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KOLKHETI PEATLAND RELICT FOREST BODIVERSITY, POSSIBILITIES DEGRSADED FOREST REHABILITATION AND CONSERVATIO

A B S T R A C T

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Content

Introduction

Actuality of the Research Topic. The Caucasus region was recently designated as one of twenty-five global "biodiversity hotspots" (Myers et al. 2000). The Caucasus biodiversity hotspot spans 500,000 square kilometres of mountains in Eurasia between the Black and Caspian seas, including Armenia Azerbaijan and Georgia, and small portions of Russia, Iran and Turkey (Fig. 1). The unique location of the Caucasus region and the presence of high mountains are the main causes of the concentration highly diverse flora and fauna in this small place. The region is influenced from arid Irano-Turanian bio-province from the east and arid East Anatolian sub-bio-province from the south. Consequently, many droughts resistant plant and animal taxa migrate from these bio-provinces towards the Caucasus. Wet and warm winds, blowing from the Black Sea supply western Caucasus (Kolkheti) with high amounts of precipitation and thus promote development of diverse plant and animal taxa. This humid and warm region is included into Kolkheti bio-province. Additionally, high mountains of the Caucasus (over 5000 m) with their differently oriented ranges, deep gorges and valleys increase landscape variation and therefore, plant and animal diversity. As a result, the Caucasus is characterized by a unique flora and fauna. many endemic plant species (approximately 25 %) and five endemic plant genera are known for the region. Additionally, the Caucasus region represents one of the main Ice Age refugia of the Northern hemisphere.

Kolkheti – a global Ice Age refugium. Kolkheti is situated in western Caucasus. During the Tertiary climate in the northern hemisphere was warm and wet and rich subtropical and tropical woody plants were distributed here. Global cooling which started approximately 15 million years ago (Moran et al. 2006) culminated into Ice Ages, therefore woody plants migrated southwards and survived only in refugia – places, which remained warm and wet climates during the Ice Age. Such refugia are situated in eastern Asia, south-eastern North America, south-western North America and western Asia. Western Caucasus and especially Kolkheti lowland, as a part of western Asia, represents one of the global Ice Age refugia. Kolkheti lowland harbours relict woody plants, e.g., plants which were widespread in Europe many millions of years ago and became extinct there during the Ice Ages. Many of these woody plants e.g., Zelkova, wing-nut, pontian oak, several species of evergreen Rhododendrons, megrelian birch tree, have their closest relatives only in eastern Asia and North America. Relict plants distributed in Kolkheti lowland refugium are rare, have isolated distribution and many of them are endangered.

Such uniqueness of the relict forests of the Colchis lowlands is due to the fact that it is represented by relict and endemic species: Quercus hartwissiana, Pterocarya fraxinifolia, Imereti oak. Many of them are found only in Colchis: such as: e.g. Hartvis Oak. Some of them are found only in Colchis and Hyrcanus, while their closest relatives are found only in East Asia and North America. This relic of plants survived the glacial period in the Colchis lowlands.

Along with the Hyrcanian Forest, relict forests of the southwestern Caspian Sea and the Colchis Plain are ancient forests in Western Eurasia with their origins, evolution, and biodiversity as a special evolutionary phenomenon. In addition, the Colchis lowland forest is the best-preserved forest and is associated with biota in Eurasia. They are especially valuable for migratory, migratory and nesting birds. These sites have been protected by the Ramsar Convention since 1997 as a wetland habitat of significant international importance for migratory birds.

The relict forests of Colchis are of the mixed type, where Laphan or Hartvis oak do not form sacred groves. The development and distribution of vegetation in the Colchis Plain is closely related to the groundwater regime.

In swampy areas, where peat soils are developed, trees are almost non-existent. There are swampy, reed and Sphagnum swamps here. Where swamps are less common, low-quality, heavily swampy, swamp-type alders are common.

In relatively improved terrain, swampy alluvial soils grow high-quality trees, which are often interfered with by such vulnerable and rare relicts as *Pterocarya fraxinifolia*. Prior to human impact, oligodominant (dominated by several species) forests were common here. Polydominant forests were even rarer and occupied a much smaller area. Monodominant forests were an even rarer occurrence and they are mostly alder. Hornbeam-alder was most widespread in the border zone of alder forests, and in the northern part of the region.

Habitats of Kolkheti lowland. Kolkheti lowland is internationally recognized as an area of species richness, endemism, taxonomic uniqueness, and globally rare major habitat types. Following habitats are to be found here:Sand dunes**;** Mires**,** Wetlands**,** Forests.

The topicality of the topic is highlighted by the project nominated by the Organization for Education, Science and Culture (UNESCO) for the World Natural Heritage Site: "Colchis Peatlands and Relic Forests". A special place in this scientific dossier is occupied by the relict forest of the Kolkheti lowland.

Research Aim and Objectives. Study of vegetation and flora of peatland relict forest of Kolkheti lowland and create management and working plan of degraded forest.

Task 1. To study: past of Kollkheti relict fores literature observe;Recent situation of relict forest, theates and anthropogenic impacts;

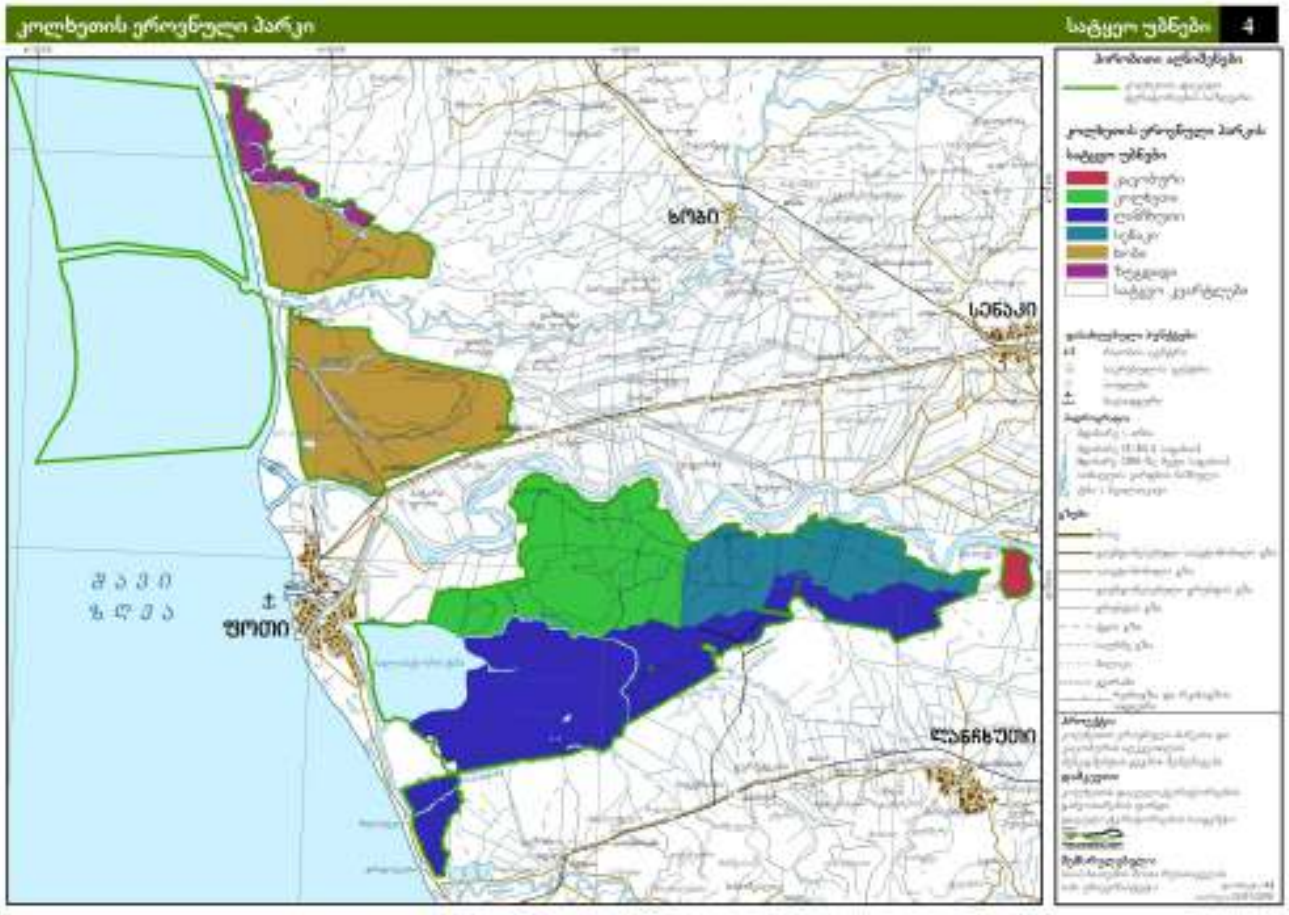
Task 2. flora and vegetation of telict forest; peat straigraphy;

Task 3.identify degraded forest

Task 4. create management plan and strategy of degraded dorest rehabilitation;

Task 5.give recommendation on *ex-situ* conservation

Objet of study. The study area of thesis is peatland relict forest of Kolkheti lowland from Kobuleti till Anaklia (see map).



