

Recent shifts in vegetation boundaries of deciduous forests,
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On the Colchic vegetation

Nugzar ZAZANASHVILI
Institute of Botany, Georgian Academy of Sciences
Tbilissi 380007, Georgia

Abstract

This paper is a short review of Colchic vegetation which is very rich in relics and endemics. The general distribution and contemporary ecological conditions of the vegetation are presented, with emphasis on evergreen Colchic relics. Apart from this summarised data for natural and introduced vegetation the relation to the global climatic change is given. The present conservation activities as well as perspectives to preserve this unique vegetation are discussed in the light of establishing a new system of protected areas in Georgia.

Introduction

Colchheti (Colkhida) is one of the historical-geographical provinces of the Caucasus, surrounded by the Great Caucasus and Small Caucasus range systems and belonging to the Black Sea catchment basin (western Transcaucasus). This region is one of the shelters for tertiary flora relics in western Eurasia. Here a lot of representatives of evergreen and deciduous relics are spread, which often determine phytosociological and spatial structures of contemporary plant communities. Prostrate and half-prostrate species define the uniqueness of this region. Since they have active vegetative reproduction ability, in most cases they also define dynamics of plant communities. The following species are typical examples: *Quercus pontica*, *Betula medwedewii*, *B. megrelica*, *Rhamnus imeretina*, *Corylus colchica*, *Sorbus subfusca*, *Vaccinium arctostaphylos*, *Viburnum orientale*, *Rhododendron luteum*; evergreens - *Rh. ponticum*, *Rh. ungerii*, *Rh. smirnowii*, *Rh. caucasicum*, *Laurocerasus officinalis*, *Ilex colchica*, *Ruscus colchicus*. Besides those many other evergreen and deciduous relic trees, shrubs, grasses and lianas occur (*Quercus hartwissiana*, *Q. imeretina*, *Buxus colchica*, *Staphylea colchica*, *Philadelphus caucasicus*, *Hypericum inodorum*, *Daphne pontica*,

D.alboviana, *Hedera colchica*, *Primula magaseifolia*, etc.). We have to point out five half-prostrate evergreen widespread species.

Physical-geographical factors of the Colkhetti region

Relief

Colkhetti borders are given by the Black Sea in the west and the Great Caucasus ranges system (in this part the highest peak is Shkhara - 5068m) in the North. The Small Caucasus ranges (Mepistskaro - 2850m) in the South and the Likhi low range, located between Great and Small Caucasus, building the eastern boundary. In the central part of the region Colketi lowland is situated. Here, due to the high soil moisture, Colkhic relic species are rare. In the relief of the Great Caucasus predominate tectonic-erosions, karst and glacial forms, on the Small Caucasus tectonic-erosions and volcanic forms.

Representatives of the Colkhic evergreen flora are distributed from sea level to the timberline - 2200-2300m a.s.l. (see Table 1), with exception of *Rhododendron caucasicum*, which is spread from 2000 to 2800-2900 (3000)m a.s.l. In most cases these species spread in valleys open for humid air masses, mainly on the shadowy slopes. *Rhododendron ponticum* and *Rh. caucasicum* grow mainly on the northern slopes, *Rh. ungeronii* prefers less shadowy slopes, *Laurocerasus officinalis* southern slopes and *Ilex colchica* the prominent elements of the relief.

Geology

The greatest part of the Colkhettian section of the Great Caucasus is structured from Jurassic slates and sandstone, Cretaceous limestone, marls, sandstone and Paleozoic granites. On the Small Caucasus Eocene volcanic bed-rocks (mainly andesites), Paleocene-Low Eocene clays, marls and sandstone (flysch) are most frequent. *Rhododendron ponticum* (and *Quercus pontica*) avoid calcareous biotops; at the same time, under relevant climate conditions, on limestone its competitor *Laurocerasus officinalis* is promoted (from Colkhic relics clearly distinguished calciphile plant is *Corylus colchica*).

Climate

Colkhetti is the most humid region in the Caucasus. The annual precipitation falls rarely short of amount to 1000mm, on the greatest part of the Colkhetti area it amounts to 1500-2500mm with a maximum of over 4000mm, which is characteristic for the middle mountains of the southern Colkhetti seaside. Besides, the distribution of precipitation throughout the year is mostly equal. In some areas on the plains autumn maxima and summer minima occur. In the mountains an intense precipitation is a necessary condition for evergreen Colkhic relics to survive the winter successfully. On an altitude of 1000-2200m

a.s.l. the snow cover lasts 90-196 days (Kordzakhia 1961). Among evergreen Colchic species the most in need for humidity is *Rhododendron urgernii* (see Table 1). In places where the annual precipitation drops below 1200mm Colchic evergreen relics rarely develop.

The annual air temperature in the plains varies between 12 and 14°C. The altitudinal thermal gradient is in the limits of 0,5-0,6°C/100m.

Soils

The greatest part of the soils is represented by alluvial soils, yellow, yellow-podzolic, red earth (up to 500-600m a.s.l.), rendzina, forest brown, mountain meadow soils and andosols (the availability of trailing-shrubs *Rhododendron caucasicum* is responsible for developing mountain peat soils). Colchic evergreen species are spread on all these soil types. The soil pH and moisture are of greater importance for plants, which avoid wet as well as dry soils.

