularly butterfly fauna, and/or particular community of rare, endemic and endangered species, as well as target species of European and Serbian concern. The project aim is to identify the PBA in Serbia where conservation efforts should be focused as a matter of urgency.

The legal basis for the selection of PBA is in documents that SR Yugoslavia has ratified: the UN Declaration on Environment and Development, Agenda 21, Convention on Biological Diversity, etc. In 1993 SR Yugoslavia also adopted the "Resolution on the policy of nature protection in SR Yugoslavia" and the "Resolution on the policy of biodiversity conservation in SR Yugoslavia". One of the most important goals of the policy of biodiversity conservation is to protect about 10% of national territory according to established priorities and the importance of the present biodiversity. Realization of this goal is enabled by the "Spatial Plan of the Republic of Serbia" (Perišić *et al.* 1996) which defines the parts of national territory important for conservation. This strategic document is the basis for the selection of protected natural sites within the national legislature and international programs (MAB, Ramsar, Emerald etc.) as well as within the PBA program.

Criteria for site selection were derived on the basis of two principles: general and special.

GENERAL CRITERIA: CHARACTERISTICS OF GEODIVERSITY AND BIODIVERSITY

Serbia has a very specific combination of biodiversity and geodiversity elements and we attempt to express that richness through PBA sites selected so that every entity represents a specific geotectonic history (origin and genesis of fauna) and actual geographical and biological conditions.

In the territory of Serbia, from the geotectonic point of view, there is a meeting of elements of the Tethys Ocean, of the African Plate and of the European Plate with numerous units of a lower order (Cvijić 1902; 1924; Zagorchev 1994; 1996; Jovanović & Srećković-Batićanin 2006). Selected PBA sites represent the following geotectonic and geological units: the Panonnian basin (10), the Vardar Zone (1, 3, 7, 8, 11, 12, 16, 17, 39), the Jadar zone (40), the Drina belt – Drina-Ivanjica unit (9, 14, 15), the Dinarides (14, 21, 22, 25, 30, 37), the Serbian-Macedonian massif (3, 18, 26), the Carpathians-Balkan massif (2, 4, 5, 6, 13, 19, 20, 27, 28, 29, 32, 33, 34, 35, 36, 38), Metohia plate (partly 21) and the Helenides – Scardo-Pindic system (23, 24, 31).

The existence of Paratethys from Triassic to Jurassic is reflected in wide areas of carbonate rocks in Eastern and Western Serbia, as well as in wide areas consisting of ophiolithes (serpentinite). Today these areas differ in terms of presence of specific flora, vegetation and fauna. The Neogene lake in the Panonnian and Peripanonnian area of Serbia has also had consequences on biodiversity. Neither location in this area has more than 85-90 butterfly species. These Middle European faunistic elements and, partially, steppe species arrived during the post-glaciation. The glaciation has also affected the composition of butterfly fauna at the Balkan Peninsula and in the high Serbian mountains.

The biodiversity of Serbia may be interpreted both through the geological-historical causes and through the recent climatic, geological, hydrogeological, pedological and orographic causes.

There are also some plant communities that represent the most important structural and functional components of the ecosystem, such that the diversity of vegetation indirectly points to the richness of the diversity of the ecosystem. There are a large number of described plant

communities (700-800) which, according to Lakušić (2005), may be classified into 26 suballiances, 242 alliances, 114 orders and 59 vegetation classes. For the first time, we have established the connection between the biomes and the particular categories given by the International Codex of Phytocoenological Nomenclature (Weber 2006). For every PBA a total number of plant communities is given, with emphasis on some important communities. Typical habitats are also described according to EUNIS classification (Lakušić 2005). The relationships between plant communities (classes) and major communities (biomes) are presented in Tab. 2.

Table 2. - Relationships between plant communities (classes) and major communities (biomes) in Serbia (Ranđelović, N. and Jakšić, P. - original).

