Batumi Shota Rustaveli State University

Faculty of Natural Sciences and Health Care

Department of Biology

"Fern Diversity and Bioecology of Adjara Flora Region"

This dissertation is submitted for gaining the academic degree of Doctor of Biology

Thesis Synopsis

Speciality: **Biodiversity**

Batumi

2017

The actuality of the Research:

Ferns are one of the oldest groups of the supreme vegetation of Tracheophyta the origin of which is related with the Devonian period of Paleozoic era. Studying of ferns is mostly interesting in a view point of formation and further recognition the development of flora and vegetation.

As representatives of the oldest flora, the ferns have been suffering anthropogenic influence for a long time, therefore the current condition of the ferns have to be studied for their future protection. Today there are known at about 15 thousand species of ferns from 750 families. The ferns are warmth and moisture amateur plants and the most diversity of species are represented in the tropical and sub-tropical regions of both hemispheres of the earth. Fern diversity is being decreased from the South towards the North. In the modern flora of temperate climate there are fixed at about 2 thousand species of ferns. Regions of Borealis are not distinguished of much diversity of ferns.

Separate representatives of Gymnosperms and Angiosperms (flowering plant) are the main objects of the research in Adjara floral region. The ferns as one of the oldest groups of supreme vegetation of tracheophyta are less studied. Nowadays, there are at about 52 species recorded in Adjara according to the conducted research and on the base of existing literature in this field. This fact shows the considerable diversity of the plants. Most of them play vital role in the vegetation. Study of the ecology of ferns, biodiversity and their distribution peculiarities, intentionally and by the means of complex methodology have not been done before. Due to this, complex study of ferns in Adjara region is very much important as it makes clear picture on their systematic and geographical structure, on spreading separate species and on their role and characteristics in the communities.

Studying of fern species in a view point of their catering, technical-decorative values is also not less important. Most of them are used in traditional medicine. Thus, study of ferns' biodiversity and ecology in their natural location is very much important in order to reveal promising species, their protection and future multiplication.

Deeper study and analysis of vertical and horizontal spreading characteristics of the vegetation in compliance with the conditions (Relief, climate, soil) of Adjara flora region, as

well studying of the current condition of ferns within the basic types of vegetation (forests, valleys) will greatly enable to save the ferns and to use them firmly in the future which is most active.

Structure and content of the thesis:

The thesis consists of 7 chapters: literature review, research object and methodology, experimental part, conclusions and bibliography. (List of tables-7; diagrams-5; pictures-29; bibliography-144; appendix-1).

Goal and objectives of the research:

The goal of our research was complex study of ferns spread in the floral region of Adjara. Namely: systematic and geographical analysis of the structure, studying of biological and spread peculiarities, investigation of rare and the ferns under threat of extinction, their current situation and importance in a view point agriculture.

The following objectives were set up in order to study the mentioned issues:

- To justify the species of ferns widespread in floral region of Adjara;
- To justify systematic structure of pteridophyte on Adjara flora region in accordance with modern nomenclature;
- To justify geographical structure of Adjara pteridophyte flora;
- To study variety of plant life forms of adult fern sporophyte;
- Botanical-geographical (vertical-zonal, ecotopological-coenosis) analysis of Adjara pteridophyte flora;
- To reveal rare species of ferns widespread in Adjara floral region and to develop protection events on the base of their current analysis;
- To summarize existing data about promising species of ferns widespread in Adjara flora region in a view point of their different importance (technical, medical, decorative).

The object and Methodics of the Research:

The research object were the ferns widespread in the whole territory of Autonomous Republic of Adjara in order to justify the areas of their spreading and analyses the separate fern species and their composition. Field data were mainly collected on the lowlands of Kobuleti and Kakhaberi, also on the mountain ranges and mountain branches of Adjara-Imereti, Arsiani and Shavsheti and mountain offshoots on the ranges of –Chakvi, Kobuleti and Chaneti. There data was also collected in the area of main rivers of Adjara: Kintrishi, Chakvistkali, korolistkali, Acharistskali, Chorokhi and in the ravines of their tributaries, in all types of vegetation formations, groups of association and zones 0-2793 m from the sea level.