Natural vegetation and its contemporary ecological condition

Figure 1 shows the distribution of natural vegetation in Colkhetti. *Alnus barbata* forests are spread in the coastal part of the Colkhetti lowlands. Nowadays only their separate groves are still remaining in the extreme western part of the Colkhetti lowlands in wet and damp biotopes, wetlands, etc. The riverside forests with *Pterocarya pterocarpa* and some other types of alder forests have disappeared. Evergreen underwood is not characteristic for lowlands alder forests, its representatives rarely occur here.

Mixed broad-leaved forests are characteristic for foothills (up to 500-600m a.s.l.) with dominant endemic relics like *Quercus imeretina*, *Zelkova carpinifolia* (northern Colkhetti), *Quercus hartwissiana*, as well as *Carpinus caucasica*, *Castanea sativa*, *Fagus orientalis*, *Tilia caucasica*, *Fraxinus excelsior*, in moist biotopes - *Alnus barbata*, etc., a second layer is represented by *Staphylea colchica*, *S. pinnata*, *Buxus colchicus*, etc. For such forests the existence of Colchic underwood (*Rhododendron ponticum*, *Rh. luteum*, *Laurocerasus officinalis*, *Ruscus colchicus*, *Ilex colchica*, *Vaccinium arctostaphylos*) and the diversity of lianas is typical. These wonderful and unique forests were damaged by human impact. In the lowlands they are totally destroyed (except *Quercus imeretina* grove in the Ajameti reserve). They are also damaged on foothills and protected only in the Bichvinta-Mjusera reserve in north-western Colkhetti (Abkhazia).

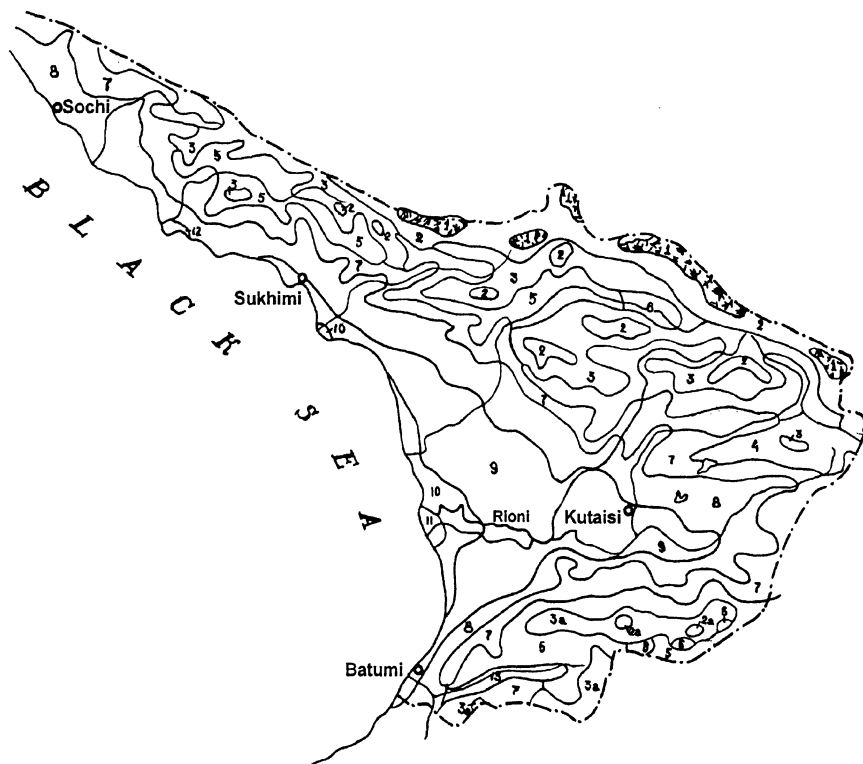


Figure 1: Map of natural vegetation of Colchheti, sc.1:2 500 000

1. Subnival open vegetation (*Primula bayernii*, *Cerastium undilatifolium*, etc.).
2. North Colkhetian alpine grasslands (*Geranium gymnocaulon*, *Festuca djimilensis*, *Woronowia speciosa*, *Carex pontica*, etc.), mats (*Sibbaldia semiglabra*, *Ranunculus brachylobus*, etc.) and *Rhododendron caucasicum* communities.
- 2a. South Colkhetian alpine grasslands (*Carex tristis*, *Agrostis lazica*, *Festuca ovina*, etc.), mats (*Campanula tridentata*, *Gentiana pontica*, etc.) and *Rhododendron caucasicum* communities.
3. North Colkhetian subalpine crooked-stem forests and woodlands (*Fagus orientalis*, *Acer trautvetteri*, *Betula litwinowii*, partly *B. megrelica*, *Quercus pontica*), shrub communities (*Rhododendron caucasicum*, *Rh. ponticum*, *Laurocarasus officinalis*, *Rhamnus imeretina*, *Corylus colchica*, etc.), tall herbaceous vegetation (*Heracleum ponticum*, *H. aconitifolium*, etc.) and grasslands (*Poa iberica*, *Calamagrostis arundinacea*, etc.). *planifolia*, *Geranium platypetalum*, etc.).
- 3a. South Colkhetian subalpine crooked-stem forests and woodlands (*Fagus orientalis*, *Acer trautvetteri*, *Betula litwinowii*, *B. medwedewii*, *Quercus*

