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"Biodiversity Hotspots" in Armenia

G. Fayvush*, K. Tamanyan*, M. Kalashyan**, E.Vitek***

Zusammenfassung

Nach der Globalen Strategie zur Erhaltung der Pflanzenvielfalt (CBD, Niederlande, 2002) sollte Armenien bis 2010 50% der wichtigsten Gebiete für die Vielfalt der Pflanzen identifizieren und schützen. Die Ergebnisse dieses Prozesses weden präsentiert. 29 Gebiete wurden als wichtige Gebiete für die Vielfalt der Pflanzen festgestellt. Zoologische Daten wurden zum Vergleich herangezogen und bestätigen die Wichtigkeit dieser Gebiete. Diese werden mit den existierenden Schutzgebieten Armeniens verglichen..

Abstract

According to the Global Strategy for Plant Conservation (CBD, Netherlands, 2002), Armenia had to identify and protect 50% of the most important areas for plant diversity by 2010. The results of the identification of important plant areas in Armenia on the basis of A and B Criteria are presented. Existence of 29 Important Plant Areas in Armenia and their connection with Specially Protected Natural Areas of the Republic have been specified. Data on invertebrate animals were reviewed which has confirmed the importance of the nature protection of those territories. Further activities according to country's obligations to Convention on Biological Diversity and Global Strategy for Plant Conservation are emphasized.

Key-words: Flora of Armenia; rare and endemic plant species, Important Plant Areas, biodiversity, conservation.

Introduction

The territory of the Republic of Armenia is part of one of the most important "hotspots" of the World biodiversity – Caucasus. Though occupying a relatively small part of the Caucasus this country shows very high biodiversity. With a territory of 29740 sq. km about 3600 species of vascular plants are registered (GABRIELIAN & OGANESIAN 2010: 7), more than 500 species of vertebrates and more than estimated 17000 species of invertebrates. Almost all main types of vegetation in Caucasus (excluding flora of wet subtropics) are present in Armenia. In some few parts, as well as in other countries of the Caucasus still territories with scarcely influenced nature exist. Currently the Republic of Armenia faces the very acute problem of preserving such ecosystems. In former times the small density of human population and traditional methods of ecosystems' usage maintained ecological balance but, in the last century human influence has multiplied. This is manifested by deforestation and intensified management of pastures. Beginning in 1920–ies the population was growing and urbanization took place. As a consequence big parts of natural ecosystems (forests, wetlands, steppes, etc.) were lost. Starting from 1992 economic and energy crises demolished the republic forests. As a result more than

* Dr. George Fayvush, Dr. Kamilla Tamanyan, Institute of Botany of National Academy of Sciences of Armenia, Acharyan str. 1, Yerevan 0063, Armenia – gfayvush@yahoo.com; ktamanian@yahoo.com
Dr. Mark Kalashyan, Institute of Zoology of National Academy of Sciences of Armenia, P. Sevak str. 7, Yerevan 0014, Armenia – mkalashian@yahoo.com

*** Dr. Ernst Vitek, Naturhistorisches Museum Wien, Department of Botany, Burging 7, 1010 Wien, Austria – ernst.vitek@nhm-wien.ac.at

10% of existing forests were cut or destroyed. Overgrazing at the same time has led to the abrupt degradation of pastures situated near settlements. Besides that the problems of invasive species and global climate changes gain great importance causing ecosystems change, species migration and even their disappearance.

All this requires scientifically based and rational approach to biodiversity conservation, especially in case of a necessary establishment of new protected areas.

Material and Methods

To get the basic data of distribution of rare and especially endemic plant species the collections of the herbarium of the Institute of Botany of National Academy of Sciences of Armenia (ERE) was analyzed, the resulting localities listed and geo-referenced.

The herbarium ERE contains ca. 400.000 specimens, mainly of the Republic of Armenia and surrounding areas. All the time (mainly until the end of 1980-ies) the scientists of the herbarium explored badly known areas and documented the relevant species. Additionally, since 2002, starting with the OPTIMA Iter to Armenia a phase of intensive exploration in collaboration with foreign institutions began: Vienna (herbarium W) 2003–2012, Madrid (MA) 2005, Palermo (PAL) 2004–2011. Some of these expeditions filled gaps in unexplored areas, some confirmed earlier findings and checked the still-existence of a rare species in place. The results have not only been additional data for rare species but also species new for the territory of Armenia and species new for science could be identified (see Table 1).