Map 1. Location of Peatlandrelict forest of Kolkheti lowland

Scientific Novelty. It is the wild surviving forests of the relict Colchian forest species (Hartvis oak, lapani, maple, fig, hornbeam, elm, etc.) that have entered the scientific dossier prepared for the World Natural Heritage nomination.

Theoretical and Practical Significance. One of the practical ecological and economic value of the dissertation is the areas identified for the restoration of degraded relict forests.

Establishment of native fast growing tree species like alder in part of the area to satisfy the demand for fuel and timber of local stakeholders.

– Re-establishment of the former Kolkheti forest to support this globally unique forest ecosystem in combination with the recreation for tourists (see Ecotourism).

– Carbon sequestration and sales of carbon credits on the Kyoto Protocol compliance market (Clean Development Mechanism) and the Voluntary Carbon Market. There is a large interest in afforestation and reforestation projects for climate mitigation. Reforestation of the (buffer) zone areas (certainly with the substantial ecological and social benefits involved) would make a very attractive carbon project that could yield several thousands of euros (gross) per ha.

The reforestation areas would allow a promising combination of immission (buffer) zone, hydrological (buffer) zone and economic income in a synergetic way.

Approbation of Work. Batumi Shota Rustaveli State University, Institute of Phytopathology and biodiversity, department of Kolkheti mire and water ecosystem conservation;Society of wild nature conservation “tchaobi”;Administrations of Kolkheti national park and Kobuleti protected areas; “Kolkheti relict forest rehabilitation project” of University of Friburg Switserland.

The Structure of the Thesis. The work consists of the following sections: Introduction, Literature Review, Materials and Methods, Results, Discussion, Conclusions, Recommendations, References. The thesis consisted of computer-printed 130 pages in Georgian language, 15 tables, 5 diagrams and 25 figures. The bibliography of the PhD thesis is consisting of 104 sources in Georgian, Russian and English languages.

ResearchMaterial and Methodology

Research Methods: The basic field research manual methodology of the dissertation is a terrestrial plant ecology guide, which includes:

Transect A transect is a linear line drawn to study plant communities in a given habitat, where plant descriptions are made using fixed intervals and squares. Such studies and data are necessary for further monitoring of plant communities;

Quadrate The quadratic method. The transect is directed in the longest direction of a given habitat. Here the distance between the squares depends on the length of the transect and the diversity of the habitat. Initially, habitat research is a descriptive "intelligence" of how phytocenological research should be conducted under which "transect".

The transect method is necessary to study how plant communities' change.It is of great importance for further monitoring

Plant commutoties PC r ropgram

Soil stratigraphic incision method. The method proposed by the Faculty of Landscape Ecology, University of Greifswald, Germany, is used in the study of soil stratigraphy of relict peatlands. By means of a special drill.

Data capture is performed every 0.5 m depth. Determination of macrofossil flora.

Literature Review

I. Why are forests of Kolkheti lowland important ecosystems?

Forests are composed of many relict and endemic taxa. Forests of Kolkheti lowland are composed of many relict woody taxa e.g. Imeretian oak, Hartwisi oak, mulberry tree, wing-nut, Kolkhic box, Pontic and Ungerni´s rhododendrons, laurel-cherry etc. Many of these woody plants are restricted only to Kolkheti region (e.g. Colchic box, Pontic and Ungerni´s rhododendrons, Hartwisi oak), some of them are distributed only in Kolkheti and Hirkan (surroundings of Elburs mountains) regions (e.g. wing-nut, *Zelkova*) and their closest relatives are found only in eastern Asia and North America. These relic plants have survived Ice Age in Kolkheti lowland, but now they are highly endangered.

Forests are home of many relict and endemic birds, reptiles and amphibians. Forests of Kolkheti lowland are favourite nesting place for the relict bird Colchic pheasant (*Phasianus colchicus*). Many endemic amphibians (*Pelodytes caucasicus*, *Bufo verucossissimus*, *Hyla arborea*) and reptiles (*Lacerta agilis grusinica*, *Darevskia derjugini barani*) etc.

Forests of Kolkheti lowland are the unique ecosystems restricted only to small part of the Black Sea coast. Forests of Kolkheti lowland are restricted only to humid regions of the Black Sea coast. In the past the natural area of distribution of forests covered lowlands of the western Caucasus (see Fig. 2). Forest was present till the end of XIX century. Famous writer Alexandre Dumas in his "The Caucasus" has also mentioned about spectacular and mysterious forests of the Kolkheti lowland. Unfortunately, the actual distribution of forests is significantly smaller.

Fig. 1. Fichora relict forest

Chapter 2Actual situation of forests of Kolkheti lowland

The Kolkheti National Park faces many challenges, such as the impact of mass tourism which affects coastal areas, or the socio-economic conditions of the indigenous population. The human pressure and impact on river ecosystems are very significant since many small villages nestle in the vicinity of the Kolkheti NP. The natural habitats provide extremely important ecosystem services for local people (e.g. pasture, charcoal, food, drinking water) Furthermore, many Kolkheti lowland areas are already highly fragmented and degraded, especially along the riverbanks within the national park. In many places, pure *Alnus* stands can be observed with very little plant diversity.

In the vicinity of the Pichori River, for example, *Alnus glutinosa subsp. barbata* dominates over a large proportion of the forests. It forms dense monospecific stands with evidence of very few species. Moreover, the tree layer looks even-aged, indicating that light conditions in the understory are unsuitable for regeneration or that a sudden event (probably floods or repeated short-rotation clearcutting) occurred in the past and affected a large area.

Forests of Kolkheti lowland are degraded. The areas which still remain endemic and relic taxa and structure of Kolkheti relic forests are small and degraded. The principal reasons for degradation of forest ecosystems are:

- Drainage – Kolkheti relic forests were badly affected by large scale drainage activities performed since 1920-1930;

- Forest harvesting – Kolkheti lowland forests have been widespread till the beginning of the 20th century (Flerov 1951, Radde 1899). Since the XX century uncontrolled cut of valuable timber plants such as wing-nut, oak, beech and hornbeam led to the degradation of Kolkheti relic forests and dominance of fast-growing alder (*Alnus barbata*). Nowadays, large thickets of monodominante alder have almost outcompeted other woody plants. Oak, beech, hornbeam, and wing nut therefore have become rare forest elements and survived only in places that are far from settlements and are difficult to access;
- Plantation of non-native woody plants – in the beginning of 1930th native forest of Kolkheti lowland has been replaced by plantations of non-native plants especially *Eucalyptus* ssp. and *Cryptomeria japonica*;

Alien plants – at present, degraded Kolkheti lowland forests harbour only a few native plants, whereas, number of alien species is rapidly increasing; The spread of invasive alien species near and within the Kolkheti NP poses another very serious issue. The precious riparian ecosystem warrants urgent action and special attention. On the banks of the Pichori River, invasive species have already modified completely the general physiognomy of the riparian vegetation. *Amorpha fructicosa,* a shrub originating from the USA, is the main threat to vegetation along the river banks. This species, which belongs to the Fabaceae family, severely modifies soil fertility by fixing nitrogen in the soil. It also occupies the river banks instead of several native woody species of high conservation value such as *Pterocaryafraxinifolia and Quercus hartwissiana.* The situation further inland also gives cause for concern as the ground is sometimes completely covered by another invasive alien species, namely *Polygonum thunbergii,* which proliferates unrestrained in the understory. In addition to the very thick, natural canopy, it can hamper seed germination and the seedling establishment of tree species to considerable extent, thus preventing potential forest regeneration. Moreover, the high proportion of other invasive species on the periphery of the Kolkheti NP (*Gleditsia triacanthos and Ambrosia artemisiifolia)* must also be mentioned. These will continue to advance right at the heart of the protected area if nothing is done to halt their progression.