- pontica*), shrub communities (*Rhododendron caucasicum*, *Rh. ponticum*, *Rh. ungerii*, *Laurocerasus officinalis*, etc.), tall herbaceous vegetation (*Ligusticum alatum*, *Milium schmidtianum*, etc.) and grasslands (*Agrostis planifolia*, *Geranium platypetalum*, etc.).
4. Fir, spruce-fir and beech-fir forests (*Abies nordmanniana*, *Picea orientalis*, *Fagus orientalis*).
 5. Fir, spruce-fir and beech-fir forests (*Abies nordmanniana*, *Picea orientalis*, *Fagus orientalis*) often with evergreen underwood (*Rhododendron ponticum*, *Laurocerasus officinalis*, *Ilex colchica*).
 6. Pine forests (*Pinus kochiana*) alternating with crooked-stemmed birch (*Betula litwinowii*) and spruce-fir forests.
 7. Beech forests (*Fagus orientalis*) mainly with Colkhic underwood (*Rhododendron ponticum*, *Rh. luteum*, *Laurocerasus officinalis*, *Ilex colchica*, *Vaccinium arctostaphylos*, etc.).
 8. Beech-chestnut forests (*Castanea sativa*, *Fagus orientalis*) alternating with oak forests (*Quercus iberica*) with Colkhic underwood (*Rhododendron ponticum*, *Rh. luteum*, *Laurocerasus officinalis*, *Ilex colchica*, *Vaccinium arctostaphylos*, etc.).
 9. Lowland and submontane mixed broad-leaved forests (*Quercus imeretina*, *Q. hartwissiana*, *Zelkova carpinifolia*, *Carpinus caucasica*, *Castanea sativa*, *Fagus orientalis*) with Colkhic underwood (*Rhododendron ponticum*, *Rh. luteum*, *Laurocerasus officinalis*, *Vaccinium arctostaphylos*, etc.).
 10. Swamp alder forests (*Alnus barbata*).
 11. Alder forests alternating with *Sphagnum* spp. bogs.
 12. Pitsundian pine forests (*Pinus pithyusa*) with *Carpinus orientalis*, *Cistus ponticus*.
 13. Ajarian oak-pine forests (*Pinus kochiana*, *Quercus dshorochensis*).

The lower mountain belt (500-1000m a.s.l.) is characterised by chestnut, beech-chestnut and beech-hornbeam-chestnut forests (Figure 1, #8). In the "chestnut zone" of north Colkheti, in relatively dry biotops (southern slopes, etc.), oak and hornbeam-oak forests (*Quercus iberica*, *Carpinus caucasica*, *C. orientalis*) are spread. Evergreen species are not specific for such oak forests. In this zone forests are also destroyed. Best preserved are the forests with evergreen understorey, since they are unapproachable for the forest industry. They are protected in Bitchvinta-Mjusera and Kintrishi reserves. Beech forests dominate between 1000 and 1500m a.s.l. (Figure 1, #7). In southern Colkheti (Ajara) beech forests with evergreen underwood occupy approximately 50% of the beech zone (it is supposed that in the northern Colkheti this indicator should not be significantly different). In the first instance beech forests set up monodominant communities. In the Caucasus beech forests are main objects for forest industry, but at the same time are beech forests with primary structure preserved in some inaccessible gorges. They are

protected in the Kintrishi reserve and in the reserves located in the north-western Caucasus.

Dark-coniferous forests (fir, spruce-fir, beech-fir; Figure 1, #4-5) are mainly spread within boundaries of 1400-2000m a.s.l. In some places they form the timberline and climb up to 2250m a.s.l. These forests are also under anthropogenic influence. At the same time they are well preserved in some inaccessible gorges (especially in northern Colkhети) and protected in reserves situated in the north-western Great Caucasus (also in Borgomi reserve, in the northern part of the Small Caucasus).

Subalpine forests are coenotically most diverse (Figure 1, #3,3a). Lower subalpine elfin woods formed with endemic relics are also unique (mainly within 1700-2000ma.s.l.). *Betula medwedewii* forests are spread only in southern Colkhети (including Turkish Lazistan), *B. megrelica* only in northern Colkhети and *Quercus pontica* in both areas. An evergreen understorey is typical for such forests. They differ in physiognomy: in most cases dominants grow nearly vertically. In Colkhети crooked-stem beech forests are widespread (mainly within 1900-2200m a.s.l.). Evergreen underwood is also typical for these forests. For the upper subalpine belt (2200-2500m a.s.l.) crooked-stem birch forests with *Rhododendron caucasicum* layers are frequent. Unfortunately, subalpine forests like broad-leaved forests are extremely damaged and spread only on 15 % of their natural distribution area. Subalpine forests are protected in Kintrishi, Pskhu-Gumista, Ritsa reserves and others located in the north-western Great Caucasus (*Betula medwedewii* and *Quercus pontica* are only protected in the Kintrishi reserve). Subalpine forests are replaced by various meadows, which are changed by alpine vegetation - from 2500ma.s.l. onwards. In the alpine belt *Rhododendron caucasicum* communities are spread up to 2800-2900m a.s.l. - this is considered a post-wood process in relation to historical changes of climate (Dolukhanov 1980, Kolakovsky 1961).

Evergreen Colkhic relics: geographical distribution, ecology and coenotical position

As we stated above, we should pay attention to 5 species, which have a common Colkhic origin and mostly half-prostrate growth form.

Laurocerasus officinalis

This species is widespread in Western Georgia (Colkhети) and partly, in the north-western and south-eastern Great Caucasus, the Small Caucasus near the Colkhети region (Borgomi valley), the Talish mountains (southern Azerbaijan), Pontic mountains, northern Anatolia (north-eastern Turkey) and in the Gilian mountains (northern part of Iran, see Figure 2); it occurs also, separated from the main area, in the north-western part of the Balkan peninsula.