The locations of 123 species of endemic plants and 452 plant species that were classified by IUCN criteria and are included in the new edition of the Red Book of

Table 1: New species described from Armenia 2005–2011.

Loncomelos exalbescens Speta (Asparagaceae)	Speta 2006
Trisetum geghamense Gabrielian (Gramineae)	Gabrielian 2007
Bromopsis zangezura Ogan. (Gramineae)	Oganesian 2007
Silene chustupica Nersesian (Caryophyllaceae)	Nersesian 2007
Papaver sjunicicum M.V. Agab. (Papaveraceae)	Agababian & Fragman-Sapir 2007
Papaver gabrielianae M.V. Agab. (Papaveraceae)	Agababian & Fragman-Sapir 2007
Papaver roseolum M.V. Agab. & Fragman (Papaveraceae)	Agababian & Fragman-Sapir 2007
Erysimum gabrielianae Polatschek (Cruciferae)	Polatschek 2008
Astragalus carolynmugarae Arevschatian (Leguminosae)	Arevschatian 2009
Cartaegus susanykleinae Gabrielian & Sargsyan (Rosaceae)	Gabrielian & Sargsyan 2009
Onobrychis aragatzi Arevschatian (Leguminosae)	Arevschatian 2009
Gundelia aragatsi Vitek, Fayvush, Tamanyan & Gemeinholzer (Compositae)	Vitek, Fayvush, Tamanyan & Gemeinholzer 2010
Papaver armenii M.V. Agab. (Papaveraceae)	Aghababyan 2011
Dianthus gabrielianae Nersesian (Caryophyllaceae)	Nersesian 2011
Dianthus takhtajanii Nersesian (Caryophyllaceae)	Nersesian 2011
Acantholimon takhtajanii Ogan. (Plumbaginaceae)	Oganesian 2011
Acantholimon manakyanii Ogan. (Plumbaginaceae)	Oganesian 2011

Armenia (TAMANYAN et al. 2010) were spotted on the map of Armenia. The more than 5000 records were analyzed using GIS-DIVA software. Then concentrations were highlighted.

The data of invertebrates, gained by UNDP/GEF project ("Development of Specially Protected Nature Areas in Armenia"), have been compared and used to confirm the areas with high concentration of rare and endangered species.

Finally these areas are compared with the existing protected areas in Armenia.

Short characteristic of the natural conditions in Armenia

Geography:

Armenia is a Transcaucasian republic, bordering with Georgia, Azerbaijan, Turkey, and Iran. It is a landlocked country with a total area of 29,740 km^2, at a distance of about 145 km from the Black Sea, and 175 km from the Caspian Sea. It lies between 38°50' and 41°18' of northern latitude and between 43°27' and 46°37' eastern longitude, and measures 400 km along its main axis (north-west to south-east). Armenia is generally a mountaineous country, having its lowest point of 375 m above sea level and culminating at 4095 m with an average altitude of 1850 m.

Climate:

A wide range of climatic zones have been recorded within Armenia. The country is located centrally in the sub-tropical zone, and thus is dominated by arid to semi-desert conditions. The altitudinal zonation adds diversity resulting from altitudinal clines. In general the climate is best characterised as dry continental, in some areas with an annual rhythm more or less similar to the Mediterranean one. The amount of sunshine is high: 2600–2800 hours per year. The average temperature varies from 2.7°C to 14.1°C (Tab. 2). Average annual precipitation is around 600 mm; it varies depending on altitude from 250 to 1000 mm (Tab. 3). Most precipitation falls in the spring. Long-lasting snow cover exists in the mountains above 1300 m, where the annual snowfall could attain 2 m, whilst it only reaches 0.5 m in the lowland steppes. In the northern part of Armenia humidity comes from the Black Sea in the west, in the southern part from the Caspian Sea in the east, the central part is in the rain shadow of mountain ridges the driest area.

Table 2: Average temperatures in different localities of Armenia (Armenian Hydro-meteorological service, 1997).