The basic methodologies of the research were traditional route, expedition-excursions, also the methodology of herbarium collection and its biological treatment. We used to collect herbarium in 2013-2016 and for this purpose we visited every region of Adjara many times. Separate types of herbarium were collected in the different phases of development according to the Skvortsov (Скворцов, 1977) methodology. We collected at about 800 herbarium samples which were given to the fund of Batumi Botanical Garden herbarium. We used to identify plants by the means of Adjara (Дмитриева, 1990) and Georgia plant identifiers (1964; 1969) and "Georgian flora"(1971, volume 1, Флора СССР (т.I, 1934) as well. We used to grant systematic status to plant by using Systematic nomenclature and comparison of Cherepanov (Черепанов, 1995), Конспект флоры Кавказа-ს (т.I, 2003), www.theplantlist.org. Except of own materials, we also used herbariums of Batumi, Tbilisi botanical gardens and Herbarium of botanical garden of Bonn University, Germany (BATU, TBI). We fulfilled multiple floral and Geo-botanical description and general phenological observation.

Scientific Novelty of the Research: At the first stage we conducted a complex study of bio-morphology, ecology, geography and importance of the ferns widespread in the floral region of Adjara.

- Composition and systematic structure of pteridophyte flora of Adjara was justified according to the modern nomenclature;

- It was the first time when new species of fern was found out by us for Georgia and Adjara;

- The geographical structure of pteridophyte flora of Adjara was justified;

- The plant life forms of variety of ferns of Adjara were justified;

- Vertical-zonal and ecological-coenosis spread regularity are studied for the separate ferns species;

- Rare and fern species under the threat of extinction were justified;

- The list of useful fern species was also justified;

- Summarized list of Adjara flora fern species is composed and there are given following characteristics for each of them: spreading in vertical zone of vegetation, their exact location, biotype, status of rarity and importance.

Collection plot of ferns was created in Batumi Botanical Garden while working on the dissertation where 38 species of ferns widespread in Adjara are gathered there.

Review of the Literature: The results of literature review are analyzed in the first chapters of the doctoral thesis. Systematic structure of ferns of Adjara floral region and soil-climate condition characterization are also given; there is a list of methodology used while research and appendix of the bibliography is also enclosed to the thesis.

Critical species of ferns in Adjara floral region

Possession of the specific species is impossible for some regions without justification of systematic status; if considering the fact that the issues of taxonomy and widespread of some species are still arguable. While studying pteridophyte flora of Adjara and justifying the composition of species the discussion covered some species of ***Dryopteris*** genus also.

Some arguable issues related to the species of Pteropsida in Adjara and the topics of systematic possession are also well discussed in the work of Askerov (1983).

1.***Dryopteris liliana*** Golitz. was described by Golitzin in 1983. However the independence of the species was criticized by Groshame (1939) the opinion of whom was also shared by Sosnovski (1941) and accordingly the species was not entered "The Georgian Flora". In 1941 Golitzin publishes the work on "the issues of *Dryopteris liliana* Golitz." in 1941, step by step formulating his own positions about the independence of the species. After the publishmenet of this work *Dryopteris liliana* is mentioned as the independent species in all botanical works of Caucasus (Гроссгейм,1949; Дмитриева, 1960; Колаковский, 1961; Долуханов, 1966; Флора Грузии, 1971), but in 1974 English pteridologist Frazer-Jenkins put the issue of independence of the species under suspension and equated it with *Dryopteris aemula.*

Thus, it is much important to identify the issue of systematic possession of *Dryopteris liliana* in Caucasus flora.

We quote the opinions and assertions of famous pteritologist Askerov in relation with the mentioned issue: He compared the samples of herbarium of *Dryopteris aemula* and *D.liliana.* He received herbarium of *Dryopteris aemula* from Frazer-Jenkins, collected on the islands of Azores and he compared those samples to the *D. Liliana* ones existed in the herbarium in of the institute of Tbilisi botanical garden and on the area of their classical distribution (village Thikhisdziri). After the critical study of these samples he concluded the following (we quote them identically from the work of author 1983):

1. *Dryopteris liliana* is well differed from *Dryopteris dilatata*-by the morphology of leaf plate, namely, leafs segment of *Dryopteris liliana*- is puffed out from the back side gaining the plant its own face;

2. According to Golitzin, *Dryopteris liliana* is more likely Atlantic species *Dryopteris aemula*-(1941);

3. Also, we can't agree with English pteritologist Frazer-Jenkins with the identity of *Dryopteris aemula* and *Dryopteris liliana,* as these two species are different from each other with some morphological (form of leaf plate, quality, cortex and fluff), anatomical (the quantity of passing branches), biochemical composition (having or not having the smell of coumarin), sign and distribution peculiarity. Therefore, we consider *Dryopteris liliana* as a sub –species of *Dryopteris aemula.*