L. officinalis, during periods of high precipitation, is distributed from sea level to 2200-2300m a.s.l. In regions where the annual precipitation is less than 1200mm it does not occur (Table 1). In humid and warm areas of the foothills (up to 500-600m a.s.l.) where snow cover is limited and does not press young branches of trees to the ground, *L. officinalis* may grow as a 14-16m high straight tree, with 50-100cm diameter (Golitsin 1935; Mandjavidze 1982).

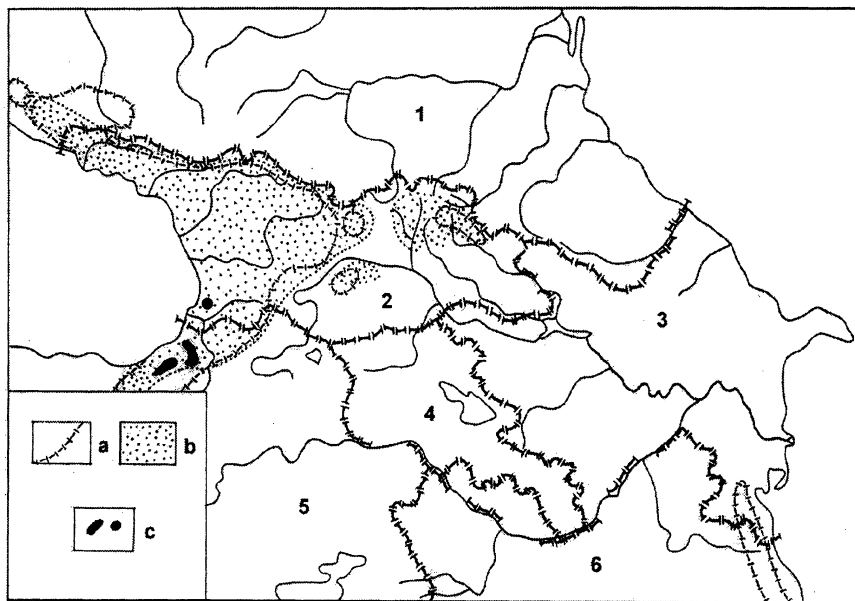


Figure 2: Distribution of *Laurocerasus officinalis* (a), *Ilex colchica* (b), *Epigaea gaultherioides* (c) in the Caucasus isthmus.

1. Russian federation, 2. Georgia, 3. Azerbaijan, 4. Armenia, 5. Turkey, 6. Iran.

However, for Colkheta the growth form of half-prostrate bush (thickets) is typical. In the middle part of the forest belt (1000-1400m a.s.l.) their height reaches 3-4,5m. At the same time does the length of branches exceed the brush height 2-4 times. The lower part of the branches are prostrate and rooted and other parts have a sickle-like form with a straight top. The diameter of the branches does not exceed 18-20cm. With higher altitudes the strength of the bushes is reduced: on 2000m a.s.l. the height is not more than 2,5m, on 2200m a.s.l. it stays below 1,5m.

L. officinalis mainly forms layers in broad-leaved as well as in dark-coniferous forests. It is especially characteristic for forests where *Tilia caucasica* is dominant or co-dominant. Authors of the Russian school of forest typology are considering all forests with such underwood as one type with 2-3 subtypes differentiated altitudinally. Dolukhanov (1989) disagrees with this formulation. He described the following associations: *Castanetum laurocerasosum* (1953),

Fageta laurocerasosa (*Fagetum laurocerasosum* typicum, *F. illicitoso-laurocerasosum*), *Piceeta laurocerasosa*, *Piceeta-Abieta laurocerasosa*, *Fageto-Abieta laurocerasosa*.)

Species	<i>Laurocerasus officinalis</i>	<i>Rhododendron ponticum</i>	<i>Rh. ungemii</i>	<i>Rh. caucasicum</i>	<i>Ilex colchica</i>
Altitude					
0-500	+	+	-	-	+
500-1000	+	+	-	-	+
1000-1500	+	+	-+	-	+
1500-2000	+	+	+	-+	+
2000-2200	+	+	-+	+	+
2200-2350	+ -	-+	-	+	-
Precipitation(mm)					
<1100	-	-	-	+	-
1100-1400	+ -	-+	-	+	+ -
1400-1800	+	+	-	+	+
1800-2200	+	+	-	+	+
>2200	+	+	+	+	+
Soils					
Calcareous	+	-+	+?	+	+
Non-calcareous	+	+	+	+	+
Forest types					
Mixed broad- leaved	+	+	-	-	+ -
Beech	+	+	+	-	+
Dark coniferous	+ -	+ -	+	-+	+
Elfin woods	+	+	+	+	+
Crooked - steam	+ -	+ -	-+	-	+ -
Density of canopy					
0,3	+	+ -	+	+	-+
0,3-0,4	+	+	+	+	+
0,5-0,6	+ -	+	+ -	-+	+
0,7-0,8	-+	-+	-	-	+ -
0,8-0,9	-	-	-	-	-+

Table 1: Some biotopological and coenotical dates

(+ frequently, well development; + - moderate frequency, partly insufficient development; - + fragmentary distribution, insufficient development).