BIOMES	VEGETATION CLASES
1. Biomes of submediterranean broad-leaved woodland and shrubs.	Paliuretea Trinajstić 1978
2. Biomes of south-European mostly broad-leaved woodlands.	Querco-Fagetea Br.-Bl. et Vlieg. 1937 Alnetea glutinosae Br.-Bl. et R. Tx. 1943 Salicetea purpureae Moor 1958 Trifolio-Geranietea Müller 1961 Epilobetea-angustifolii Tx. et Prsg. 1950 Betulo-Adenostyletea Br.-Bl. et R. Tx. 1943 Molinio-Arrhenatheretea Tx. 1937 Bidentetea tripartiti Tx., Lohm. et Prsg. 1950 Chenopodietea albae Br.-Bl. 1951. em Lohm. R. et J. Tx. 1961 Artemisietea vulgaris Lohm., Prsg. et Tx. 1950 Agropyretea repentis Oberd., Müll. et Görs 1967 Plantaginetea majoris Tx. et Prsg. 1950 Stellarietea mediae Tx., Lohm. et Prsg. 1950 Lemnetea Koch et Tx. 1954 Potametea Tx. et Prsg. 1942 Littorelletea Br.-Bl. et Tx. 1943 Phragmitetea communis Tx. et Prsg. 1942 Montio-Cardaminietea Br.-Bl. et Tx. 1943 Isoeto-Nanojuncetea Br.-Bl. et Tx. 1943 Scheuschzerio-Caricetea fuscae Nordh. 1936 Oxicocco-Sphagnetea Br.-Bl. et Tx. 1943

BIOMES	VEGETATION CLASES
3. Biomes of European mostly coniferous forests of boreal type.	Vaccinio-Piceetea Br.-Bl. 1939 emend. Zupančić 1976 Erico-Pinetea Horv. 1959
4. Biomes of high mountain rocks, pastures, snow-patches and avalanches of Alpine and High-Nordic type.	Asplenietea trichomanis Br.-Bl. 1934 corr. Oberd. 1977 Thlaspitea rotundifolii Br.-Bl. 1947 Festuco-Seslerietea Barb. et Bon. 1969 Juncetea trifidi Hadač 1944 Nardo-Calunetea Preis. 1949 Salicetea herbaceae Br.-Bl. 1947 Epipetrea lichenosa Klement 1955 Asplenietea rupestris Meir. et Br.-Bl. 1934
5. Biomes of steppes and woodland steppes.	Drypetea spinosae Quezel 1967 Festuco-Brometea Br.-Bl. et Tx. 1943 Festucetea vaginatae Soo 1968 emend. Vich. 1972 Thero-Salicornietea Pign. 1953 emend. Tx. 1955 Festuco-Puccinellietea Soo 1968
6. Biomes of stony grounds, pastures and woods on stony grounds.	Querco-Fagetea Br.-Bl. et Vlieg. 1937 Alliance Syringo-Carpinion orientalis Jacucs 1959 Alliance Fraxino-Acerion Fukarek 1969 Ass. Lauroceraso-Fagetum Jov. 1967 Vaccinio-Piceetea Br.-Bl. 1939 emend. Zupančić 1976 Alliance Pinion peucis Horv. 1950 Alliance Pinion mugi Pawl. 1928 Ass. Wulfenio-Pinetum mugo Grebenščikov 1943 Alliance Piceion omorikae Tregub. 1941 Alliance Pinion heldreichii Horv. 1946 Festuco-Seslerietea Br.-Bl. 1948 Alliance Oxitropidion dinaricae Lakušić (1968) 1970 Alliance Edraiantho-Seslerion Horvat 1949 Juncetea trifidi Hadač 1944 Ordo Seslerietalia comosae Sim. 1957

In order to choose the indicators that form a network of causes of richness of the Serbian biodiversity, we turn to Walter's scheme of continuous connection between climate, vegetation and soil expressed in a form of zonobiomes (Walter 1984). Corresponding to this division of climate types in Serbia, according to the division given by Stevanović & Stevanović (1995), the following entities may be discerned:

1. Mediterranean zonobiome with arid-humid climate, with red soil (Terra rosa) and sclerophyllic vegetation. It is represented in some parts of Metohia.