Station	Altitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Megri	700	1,4	3,3	7,9	13,8	18,9	23	26,1	25,7	21,2	15,2	9,2	4,0	14,1
Artashat	860	-6,1	-3,4	3,8	11,6	17,1	21,3	25,2	24,5	19,4	12,6	5,2	-1,5	10,8
Ashtarak	1090	-3,9	-2,6	3,8	10,8	16,0	20,4	24,4	24,4	19,8	13,4	5,8	-1,3	10,9
Goris	1400	-1,1	-0,1	2,8	7,9	12,9	16,2	19,1	18,7	14,6	10,1	4,9	0,8	8,9
Tashir	1507	-5,0	-3,6	-0,6	5,6	10,4	13,3	16,0	15,7	12,1	7,5	2,2	2,5	5,9
Djadjur	1840	-8,3	-6,3	-2,2	4,2	9,5	12,7	16,3	16,8	12,8	8,2	1,3	-4,5	5,0
Sevan	1940	-8,2	-7,3	-3,3	3,4	8,9	12,1	15,7	15,7	12,1	6,5	0,6	-5,4	4,2
Sevan pass	2104	-7,4	-7,0	-3,9	2,3	7,4	10,4	13,3	13,4	10,0	5,7	0,4	-4,7	3,3
Aragats	3229	-12,8	-12,5	-10,2	-5,0	-0,5	3,6	8,5	9,2	5,0	-0,7	-6,2	-10,5	-2,7

Table 3: Average precipitation (mm rain) in different localities of Armenia (Armenian Hydrometeorological service, 1997).

Station	Altitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Megri	700	18	18	32	41	52	30	10	7	13	23	24	15	283
Artashat	860	18	25	26	28	32	19	12	4	13	15	26	21	239
Ashtarak	1090	19	30	34	36	55	49	18	14	17	16	42	27	357
Goris	1400	39	68	73	94	103	87	33	35	54	60	73	51	770
Tashir	1507	22	28	39	71	129	133	83	61	58	44	34	20	722
Djadjur	1840	18	32	25	60	95	109	43	26	43	28	31	33	543
Sevan	1940	26	30	41	65	103	78	50	41	39	51	38	26	588
Sevan pass	2104	35	44	63	83	114	104	67	49	52	62	49	34	756
Aragats	3229	32	42	74	91	110	85	89	54	56	32	65	33	763

Geomorphology:

Four main geomorphological regions can be recognised within Armenia. 1. Mountain ridges and valleys in the north-east of the country which bear witness of extensive erosion. 2. Areas covered by lava of relatively recent (upper Pliocene) origin within Asia Minor characterised by gentle slopes with little evidence of erosion but, in which larger rivers have carved out deep gorges and canyons. 3. A series of ridged mountains in the south of Armenia, which constitute the Minor Caucasus system and show intense erosion. 4. The Ararat Valley representing the lowest part of the Ararat depression which is covered with alluvial and proluvial sediments.

Landscape:

The mountainous nature of Armenia results in a series of highly diverse landscapes with varying: geological substrate, terrain, climate, soils, and water supply. There are seven distinct landscape types described for Armenia: deserts, semi-deserts, dry steppes, steppes, woodlands, sub-alpine and alpine lands. The great diversity of ecosystems and vegetation types is correlated with the variety of landscapes, ranging from sand deserts and semi-deserts situated at 400 m above sea level to alpine meadows and turfs at 3000 m, from xeric mountain formations to wetland vegetation, or from mesophilous forests to feather grass steppes.

Vegetation:

The diversity of landscapes and orography is an important determinant of Armenia's diverse vegetation. The lower mountain belt (480–1200 m) is covered by semi-desert (or phryganoid) formations, gypsophilous or halophilous vegetation. There are salt marsh areas as well as the only known Transcaucasian sand desert. The middle and upper mountain belts (1200–2200 m) are characterised by various kinds of steppe and forest vegetation, meadow-steppes, shrub steppes and thorny cushion (tragacanth) vegetation. The altitudinal span of the forest belt varies from 500 to 1500 (–2000) m depending of the region, and may be approaching to 2400 m when open park-like tree stands are included. The subalpine and alpine belts (2200–4000 m) are covered by meadows and turf.