Under a canopy of a density of 0,6 in beech forests *L. officinalis* stops fructification. In beech forests, on the northern slopes, where the value of the density is over 0,7 it does not occur. On the southern slopes with the extreme density of 0,85 it occurs as solitary weak individuals. In fir and spruce forests it cannot live under canopies with such a density. *Betula medwedewii* and *Quercus pontica* elfin woods with evergreen underwood are structurally peculiar: here in most cases a layer of bush is higher than elfin wood. *L. officinalis*, like *Rhododendron ungeronii*, often occurs outside the forest canopy, where it forms strong, up to 4-4,5 m high bushes.

Rhododendron ponticum

It spreads mainly in neighbourhood regions of the catchment basin of the Black Sea (Figure 3). Beyond its main area, it occurs in the eastern part of the Balkan peninsula, separately - in the southern part of Iberia and Lebanon mountains.

With its growth form and ecological peculiarities it resembles *Laurocerasus officinalis*. Normally it develops in the mountains where the annual rainfall is over 1300mm and does not grow in areas with precipitation lower than 1100mm. Altitudinally it spreads from sea level to the timberline (2200-2300m a.s.l.). In the foothills, where winter is quite warm, it seldom grows as a low, straight tree. In the understorey *Rh. ponticum* is strictly linked with fresh soils and often occurs in combination with *Rubus hirtus*, *Trachystemon orientale*, *Hedera colchica* or *Viburnum orientale* (Dolukhonov 1980).

Rh. ponticum is especially typical for beech, chestnut and hornbeam-beech-chestnut forests, although it occurs in other types as well. They are described as: Quercetum pontico-rhododendrosum (Maleev 1936), Fagetum rhododendrosum (Povarnitsin 1936), Castanetum rhododendrosum (Dolukhanov 1953), Fageta rhododendrosa, Fagetum rhododendrosum typicum, Piceeta rhododendrosa, Abieta rhododendrosa (Dolukhanov 1980), etc. Moreover, on the timberline it occurs together with *Laurocerasus officinalis*, *Ilex colchica* and *Ruscus colchicus* (partly with *Rhododendron ungeronii*) and is typical for trailing elfin woods (*Quercus pontica*, *Betula medwedewii*).

It develops best on the northern slopes of humid mountains under the forest canopy with a density from 0,3 to 0,6, in less moist conditions - with densities of 0,5-0,65.

In forests with *Rh. ponticum* underwood the natural forest regeneration is suppressed, this particularly influences the dynamics of many forest types and in some cases forests are replaced by *Rhododendron* bushes.

Rhododendron ungeronii

It is a local endemic spread in the south Colchheti (including Lazistan, the north-west Turkey, Figure 3).

Rh. ungeronii develops in the upper belt of the forest zone (mainly 1400-2000m a.s.l., 2200m a.s.l.), where the annual precipitation is over 2500mm. Physiognomically the bush resembles *Rh. ponticum*. In undergrowth the height

of the bushes on 1700m a.s.l. reaches 2,5m and in glades 4-4,5m. The length of the stem is 2-3 times more than bush height. This species is more light-requiring and often occurs beyond the forest canopy.

Rh. ungerii forms strong bush (underwood) in beech, beech-fir and spruce-fir forests. Seldom it occurs under a canopy with a density of about 0,5 and does not develop when this value is over 0,6. Underwood formed by *Rh. ungerii* prevents natural forest from regeneration and often replaces them for a long time.

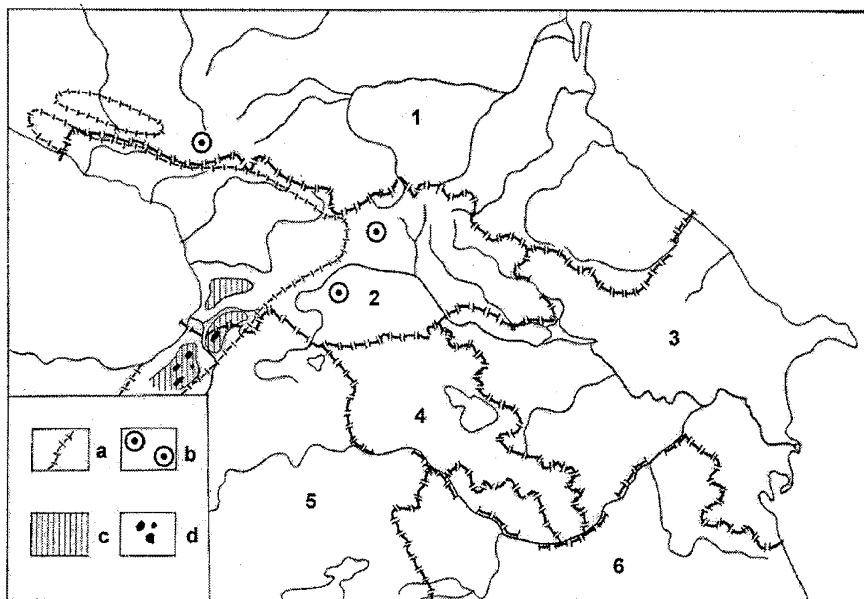


Figure 3. Distribution of *Rhododendron ponticum* (a,b), *Rh. ungerii* (c) and *Rh. smirnowii* (d) in the Caucasus isthmus.

1. Russian federation, 2. Georgia, 3. Azerbaijan, 4. Armenia, 5. Turkey, 6. Iran

Rhododendron caucasicum

This species is more widespread in the Caucasus than other Colchic relics, though its whole area is narrower than that of *Rh. ponticum* and *Laurocerasus officinalis*, which are also distributed beyond the Caucasus isthmus (everywhere except driest part).

