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Colchic and Hyrcanian forests of the Caucasus: similarities, differences and conservation status

Abstract

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Along with high degree of vascular plant endemism (more than 25%) the existence of two refugia of the Tertiary flora – Colchic and Hyrcanian – are the most unique features of the Caucasus ecoregion. Likewise, Colchic and Hyrcanian forests are classified as temperate rainforests. There are certain physical-geographical and biological similarities and even more differences between Colchic and Hyrcanian regions, reflected on compositions of flora, types of vegetation zonation, as well as spectrums of vegetation formations. An “individualities” of these two unique nature phenomena define the necessity of their equal and effective conservation. Currently, the Colchic forests are better protected: almost half a million hectares, or 16.5% of Colchic region, is covered by protected areas, but there are still some evident gaps to be filled with regard to improve spatial structure of protected areas system and properly cover the most vulnerable ecosystems. More problematic situation is observed in case of Hyrcanian forests, particularly in Iranian part: lack of high categories of protected areas (IUCN categories I-IV), in terms of both number and territory, is the main obstacle for development of protected areas system in Hyrcanian region.

Key words: Colchis, Hyrkan, Caucasus, forests, conservation.

Introduction

The Caucasus ecoregion, which historically is interpreted as the isthmus between the Black and the Caspian seas, covers a total area of some 580,000 km² that extends over the nations of Armenia, Azerbaijan and Georgia, the North Caucasus portion of the Russian Federation, the north-eastern part of Turkey, and a part of north-western Iran (Williams & al. 2006). One of the most biologically rich regions on Earth, especially in the temperate context, the Caucasus ranked among the planet's 34 most diverse and endangered Biodiversity Hotspots (another temperate Hotspots included in the list is the Mediterranean) (Mittermeier & al. 2004).

Along with high degree of vascular plant endemism (more than 25%) the existence of two refugia of the Tertiary flora – Colchic and Hyrcanian – are the most unique features of the Caucasus ecoregion. Likewise, Colchic and Hyrcanian forests are classified as temperate rainforests (Nakhutsrishvili & al. 2011). Consideration of Colchic and Hyrcanian forests as subtropical (Rikli 1943; Gulisashvili & al. 1975) does not have enough justification. Colchic and Hyrcanian rainforests cannot be considered subtropical climatically or structurally in terms of plant communities: first of all, air temperature (especially in winter) is lower and there are no broad-leaf evergreen forests as in subtropical regions.

In this article, we discuss biophysical and biological similarities and differences between these two most diverse forest refugia in the Western Eurasia (Dolukhanov 1980), as well as status of their conservation.

Location and physical-geographic characteristics

The Colchic region, which took shape mainly from the end of the Middle Sarmatian, i.e. 11-12 million years ago (Kolakovskiy 1961; Shatilova & al. 2011), is located in the catchment basin of the Black Sea. Most scientists incline to consider Upper Miocene as the formation time of Hyrcanian region too (Safarov 1979). It is located at the extreme south-eastern end of the Caucasus, covering the eastern slopes of the Talysh Mountains and northern slopes of the Alborz Mountains at the southern coastal area of the Caspian Sea. The Hyrcanian biogeographic region goes beyond Caucasus borders: distribution of components of Central Asiatic flora and vegetation in the eastern part of this region is already substantial, but for purpose of this article we show whole south Caspian/Hyrcanian forest area (Fig. 1). The total area of all forests of the Colchic region, estimated by the GIS unit of WWF Caucasus using Google images, is ~ 3 million hectares, whereas the total estimated area of Hyrcanian rainforests, which covers all types of forests of Talysh and Alborz mountains, is around 1.96 million hectares.

As it was already mentioned, these unique forests can mostly be classified as temperate rainforests due to the same reasons as for other temperate rainforest regions: relevant slopes of barrier-mountains located along coastlines that trap a large portion of the humidity from oceanic/sea air masses. In the Caucasus, these barriers are formed by a topographical triangle created by the intersection of the western part of the Greater Caucasus Mountain Range (Georgia, Russia), western part of the Lesser Caucasus Mountain Chain (Turkey and Georgia) and Likhi ridge (bridge ridge between Greater and Lesser Caucasus, Georgia) at the Black Sea; and by the Talysh-Alborz Mountain Range at the southern-south-western coast of the Caspian (Iran and Azerbaijan). Montane barriers also contribute to a warm and humid climate that has been present since the late Tertiary and is the primary reason that the Caucasus has acted as a shelter for hygro-thermophilous (Doluchanov & Nachuerišvili 2003) relicts during the Quaternary ice ages. Consequently, Colchic and Hyrcanian forests are the oldest forests in Western Eurasia in terms of their origin and evolutionary history, the most diverse in terms of relict and endemic woody species and tree diversity, and the most natural in terms of transformation of historic structure (Ministry of Ecology and Natural Resources of Azerbaijan & Iranian Cultural Heritage-Handicrafts and Tourism Organization 2009).



