

FURTHER DEVELOPMENT OF PRIME BUTTERFLY AREA NETWORK IN ARMENIA

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Introduction

The Prime Butterfly Areas (PBAs) is a conservation tool – one of the options of Important Biodiversity Areas (Anderson 2002, Heath and Evans 2000). Prime Butterfly Areas have been identified for most of Europe with an intention to support other conservation networks, such as Natura 2000, Pan-European Ecological Network, Pan-European Biological and Landscape Diversity Strategy and Bern Convention (van Swaay and Warren 2006). In Armenia, identification of Prime Butterfly Areas was started in 2013 with a pilot project in Southern Armenia (Khanamirian et al. 2014), when the first set of seven PBAs was identified and assessed, and then continued with assessment of additional three PBAs (Khanamirian 2016). Meanwhile the country hosts 236 species of butterflies, many of those are endemics for the region (Butterfly Conservation Armenia 2019), and they are not covered with the existing network of PBAs. Quite large species diversity is conditioned by wide variety of habitats that exist in this mountainous country. Meanwhile economy of Armenia is developing and that can have a negative impact on species and habitat diversity, which are not entirely covered by the network of protected areas in Armenia. Last publication of Red Book of the Animals of the Republic of Armenia (Aghasyan and Kalashyan 2010) identified 24 species of butterflies that are threatened. The recently implemented works on Atlas of Butterflies in Armenia demonstrate necessity for inclusion of additional 72 species in the next edition of the Red Book (van Swaay et al. *in prep*). Thus, there was an obvious need for further development of the network of Prime Butterfly Areas in the country, as these areas are becoming drivers in further transformation of the lands' status, making them protected at National Level, included in Emerald Sites under Bern Convention, designated as Key Biodiversity Areas, etc. The article therefore focuses on continuation of identification and assessment of Prime Butterfly Areas in Armenia.

Methods

The identification of Prime Butterfly Areas is based on methodology developed for Europe (van Swaay and Warren 2006), and local adaptations of that under some local conditions, such as Turkey (Zeydanlı et al. 2012), Bulgaria (Abadjiev 2003), and others. Therefore, the methodology assigns to designate the Prime Butterfly Area as such, if two of the following have been represented: a species included in Red Data book of European butterflies (van Swaay and Warren 1999), in Appendix II of the Bern Convention (on the conservation of European wildlife and natural habitats) and/or the EU Habitats and Species Directive, as well as species of national concern listed in Red Book of Animals of the Republic of Armenia (Aghasyan and Kalashyan 2010). The data on butterfly species composition and distribution that is used for the current publication was collected from 1997 to 2013. The process itself undergoes through two steps: at first, all the potential PBAs in the country have been preliminarily identified; at second, their assessments are being implemented.

Results

Preliminary identification of potential PBAs in Armenia resulted to a list of 32 sites (which are being gradually added, when new data emerges), see the map on Fig 1. Out of those the PBAs numbered from 01 to 07 have been assessed during implementation of the first project “Butterfly species and habitat conservation in Southern Armenia”, the PBAs #08 to #10 – in frames of project “Expansion of Prime Butterfly Area Network in Armenia”, the PBA #12 – during implementation of project “Assessment of global conservation status of *Polyommatus myrrha cinyraea* – endemic of Middle East and Southern Caucasus”, and PBA #31 in frames of currently implemented project “Assessment of global conservation status of *Polyommatus diana* – endemic of Transcaucasia”.