Phytogeography

Armenia is situated between two very distinct phytogeographical domains: the Boreal and Ancient Mediterranean Subkingdoms and at the junction of two floristic provinces

- Caucasian and Armeno-Iranian (TAKHTAJAN 1986). The peculiarity of each, enhanced by vertical zonation, is the cause of the great variety of the country's vascular flora and vegetation. About 3600 vascular plant species occur on its territory. The floristic zones within Armenia can be found in TAKHTAJAN (1954–2010).

Important plant areas

In 2002 by decision VI\9 of the conference of the parties of the Convention on Biological Diversity the Global Strategy for Plant Conservation was approved. Its main goal is "to stop reduction of biodiversity" and 16 targeted tasks are pointed. Parties and Governments are requested to provide timely and adequate support for its implementation. We consider the targeted task "b-v" especially important – to provide protection of 50% of most valuable regions from point of plants' biodiversity before 2010. Those regions have to be determined in accordance with criteria which includes endemism, diversity of species and/or originality of the habitats including relic ecosystems and, also taking into account the services provided by ecosystems.

In that way, in accordance with the Global Strategy for Plant Conservation countries that have signed the Convention on Biological Diversity had to reveal and provide protection of 50% of most important plant areas until 2010.

An Important Plant Area (IPA) is a natural or semi-natural site exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high botanic value. «Plantlife International» organization has worked out and offered three criteria for highlighting of the important plant areas (ANDERSON 2002).

Criterion A – The side holds significant populations of one or more species that are of global conservation concern.
Criterion B – The site has an exceptionally rich flora in relation to its biogeographic zone.
Criterion C – The site is an outstanding example of a habitat type of global plant conservation and botanical importance.

The work on highlighting of important plant areas in Armenia with presented criteria was started by ASATRYAN (2008) in 2003; however the lack of data on plants' distribution on the republic territory did not let her finalize the work.

Results

In the first stage the distribution of 123 local endemic Armenian plant species was analyzed (more than 900 localities recorded). 15 areas with high concentration have been found and identified as presumable Important Plant Areas. At the next stage similar work was done with 452 plant species that were classified by IUCN criteria (more than 6000 localities recorded) and are included in the new edition of the Red Book of Armenia (TAMANYAN et al. 2010). All habitats of species evaluated as CR, EN and VU (Critically Endangered, Endangered, Vulnerable) including endemics were spotted on the map of Armenia (Fig. 1). This gave more detailed picture for some of the previously found areas, allowing them to be divided into separate units, and 6 additional IPAs could be identified.

The such completed data allow to determine 29 important plant areas (IPA) in Armenia using A and B criteria in the definition of ANDERSON (2002): alpine parts of Aragats [1]