Fig. 1. Location of Colchic and Hyrcanian forest areas.

In addition to a common barrier effect, there are other biophysical similarities: in both areas, yellow soils are distributed (in Colchis – red soils too) in submontane zone up to 500-600 m above sea level, which together with high annual precipitation (in average 1200-1400 mm in Hyrcanian and 1800-2000 in Colchic) and warm climate (mean annual air temperature at the sea level in both regions is around +14oC) create convenient conditions for cultivation of some subtropical crops (tea, mandarin, lemon, orange, grapefruit, kiwi, and some others).

Differences are even more apparent between both areas: Colchic area, which is generally located further north than Hyrcan, is much more humid (with maximum mean annual precipitation >4500 mm, when maximum for Hyrcan is around 2200 mm); apart from this, precipitation in Colchis is more or less equally distributed during a year/seasons, whereas summer minimum is recorded in Hyrcan. There is also significant difference in altitudinal distribution of precipitation: in Hyrcanian area with increasing of altitude not only temperature is decreased, but also precipitation, in average on 80 mm/100 m. This is why typical Hyrcanian forests are concentrated within boundaries of high precipitation area, i.e. up to 500-600 m. Relict Hyrcanian vegetation still occurs up to 1000 m, but above these altitudinal limits it is changed by common Caucasian type of beech forest (*Fagus orientalis*), and then by dry *Quercus macranthera* woodlands and/or different types of steppes at the timberline and in subalpine zone: mean annual precipitation above 1800-2000 m is decreased to 300-400 mm (Safarov 1979).

Opposite to Hyrcan type of mountain zoning, precipitation with increasing of altitude does not decrease in Colchic area, and Colchic type of forest occurs along whole altitudinal profile of vegetation formations including lower subalpine belt up to 2200 m (Dolukhanov 1980; Nakhutsrishvili 2013; Zazanashvili 1999).

Table 1. Comparison of vegetation zones.

Altitude (m above sea level)	Main vegetation formations	
	Colchis	Hyrcan
0-1000	(a) Mixed broad-leaved forests with <i>Quercus hartwissiana</i> , <i>Q. imeretina</i> , <i>Castanea sativa</i> , <i>Fagus orientalis</i> , <i>Zelkova carpinifolia</i> , <i>Alnus barbata</i> , <i>Carpinus caucasica</i> (= <i>C.betulus</i>) (b) Chestnut and beech-chestnut forests (<i>Castanea sativa</i> , <i>Fagus orientalis</i>)	(a) Mixed broad-leaved, mostly oak-irontree, irontree-hornbeam-oak, oak-azad/oak-hornbeam-azad (<i>Quercus castaneifolia</i> , <i>Parrotia persica</i> , <i>Carpinus caucasica</i> (= <i>C.betulus</i>), <i>Zelkova carpinifolia</i> , <i>Albizzia julibrissin</i>) (b) Oak forests (<i>Quercus castaneifolia</i>) (c) beech/beech-hornbeam forests (<i>Fagus orientalis</i> , <i>Carpinus caucasica</i> = <i>C.betulus</i>)
1000-1500	(a) Beech forests (<i>Fagus orientalis</i>) (b) Spruce-fir forests (<i>Abies nordmanniana</i> , <i>Picea orientalis</i>)	(a) Beech forests (<i>Fagus orientalis</i>)
1500-2000	(a) Spruce-fir forests (<i>Abies nordmanniana</i> , <i>Picea orientalis</i>) (b) Beech forests (<i>Fagus orientalis</i>) (c) Beech (<i>Fagus orientalis</i>), oak (<i>Quercus pontica</i>) and birch (<i>Betula medwedewii</i> , <i>B. litwinowii</i>) krummholz	(a) Steppes (b) <i>Quercus macranthera</i> (c) <i>Fagus orientalis</i>
2000-2500	(a) Birch/ash-birch (<i>Betula litwinowii</i> , <i>Sorbus aucuparia</i> = <i>S.caucasigena</i>) krummholz (b) <i>Rhododendron caucasicum</i> thickets (c) Subalpine meadows	(a) Steppes (b) <i>Quercus macranthera</i> woodlands

Vegetation and flora

There are even more differences than similarities in structure and composition of flora and vegetation. When comparing spectrums of main vegetation formations of these two refugia, only *Fagus orientalis* forest is clearly common (Table 1).

Main physiognomic difference creates wide distribution of evergreen, among them, broad-leaf species (mostly sub-prostrate shrubs) in Colchic forests and particularly within understory: relict species such as *Rhododendron ponticum*, *Rh. ungerii*, *Rh. smirnowii*, *Laurocerasus officinalis*, *Ilex colchica* often form high (up to 4 m), dense underwood. Evergreens also create separate communities outside forest canopy. Meanwhile, participation of evergreens generally, and particularly broad-leaved evergreen species in Hyrcanian forest, is insignificant. Apart from this, there are limited areas occupied by dark conifers and no “Krummholtz” formations due to probably lack of precipitation in higher altitudes.