Rh. caucasicum communities are mainly situated between 2000 and 2900m a.s.l. They are drawn to the northern slopes. The stem of this species is developed from the base forming quite far-stretching branches. They either lie on the peat soil or are covered with it and are rooted by a great number of surface-lying roots. In the underwood the height of this plant is 60-100cm; in the open areas - two or three times less. The distribution of this species beyond forests is

generally considered as secondary process due to historical changes of climate and anthropogenic impact. Remains of crooked-stem forests located within *Rh. caucasicum* communities spread on 2600-2650m a.s.l.

Rh. caucasicum mainly develops in crooked-stem forests and elfin woods (*Betula litwonowii*, *B. raddeana*, *B. medwedewii*, *Fagus orientalis*, *Quercus pontica*). Some communities have been described: Rhododendretum caucasicum, Fagetum caucasicum-rhododendrosum, Betuletum rhododendrosum, B. herboso-rhododendrosum (Bush & Bush 1936). It is more light-requiring than *Rh. ponticum*; e. g. in the beech forests it grows only under a canopy with a density of less than 0,5, often accompanied by various grasses, mosses and subshrubs. It permanently occurs together with *Gymnocarpium dryopteris*, *Huperzia selago*, *Vaccinium myrtillus*, *Empetrum hermaphroditum*, etc.

Ilex colchica

Ilex colchica is quite widespread in the Caucasus areas (Figure 2), but in compact thickets it is only distributed in Colkhethi.

In Colkhethi it spreads from the sea level to the subalpine belt, but it especially is typical for altitudes of 1000-2000m a.s.l. (up to 2150m a.s.l.). It grows mostly under fir and beech-fir, partly also beech and spruce forests. Some communities have been described: Piceeta ilicetosa, Piceeto-Abieta ilicetosa, Abieta ilicetosa, Fageto-Abieta ilicetosa, Fagetum ilicetosum typicum, F. ilicetosum superior, F. festucoso-ilicetosum (Dolukhanov 1989). A monodominant underwood of *I. colchica* can be seen in small areas only (about 0,2ha). It often occurs in combination with *Laurocerasus officinalis* and *Ruscus colchicus*. *I. colchica* develops better in well drained, fresh and moderately dry soils. In forests it may develop on cobbly biotops, limestone screes, etc. *I. colchica* is a highly shadow resistant species: in fir forests with a 0,6 density of canopy it begins fructification and occurs even under a density of 0,9. The height of *I. colchica* underwood is seldom over 1,5 m.

Dynamic tendencies in relation with global change

Natural vegetation

In the Caucasus investigations of vegetation dynamics in relation to global climatic changes is a new enterprise. In Georgia an appropriate governmental programme, supported by GEF in 1997-98, has been launched. The team of colleagues from the Institute of Botany of the Georgian Academy of Sciences is also participating in this project. In 1996 the high-mountain vegetation was emphasized, but in 1997 the same activities are planned in the Colkhethi region (Ajara). According to some preliminary data, collected during the compilation of vegetation maps of Ajara and through decoding of space photo-information as well as analysis of other available information, some tendencies have been shaped out. However, further confirmation is necessary.

This area is characterised by an increase of the upper distribution border of some Colchic evergreen relics. According to some references and our present investigations they are in some areas distributed up to 2400 m a.s.l., and *Rhododendron caucasicum* is quite frequent on heights of 3000(3100)m a.s.l., occasionally surrounded by subnival vegetation, which is evidently unusual and therefore at least needs special investigation. It is difficult to estimate this occurrence as a clearly evident tendency. In any case we found out (for the end of the 80ies) that some individuals and groups of *Quercus macranthera*, which is quite frequent in the eastern and southern Caucasus but unusual for the western Caucasus (Colkhети), were distributed between 2000-2200m a.s.l. This was estimated earlier (e.g. Gagnidze *et al.* 1985) but not on similar elevations; at the same time the positive (developing) tendency for this species could be presumed.

Adventitious/introduced species

The introduction of species in the Colkhети region should have been started in ancient times - considering the fact that the Greek already have established town-colonies in this area - but it is difficult to estimate clearly these first steps of introduction (it is still a matter of discussion if species like *Ficus carica*, *Laurus nobilis* and others are native or introduced and later distributed in Colkhети). The second wave of introductions occurred during the colonising of Georgia by Russia in the beginning of the XIX century.

Presently, e.g. in the southern Colkhети (Ajara), on an area of 3000km², about 1650 species are found, among them 7% are adventitious, in the coastal area about 14% (Manjavidze 1982, etc.). The adventitious flora of Colkhети is well studied (Memiadze 1971, Iabrova-Kolakovsky 1977, etc.), but geobotanically introduced or adventitious vegetation is investigated in much less detail. Amongst others the contemporary geobotanical position of herbaceous adventitious vegetation is relatively well studied, like *Paspalum dilatatum* of Brazilian origin which was introduced in about 1910 as a forage grass and presently is one of the main dominants of secondary grasslands in the Colkhети lowland. The same could be applied to the east Asian *P. digitaria*, the north American *Andropogon virginicus* and others.