2. Zonobiome of temperate broadleaf forests with temperate climate, brown and grey forest soil and dominant associations of oak and beech. This biome is the most extensive one in Serbia.

3. Zonobiome of steppes with semi-arid continental climate, chernozem as substrate and grass and mosaic steppe-forest vegetation. It is represented mostly in the north, in the Panonnian part of Serbia.

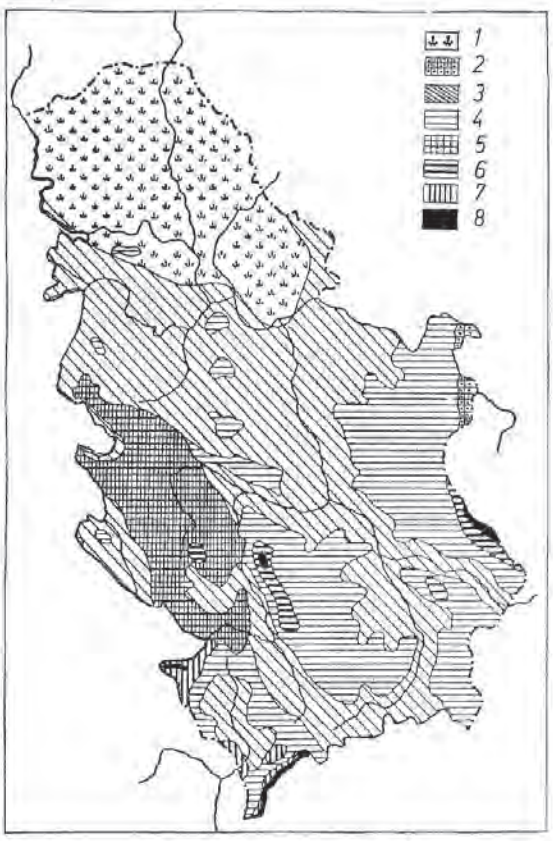
Besides these primary types of biomes there are also mountain biomes corresponding to the northern regions of the Holarctic:

4. Zonobiome of montane coniferous forests with cold temperate climate and spodosol soils.

5. Alpine tundra zonobiome with conditions of alpine climate on initial soils. Effects of such differentiation of ecological factors may be perceived by observing the differentiation of vegetation in Serbia. Corresponding to this, the selection of PBAs should be based on vegetation: selection of representative vegetation units of higher orders within the territory of Serbia ensures that all main types of habitats of Serbia will be represented. Selection of PBAs based on this principle is found on the vegetation map of Serbia (Horvatić 1967; Stevanović 1995 - adapted).

We must note that the vegetation representation at the map of Serbia is the simplified one. For example, the territory of Vojvodina (Panonnian basin) is represented as one homogenous unit. However, this whole area may be further divided. The vegetation maps of certain Prime Butterfly Areas are included in the descriptions of the PBAs. Besides the horizontal differentiation of vegetation in Serbia, there is also a very important vertical differentiation, as shown at Map 1.

One of the leading criteria was the anthropogenic pressure in each area. The idea behind the selection of these sites is that through such PBAs (for example Fruška Gora, Avala, Sićevo gorge, Grmija, etc.) a monitoring system may be organized allowing for observation of the rate and character of biodiversity changes, especially changes in the composition of butterflies communities.



Map 1. - Vegetation map of Serbia as base for PBA s selection.