Forests of Kolkheti lowland are fragmented. At present only a few small fragmented woody patches are distributed in the Kolkheti lowland (Fig. 3). These are small rests of once large and continuously distributed forest ecosystem. The main causes of fragmentation are:

- Development of infrastructure – natural area of distribution of forests of Kolkheti lowland are fragmented because of development of settlements and infrastructure;
- Industrialisation – recently Supsa and Kulevi oil Terminals Anaklia Sea Port were built in Kolkheti lowland;
- Conversion of land for agriculture – large area of former continuous forest has been transformed into plantations of maize and tee, or converted into pastures. Subsequently it became evident, that the idea to establish a well-developed agriculture in the region was a complete failure since the soils of Kolkheti lowland are very poor.

Problems in conservation of Forests of Kolkheti lowland

Poor socio-economic situation of the region. The present-day socio-economic hardship with its high population pressure and the increasing demand for timber causes even more damage to the forest. Local population uses timber for heating. Additionally, illegal trade of timber is often the only income for many local farmers. Fortunately, recent restructuring of the Ministry of Environment of Georgia, has significantly improved controlling process of forest resources in the country. But alternative income to non-profitable maize trade and illegal logging has not been offered to farmers.

Incorrect **forest management.** Kolkheti National park was recently established to protect forests and other unique habitats of Kolkheti lowland. However, most of the territory of KNP is dominated by degraded forest, composing mostly of alder and invasive species (Denk et al. 2001). Former dominant taxa such as wing-nut, Hartwissi oak, Imeretian oak, hornbeam are rare and without habitat management these trees can become extinct. Unfortunately, plan of restoration of the forest has not yet been established.

Absence of conservation status of Tikeri and Khobi Forests. There are only a few forest patches in the Kolkheti lowland, which still remain structure and biodiversity of Kolkheti lowland forest, but their conservation status has not yet been evaluated. Good example is a small patch of Tikeri Forest near Kobuleti (Fig. 3), which is characterized by higher biodiversity than the forests from KNP.

Lack of qualified scientific personnel. In general, Georgia is short of well qualified forest ecologists. Modern methods and scientific approaches in management of natural resources and especially of forest resources are lacking. Therefore, inclusion in the project of well-qualified forest ecologists is urgently necessary.

Chapter 3 . Vegetation of Kolkheti relict peatland forest

The plant community has three / four tiers:

The first tier is represented by woody species forming the Kolkheti lowland forest:

Pterocarya fraxinifolia, Alnus glutinosa subsp. *barbata, Acer orthodocampestre, Carpinus betulus).*

The second tiers: *Viburnum opulus, Crataegus microphylla, Ilex colchica, Ruscus ponticus, Buxus colchica*

The thirf tier:*Asplenimfilix mas, Juncus acutus., Typha angustifolia, Polygonum thunbergii, Glehoma hederaceae,Carex sylvatica, Microstegium japonicum, Duchesne indica.*

Four tiers: mosses

3.1. Relict forest of Kobuleti lowland (South Kolkheti)

Plant communities of *Alder* forest of Kobuleti lowland Table 1

Species	Species composition after Braun-Blanquetia																				
Quercus hartwissiana																				1a	1
Alnus glutinosa subsp. *Barbata*	3	3	2a	3	3	.	3	2a	3	3	2q	2a	3	3	2a	3	3	2b	3	3	3	3
Rubus discolor	1	1	.	1	1	1	.	1	1	1	1	1	.	1	1	1	1	1	1	1	1	.
Hedera helix	1	1	1	1				1							1		2a					
Crataegus macrophylla							1							2a								
Smilax excelsa	.2a	2a.	.	.	.	.	2a.	.	.	.	1a	1	.	.	.	2a.	.	.	.	.	.	.
Viburnum opulus	2a									2a				2a					3a			
Rhamnus frangula	3						1	3			1	2a				1		2a			3	
Carex lasiocarpa	2m	2m	2a	.	.	.	.1	.	.1	.	.	.	.	.1	.	.	.1	.	.	.	.	.
Polygonum hydropiper		2a					2b				3		3b			2a						
Iris pseudacorus																		2b				
Lonicera caprifolia	.	2a	.	3	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.1	.	.1	.
Carpinus betulus											.	.	.	.	.	.	.	.	1.	.	.2a	.
Salix caprea	.	.	.	.															1		2b	2a
Salix cinerea																			1		2b	2a
Lythrum salicaria	2m	.	.	3	2m	.	.	.	.	1	2a	2a	1	2a	2m	2m	2a	2a	2a	1	2m	2a
Solidago virgaurea	.	.	1	.	.	.	.	.	2a	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus effuses		2b		2a			2b			2b			2a		1	1	1	1	1			
Carex pendula	.	.	1	.	.	.2a	.	.2a	.	.	.	.	.	.	.	.	.	.	.	.2a	.	.
Sparganium neglectum	.	2m	.	.	.	.	.	.	.	.	3	2b	2a	2b	2a	2a	2a	2b	2b	3	.	2b
Epilobium palustre	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Osmunda regalis	.	.	.	.	.	.	.	2m	.	.	1	1	1	1	1	1	1	.	2m	.	1	2m
Pteridium aquilinum												3	2b	2a	2b	2a	2a	2a	2b	2b	3	.
Molinia litoralis	.	.	.	.	.	.	.2a	.	.	2b.	.	.	.	1	1	.	1	1	1	2b	2a	2a
Euonimus europeae	.	.	.	.																1a		
Bidens cernua	2a	2a	2a.	.	.	2a.	.	.	.	2a.	.	.	.	2b.	.2b	2b.2b	.	.	.	.	.	.
Galium palustre	.	.	.	.	1	1	.	.	.	.	.	1	1	.	1	1	.	1	1	.	.	.
Mentha pulegium	2a.	2a.	.	.	.	.	2a.	.	.	.	1	.	1	.	.	.	.	.	.	.	1	.
Polygonum thunbergii	3	.3	1	.	.	.	2b.	.	3.	.3	.3	3.	.3a	.	2b.	.2b	.	.	1	.2b	.	.

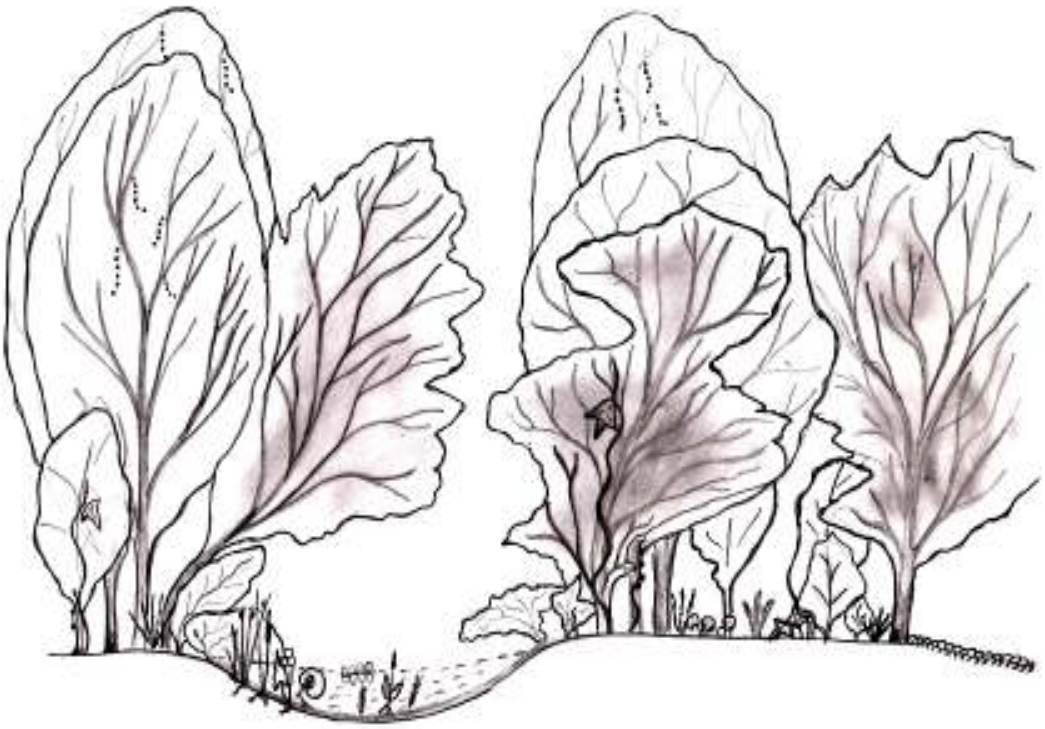


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Figure 2. Profile diagram of Kobuleti *Alder* forest