Considering trees and shrubs, it should be mentioned that in spite of the diversity of introduced species a trace of "Laurophyllisation" is not yet found in Colkhети and the prime reason for this is probably the fact that native Colchic relics (among them evergreen ones) are still keeping powerful coenotic positions in the natural vegetation. However, it must be mentioned also that sufficient attention to the process of Laurophyllisation has so far not been paid. One of the most aggressive introduced species appears to be the North American *Robinia pseudoacacia*, which is widely distributed throughout the whole Colkhети region. It builds monodominant forests up to the lower mountain belt (1000-1200m a.s.l.) on deforested areas and frequently participates in the structure of primary forests. Especially some species should be mentioned

which are mixing with aboriginal species and in particular cases even replace them. Such species are: the Japanese *Cryptomeria japonica*, the North American *Pinus taeda*, the Australian *Acacia dealbata*, the Chinese *Paulownia tomentosa*, as well as *Ailanthus altissima*, *Asimina triloba*, *Catalpa speciosa*, *Acer palmatum*, *Rhus chinensis*, *Deutzia scabra*, *Hydrangea macrophylla*, *Pueraria hirsuta*, etc. often species of laurineous forests.

The gradual expansion of some species (particularly *Robinia pseudoacacia*) could be linked with a general tendency of global climate changes, but this subject needs special investigation.

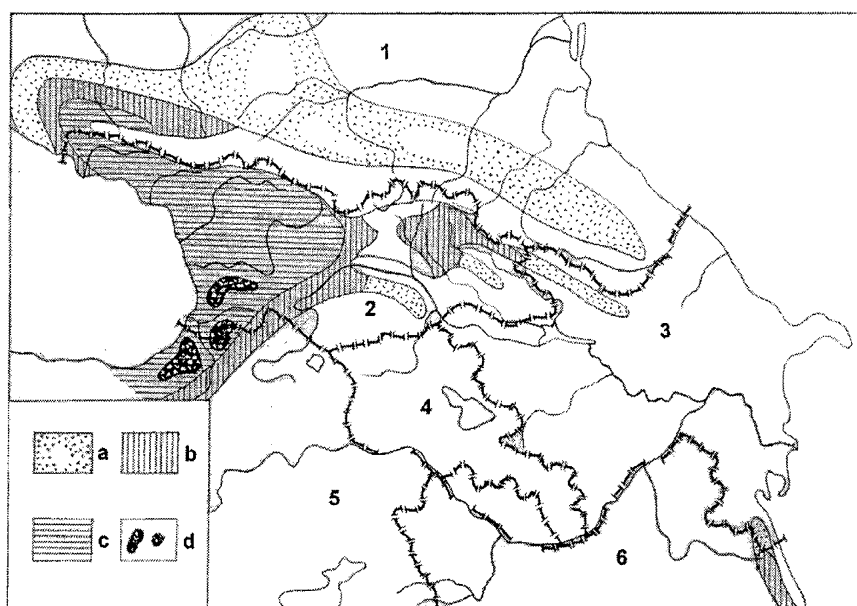


Figure 4: Distribution of half-prostrate Colchic relics in the Caucasus isthmus (*Laurocerasus officinalis*, *Rhododendron ponticum*, *Rh. luteum*, *Rh. ungeronii*, *Rh. smirnowii*, *Vaccinium arctostaphylos*, *Epigaea gaultherioides*, *Viburnum orientale*, *Ruscus colchicus*, *Ilex colchica*, *I. stenocarpa*, *I. hyrcana*, including *Rhododendron X sochadze*, except *Rhododendron caucasicum*):

a - areas where spread 1-2 species; b - 3-4; c - 5-8; d - 9-11

(by Dolukhanov 1980)

1. Russian Federation, 2. Georgia, 3. Azerbaijan, 4. Armenia, 5. Turkey, 6. Iran

Diversity and conservation

As it is shown on Figure 4 the maximal quantity of Colchetic half-prostrate relics occurs in the south Colcheti (Ajara and adjacent Turkish territory, in the Small Caucasus and Pontic mountains). The same region is characterised by the

highest value of diversity of trees and shrub species in the Caucasus. Particularly in the lower mountain belt (200-1200m a.s.l.) of south Colkhети on an area of 100-200km² over 100 species of trees and shrubs are present - among them many relics of Colkhetic and other origin: widespread are: *Abies nordmanniana*, *Picea orientalis*, *Alnus barbata*, *A. incana*, *Fagus orientalis*, *Fraxinus excelsior*, as well as *Taxus baccata*, *Buxus colchica*, *Quercus pontica*, *Q. hartwissiana*, *Pterocarya pterocarpa*, *Periploca graeca*, *Evonymus latifolia*, *E. leioplea*, *Daphne pontica*, *Diospyros lotus*, *Hedera colchica*, *Hypericum androsaemum*, *H. inodorum*, *Ilex colchica*, *Laurocerasus officinalis*, *Mespilus germanica*, *Ostrya carpinifolia*, *Rhododendron ponticum*, *Rh. luteum*, *Ruscus colchicus*, *Smilax excelsa*, *Staphylea colchica*, *S. pinnata*, *Tilia caucasica*, *Ulmus elliptica*, *Vaccinium arctostaphylos*, *Viburnum orientale*, *V. opulus*, local endemics - *Betula medwedewii*, *Epigaea gaultherioides*, *Rhododendron smirnowii*, *Rh. ungeri*, *Phillyrea medwedewii*, and some species occurring rarely in the Caucasus as e.g. *Arbutus andrachne*, etc. Some of the aforementioned species are not characteristic for the northern Colkhети, but some of the species are still relatively widespread such as *Zelkova carpinifolia*, *Quercus imeretina*, in limestone biotops *Corylus colchica* (it should be mentioned that the grade of endemism in the Colkhetic limestone rock-scrub vegetation reaches up to 80% - Sokhadze 1982). The coastal area is characterised by *Pinus pithyusa*, etc.