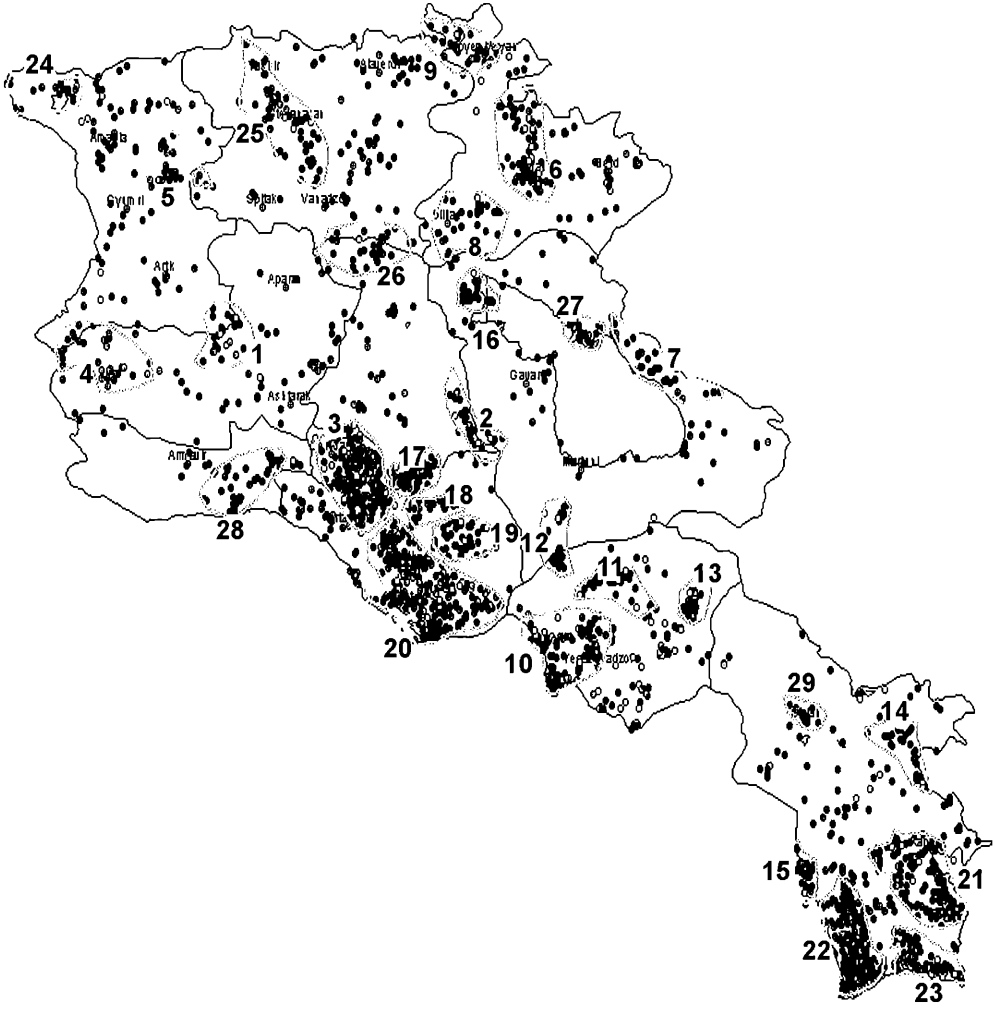

Fig. 1: Accumulation of locations of rare and endangered species of the flora of Armenia: alpine parts of Aragats [1] and Gegham [2] mountains, outskirts of Yerevan city including "Erebuni" reserve [3], outskirts of Arteni Mountain [4], Shirak mountain ridge in outskirts of Djadjur pass [5], Ijevan outskirts [6], Areguni mountain ridge [7], Sevan pass [8], Debed river basin from Vanadzor to Alaverdi [9], Vayk ridge from Areni to Gnishik, including Ayar gorge [10], Yeghegis river gorge [11], Selim pass outskirts [12], Jermuk outskirts [13], Goris outskirts [14], Zangezur range [15], outskirts of Sevan town [16], outskirts of Azat river valley [17], Yerah range [18], Goravan's sandy desert [19], and outskirts of Khor Virab monastery [20], Khustup mountain and "Shikahoh" reserve [21], the western part of Meghri region [22] and the eastern part of Meghri region [23]. Additional IPAs identified are: vicinity of Arpi lake [24], Lakes of Lori region [25], Bazum range [26], Ardanish peninsula [27], Armavir's solonchaks (salt body) [28] and outskirts of Sisian town [29].

and Gegham [2] mountains, outskirts of Yerevan city including "Erebuni" reserve [3], outskirts of Arteni Mountain [4], Shirak mountain ridge in outskirts of Djadjur pass [5], Ijevan outskirts [6], Areguni mountain ridge [7], Sevan pass [8], Debed river basin