Table 2

Species	Species composition of Alneta&Pterocaryeat forest after Braun-Blanquetia																				
Quercus hartwissiana																				1a	1
Alnus glutinosa subsp. *barbata*	2	3	2	2a	2a	3	3	3	2b	3	2b	2	2a	3	3	3	3a	2	2b	3	3	
Pterocarya fraxinifolia	3	3	2a	3	3	.	3	2a	3	3	2b	2a	3	3	2a	3	3	2b	3	3	3	3
Rubus discolor	1	1	.	1	1		.					1	.	1	1	1				1	1	.
Hedera helix	1	1	1	1				1							1		2a					
Crataegus macrophylla							1							1a								
Smilax excelsa	.2a	2.	.	.	.	.	2.	.	.	.	1a	1	.	.	.	2.	.	.	.	.	.	.
Viburnum opulus	2a									2				2a					3a			
Frangula alnus	3						1	3			1					1		2a				
Polygonum hydropiper		2a					2b				3		3b			2a						
Buxus colchicus																		2b				
Lonicera caprifolia	.				.	5	.	.	.	.	.	.	.	.	.	.	.	.	.1	.	.1	.
Salix caprea	.	.	.	.															1		2b	2a
Amorpha fruticosa																			1		2b	2a
Lythrum salicaria	2m	.	.	3	2m	.	.	.	.	1	1	2a	1	2a	2m	1	1	1		1	2m	2a
Solidago virgaurea	.	.	1	.	.	.	.	.	2a	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus effuses		2b		2a			2b			2b			2a		1	1	1	1	1			
Carex pendula	.	.	1	.	.	.2a	.	.2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sparganium neglectum	.	2m	.	.	.	.	.	.	.	.	3	2b	2a	2b	2a	2a	2a	2b	2b	3	.	2b
Euonimus europeae	.	.	.	.																1a		
Bidens cernua	2a	2a	2a.	.	.	2a.	.	.	.	2a.	.	.	.	2b.	.2b	2b.2b	.	.	.	.	.	.
Galium palustre	.	.	.	.	1	1	.	.	.	.	.	1	1	.	1	1	.	1	1	.	.	.
Mentha pulegium	2a.	2a.	.	.	.	.	2a.	.	.	.	1	.	1	.	.	.	.	.	.	.	1	.
Polygonum thunbergii	3	.3	1	.	.	.	2b.	.	3.	.3	.3	3.	.3a	.	2b.	.2b	.	.	1	.2b	.	.

Tchuria forest (Kolkheti National Park)

The floristic composition of the Churia forest district formed the basis for the inclusion of these areas in the UNESCO World Natural Heritage nomination dossier "Colchis Forests and Wetlands".

Table 3

Tchuria	Species composition of polydominant deciduous relict forest of Trchuria after Braun-blanquetia																														
Transect N.		9	20	21	22	23	24	25	26	27	28	15	16	17	14	18	19	3	4	5	11	13	10	12	7	6		2			
Transect	MT		FT	FT	FT	FT	FT	FT	FT	FT	FT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT				
Record	9		1	2	3	4	5	6	7	8	9	15	16	17	14	18	19	3	4	5	11	13	10	12	7	6		2			
Date	22		25	25	25	25	25	26	26	26	26	24	24	24	24	24	24	21	21	21	22	22	22	22	21	21		21			
Size of quadrate	15		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15		15			
High of trees (m)	15		19	20	19	20	19	20	19	20	19	17	17	21	20	25	20	18	20	20	15	20	20	15	15	15		20			
Herbs&grasses (sm	90		105	100	105	100	95	85	95	95	90	90	105	95	100	110	150	90	80	110	100	90	85	120	70	85		100			
Quercus hartwissiana	2a	1a		2m	2a	2a	1a	2a	2a	2a	2m	1a	1a		1	1	1a		4	2b	2a	2m	2a	2m	2m	2a		3			
Pterocarya fraxinifolia	2b	2q		2a	3	3	2a	3	3	2b	3	3	3	3	3	3	3		3	3	3	3	3	2a	2a			3			
Acer orthocampestre		1	1	1		1	1	1	1	1	1	1	1		1			2a	1	1	1	1				1		1			
Ulmus glabra		1		1	1	1		1	1	1	1	1	1	1	1	1	1			1	1	1		2m		1		1			
Carpinus betulus			1	2m	2b	5	4	5	5	5	5	4	5	3	4											5					
Fagus orientalis			1a	1																											
Ilex colchica	1																								1			1			
Alnusglutinosa subsp. barbata																				2m	2m		2a								
Ficus colchica														1			2m	2m	2m												
Mors nigra																			3		2a										
Zelkova carpinifolia																							4	2a	2m			3			
Rhamus frangula	2a					2a		2a			1	2a		2m		2m		2a		2a			1	2m		2a					
Populus nigra																															
Salix alba							3	2b		2a		2b		2a		2a		2a		2b		2b		3		2b					
Salix cinerea	2m																							2m							
Pyrus balansae							1								1		1			1		1		1							
Malus sylvatica	+										1					1															

Crataegus microphylla																					2b				3
Viburnum opulus										1	1				1		1		1		1		1		1
Cornus mas				1		1		1		1	1		1		1			2m					1	2m	
Ilex colchica						1		1			1		1				1		1						
Humulus lupulus				1				1															1		
Periplica graeca																			1						
Smilax excels																									
Vitis sylvestris				1		1		1		1	1		1				1		1		1		1		
Clematis vitalba				1		1				1															
Rubus discolor																		2m			1				1
Rubus anatolicus										1															
Hedera colchica	2m			1		1		1		1	1		1		1		1		1		1				
Hedera helix						1																			
Lonicera caprifolium		1				1		1		1			1		1		1		1		1		1		1
Hydrocotyle vulgaris				1		1		1		1	1	2m		2m		2m		2m		2m			1		1
Solidago canadensis																							1		1
Lycopus europaeus	2a												1		1										
Holcus lanatus	2b																								
Calystegia sepium								1									1								
Solidago virgaurea																									
Mentha pulegium																									
Salvinia natans				1																					
Stachys palustre																									
Veronica becca-bunga																									
Aster laevis																									
Hibiscus ponticus																									
Ludwigia palustris						1		1			1		1		1		1		1		1		1		1
Hypericum mutilum																									
Osmunda regalis				1		1					1		1		1		1		1		1		1		1
Polygonum thunbergii																									
Duchesnea indica																									
Potentila reptans				1		1		1		1			1										1		1
Galium palustre			2m		2m		2m		2m		1		1	2m			1								1
Hypnum cupressiforme				1							1	1a			1	2m			1	1a			1		1
Lophocolea bidentata										1					1		1		1	1a			1	2m	