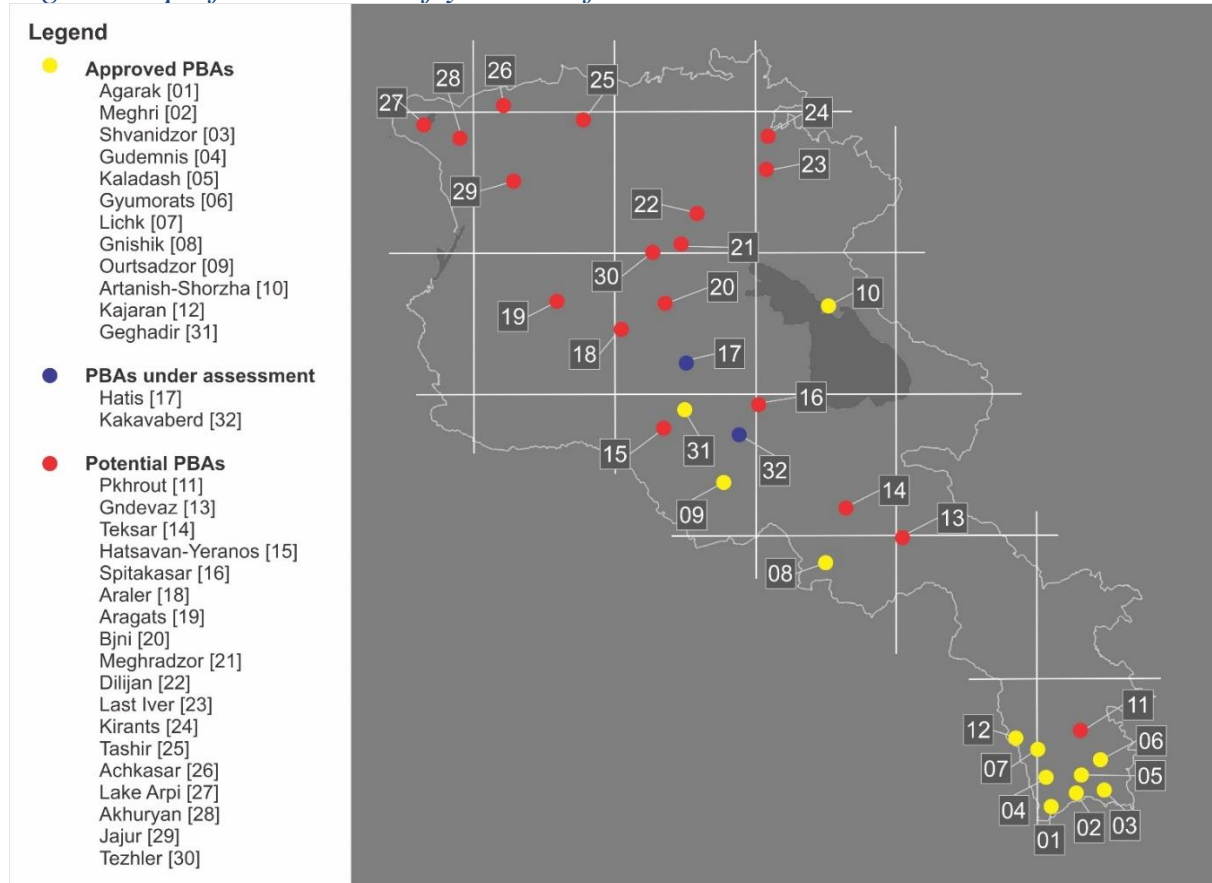
After finalizing of the first pilot project, the following PBAs have been assessed and described below:

Gnishik [08]

The area (about 3,840 ha) is located at the north-eastern slopes of Hayotsdzor mountain ridge at elevations from 1200 to 2320 m above sea level. The average steepness of slopes is from 10° to 25°. The area is cut by deep rocky canyon; from the lower part to upper the habitats change significantly, and include variegated semideserts, tragacanth and sainfoin mountain steppe, elements of meadows, riparian forest (see Fig. 2). broad-leaved forest and alpine grasslands. Dominant vegetation among herbs are various grasses (*Poa sp.*, *Festuca sp.*, etc), and especially wide variety of legumes (*Astragalus sp.*, *Onobrychis sp.*, *Trifolium sp.*, etc.); among bushes are tragacanth, sainfoin (*Onobrychis*

cornuta), rosehip (*Rosa sp.*), hawthorn (*Crataegus sp.*), honeysuckle (*Lonicera sp.*), and others; among trees are poplar (*Populus sp.*). The area is characterized by relatively dry climate with short rainy seasons.