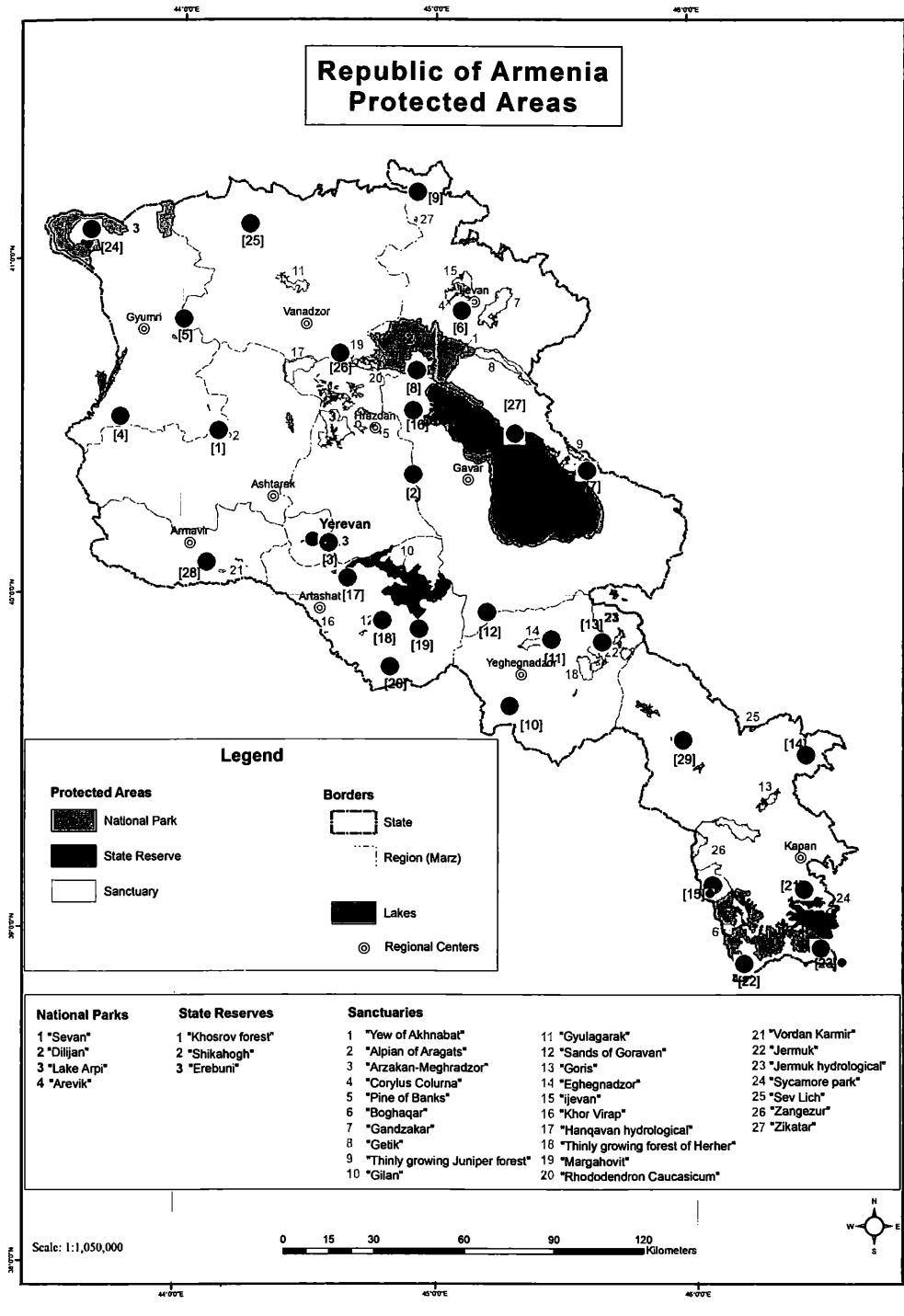

Fig. 2: Important Plant Areas (red dots) compared with the existing protected areas (Specially Protected Natural Areas) of Armenia.

from Vanadzor to Alaverdi [9], Vayk ridge from Areni to Gnishik, including Ayar gorge [10], Yeghegis river gorge [11], Selim pass outskirts [12], Jermuk outskirts [13], Goris outskirts [14], Zangezur range [15], outskirts of Sevan town [16], outskirts of Azat river valley [17], Yerah range [18], Goravan's sandy desert [19], and outskirts of Khor Virab monastery [20], Khustup mountain and "Shikahoh" reserve [21], the western part of Meghri region [22] and the eastern part of Meghri region [23], vicinity of Arpi lake [24], Lakes of Lori region [25], Bazum range [26], Ardanish peninsula [27], Armavir's solonchaks (salt body) [28] and outskirts of Sisian town [29] (Fig. 1).

To support these botanical results data on the distribution of invertebrates of the Red Book of Armenia and on endemic species of beetles were compared with the already identified IPAs. A significant overlap was revealed – more than 90% of endemic beetle species and other rare invertebrates are registered in IPAs. The known localities of only 11 species of invertebrates from the Red Book and 14 endemic beetle species are not in the defined IPAs. It is necessary to point out here that based on these additional data the most rich IPAs appeared to be number 3 – Yerevan outskirts including "Erebuni" reserve (32 species from the Red Book and 29 endemic beetles), 19 – Goravan's sandy desert (28 and 16 species respectively), 15 – Zangezur mountain ridge (36 and 22 species), 21 – Khustup mountain and "Shikahoh" reserve (11 and 21 species) and 23 – Eastern part of Meghri region (20 and 14 species).