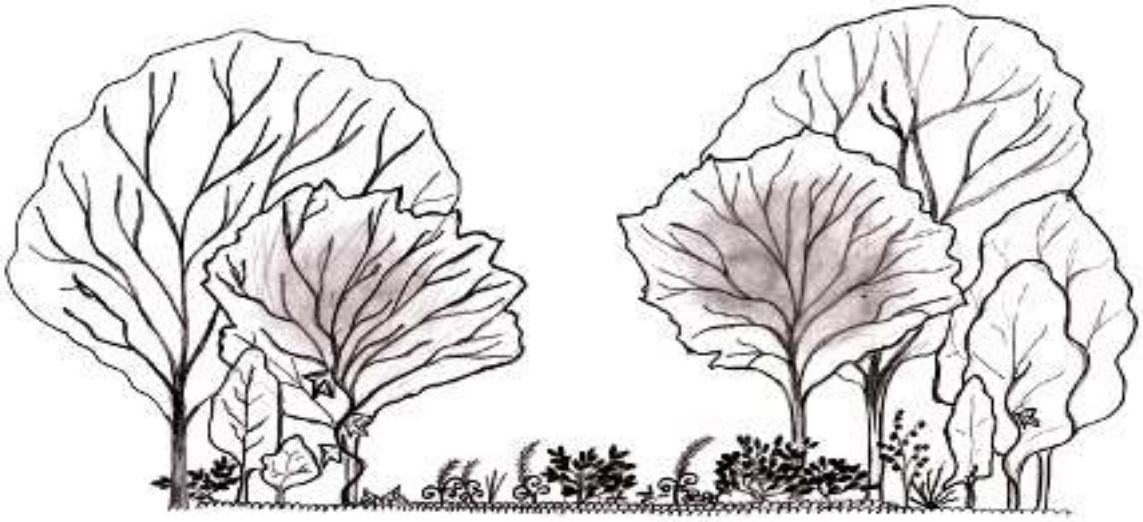


Figure 3. Profile diagram of Tchuria Polidominant deciduous forest

Figure 4. *Quercus hartwissiana*

Figure 5. *Viburnum opulus*

Figure 6 *Pterocarya fraxinifolia*

Figure 7 *Carpinus betulus*

3.2. Flora of Kolkheti peatland relict forest

Table 4

	Bryophyta
Bartramiaceae	
1	***Philonotis****marchica (Hedw.) Brid.*
Cephaloziaceae**Mig.**	
2	***Cephalozia****connivens* (Dicks.) Lindb
3	***Odontoschisma****denudatum* (Nees) Dumort.
4	***Atrichum*** *undulatum* (Hedw.) P. Beauv.
5	***Calliergonella*** *cuspidata* (Hedw.) Loeske
Dicranaceae	
6	*Campylopus filifolius* (Hornsch.) Mitt.
7	*Campylopus fragilis* (Brid.) Bruch & Schimp.
Hypnaceae	
8	*Hypnum cupressiforme* Hedw.
Polytrichaceae	
9	*Polytrichum strictum* Menzies ex Brid.
Sphagnaceae	
10	*Sphagnum cuspidatum* Ehrh. ex Hoffm.
11	*Sphagnum palustre* L.
12	*Sphagnum papillosum* Lindb.
DicranaceaeSchimp.	
13	***Campylopus*** *pyriformis (Schultz) Brid.*
14	*C. fragilis* (Brid.) Bruch &Schimp.
15	***Paraleucobryum****longifolium* (Ehrh. ex Hedw.) Loeske
Fagaceae	
16	***Quercus*** *hartwissiana* Steven
17	***Fagus*** *orientalis* L.
Betulaceae	
18	***Alnus*** *glutinosa subsp. barbata* (C.A.Mey.) Yalt.
19	***Carpinus*** *betulus*L.
Aceraceae	

20	***Acer*** *campestre*L.
Ulmaceae	
21	***Ulmus*** *glabra Huds*
22	***Zelkova*** *carpinifolia* (Pall.) K. Koch
Juglandaceae**A.Rich.exKunth**	
23	***Pterocaria****fraxinifolia*(*pterocarpa*) (Michx.)Kunth ex J.Jljinsk.
Moraceae	
24	***Ficus*** *carica*L.
25	***Morus*** *nigra*L.
26	*Morus alba*L.
Rhamnaceae	
27	***Frangula****alnus* L.
Salicaceae **Mirb.**	
28	***Populus*** *nigra* L.
29	***Salix*** *alba* L.; *S.micans*Anderss.[*A.albasubsp.micans*(Anderss.)Reich.fil.
30	*S.cinerea* L.
31	*S.caprea* L.
Fabaceae	
32	***Gleditsia*** *triacanthos* L.
33	***Amorpha*** *fruticosa*L.
Rosaceae	
34	***Malus*** *sylvestris (L.) Mill.*
35	***Crataegus*** *microphylla K.Koch*
36	***Rubus****anatolicus*Focke
37	*R.discolor*Boiss.
38	*R.hirtus*Waldst.& Kit.
39	***Duchesnea****indica*(Andr.) Focke
40	***Potentilla****erecta*(L.) Raeusch.
41	*P.reptans* L.
42	***Pyrus balansae*** Focke
Adoxaceae	
43	***Viburnum opulus*****L.**
Cornaceae	
44	***Cornus*** *mas*L.
Ruscaceae	
45	***Ruscus*** *ponticus*Woronow
Aquifoliaceae	
46	***Ilex*** *colchica*Pojark.
Buxaceaea	
47	***Buxus****colchica*L.
Cannabaceaea	

48	***Humulus*** *lupulus*L.
Apocynaceae	
49	***Periploca*** *graeca*L.
Smilacaceae	
50	***Smilax*** *exelsa*L.
Vitaceae	
51	***Vitis*** *vinifera* subsp. *sativa* Hegi
Ranunculaceae	
52	***Clematis*** *vitalba*L.
Araliaceae**Juss.**	
53	***Hedera*** *colchica* (C.Koch) C.Koch.
54	*H.helix* L.*(H.caucasigena* Pojark.)
Caprifoliaceae**Juss.**	
55	***Lonicera****caprifolium* L.
56	*L. japonic*a Thunb.
Apiaceae**Lindl. *(Umbelliferae* Juss.)**	
57	***Daucus****carota*L.
58	***Hydrocotyle****ranunculoide*sL.
59	*H. ramiflora* Maxim.
60	*H. vulgaris* L.
61	***Oenanthe****aquatica*(L.) Poir.
Asteracea**eDumort. (CompositaeGiseke.)**	
62	***Achillea****beibersteinii*Afan.
63	*A. filipendulina*Lam.
64	*A. nobili*s L.
65	***Ambrosia****artemisiifolia* L.
66	***Antennaria****caucasica*Boiss.
67	***A.*** *absinthium* L.
68	*A. vulgaris* L.
69	***Aster****salicifolius* Lam.
70	***Bidens****cernua* L.
71	*B.tripartita* L. (*B.orientalis*Velen.)
71	***Carpesium****abrotanoides*L.
72	*C. cernuum* L.
73	***Pulicaria****dysenterica*(L.) Gaertn.
74	***Cirsium*** *incanum* (S.G.Gmel.) Fisch.
75	***Conyzanthus****graminifolius*(Spreng) Tamamsch.
76	***Dichrocephala*** *integrifolia* (L.f.) Kuntze
77	***Echinops****colchicus*Sosn.
78	***Erigeron*** *annus* (L.) Pers. (*Stenactisannua* (L.) Cass.
79	*E. canadensis* L.
80	***Filago****gallica* (L.) L.
81	***Galinsoga****ciliata*(Rafin) Blake

82	*G. parviflor*a Cav.
83	***Gnaphalium****affine* D.Don.
84	*G. luteoalbum* L.
85	***Grossheimia*** *polyphylla* (Ledeb.) Holub. *(G.ossica* (C.Koch) Sosn. &Takht.)
86	***Gymnaster****savatieri*(Makino) Kitam.
87	***Helianthus****tuberosus* L.
88	***Leontodon****danubialis*Jacq.
89	***Leucanthemum*** *vulgare* Lam.; *(L.vulgareLam.*subsp.*multicaule*A.Khokhr.)
90	***Santolina****chamaecyparissus* L.
91	***Senecio*** *erraticus* Bertol. *(Jacobaea erratica* (Bertol.) Fourr.)
92	*S. sylvatic*us L.
93	*S.vernalis*Waldst.& Kit.
94	*S.vulgaris*L.
95	***Sigesbeckia****orientalis* L.
96	***Silybum****marianum* (L.) Gaertn.
97	***Sonchus****arvensis*L.
98	***Solidago****canadensis* L.
99	***Tagetes****minuta*L.
***Boraginaceae*Juss.**	
100	***Myosotis****palustris*(L.) Nathh.
101	***Cardamine****hirsute* L.
102	***Rorippa****palustris*(L.) Besser
***Caryophyllaceae*Juss.**	
103	***Stellaria****media* (L.) Vill.(*Alsinula media* (L.) Dostal, comb.invalid.)
***Convolvulaceae*Juss.**	
104	***Calystegia*** *sepium* (L.) R.Br.
105	*C. soldanella* (L.) R. Br.
106	*Convolvulus arvensis*L.
***Euphorbiaceae*Juss.**	
107	***Euphorbia****palustris* L.
***Fabaceae*Lindl. (*Leguminosae*Juss.)**	
108	***Amoria*** *ambigua* (Bieb.) Sojak *(Trifolium ambiguum*Bieb.)
109	***L.****palustris*Willd.
110	***Medicago****arabica* (L.) Huds.
111	*M. denticulate* Willd.
112	***Ononis****arvensis* L.
113	***Psoralea****acaulis*Stev.
114	***Securigera*** *varia* (L.) Lassen *(Coronilla varia* L.)
115	***Trifolium****campestr*eSchreb.
116	*T. fragiferum* L.
117	*T. resupinatum* L.
118	*T. subterraneum* L.
119	*T. tumens*M.Bieb.