Mid-European province: Panonnian sector - lowland zone of steppe vegetation (*Festucion rupicolae*) and forest-steppe (*Aceri tatarici-Quercion*). PBA: 3, 10;
Lower forests zone alliance *Quercion frainetto* of Moesian province. PBA: 4, 5, 22, 25, 26, 27, 32, 40;
Mesophyllous broadleaf beech and hornbeam forests (*Fagion moesiacae, Querco-Carpinion betuli*) of Moesian province. PBA: 1, 2, 5, 6, 7, 8, 11, 12, 13, 17, 18, 19, 20, 21, 26, 27, 28, 29, 33, 35, 36, 38, 39;
Mesophyllous broadleaf beech and hornbeam forests (*Fagion moesiacae, Querco-Carpinion betuli*) of Iliric province. PBA: 9, 14, 15, 25, 30, 37, 39;
Coniferous spruce forests (*Vaccinio-Piceion*). PBA: 16, 34, 36;
Zone of relict Balkan pines forests (*Pinion heldreichii, Pinion peucis*). PBA: 21, 23, 24, 31;
Zone of alpine tundra vegetation (*Festuco-Seslerietaea, Juncetaea trifidi*). PBA: 16, 21, 31, 34.

Among the numerous anthropogenic pressures we chose air pollution with sulfur-dioxide and nitrogen-dioxide as pollutants (Kadović & Knežević 2004) for our study. They are the most important types of pressure on butterfly fauna (Map 2-3).

SPECIAL CRITERIA: CHARACTERISTICS OF BUTTERFLY FAUNA AND PRESENCE OF TARGET SPECIES.

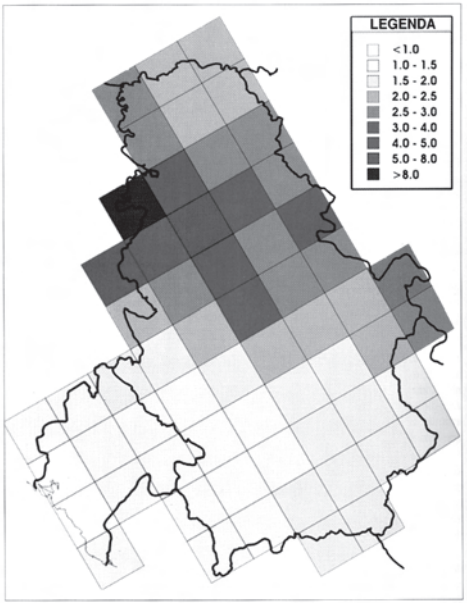
The criteria for selecting Prime Butterfly Areas were defined by van Swaay and Warren (2003; 2006). According to their definition, "The PBAs are designed to cover both discrete individual sites and larger regions within which target species may be widely distributed." The same authors also defined the main selection rules used to decide whether areas should be described for a target species, shown in Tab. 3.

Table 3. - Main selection rules used to decide PBA for Target species.

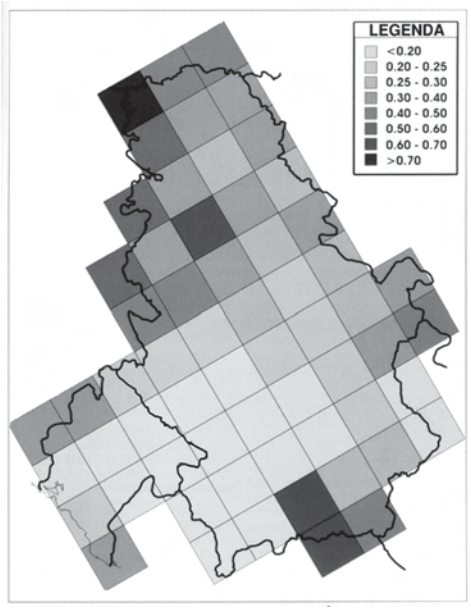
Distribution class within country	**Recommended selection**
<1% (i.e. very rare species)	Select a maximum of the three "best" sites preferably each containing >10% of total country population. However, where several smaller breeding areas occur close together it may be better to describe these as one larger PBA, rather than as one large, continuous population.
1-5% (i.e. moderately rare species)	*If species is widely distributed, select three "best" areas *If species is concentrated in a small number of discrete sites, each with large populations (>10% of country population), select three "best" sites.
>5% (i.e. quite widespread species)	Select three "best" areas each containing numerous populations (e.g. collectively >10% of total country populations).