In recent years Armenian Society for the Protection of Birds identified 18 Important Bird Areas in Armenia (http://www.aspbirds.org/list.php). Most of them are very similar to the Important Plant Areas, and confirm the importance of conservation of these territories.

Finally the resulting IPAs are compared with the existing system of protected areas (SPNAs). The 29 IPAs were spotted on the SPNAs map of Armenia (Fig. 2). The majority of those are in the territory of already existing SPNAs (natural monuments were not taken into account). However, it is necessary to mention that eight very important and valuable areas are still outside of SPNAs of Armenia: Shirak mountain ridge in the outskirts of Djadjur pass [5], relic lakes of Lori plateau [25], Alaverdi outskirts [9], Arteni mountain [4], alpine parts of Gegham mountain ridge [2], upper reaches of Argichi river and Selim pass [12], Azat river outskirts on Ararat valley [17] and Sisian town outskirts [29] on Syunik plateau. Another 11 highlighted areas are partly covered by reservates created for other purposes, not having the goal of conservation of the complete biodiversity. For instance it is obvious that there are not enough protected areas in the most vulnerable and already heavily transformed Ararat Valley (IPA 18 and 28).

Specially Protected Natural Areas of Armenia (SPNA)

A network of specially protected natural areas has started to be formed yet from the time of Soviet Union and included areas with different protection level such as reserves, reservates, national parks. The RA "Law on Specially Protected Nature Areas" (SPNA) adopted in 2006 included to the above mentioned one more: nature monuments. The SPNAs formed caused dissatisfaction from specialists (GABRIELYAN et al. 1990). Mainly forested territories were allotted and, as a result significant and very important part of the Republic ecosystems and biodiversity was not covered by the SPNA network. "Strategy on Developing Specially Protected Nature Areas of Armenia" was endorsed

in 2002, targeting significant increase of representation of the biodiversity on SPNAs. Currently SPNAs of Armenia are represented by four National Parks, three reserves and 25 reservates. Besides that the list of natural monuments is approved, fifteen out of them are biological objects. A number of natural reserves, reservates and national parks are at the stage of formation currently. It needs to be mentioned here that most of above mentioned SPNAs by their status and according to the RA "Law on Specially Protected Nature Areas" are not compliant with IUCN criteria. For example "Natural reserves" in the republic are not compliant with Ia IUCN category (Strict nature reserve), but rather fall under the category II – National Park since certain non-scientific activities are permitted in its territory. National Parks in Armenia rather fall under categories IV (Habitat\species management area) or V (Protected landscape) of IUCN. Reservates are more or less compliant to the category VI – Protected area with sustainable use of natural resources.

Discussion

Starting from 2006 implementation of the project on the Red List of Caucasus plants has begun in the Caucasus (CEPF, IUCN). During implementation the specialists of all Caucasus countries were verifying distribution and evaluating the threat of extinction of all Caucasian endemics.

In recent years an inventory of biodiversity was undertaken in all reserves, national parks and some reservates. As a result of this inventory, organized by Ministry of Nature protection of Republic of Armenia in 2004-2008, it was established that 75-80% of all vascular plant species and vertebrate and invertebrate animals of Armenia are met in those SPNAs, which is a very high value. On the other hand only 207 (46%) out of 452 species of vascular plants, 99 (64%) out of 154 species of vertebrates and 62 (39%) out of 157 invertebrates included in the new edition of the Red Book of Armenia (TAMANYAN et al. 2010, AGHASYAN & KALASHYAN 2010) are met in the territories of national parks and natural reserves. These numbers indicate that existing system of SPNAs is not sufficiently representative of ecosystems composition for preserving even the half of plants and invertebrate animals under categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) by IUCN classification.

The Republic of Armenia has ratified Bern convention in 2008. Comparing our results of Important Plant Areas with already existing SPNAs, it can be said that Armenia has fulfilled its obligation by the target task "b-v" of the Global Strategy for Plant Conservation. However this is the minimum task. For full-fledged conservation of all rare and endangered species of plants and invertebrates it is absolutely necessary to implement additional protected areas and change the protection regime in some existing SPNAs.

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