120	***Vicia*** *sativa* L.
Geraniaceae **Juss.**	
121	***Geranium*** *palustre* L.
122	*G.rotundifolium* L.
Hypericaceae **uss.**	
123	***Hypericum*** *perforatum* L.
Lamiaceae **Lindl. (*Labiatae* Juss.)**	
124	***Galeopsis*** *tetrahit* L.
125	***Glechoma*** *hederacea* L.
126	***Lamium*** *album* L.
127	***Lycopus*** *europaeus* L.
128	***Mentha*** *pulegium* L.
129	***Perilla*** *nankinensis* Wender.
Lythraceae St.-Hil	
130	***Lythrum*** *salicari*a L.
Malvaceae **Juss.**	
131	***Hibiscus*** *ponticus* Rupr.
132	***Kosteletzkya*** *pentacarpos* (L.) Ledeb. (*Hibiscus pentacarpos* L.)
Onagraceaea	
133	***Epilobium*** *palustre* L.
134	***Ludwigia*** *palustris* (L.) Elliott
Oxalidaceae **R.Br.**	
135	***Oxalis*** *acetosella* L.
136	***Xanthoxalis*** *corniculata* (L.) Small (*Oxalis corniculata* L.)
Phytolaccaceae **R.Br.**	
137	***Phytolacca*** *Americana* L.
Plantaginaceae	
138	***Plantago*** *lanceolata* L.
139	*P.major* L.
Polygonaceae **Juss.**	
140	***Persicaria*** *amphibia* (L.) Delarbre *(Polygonum amphibium* L
141	P. *hydropiper* (L.) Spach (*Polygonum hydropiper* L.)
142	*P.aviculare* L.
143	***Polygonum*** *perfoliatum* L.
144	*P. posumbu* Buch.-Ham. ex D. Don
145	*P. thunbergii* Siebold&Zucc.
146	***Rumex*** *acetosella* L.
Primulaceae **Vent.**	
147	***Lysimachia*** *vulgaris* L.
Ranunculaceae **Juss.**	
148	***Ficaria*** *calthifolia* Reichenb.
149	***Ranunculus*** *bulbosus* L.
150	*R. muricatus* L.

151	*R.oreophilus* Bieb. (*R.acutilobus*Ledeb., *R.makaschwilii* Kem.-Nath.)
152	*R. sceleratus* L.
153	*R. trachycarpus*Fisch. &C.A.Mey. (*Ranunculus marginatus* d'Urv.)
Celastraceae	
154	***Euonimus** europaeus*
***Rubiaceae*Juss.**	
155	***Galium**palustre*L.
156	*G. tricornutum* Dandy
***Sambucaceae*Batsch ex Borkh.**	
157	***Sambucus**ebulus*L.
***Solanaceae*Juss.**	
158	***Datura**stramonium* L.
159	***Solanum**pseudocapsicum* L.
***Violaceae*Batsch.**	
200	***Viola**arvensis*Murr.
201	***V. odorata***
Amaryllidaceae J. ST.-Hil.	
202	***Leucojum**aestivum* L.
***Commelinaceae* R.Br.**	
203	***Commelina**communis* L.
204	***Tradescantia**virginiana* L.
***Cyperaceae*Juss.**	
205	***Bulbostylis** tenerrima* (Fisch. &C.A.Mey. exLedeb.) Palla
206	***Carex**pendula*
207	***C. lasiocarpa*** **L.**
208	***Eleocharis** palustris* (L.) Roem. &Schult.
209	***Fimbristylis** annua* (All.)Roem.et Schult.
210	***Juncellus** serotinus* (Rottb.) C.B.Clarke
211	***Kyllinga**gracillima*Miq.
212	***Pycreus**korshinsky*i (Meinsh.) V.I.Krecz.
213	***Scirpus**triqueter* Godr. (*Schoenoplectus litoralis* (Schrad.) Palla)
214	***Iris**pseudocorus L.*
215	***Sisyrinchium**angustifoliu**m*** Mill.
***Juncaceae* Juss.**	
216	***Juncus**acutus* L.
217	*J. bufonius* L.
218	*J.effusus*L.
219	*J. lampocarpus* Ehrh. ExHoffm. (*Juncus articulatus* L.)
220	***Luzula** forsteri* (Smith) DC.*(Juncus forsteri* Smith)
***Poaceae* Barnhart**	
221	***Aegilops**cylindrica Host*
222	***Agropyron** caninum* (L.) P.Beauv.
223	***Agrostis** alba* L*. Poa nemoralis* L.

224	*A. gigantea* Roth. [*A.alba s*ubsp.*gigantea* (Roth.) Jir.]
225	***Aira*** *elegan*sWilld. ExGaudin.(*A.capillaris* Host.)
226	***Andropogon****virginicus* L
227	***Anthoxanthum****amarum*Brot.
228	*A. odoratum* L.
229	***Arthraxon****hispidus* (Thunb.) Makino
230	***Bromus****japonicas* Thunb.
231	*B. tectorum* L.
232	***Calamagrostis****arundinacea*(L.) Roth.
233	*C.epigeio*s (L.) Roth.
234	***Catabrosa*** *aquatic*a (L.) Beauv. (*Aira aquatica* L.)
235	***Digitaria*** *sanguinalis* (L.) Scop. [*D.vulgaris* (Schrad.) Bess.]
236	*D. ciliaris* (Retz.) Koeler
237	*D. ischaemum*(Schreb.) Muhl.
238	*D.violascen*s Link *[D.chinensis* (Retz.) A.Camus ;*Paspalum chinense* Nees]
239	***Echinochloa*** *crusgalli* (L.) Beauv.s.l.
240	***Eleusine****indica*(L.) Gaertn.
241	*E. tristachya*(Lam.) Lam.
242	***Eragrostis*** *minor*Host.
243	*E. pilosa* (L.) P.Beauv.
244	***Erianthus*** *ravennae* (L.) P.Beauv. (*Saccharum ravennae* (L.) L.)
245	***Leersia****oryzoides*(L.) Sw.
246	***Leymus****racemosus*(Lam.) Tzvelev
247	***Lolium*** *loliaceum* (Bory&Chaub.) Hand.-Mazz.
248	***Panicum****dichotomiflorum*Michx.
249	*P. lanuginosum* Elliott (*Panicum acuminatum* Sw.)
250	***Paspalum****dilatatum*Poir.
251	*P. paspalodes* (Michx.) Scribn. (*Paspalum distichum* L.)
252	*P. thunbergii* Kunth ex Steud.
253	***Phalaroides*** *arundinacea* (L.) Rauschert (*Phalaris arundinace*a L.)
254	***Phleum****paniculatum*Huds.
255	*Ph. Phleoides* (L.)Karst. (*P.boehmeri.*Wib.;*Phalarisphleoides* L.) .
256	***Poa****annua* L.
257	*P. bulbosa* L.;*P.crispa*Thuill. [*P.bulbosa* subsp.*vivipara* (Koel.) Arcang.]
258	*P. compressa* L.
259	*P.trivialis* L.
260	***Polypogon*** *semiverticillatus* (Forssk.) Hyl. *(Polypogon viridis* (Gouan) Breistr.)
261	***Rostraria****cristat*a (L.) Tzvel. (*Koeleriaphleoides* (Vill.) Pers.)
262	***Sorghum****halepense* (L.) Pers.
263	***Sporobolus****fertilis* (Steud.) Clayton
264	***Tragus****racemosus* (L.) All.
265	***Vulpia*** *myuros* (L.) C.C.Gmel.