Fig. 1. Map of Prime Butterfly Areas of Armenia



There are 163 butterfly species (72% of total number of species in Armenia) recorded in this area. Two of the species included in IUCN Red List, 12 species included in European Red List, 14 species included in National Red Data Book. The species of national and international concern are:

Carcharodus lavatherae, *Parnassius mnemosyne*, *Parnassius apollo*, *Papilio alexanor*, *Zegris eupheme*, *Colias aurorina*, *Colias chlorocoma*, *Tomares romanovi*, *Pseudophilotes vicrama*, *Maculinea arion*, *Maculinea alcon*, *Aricia anteros*, *Polyommatus dorylas*, *Polyommatus damon*, *Polyommatus eriwanensis*, *Polyommatus surakovi*, *Polyommatus huberti*, *Polyommatus ninae*, *Polyommatus turcicus*, *Polyommatus iphigenia*, *Pseudochazara schahrudensis*, *Hipparchia statilinus*, *Chazara briseis*, *Brethis ino*, *Mellicta aurelia*.

The major threats for the area are related to overgrazing and uncontrolled

mowing, also since the area is widely used for picnics, there is a high risk of fire, which comes from non-careful behavior. The area is managed mainly with the community Gnisheek, with the livestock husbandry as the major income source. Therefore, the area serves for grazing and haymaking. The livestock (mainly cattle, sheep, and in a less extent – goats) is grazing here from April till September. Intensive use of pastures might cause significant decrease or even removal of host-plants of key species, and especially destruction of productive top-soil layer at the slopes by feet of livestock. Mowing that was transferred into automatic – removes significant portion of the host-plants at flatter areas in the time of larval development or egg-laying. The mentioned threats negatively influence mostly species that develop on herbs.

*Fig. 2. Noravank canyon: combination of semi-desert and mountain steppe. Habitat of *Pseudochazara schahrudensis**



The following species are suspected to be affected by over-exploitation of the area: *Carcharodus lavatherae*, *Parnassius mnemosyne*, *Zegris eupheme*, *Tomares romanovi*, *Pseudophilotes vicrama*, *Pseudophilotes bavius*, *Maculinea arion*, *Maculinea alcon*, *Ultraaricia crassipuncta*, *Polyommatus dorylas*, *Polyommatus damon*, *Polyommatus eriwanensis*, *Polyommatus surakovi*, *Polyommatus huberti*, *Polyommatus ninae*, *Polyommatus turcicus*, *Polyommatus iphigenia*, *Pseudochazara schahrudensis*, *Hipparchia statilinus*, *Chazara briseis*, *Brethis ino*, *Mellicta aurelia*. Among the mentioned species the population of *Pseudophilotes bavius* is of special concern, since it is the

only known population of the species living in Armenia.

To secure conservation of the area it is important to strengthen the protection regime and to manage grazing and mowing on a sustainable level. To increase financial sustainability of the local community it is important to use the potential of tourists and to support development of ecotourism in the area. In 2015-2016 the negotiations with the Gnishik Intercommunity Fund lead to development of infrastructure for butterfly-watching in two communities: Gnishik and Areni. In frames of that three butterfly-watching trails: Amaghous steppe, Noravank semi-desert, and Gnishik steppe have been developed.

Ourtsadzor [09]

The area (about 6,120 ha) is located at the south-western slopes of Gegham mountain ridge, in neighborhood of Khosrov Nature Reserve, at elevations from 1200 to 2200 m above sea level. The average steepness of slopes is from 10° to 30°. The area is formed by arid type of vegetation with domination of multi-year plants. Among herbs there are various grasses and legumes dominating; among bushes the most common vegetation types are *Onobrychis cornuta*, *Athrappaxis spinosa*, and *Rhamnus pallasii*, and in less number the rosehips (*Rosa sp.*); among trees the dominating are *Juniperus polycarpus*, *Celtis glabrata*, and some species of *Crataegus*. Along rivers the common species are honeysuckle (*Lonicera sp.*), and poplar (*Populus sp.*). The area is characterized by dry climate with short rainy seasons. In total, there are 131 butterfly species (58% of total number of species in Armenia) recorded in Armenia. There are 5 species included in European Red List, 13 species included in National Red Data Book. The species of national and international concern are:

Carcharodus lavatherae, *Papilio alexanor*, *Zegris eupheme*, *Colias aurorina*, *Colias chlorocoma*, *Callophrys danchenkoi*, *Lycaena asabinus*, *Tomares romanovi*, *Pseudophilotes vicrama*, *Plebeius christophi*, *Polyommatus eriwanensis*, *Polyommatus huberti*, *Polyommatus surakovi*, *Polyommatus ninae*, *Pseudochazara schahrudensis*, *Proterebia afra*, *Chazara briseis*, *Melitaea turkmanica*, and others.