Other guidelines for selection PBAs were:

- If PBAs selected for two or more species overlap, they should be combined to form a single area.
- If there are more than three "best" sites or regions, the ones with most target species should be chosen.



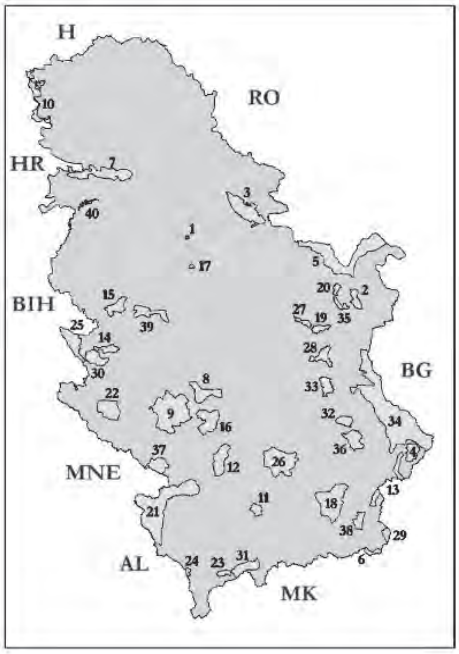
Map 2. – Mean annual concentration of sulfur-dioxide (μgS·m^{-3}) in the territory of Serbia in 2000 (Kadović & Knežević, *Eds*. 2004.)



Map 3. – Mean annual concentration of nitrogen dioxide (μgN·m^{-3}) in the territory of Serbia in 2000 (Kadović & Knežević, *Eds*. 2004.)

- For the very widespread species with no obvious core areas, no separate PBAs should be selected when it is possible to include the species in PBAs selected primarily for other species.

Selection of 40 PBA sites, shown in Tab. 4 and Map 4, preceded the analyses of 50 potential PBAs.



Map 4. Position of 40 PBA in the territory of Serbia.

Table 4. - List of 40 PBA sites for Target species in Serbia.

No	**Name of PBA**	Number of species in PBA	Number of Target species	Level of fauna knowledge		
				excellent	satisfactory	insufficient
1	Mt Avala	111	10	+		
2	Mt Deli Jovan	67	4			+
3	Deliblatska Peščara sand	88	5		+	
4	Dimitrovgrad – Golemi Vrh	114	16		+	
5	Đerdap gorge	104	8		+	
6	Golemi Vrh - Karamanica	51	3			+
7	Mt Fruška Gora	113	12	+		