***Thyphacea*e Juss.**	
266	***Sparganium*** *neglectum* Beeby (*Sparganium erectum* subsp. *neglectum* (Beeby) K.Richt.)
267	***Typha****angustifolia* L.
268	*T. latifoli*a L

Flora of Kolkheti relict peatland forest presented: mosses- 6 family, 9 genera and 12 species; Trees-10 familys, 13 generis a and 16 species;scrubs-6 family, 7 genera, 7 species; Lianas: 8 Family, 8 Genera and 12 species; herbs-25 family, 79 genera, 166 species, grasses: 6family, 46 genera, 63 species. Total Flora of Kolkheti relict peatland forest consista: 58family, 152genera 268 species.

Chapter 4. Invasive plant of Kolkheti Relict forest

The spread of invasive alien species near and within the Kolkheti NP poses another very serious issue. The precious riparian ecosystem warrants urgent action and special attention. On the banks of the Pichori River, invasive species have already modified completely the general physiognomy of the riparian vegetation. *Amorpha fructicosa,* a shrub originating from the USA, is the main threat to vegetation along the river banks. This species, which belongs to the Fabaceae family, severely modifies soil fertility by fixing nitrogen in the soil. It also occupies the river banks instead of several native woody species of high conservation value such as *Pterocarya fraxinifolia* and *Quercus hartwissiana*. The situation further inland also gives cause for concern as the ground is sometimes completely covered by another invasive alien species, namely Polygonum thunbergii, which proliferates unrestrained in the understory. In addition to the very thick, natural canopy, it can hamper seed germination and the seedling establishment of tree species to considerable extent, thus preventing potential forest regeneration. Moreover, the high proportion of other invasive species on the periphery of the Kolkheti NP (*Gleditsia triacanthos* ,*Ambrosia artemisiifolia, Solidago Canadensis, Polygonum thunbergii)*) must also be mentioned. These will continue to advance right at the heart of the protected area if nothing is done to halt their progression.

Chapter 5. Soil Stratigraphy of peatland forest

To confirm that there was once a forest in the forests adjacent to the Ispani mire in the forests surrounding the Kobuleti Protected Areas, stratigraphic incisions were made using a special drill to make a stratigraphic incision in the peat. The soil structure is studied. Stratigraphic incisions showed that the soil was of the peat type.

In stratigraphic cuts of peat, clay, gitia are often found in the cut, which indicates the presence of a river basin or sea level.

Figure 9. Peat strathygraphy

Table 5

Plant species Strathygraphy Legend

I layer	Depth sm	Macrofossil flora	˘ ▒	Sphagnum peat sand
Alnus barbata	0-50	▒▲¥	▲	Alder
Rhamnus frangula	50-100	▒▲¥	▼	Quercus
Salix cinerea	100-150	▒▼▲▲	◄	Cornus
II layer	150-200	===▼▼▒	►	fire
Osmunda regalis	200-250	▒▲▲▼▼≠ῶῶ	□	water
Juncus acutus	250-300	===◄◄◄ῶῶῶ	◊	*Polytrichum*
Polygonum thunbergii	300-350	◄◄◄###===	=	Gitja
Lisymachia vulgaris	350-400	===◄◄►►ῶῶ	¥	*Pteridium*
Epilobium palustre	400-425	==▼▼ῶῶ▲▲	▓	Sphagnum&Phragmites peat
Liana	425-450	□□□●●●▼○○ῶ	▒	Phragites peat
Hedera colchica	450-500	==□□○○▲▲	ῶ	leavs

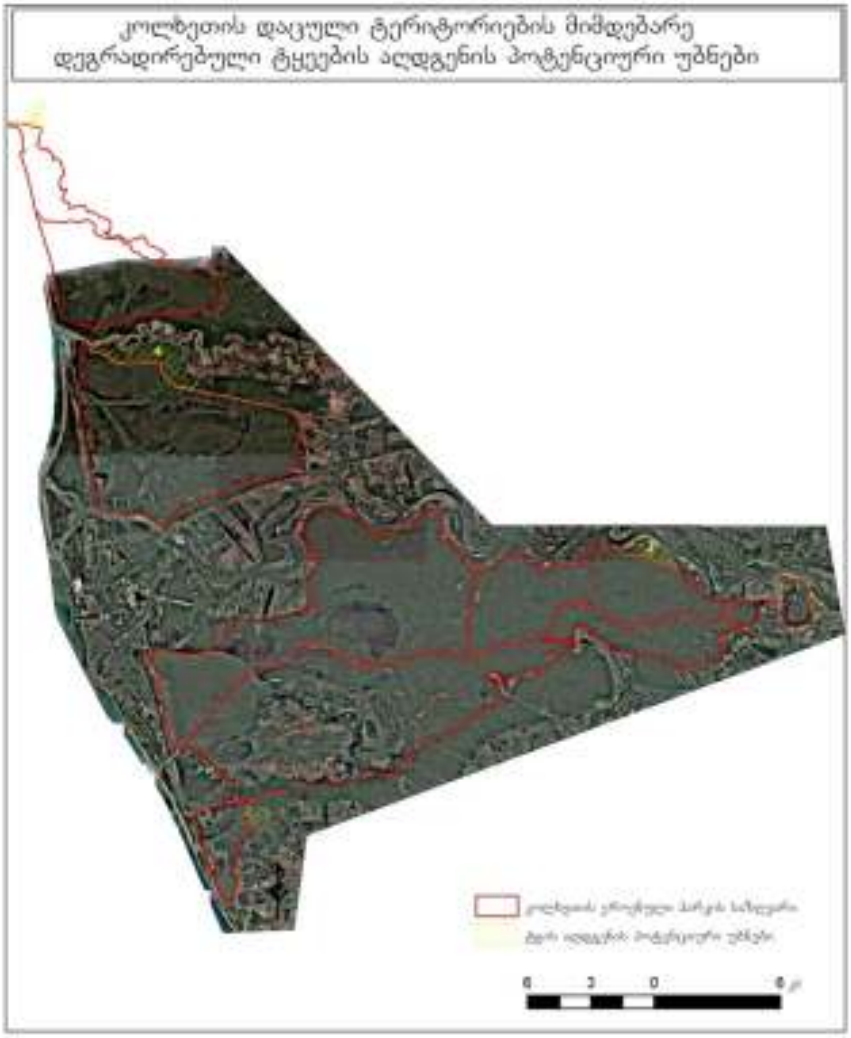
Smilax excelsa	500-550	□□□▼▼◊◊●●õ	○	Macrofossil
	550-600	⫴⫴õõ●●●◊◊	◙	clay
	600-650	▬¥¥	●	Trapa natans
			ł	Mollinia
			■	Detritus gitja
			‖	Organic
			○	wood

Chapter 5. Potential areas for restoration of degraded relict forests

During the field trip, the estimated area of degraded relict forests adjacent to Kolkheti National Park was first identified and the deforested and degraded forest areas in Senaki, Abasha, Zugdidi and Khobi forest areas were selected, where forests could be restored.

In the mentioned restoration areas were determined: location of the plot, brief description of the plot are the woody plants left on the degraded plots. If necessary, the soil structure was studied where the hydrological regime was violated.