The total quantity of trees and bushes gradually decreases with altitude. Between 1100-1500m a.s.l. there are 75 species, in the range of 1500-2100m a.s.l. 55 species, over 2000m a.s.l. 43 species (Manjavidze 1982). However, this general rule does not apply to the Colkhetic relics. The majority of which is concentrated in the lower subalpine sub-belt (1700-2200m a.s.l.).

The lower forest and subalpine belts are distinguished by a high phytocoenotic diversity; in the northern Colkhети, e.g. in the Bichvinta-Mjusera reserve, in the range of 0-100 m a.s.l. and on an area of 0,5 km² there is a hornbeam-oak forest (*Quercus iberica*, *Carpinus orientalis*) on the top of ridges. The southern and eastern slopes are occupied by another type of oak forest (with *Carpinus caucasica*), the northern and western slopes by a beech-chestnut forest (*Castanea sativa*, *Fagus orientalis*) with an evergreen understorey. The coastal sand plain is characterised by a *Pinus pithyusa* forest with *Cistus tauricus*, the coastal rocky abrasive biotops by *Pinus pithyusa* in a complex with rock-scrub vegetation. The same area with relatively developed soils includes communities with *Arbutus andrachne*, apart from this these small areas are characterised by *Alnus barbata* forests in the bottoms of gorges, *Erica arborea* communities, etc.

The diversity of Colkhetic vegetation is best evident in the above-mentioned reserve, as well as in Kintrishi and Pskhu-Gumistra reserves (Figure 5).

Through the initiative of the World Wide Fund for Nature (WWF) a new system of protected areas is presently on the way to be established. This project proposes the creation of areas with several protection categories

(national park, managed nature reserve, protected landscape, etc.); the establishment of Colchheti National Park is also planned. Both areas generally include Colchhetian evergreen vegetation. In 1997 a WWF Project Office in Georgia (Director - Dr. G. Sanadiradze) launched the planning activities for a National Park in south Colkheti (Ajara) using GIS methods. The overall goal of the establishment of this national park is the conservation of diversity of relic Colchic vegetation.

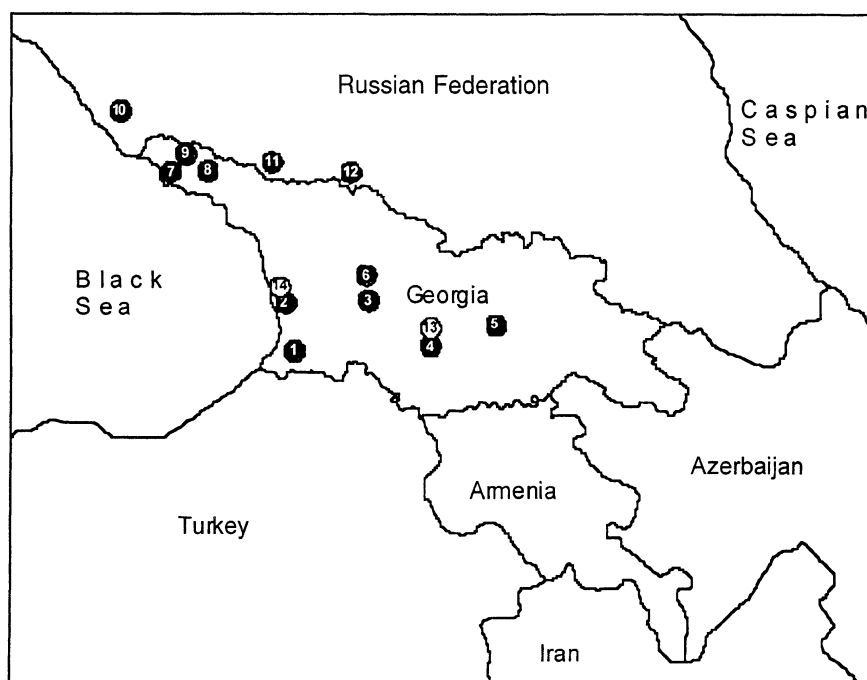


Figure 5: Location of nature reserves where Colchic evergreen vegetation is protected in the Caucasus.

EXISTING STRICT NATURE RESERVES	ALTITUDINAL LOCATION (m)	AREA (ha)	MAIN OBJECTS FOR PROTECTION
1. Kintrishi	450-2600	13893	Colkhic mountain forests, elfin woods
2,6. Sataplia-Colkhети	0 - 500	854	Colkhети lowland wetlands
3. Ajameti	100-200	4845	<i>Quercus imeretina</i> forests
4. Borjomi	600-2200	17948	Fir-spruce, pine, beech forests
5. Saguramo	500-1400	5359	Beech forests with some Colkhic relics
7. Pitsunda-Mjusera	0 - 100	3645	<i>Pinus pithyusa</i> , Colkhic foothill forests
8. Pskhu-Gumista	300-2850	40819	Beech, spruce-fir, subalpine forests
9. Ritsa	2000-2200	16289	Subalpine dark- coniferous forests
10. Caucasian Biosphere	500-3360	267277	North-west Caucasian mountain forests
11. Teberda	1500-4040	84996	North-west Caucasian mountain forests
12. Kabardino- Balkerian	1000-5000	74081	North-west Caucasian mountain forests
PLANNED NATIONAL PARKS			
13. Borjomi-Kharagauli	1000-2600	50400	Fir-spruce, pine, beech forests
14. Colkhети wetlands	0 - 20	15000	<i>Alnus barbata</i> forests, <i>Sphagnum</i> bogs

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