The area is located at the buffer zone of Khosrov Nature Reserve. The area is traditionally used by surrounding communities for collection of eatable herbs and berries, and for grazing of sheep and goats. Part of the area is often used for picnics, which potentially increases danger of occasional fire, especially in summer season. Part of the area is managed by Khosrov Nature Reserve. Grazing and wild herb collection deal with complete or partial removal of host-plants, and in case of intensification of the process can cause serious damage to the habitat and result in decline of such species as *Carcharodus lavatherae*, *Carcharodus stauderi*, *Papilio alexanor*, *Zegris eupheme*, *Callophrys*

danchenkoi, *Tomares romanovi*, *Pseudophilotes vicrama*, *Polyommatus eriwanensis*, *Polyommatus huberti*, *Polyommatus surakovi*, *Pseudochazara schahrudensis*, *Proterebia afra*, *Melitaea turkmanica*. In the same time the fire can potentially destroy entire habitat. To secure conservation of the area it is important to strengthen collaboration with the surrounding communities and promotion increase of their sustainability. One of the opportunities is development of nature tourism (bird and butterfly watching), which can attract flow of visitors and become beneficial for the local communities providing them with a new opportunity of hospitality and catering service. For promotion of birdwatching as one of string driving forces of nature tourism, the area is also included in Key Birding Sites of Armenia. During 2015-2016 the collaboration with Khosrov Nature Reserve was started. The butterfly-watching trail Kotuz Mtn was developed.

Artanish-Shorzha [10]

The area (about 62,100 ha) is located at the southern slopes of Aregouni mountain ridge at the north-eastern shore of the Lake Sevan, at elevations from 1900 to 2500 m above sea level. The average steepness of slopes is about 10° to 15°. The area is mostly represented by calcareous grasslands alternated with juniper woodlands, and meadows, some smaller patches are covered by residual oak woodlands. Dominant vegetation at the rangelands are grasses and legumes (*Astragalus* sp., *Onobrychis* sp, *Trifolium* sp., etc.); among bushes are tragacanth, sainfoin (*Onobrychis cornuta*), and rosehip (*Rosa* sp.); among trees are juniper (*Juniperus polycarpus*) and hawthorn (*Crataegus*). Despite on the general cold climate of the Lake Sevan the site, which is located at southern face is relatively warm, which makes possible growing apricots by local farmers. In total 111 species of butterflies (49% of total number of species in Armenia) was recorded here. Two of the species included in IUCN Red List, 10 species included in European Red List, 7 species included in National Red Data Book. The species of national and international concern are:

Carcharodus lavatherae, *Carcharodus flocciferus*, *Parnassius mnemosyne*, *Colias aurorina*, *Tomares callimachus*, *Pseudophilotes vicrama*, *Maculinea arion*, *Maculinea alcon*, *Ultraaricia crassipuncta*, *Polyommatus dorylas*, *Polyommatus damon*, *Polyommatus ninae*, *Pseudochazara schahrudensis*, *Pseudochazara beroe*, *Hipparchia statilinus*, *Chazara briseis*, *Brethis ino*.

The area is located in recreational and buffer zones of the National Park and therefore is used by surrounding communities and tourists. Such activities create might have the negative influence on the ecosystems of the area; among threats the overgrazing and intensive mowing should be highlighted. The livestock, which is breed the surrounding communities (cows and sheep) can

potentially cause removal of the host-plants and slope erosion. Also at the end of summer (which is by the way the hot tourism season at the Lake Sevan area), the occasional fire caused by non-careful behaviour becomes one of the serious risks.