4. According to the modern opinion, *Dryopteris aemula* is Atlantic-Colchis species with irradiations in the East Turkey;

5. *Dryopteris aemula*, -as it seems, was distributed in more moisture conditions of the Atlantic coast. After it started migration up to the East till Colchis. In Pliocene, deterioration of environmental conditions caused colossal separation of *Dryopteris aemula* area;

Thus, according to Askerov *Dryopteris liliana* is not the other species but it is a sub-one of Dryopteris *aemula= Dryopteris aemula (*Aiton) O.Kunze. *ssp. liliana* (Golitz.) A. Asker.

2. *Dryopteris alexeenkoana* Fom., It is the second critical species in a view point of systematic possession. Some European pteridologist think that it is identical to *D.dilatata.* As it is visible from Askerov's researches typical herbarium of *Dryopteris alexeenkoana* is more likely to *D. Dilatata* one from the West Europe. However, there are much distinctive signs among them, namely: *D.alexeenkoana* has bright green leafs with puffed out plates and segments; it is different with anatomical structure and specific smell also (Наврузова, Аскеров, 1981).

Thus, Askerov claims that ***Dryopteris alexeenkoana*** is the West-European-Colchis sub species of *D. dilatata* =***Dryopteris dilatata*** (Hoffm.) A. Grey. Ssp. ***alexeencoana.***

As for the critical species- ***Dryopteris kemularia*** Mikel.,as it is considered by Askerov is the same as ***Dryopteris remota*** which is in fact recorded in Europe (Switzerland, Baden) and represents very hibridogenious and frutfuil species. It is one of the European species of

Dryopteris genus, the East border of which is situated exactly in Caucasus. It was found and recorded by Mikeladze for the first time in Adjara in 1959 as the new species - *Dryopteris alexeenkoana.* In Caucasus, ***Dryopteris remota*** is speared in Adjara, Abkhazia, Upper Imereti and it even reaches the North Ossetia.

Scientists, co-workers of botany institute partially agree with these analysis and conclusions made by Askerov in the revised publication "Conspectus of Caucasus Flora" (2003), where they claim that ***Dryopteris remota*** is identical to ***Dryopteris kemularia,*** but as for ***D.liliana*** and ***D.alexeencoana*** they say that they are independent species and not sub-species as they are discussed on Askerov's works.

We agree with systematic structure of genus ***Dryopterisis***- which is given in the conspectus of Caucasus flora, as this is the newest and most modern literature data and besides these species are found in nature and we compared them critically with the herbarium data.

Variaty of nonindigenous (adventive invasional) ferns of Adjara flora region

Sub-spontaneous plants are one of the categories of nonindigenous plants distributed in the nature from the culture (Kikodze 2010).

One of the objects of our research were the ferns distributed in Batumi botanical garden and indigenous ferns of Black Sea flora and vegetation while studying sub-spontaneous (Sub-spontaneous plants are one of the categories of nonindigenous plants distributed in the nature from the culture (Kikodze 2010) distributed ferns in Adjara. While literature review, we paid attention to the data about flora of the West and South-West Georgia where vegetation of Adjara flora region is also represented. From the existed literature it is found out that nonindigenous ferns are only met in Adjara flora region and nonindigenous, cryptogamous species of the highest plants have not been met yet neither on the North nor central Colchis adventive floras.

Information about nonindigenous fern origin and distribution is given in "Adventive flora of Adjara" (Davitadze 2011):

Cyrtomium falcatum -is the South-Asian perennial grass, introduced in Batumi botanical garden. Nowadays it is distributed in the secondary grasses of Chakvi and Batumi sea coasts alongside the indigenios ferns (Davitadze 2001).

Adiantum cunneatum -is the Brazilian perennial grass. Wild species were collected for the first time in the areas of Green Cape in 1956. Distributed mainly in the secondary plant groups at Batumi-Chakvi roadside moist slopes.

Dryopteris atrata - is the East Asian perennial decorative plant. Collected in the areas of Green Cape for the first time in 1958. Nowadays distributed in the secondary grassy plants at the coastal parts.

Onoclea sensibilis -is the East Asian decorative fern; it is planted in Batumi parks. Wild ones are collected in 1967 in the areas of Green Cape and under the crones of tree-plants of Batumi parks. Nowadays they are met on moist grassy slopes of Batumi- Chakvi areas.

