Identification of Important Plant Areas in Georgia (Caucasus Biodiversity Hotspot)

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INTRODUCTION

Georgia's plant cover:

Georgia occupies an interesting geobotanical position as a part of the Caucasus – the region which links Europe with Asia. The country is characterized by rather contrasting natural conditions that account for extremely high diversity of plant communities on a comparatively small area. The landscape of the country includes different types of desert and semi-desert vegetation mainly in the eastern parts of Georgia, luxuriant Colchic forests of moist, almost subtropical climate in the west, and high-mountain plant communities in the north and the south.
Considerable difference between the climates of East and West Georgia determined the diversity of their vegetal landscapes, as well as the altitudinal zonation.
The absence of arid and semi-arid vegetation zones is characteristic to West Georgia. It accounts for a more simple profile of altitudinal zonation here represented by 5 main zones: forest (0–1900 m), subalpine (1900–2500 m), alpine (2500–3100 m), subnival (3100–3600 m), nival (above 3600 m) zones.
In East Georgia, the altitudinal zonation is more complicated. One can observe 6 main zones here: desert, dry steppe and arid light forest (150–600 m), forest (600–1900 m), subalpine (1900–2500 m), alpine (2500–3000 m), subnival (3000–3500 m), and nival (above 3500 m) zones. The borderline between the semi-arid and forest zones varies considerably depending on climatic conditions and slope exposure. Within the forest and subalpine zones of South-Georgian upland there are small areas occupied by semi-arid ecosystems with prevalence of mountain-steppe vegetation [Nakhutsrishvili, 1999].
Georgia's flora numbers more than 4,100 species of vascular plants [Gagnidze, 2005], 254 of which are endemic to Georgia.

Ecoregional Conservation Plan for the Caucasus:

Biodiversity of the Caucasus is being lost at an alarming rate. The major threats to plant diversity in the Ecoregion are: illegal logging, fuelwood harvesting, and the timber trade; overgrazing; infrastructure development; and pollution of rivers and wetlands. These threats lead to habitat degradation, decline of species populations, and disruption of ecological processes – all contributing to the overall loss of biodiversity.
On a series of stakeholder workshops held from 2000-2003, combined with background reports and assessments coordinated by the WWF Caucasus Programme Office (WWF-Caucasus), Ecoregion Conservation Plan (ECP) was elaborated. More than 140 experts from the six countries participated in preparation of the Ecoregion Conservation Plan representing a variety of scientific, governmental, and non-governmental organizations. Existing conservation strategies and investment portfolios, such as those prepared with support from the MacArthur Foundation, the German Bank for Reconstruction and Development (KfW), and the Critical Ecosystem Partnership Fund (CEPF), were incorporated into this ECP.
The purpose of the ECP is to create a roadmap for conserving the rich biodiversity of the Caucasus Ecoregion. The ECP outlines a vision and long-term goals for biodiversity conservation in the Caucasus Ecoregion, which will be achieved through implementation of a concrete set of short- and medium-term actions.
According to the Ecoregional Conservation Plan for the Caucasus, four priority biomes – forest, freshwater, marine, and high mountains – will be the bio-geographical focus of conservation efforts, as these contain the bulk of biodiversity with the most pressing threats. Within these biomes, 56 Priority Conservation Areas (PCAs) were determined to help further focus conservation efforts [Williams et al., 2006].

Georgia's network of protected areas:

Georgia founded the first strict nature reserve in the Caucasus Ecoregion – the Lagodekhi Strict Nature Reserve – in 1912.
At present there are 14 Strict Nature Reserves, 8 National Parks, 12 Managed Nature Reserves, 14 Natural Monuments and 2 Protected Landscapes in Georgia. The total area of Protected Areas is 495 892 hectares, which is about 7 % of the country's territory.
About 75 % of Protected Areas are covered by forests [http://dps.gov.ge]

What are IPAs?

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.
Tree basic principles of IPA identification are:
Criterion A - The site holds significant populations of one or more species that are of global or regional conservation concern.
Criterion B - The site has an exceptionally rich flora in a regional context in relation to its biogeographic zone.
Criterion C - The site is an outstanding example of a habitat or vegetation type of global or regional plant conservation and botanical importance [Anderson, 2002].