Fig. 3. Artanish peninsula: Juniper woodlands and mesophilic steppes. Habitat of Brethis ino



The mentioned threats negatively influence the following species: *Carcharodus lavatherae*, *Carcharodus flocciferus*, *Tomares callimachus*, *Pseudophilotes vicrama*, *Maculinea arion*, *Maculinea alcon*, *Ultraaricia crassipuncta*, *Polyommatus dorylas*, *Polyommatus damon*, *Polyommatus ninae*, *Polyommatus firdussii*, *Polyommatus vanensis*, *Pseudochazara schahrudensis*, *Pseudochazara beroe*, *Chazara briseis*, *Hipparchia statilinus*, *Brethis ino*. It should be noted that the area is isolated from the other *Onobrychis cornuta* dominated dry mountain steppes in Armenia. Therefore, such species as *Tomares callimachus*, *Polyommatus firdussii*, *Polyommatus vanensis*, *Pseudochazara schahrudensis*, and some others are represented in isolated populations. The phenomena have a significant scientific potential for taxonomy and conservation potential for protection of genetic diversity. To secure conservation of the area it is important to place sustainable practices of grazing management and mowing, and to improve fire security in the area. It is also important to collaborate with the surrounding communities with the main aim of increasing number of butterfly-watchers in the area. In 2015-2016 the negotiations with the Lake Sevan National Park have been conducted, and they

lead to development of annual butterfly monitoring in the area and negotiations in development of butterfly-watching in the PBA. In particular, the butterfly-watching trail Artanish Steppe was designed.

Kajaran [12]

The area (about 20,100 ha) is situated at the Northern Slopes of the Southern face of Zangezour Mountains, at the gorge of Voghchi River. It occupies an elevation range from 2000 to 2800 m above sea level. The average steepness of slopes is about 10° to 20°. The area is represented by alpine carpets, alternated with rocky outcrops, screes, and taluses (see Fig. 4). Bottom of the gorge is occupied by wet meadows. In lower part of the gorge there is a deciduous forest made mainly from oak, with some representation of hornbeam and willow. Dominant vegetation at the open slopes are various grasses and other herbs (*Echinops* sp., *Astragalus* sp., *Onobrychis* sp. etc.); among bushes – junipers (*Juniperus* sp.). The gorge is quite humid and supports wide variety of meadow plants. There are 109 species of butterflies (48% of total number of species in Armenia) have been recorded in the area. Two of the species included in IUCN Red List, 10 species included in European Red List, 6 species included in National Red Data Book, as well as some regional endemics, which require further assessment of their conservation status. The species of national and international concern are: *Carcharodus orientalis*, *Parnassius mnemosyne*, *Parnassius apollo*, *Colias thisoa*, *Pseudophilotes vicrama*, *Maculinea arion*, *Ultraaricia anteros*, *Polyommatus myrrha cinyraea*, *Polyommatus damon*, *Hyponephele lycaonoides*, *Pseudochazara beroe*, *Pseudochazara daghestana zangezura*, *Chazara briseis*, *Argynnis aglaja*, *Euphydryas aurinia*.

The area is partly covered by Zangezour Biosphere Complex, and the gorge is used as catchment basin for drinking water. That is why the livestock access to the gorge is already restricted, and the site is one of the few in Armenia, which are not affected by overgrazing. Despite on that, the site is facing another threat: the small Hydro Power Plant is being constructed in the gorge (2016-2019). The potential influence of it on the butterfly fauna was not well studied, while reduction of the water flow in the river can have a significant influence on the micro-climate of the gorge, and therefore affect specialized plants and butterflies. While the mentioned threat affects entire fauna of butterflies, it can especially have significant negatively influence on the following species: *Carcharodus orientalis*, *Colias thisoa*, *Pseudophilotes vicrama*, *Maculinea arion*, *Ultraaricia anteros*, *Polyommatus myrrha cinyraea*, *Polyommatus damon*, *Hyponephele lycaonoides*, *Argynnis aglaja*. It should be noted that the area is the only place in Armenia for *Polyommatus myrrha cinyraea* and *Hyponephele lycaonoides*. Also it is important to mention that the species status

of *Argynnis aglaja* in this gorge is not yet clarified - some authors think that the population here is an isolated form of *Argynnis alexandra*. Thus number of species in the gorge are of special conservation concern while the others are interested for taxonomy science.