No	**Name of PBA**	Number of species in PBA	Number of Target species	Level of fauna knowledge		
				excellent	satisfactory	insufficient
8	Mt Goč – Mt Studena – Mt Stolovi	94	4		+	
9	Mt Golija	59	1			+
10	Gornje Podunavlje region	84	6	+		
11	Mt Grmija	127	13	+		
12	Ibarska Klisura gorge	83	7	+		
13	Jerma river gorge	101	11		+	
14	Đetine river gorge	118	11	+		
15	Gradac river gorge with Mt Maglješ and Mt Povlen	95	10		+	
16	Mt Kopaonik	138	17	+		
17	Mt Kosmaj	106	8	+		
18	Mt Kukavica	81	8		+	
19	Lazareva river canyon	70	9		+	
20	Majdanpek – Mt Rudna glava – Mt Mali Krš	86	7		+	
21	Mt Metohian Prokletije	145	16	+		
22	Mt Zlatar with Mileševka canyon	74	4		+	
23	Mt Ošljak	90	6		+	
24	Mt Paštrik – Gorožup	98	11		+	
25	Mt Tara with Beli Rzav gorge and Veliki Rzav river	140	16	+		
26	Mt Radan	91	9		+	
27	Resava river gorge – Mt Kučaj	74	4		+	
28	Mt Rtanj	102	10		+	
29	Mt Rudina	63	5		+	
30	Zlatibor plateau with Mokra Gora ans Šargan	94	6		+	
31	Mt Šar-Planina – Brezovica	151	19	+		
32	Sićevačka gorge	77	10		+	
33	Sokobanjska Moravica river – Mt Devica	87	8		+	
34	Mt Stara Planina	134	14	+		
35	Mt Stol – Mt Veliki Krš	101	15		+	
36	Mt Suva Planina	86	8		+	
37	Tutin – Hum – Dolovska Reka river	68	6			+
38	Mt Veliki Strešer – Mt Besna Kobila	67	5			+
39	Mts Valjevske Planine – Mt Maljen, Mt Suvobor	88	7		+	
40	Zasavica march	57	5		+	

Through a process of selection, 10 potential PBAs were rejected because they did not meet given criteria. In this process, in addition to the original criteria, supplementary criteria were established for selection, based on the total number of target species and on the quantitative composition of fauna of a certain area. In order to apply the secondary criteria, potential PBA sites were divided into several different groups. The basic idea was that high mountains have distinguished biomes with plant communities that correspond to certain altitude zones. Map 5. shows that high mountains on the Balkan Peninsula have 9 vegetation zones.

This richness of vegetation leads to high faunistic richness of butterflies. Areas in the Pannonian basin confirm this fact: they have no distinct mountain biomes and the number of vegetation zones is minimal. For this reason a scale to estimate the utility of potential PBAs based on the number of present butterfly species was suggested (Table 5).

Table 5. - Scale for estimating the utility of potential PBAs based on total number of butterfly species.

Estimate of potential PBA site	Quantitative composition of butterfly fauna		
	Pannonian basin and Peripannonian region	Mountainous region of Serbia (up to 1000 m)	High mountains in Serbia (over 1000 m)
Extreme abundance	>60	>100	>130
Abundance	50-60	90-100	120-130
Moderate abundance	40-50	80-90	110-120
Poor abundance	<40	<80	<110

Finally, for definite selection of PBA sites three more elements are taken into consideration:

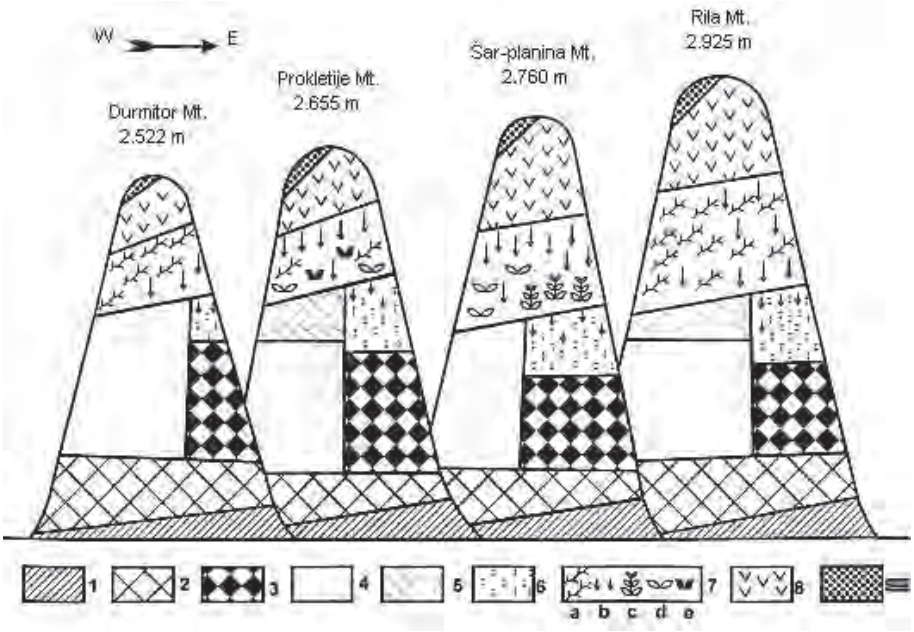
-previous protection based on national legislation,