Also, flora of Colchic and Hyrcanian forests quite differs. In table 2, principal differential woody species of these two refugia are included.

Common woody relicts include: *Alnus barbata*, *Zelkova carpinifolia*, *Pterocarya fraxinifolia*, *Diospyros lotus*, *Vaccinium arctostaphylos*, *Laurocerasus officinalis*, *Daphne pontica*, *Arachne colchica*, *Hypericum androsaemum*, *H. inodorum*, *Philadelphus caucasicus*; taxonomically very close species are *Buxus colchicus* and *B. hyrcana*, *Ruscus colchicus* and *R. hyrcanus*, *Ilex colchica* and *I. hyrcana*. In addition, following widespread Caucasian species are common: *Fagus orientalis*, *Quercus iberica*, *Carpinus caucasica* (*C. betulus*), etc.

Tab. 2. Principal differential woody species of Colchic and Hyrcanian regions.

Life form	Principal differential woody species	
	Colchis	Hyrcan
Trees	<i>Abies nordmanniana</i> , <i>Quercus hartwissiana</i> , <i>Q. imeretina</i> , <i>Q. pontica</i> , <i>Betula medwedewii</i> , <i>Sorbus subfusca</i> , <i>Castanea sativa</i> , <i>Staphylea colchica</i>	<i>Quercus castaneifolia</i> , <i>Parrotia persica</i> , <i>Albizzia julibrissin</i> , <i>Gleditcia caspica</i> , <i>Acer velutinum</i> , <i>A. insigne</i> , <i>Alnus subcordata</i>
shrubs	<i>Rhamnus imeretina</i> , <i>Corylus colchica</i> , <i>Daphne alboviana</i> , <i>Rhododendron ponticum</i> , <i>Rh. ungerii</i> , <i>Rh. smirnowii</i> , <i>Rh. caucasicum</i> , <i>Epigaea gaultherioides</i> , <i>Viburnum orientale</i>	<i>Danae racemosa</i>
Lianas	<i>Hedera colchica</i> , <i>Dioscorea caucasica</i>	<i>Hedera pastuchovii</i>

We will not discuss further reasons of differences between Colchic and Hyrcanian regions, as the above mentioned ones depict the “individualities” of these two unique nature phenomena in order to underline the necessity of their equal and effective conservation.

Conservation

The first protected areas in Colchic region were established mostly in 50th of the last century. At present, there are: 9 Strict Nature Reserves (Georgia: Kintrishi, Kobuleti, Sataplia, Adjameri, Pskhu-Gumista, Pitsunda-Myusera, Ritsa; Turkey: Djamili-Efeler, Djamili-Gorgit, Orumcek Forest, Turkey), 7 National Parks (Russia: Sochinsky; Georgia: Kolkheti, Mtirala, Machakhela, part of Borjomi-Kharagauli; Turkey: Kachkar Mountains, Hatila Valley, Altindere Valley) and 1 Biosphere Reserve (Djamili, Turkey). By country, they equal to 208,455 ha in Georgia, 99,691 ha in Turkey and 190,000 ha in Russia.

Thus, almost half a million hectares, or 16.5% of Colchic region, is covered by protected areas, which is considerable figure. Protected areas include representative territories of almost all Colchic ecosystems, except submontane polydominat forests (up to 500-600 m), which are largely replaced by settlements and agricultural lands, and high mountains. It is obvious the need for additional conservation of remnant submontane forest areas and high mountain ecosystems, especially timberline crumholtz forests of relict and Colchic endemic species, such as *Quercus pontica* and *Betula medwedewii*. There are also some evident spatial gaps: (1) there are no protected areas in Racha and Samegrelo regions of Georgia, i.e. in limestone part of south-western slope of the Greater Caucasus mountain range, extremely rich in endemic species; (2) insufficient coverage is observed in quite large area, south-west from city Trabzon/Altindere Valley National Park in Turkey. Filling in these gaps will contribute to creation of future Colchic ecological network of protected areas.

Much more problematic situation is observed in case of Hyrcanian forests: forest decline has been dramatic over nearly five decades of logging and other uses. For instance, in 1963, the Hyrcanian forests of Iran totaled some 3 million ha, but nowadays roughly 1.8 million ha remain, which means a drop of over 40% (Ministry of Ecology and Natural Resources of Azerbaijan & Iranian Cultural Heritage-Handicrafts and Tourism Organization 2009). There is still lack of high categories of protected areas (IUCN categories I-IV) in Iranian part. In Azerbaijan's part of Tallish Mountains, although Hyrcan National Park and Sanctuary cover around 40,000 ha or 37% of Azerbaijan's Tallish forests, Azerbaijan's part of Hyrcanian region itself is 108,000 ha or just 5.5% of total area of Hyrcan.

In conclusion, development of conservation activities in both refugia, and especially in Hyrcanian one, is evident, which requires urgent attention from governments and conservation organizations to guarantee the survival of these unique forests.

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