To secure conservation of diversity of plants and butterflies in this area it is important to include it entirely into the Zangezour Biosphere Complex, and in short-term perspective to secure the proper Environmental Impact Assessment of the HPP and other possible business projects. It is also important to collaborate with the Zangezour Biosphere Complex on development of butterfly-watching in the area, which can create different value for this spectacular gorge among decision-makers and local communities. In frames of the last activity, the butterfly-watching trail Voghchi subalpine was developed.

*Fig. 4. Voghchi river gorge: subalpine landscape.
Habitat of *Polyommatus myrrha cinyraea**



Geghadir [31]

The area (about 380 ha) is situated at the Southern slopes of Voghchaberd Mountain Ridge at about 20 km from the capital Yerevan. The elevation range occupied by the area is from 1680 to 2090 m above sea level, with an average steepness of slopes about 5° to 15°. At the lower part the area is represented by arid steppe zone while at the higher altitude the habitat becomes changed into meadows. Among dominant vegetation various grasses (such as *Stipa* sp., *Poa* sp. and *Festuca* sp.), and other herbs and bushes (*Astragalus* sp., *Onobrychis*

sp. and *Rosa* sp.) should be mentioned.

Number of butterfly species, recorded in the area makes 120 (51% of total number of species in Armenia). Six species are included in European Red List and 9 species are included in National Red Data Book. Also there are number of regional endemics, which require further assessment of their conservation status. The species of national and international concern are: *Carcharodus orientalis*, *Papilio alexanor*, *Colias aurorina*, *Tomares romanovi*, *Pseudophilotes vicrama*, *Ultraaricia anteros*, *Polyommatus diana* (see Fig 5), *Polyommatus eriwanensis*, *Polyommatus huberti*, *Polyommatus ninae*, *Polyommatus iphigenia*, *Proterebia afra*, *Pseudochazara schahrudensis*, *Chazara briseis*, *Argynnis aglaja*, *Euphydryas aurinia*.

The area is not covered by any of Protected Areas or Emerald Sites. There is a nomadic grazing in the area, which already causes grassland degradation in some parts of the PBA. Close proximity of the PBA to the village Geghadir, and existence of appropriate infrastructure (mobile houses and watering place) at the upper part of the gorge makes the livestock grazing in the area rather easy. In the same time the site is used for hay-making. The removal of host-plants of priority species, degradation of the top-soil layer by the feet of livestock, and uncontrolled mowing are the threats, which influence number of species in the area. Among others, it is important to mention *Polyommatus diana*, which is assessed for the Red Book of Animals of Armenia as Endangered, and, being an endemic of Transcaucasia is a candidate for Global assessment. The species is monophagous and has a very restricted distribution range as within the current PBA, as in Armenia. Degradation of the meadow-type habitat can cause irreversible consequences for the species.

To protect the species diversity of Geghadir PBA, it is necessary to: (1) include the area into existing Emerald Network and develop management plan for it; (2) to award it with a national conservation status. e.g. sanctuary; (3) to design and introduce a site-specific, habitat friendly grazing and mowing plan; (4) to develop butterfly-watching in the area, thus bringing the end users of the agro production directly to the farmers, which can help in increasing of profit from the area unit, and therefore in decreasing the load on the grasslands.

Conclusion

The existing network of Prime Butterfly Areas of Armenia requires continuation of the assessments and further inclusion of these areas into national or international conservation networks, such as Emerald Sites, protected under Bern Convention. Another major piece of the work is related to development of capacity for sustainable management of PBAs, which includes identification of local enthusiasts, who can act as caretakers, their training,

making PBAs more attractive for local tourists, and eventually development of sustainable self-financing models of the PBAs.

*Fig. 5. Target species for Geghadir PBA: *Polyommatus diana**



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