IPAs in the Global Strategy for Plant Conservation:

"In their sixth meeting held in the Hague, Netherlands from 7 to 19 April 2002, the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) adopted the Global Strategy for Plant Conservation including 16 global targets for 2010. For the first time [it was made possible] to measure the aims of the CBD in preserving biodiversity ... against targets and [assess] the progress made in achieving them ..." [Anderson, 2002]
Pursuant to decision IX/35, the tenth meeting of the Conference of the Parties (COP 10) was held in Nagoya, Aichi Prefecture, Japan, from 18 to 29 October 2010. By the COP 10 Decision X/17, a Consolidated update of the Global Strategy for Plant Conservation 2011-2020 was adopted by the Parties.
The Strategy consists of the following five objectives: (a) Objective I: Plant diversity is well understood, documented and recognized; (b) Objective II: Plant diversity is urgently and effectively conserved; (c) Objective III: Plant diversity is used in a sustainable and equitable manner; (d) Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on Earth is promoted; (e)Objective V: The capacities and public engagement necessary to implement the Strategy have been developed.
Target 5 of this strategy calls for the protection of 75% of the most important areas for plant diversity by 2020 [http://www.cbd.int/decision/cop/?id=12283].

IPAs in the Plant Conservation Strategy for the Caucasus:

The project Coordination and Development of Plant Red list Assessments for the Caucasus Biodiversity Hotspot was implemented by IUCN in collaboration with Missouri Botanical Garden, USA, WWF Caucasus Programme Office, and botanists from six countries of the Caucasus (Armenia, Azerbaijan, Georgia, Russia, Turkey and Iran) with financial support from CEPF in 2006-2009. The project aimed to provide a series of Red List training and validation workshops specifically tailored to the Caucasus region so that local botanists could use internationally accepted methods for plant conservation assessment and monitoring - IUCN Red List Categories and Criteria - and the Species Information Service (SIS) as tools for data management and analysis. The work has resulted in a comprehensive overview of the distribution and conservation status of the endemic plant species of the Caucasus region based on current knowledge: a comprehensive list of Caucasus endemic plant taxa (ca. 2,750 species/subspecies) and Red List assessments of ca. 1,200 taxa, of which ca. 60% were assessed as threatened. The final product of the project "The Red List of Endemic Plants of the Caucasus Region" is planned to be issued in 2011; the assessment will also be published on the IUCN Red List web-site.
The Caucasus Plant Red List Authority was established at the IUCN Species Survival Commission within the framework of the above project and the Red List workshops introduced participants to the IUCN Red List process and highlighted the use of assessments for conservation planning and the development of a regional Plant Conservation Strategy. Targets listed in the draft of the Plant Conservation Strategy for the Caucasus correspond to the targets of the Global Strategy for Plant Conservation. CEPF has been solicited for support of publication in 2011 of the Strategy, to be titled the "Caucasus Plant Conservation Initiative". The Strategy calls for identification of Important Plant Areas to be completed by 2012.

DATA

Red List assessments of Georgia's endemic plant species from the above mentioned project were used to undertake first steps in identification of IPAs in Georgia. Of the c. 255 species / subspecies of vascular plants considered endemic to Georgia, 152 (ca. 60%) were assessed as threatened (Assessors: R. Gagnidze, Sh. Shetekauri, Z. Manvelidze; Evaluators: G. Nakhutsrishvili, K. Batsatsashvili) [see Fig.1, 2]. Taxonomically problematic species accepted and considered as endemics of Georgia by Gagnidze [2005] assessed as Data Deficient were nevertheless considered in the present IPA identification process, when available data on distribution and threats allowed for their provisional qualification for threatened categories (except apomictic taxa).
TB, TBI, TGM Herbaria and Flora of Georgia [Ketkhoveli et al., 1975-2009] were consulted for occurrence data of the target taxa.

METHODOLOGY

The work was based on the principles of IPA identification described in the Guide to Implementing Target 5 of the Global Strategy for Plant Conservation: Identifying and Protecting the World's Most Important Plant Areas by Plantlife International [2004], and taking into account the recommendations by Anderson [2002].
The available data allowed usage of the Criterion A for identification of priority areas to target plant conservation at a site based level by locating subpopulations of the most threatened plant species.
The data set was analysed using DIVA-GIS [http://diva-gis.org]. The grid-based diversity mapping method in DIVA-GIS was used to locate the areas with the greatest number of the target species, and Rebelo's [1994] complementarity algorithm to select the least number of grid cells to capture all species. The grid cell size used was 10 x 10 km.