5.1. Potential degraded forest restoration sites in the vicinity of the Kolkheti Protected Areas



Map 2. 1,2 –Lanchkhuti; 3 -Senaki; 4- Khobi; ; 5,6 - Zugdidi; 7- Abasha

Map 3. Senaki Proposed Forest Renaturalisation Area

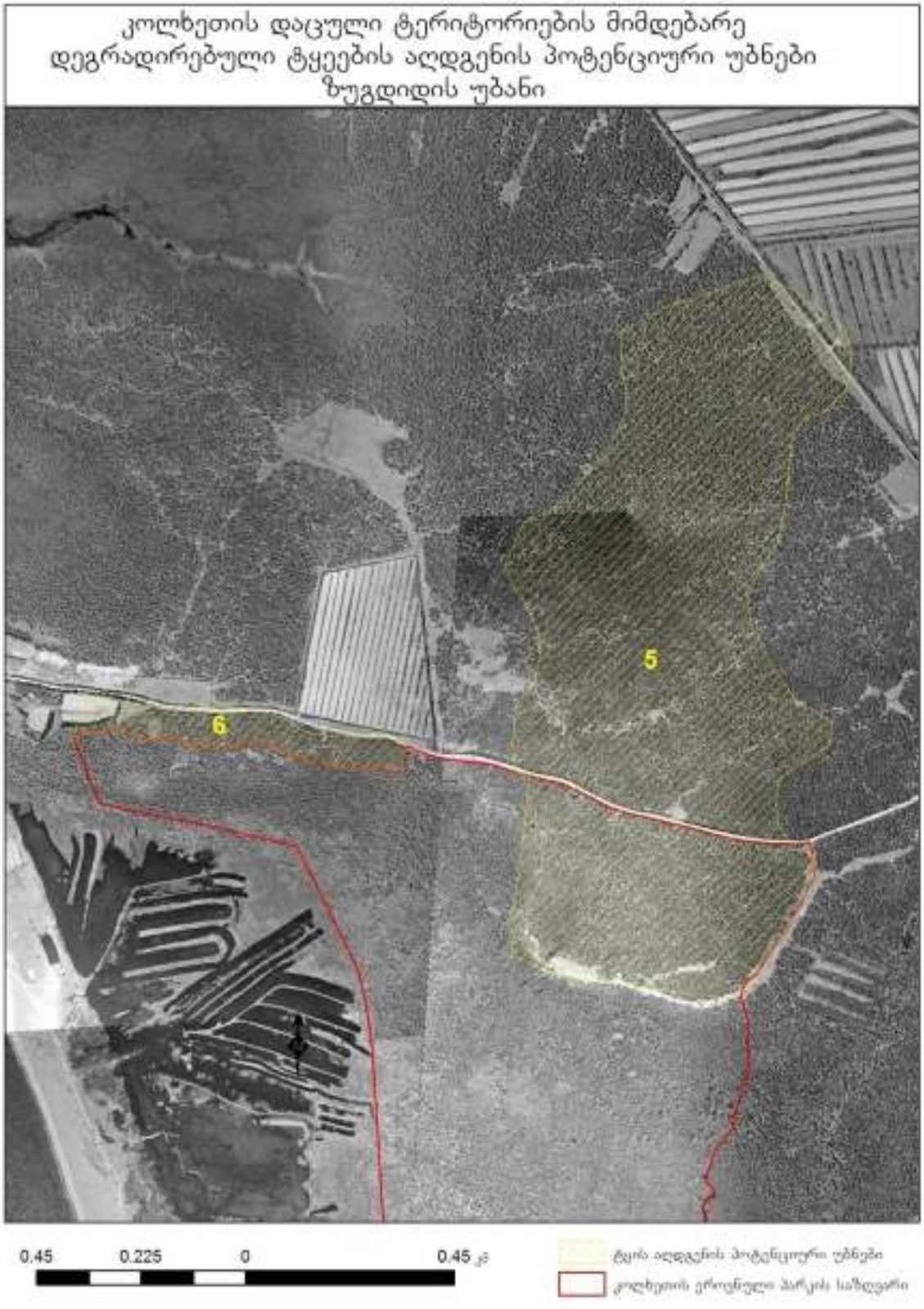
Dominant trees: *Alnus glutinosa* subsp. *barbata, Pterocaria fraxinifolia*

Map 4. Lanchkhuti Proposed Forest Renaturalisation Area

Dominant species: *Pterocaria fraxinifoliawith many seddlings, Alnus barbata, Morus nigra, Ficus carica , Crataegus macrophylla*

Map 5. Khobi Proposed Forest Renaturalisation Area

Dominant species: *Pterocaria farxinifolia, Carpinus betulus*



Map 6. Zugdidi Proposed Forest Renaturalisation Area

Dominant species: *Alnus glutinosa* subsp. *barbata,*

Map 7. Abasha Proposed Forest Renaturalisation Area

Dominant trees: *Alnus glutinosa* subsp.*barbata, Gleditsia triacanthus*

5.2.

Map 8. **Proposed** Proposed Forest Renaturalisation Areas **in Kobuleti**

Dominan species: *Alnus glutinosa* subsp. *barbata , Frangula alnus, Eucalyptus cinerea*

Chapter 6. Degraded forst renaturalisation working plan

1Issues regarding invasive species: Inventory and mapping of the current status of invasive species within the Kolkheti NP as well as in the direct vicinity. An Action Plan must be drawn up to counteract invasive species throughout the entire area;
2) Forest renaturation: Establishment of an ex situ culture with the most symbolic native trees (e.g., Pterocarya fraxinifolia, Quercus hartwissiana, Ficus carica) for renaturation purposes;
3) Involvement of local people: The Kolkheti NP Management Plan should include a global strategy to share the resources and benefits of the national park with local stakeholders.

Results

1. Kolkheti refugia is characterised by a warm, humid climate, promoting the development of lush forest vegetation. It is also one of the main refugia of relict trees in this part of the Western Eurasia region;
2. Before anthropogenic impact forest of Kolkheti lowland was *polidominant* such Tchuria forest;
3. Main forest vegetation types of Kolkheti lowland are: *Alder, Alneta-Pterocaryeta; mixed polidominant decidios forest uderstroy with Ilex colchica, Buxus colchica,Ruscus pontica, with liana Smilax excels, Hedera colchica, Humulus lupulus, Periploca graeca;*
4. Flora of Kolkheti relict peatland forest presented: mosses- 2 family, 5 genera and 6 species; Trees-10 familys, 13 generis a and 16 species; scrubs- 6 family, 7 genera, 7 species; Lianas: 8 Family, ,8 Genera and 12 species; herbs-25 family, 79 genera, 113 species, grasses: 6 family, 46 genera, 66 species. Total Flora of Kolkheti relict peatland forest consists: 57 family, 158 genera 220 species.
5. Relict forest habitat protected under EMERALD network and EUNIS Habitat list;
6. Polidominant relict forest of Tchuria included in the UNESCO WNH nomination scientific dossier : “Forests and wetlands of Colchis” ;
7. It was determined degraded forest rehabilitation potencial area in Kolkheti National Park and in Kobuleti Proteced area;
8. It was created degraded forest renaturalisation working plan;

9. Informations of flora and vegetation, threathes of PhD work included in updated Kolkheti National Park management plan and Kobuleti Protected areas management plan;

Recommendation

1. Issues regarding invasive species: Inventory and mapping of the current status of invasive species within the Kolkheti NP as well as in the direct vicinity. An Action Plan must be drawn up to counteract invasive species throughout the entire area;

2. Forest renaturation: Establishment of an ex situ culture with the most symbolic native trees (e.g., *Pterocaryafraxinifolia, Quercus hartwissiana, Ficus carica)* for renaturation purposes;

3. Involvement of local people: The Kolkheti NP Management Plan should include a global strategy to share the resources and benefits of the national park with local stakeholders.

4. Increase of public awareness. Enhance communication among stakeholders and encourage public awareness and involvement in addressing the problems of the Kolkheti relic forest.

List of publication

1. Matchutadze I., Goradze R., Goradze I., Tsinaridze M., Tetemadze N., Cheishvili T., Memarne Q., 2020, Unique Habitats of Kolkheti (West Georgia): Threats, Conservation and Wise Use, The 6th International EcoSummit Congress - EcoSummit 2021 – Building a sustainable and desirable future: Adapting to a changing land and sea-scape, will take place at The Gold Coast Convention Centre, Gold Coast, Australia, from 14th – 18th June 2021. https://www.journals.elsevier.com/water-research/conferences/6th-international-ecosummit-congress-ecosummit-2020ElsevierCiteScore: 14.5 **i** Impact Factor: 9.130 **i** Source Normalized Impact per Paper (SNIP): 2.542 SCImago Journal Rank (SJR): 2.932
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