-protection based on international initiatives (MAB, Ramsar, Emerald etc.), and

-the cross-border character of the chosen area that presents the possibility of international cooperation.

One of the criteria for establishing PBAs in Serbia may be the representation of habitats in certain areas. Recently a list of EUNIS

habitats in Serbia (Lakusic *et al.* 2005) was published. This list includes more than 1200 basic habitats units, classified into 41 classes or 8 basic types of habitats. A map of Serbia with CORINE types of habitats is expected very soon. In this regard, in the process of establishing PBAs, certain areas may be chosen for PBAs according to the number of EUNIS or CORINE habitats.



Map 5. - Vegetation zones of high mountains on the Balkan Peninsula: 1. Beech forest zone, 2. Spruce and beech forest zone, 3. Subalpine beech zone, 4. Spruce and fir forest zone, 5. Spruce forest with Balkan pine, 6. Subalpine meadows, 7. Zone of coniferous and shrub community (a – *Pinus mugo*, b – *Juniperus sibirica*, c- *Rhododendron myrifolium*, d – *Vaccinium myrtillus*, e – *Bruckenthalia spiculifolia*), 8. Meadows with *Caricion curvulae* and *Seslerion comosae*, 9. Vegetation of subnival zone. (According to Varga 1972 and Jakšić 2003).

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РАЗВОЈ МЕТОДА И КРИТЕРИЈУМА ЗА ИЗБОР ЦИЉНИХ ВРСТА И ОДАБРАНИХ ПОДРУЧЈА ЗА ДНЕВНЕ ЛЕПТИРЕ У СРБИЈИ

Предраг Н. Јакшић

Р Е З И М Е

У оквиру Агенде 21, бројних програма Европске Уније, као и иницијатива за заштиту биодиверзитета на националном нивоу, покренут је и програм заштите дневних лептира. Дневни лептири су се у целој Европи издвојили по свом значају, заједно са васкуларним биљкама и кичмењацима, као групе организама које представљају основ за доношење одлука о заштити неког подручја. Иницијатива за заштиту је покренута од стране Butterfly Conservation, организације која на нивоу Европе обједињује све субјекте који могу допринети заштити и очувању дневних лептира, како из тзв. владиног сектора, тако и из сектора невладиних организација (NGO).

Централно место у том програму представља развој метода и критеријума за избор најзначајнијих представника фауне дневних лептира Србије. Тај избор је заснован на критеријумима које су развили Swaay и Warren (2006) и критеријумима који су наведени у Црвеној Књизи дневних лептира Србије (Jakšić 2003). Од 193 врсте дневних лептира Србије, према овим критеријумима, одабрано је 38 врста, оне представљају циљне врсте (target species).

Други значајан сегмент овог пројекта представља избор оних делова територије Србије који ће првенствено репрезентовати центре диверзитета фауне дневних лептира. Имајући у виду разноврсност геодиверзитета и биодиверзитета (првенствено флористичког и вегетацијског) Србије, настојали смо да кроз избор Одабраних подручја за дневне лептире у Србији представимо и остале облике разноврсности. Уједно, тиме смо довели у каузалну везу разноврсност дневних лептира са абиотичким и биотичким еколошким чиниоцима. Непосредним теренским радом у протеклих неколико година истражили смо нешто више од 50 подручја а за Одабрана подручја за дневне лептире у Србији сачинили смо листу од 40 подручја.