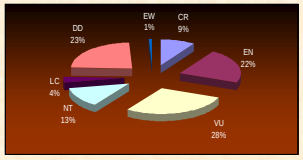
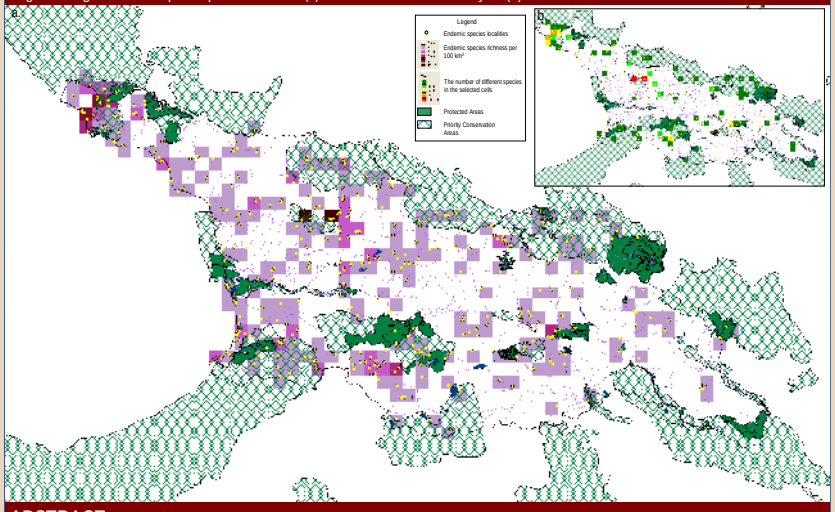


Fig. 1. Red List assessments of Georgia's endemic plant species.

Fig. 2. a. Amygdalus georgica Desf. – VU; b. Iris winogradowii Fomin – CR; c. Gymnospermium smirnowii (Trautv.) Takht. – EN; d. Paeonia steveniana Kem.-Nath. – EN; e. Hibiscus ponticus Rupr. – EN; f. Heracleum wilhelmsi Fisch. & Ave-Lall. – EN. © Otar Abdaladze.

Fig. 3. Georgia's endemic plant species richness (a) and reserve selection analysis (b)



ABSTRACT

Georgia is a part of the Caucasus Biodiversity Hotspot. Its flora of vascular plants numbers approximately 4100 species, of which c. 255 are endemic to Georgia. Ca. 60% of Georgia's endemic plant species are qualified for the threatened categories (CR, EN, VU) according to the species conservation status evaluation system elaborated by IUCN – The World Conservation Union.
Data on Georgia's endemics were used for preliminary identification of important Plant Areas (IPAs) as a basis for establishment of new protected areas in the country.
Up to 20% of Georgia's endemic plant species are calciphilous lithophytes occurring on limestone mountain ridges that are stretched almost parallel to the Main Watershed Range of the Greater Caucasus in Colchis, West Georgia, also occur in Lesser Caucasus system and in a form of patches on the Greater Caucasus in East Georgia. Approximately 80% of the endemics confined to limestone rock and scree habitats are assessed as threatened (by overgrazing, infrastructure development, tourism and recreation, global climate change). GIS analysis of the distribution of the endemic calciphytes has made it possible to preliminarily identify IPAs on Georgia's limestone ridges (criterion A for identification of IPAs) that will help in establishment of borders of new protected areas, for instance, those in Racha and Svaneti, planned according to Ecoregional Conservation Plan for the Caucasus by L. Williams et al. (2006).
IPA identification process will continue to include more widespread endemics of the Caucasus as well as non-endemic species threatened at the regional level.

RESULTS & DISCUSSION

Richness

Fig. 3 presents the threatened plant species richness map. We used the 10 x 10 km grid highlighted in different colours to show the richness.
The "hotspots" (high richness values) are mainly found on the limestone ridges of the Greater Caucasus in Abkhazeti, Samegrelo, Racha-Lechkhumi (9-14 species per grid cell); there are relatively species-rich plots on the limestone habitats of the Lesser Caucasus in Trialeti (7-8 species in a grid-cell). Another "hotspot" is found on semi-arid areas of Tbilisi surroundings (Mtskheta vicinity) (7-8 species in a grid cell).
Up to 20% of Georgia's endemic plant species are calciphilous lithophytes occurring on limestone mountain ridges (Gagra, Bzipi, Egrisi, Askhi, Okriba, Khvamli, Racha ridges to Rikoti pass) that are stretched almost parallel to the Main Watershed Range of the Greater Caucasus in Colchis, West Georgia, also occur in Lesser Caucasus system and in a form of patches on the Greater Caucasus in East Georgia (Kakheti, Meskheti, Djavakheti, Trialeti) [Maruashvili, 1970]. Approximately 80% of the endemics confined to limestone rock and scree habitats are assessed as threatened (by overgrazing, infrastructure development, tourism and recreation, global climate change) [Williams et al.,2006].
C. 40% of the threatened endemics considered in the IPA identification process are confined to limestone habitats.
Analysis of the threatened endemic species richness performed using DIVA-GIS will help in delimitation of new protected areas, for instance, those in Racha,Svaneti, and Samegrelo identified as Priority Conservation Areas planned according to Ecoregional Conservation Plan for the Caucasus [Williams et al., 2006] and already planned to be established by the Ministry of Environment Protection and Natural Resources of Georgia.
The areas with high values of the threatened endemic species richness partly overlap with existing (Tbilisi National Park) or planned (Samegrelo Protected Areas) Protected Areas. The question needs more thorough analysis.

Reserve Selection

Explicit, quantitative procedures for identifying biodiversity priority areas are replacing the often ad hoc procedures used in the past to design networks of reserves to conserve biodiversity. This change facilitates more informed choices by policy makers, and thereby makes possible greater satisfaction of conservation goals with increased efficiency. A key feature of these procedures is the use of the principle of complementarity, which ensures that areas chosen for inclusion in a reserve network complement those already selected. [Justus, Sarkar, 2002].
Complementarity analysis is based on the algorithm described by Rebelo [1994] and Rebelo & Sigfried [1992]. The aim was to identify grid cells with defined size, which complement each other in terms of species composition. The process is iterative, whereby the first cell is the richest in number of species. The second iteration locates a grid cell that is richest in species not already represented in the first iteration. This iterative process continues until all species have been represented. [Smidt et al., 2007].
Thus, complementarity analysis investigates the minimum areas for nature reserve selection by protecting maximum number of species [Chen, Bi, 2007].
Based on this algorithm we obtained 68 optimal grid cells for representing 152 target species.

Further works

IPA identification in Georgia is an on-going process that will continue to include more widespread endemics of the Caucasus as well as non-endemic species threatened at the regional level.
Besides, more thorough analysis to predict species distributions using occurrence records in museums and herbaria as well as on-site investigations of recorded localities, where possible, to correctly geo-reference subpopulations is necessary for proper delimitation of pre-selected IPAs [e.g., Elith et al., 2006].
Additional extensive work in needed to identify indicator species and assess their richness throughout each habitat type (Criterion B) and define threatened habitats (Criterion C) for comprehensive IPA selection process.
At the same time the degree of threat and the need for protection of each pre-selected IPA should be taken into account; consideration should be given to identifying IPAs on sites that contain several features of the IPA national list of Criteria A, B, C species and habitats in one place, in order to focus conservation action; etc. [Anderson, 2002].

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REFERENCES

Anderson, S. Identifying Important Plant Areas. Plantlife International. 2002.
Chen, Y., Bi, J. Biogeography and hotspots of amphibian species of China: Implications to reserve selection and conservation. Current Science 92(4): 480-489, 2007.
Elith, J., Graham, C. H., Anderson, R. P., Dudı´k, M., Ferrier, S., Guisan, A., Hijmans, R. J., Huettmann, F., Leathwick, J. R., Lehmann, A., Li, J., Lohmann, L. G., Loiselle, B. A., Manion, G., Moritz, C., Nakamura, M., Nakazawa, Y., Overton, J. McC., Peterson, A. T., Phillips, S. J., Richardson, K. S., Scachetti-Pereira, R., Schapire, R. E., Sobero´n, J., Williams, S., Wisz, M. S. and Zimmermann, N. E. Novel methods improve prediction of species' distributions from occurrence data. Ecography 29: 129/151, 2006.
Gagnidze, R. Vascular plants of Georgia. A nomenclatural checklist. Tbilisi. 2005.
Identifying and protecting the world's most important plant areas. 2004. PLANTLIFE INTERNATIONAL. www.plantlife.org.uk
Justus, J., Sarkar, S. The principle of complementarity in the design of reserve networks to conserve biodiversity: a preliminary history. J. Biosci. (Suppl. 2) 27: 421–435, 2002.
Ketskoveli, N., Kharadze, A.., Gagnidze, R. (Eds.)., Flora of Georgia.1-15. Metsniereba, Tbilisi. 1971-2005. (in Georg.)
Maruashvili, L. Physical Geography of Georgia. P. 2. Tbilisi. 1970.
Nakhutsrishvili, G. Vegetation of Georgia. Braun-Blanquetia. Camerino, Italy. 1999.
Smidt, E. C., Silva-Pereira, V., Borba, E. L. & van Den Berg C. Richness, distribution and important areas to preserve Bulbophyllum in the Neotropics. Lankesriana 7(1-2): 107-113, 2007.
Williams, N. Zazanashvili, G. Sanadiradze and A. Kandaurov (Eds.). Ecoregional Conservation Plan for the Caucasus. WWF, KfW, BMZ, CEPF, MacArthur Foundation. Tbilisi, 2006. Printed by Signar Ltd. 220 p.; can be downloaded from http://assets.panda.org/downloads/ecp__second_edition.pdf