Pteris vittata -is the perennial plant of the Mediterranean sea Wild ones are collected in Batumi botanical garden and the areas of green cape. Nowadays they it is distributed on dry grassy slopes of Batumi and Chakvi (Davitadze 2002);

According to the latest literature data (The alien flora of Georgia, Kikodze 2010) there were fixed 5 species of nonindigenious, sub-spontaneous ferns in the flora region of Adjara: *Cyrtomium falcatum* Sm.; *Dryopteris atrata* (Well.) Ching.; *Onoclea sensibilis* L., *Pteris vittata* L., *Adianthum cuneatum* Langst. et. Eish.

On the base of Batumi botanical garden herbarium, processing of literature sources and the research results, nowadays there are recorded 8 species of 6 genus of 4 family's sub-spontaneous ferns by us in the flora region of Adjara. All these species are perennial grassy plants (table 6). (Vasadze 2015).

While analysis of systematic structure of sub spontaneous ferns distributed in Adjara, it is found out that they are united in five families: *Pteridaceae* (3 species), *Dryopteridaceae* (2 species), *Dennstaedtiaceae, Onocleaceae and Nephrolepidaceae* (one species) and in 7 genis: *Adiantum* (1 species), *Cyrtomium* (1 species), *Dryopteris* (1 species), *Hypolepis* (1 species), *Onoclea* (1 species), *Pteris* (2 species), *Neprolepis* (1 species).

Sub spontaneous ferns of Adjara flora region are distributed according to their origin in the following order: Eastern species - 4 species: *Cyrtomium falcatum* (L.f.) C. Presl, *Dryopteris*

atrata (Nallich.) Ching., *Hypolepis punctata* (thumb.) Mett ex., *Onoclea sensibilis* L., Mediterranean - 1- *Pteris serrulata* Forssk., African 1-*Pteris vittata* L., Tropical 1-*Nephrolepis exaltata* (L.) Schott, South American 1 - *Adiantum cunneatum* Langst. et Eish.

Table 1.

Variety of Sub-spontaneous ferns of Adjara Flora region

Species	Family	Place of Origin	Life form	Protection Status
Adiantum cuneatum Langst. et. Eish.	*Pteridaceae*	South America	Perennial grass	
Cyrtomium falcatum (L. f.) C. Presl	*Dryopteridaceae*	East Asia	Perennial grass	
Dryopteris atrata (Nallich.) Ching.	*Dryopteridaceae*	East Asia	Perennial grass	
Hypolepis punctata (thumb.) Mett ex Kuhn	*Dennstaedtiaceae*	East Asia	Perennial grass	
Onoclea sensibilis L.	*Onocleaceae*	East Asia	Perennial grass	
Pteris vittata L.	*Pteridaceae*	Africa	Perennial grass	LC ver 3.1
Pteris serrulata Forssk.	*Pteridaceae*	the Mediterranean sea	Perennial grass	
Neprolepis exaltata (L.) Schott	*Nephrolepidaceae*	Tropical	Perennial grass	

Habitats of sub-spontaneous ferns distributed in Adjara are allegedly similar to the ones distributed in their native lands.

At the eco-type of dry rocky slopes, at the stony places and on the walls of rocks are met the following species: *Cyrtomium falcatum* (L. f.) C. Presl., *Pteris vittata* L., *Pteris serrulata* Forssk. *Adiantum cunneatum* Langst. et. Eish –is the species for wet rocky site.

In the forest eco-type, there are met: *Dryopteris atrata* (Nallich.) Ching., *Hypolepis punctata* (thumb.) Mett ex Kuhn.*Onoclea sensibilis* L., And *Nephrolepis exaltata* (L.) Schott-is distributed in moisture valley eco-type.

More frequently are met the following species of ferns in Adjara flora region: *Cyrtomium falcatum* (L. f.) C. Presl, *Dryopteris atrata* (Nallich.) Ching., *Hypolepis punctata* (thumb.) Mett ex Kuhn, *Neprolepis exaltata (L.)* Schott., *Onoclea sensibilis* L, but *Pteris vittata* L., *Adiantum cuneatum* Langst. et. Eish. and *Pteris serrulata* Forssk are more seldom.

Only one species- *Pteris vittata* L. Is protected by „IUCN" Internation Union for Conservation of Nature) from Adjara flora region sub-spontaneous ferns.

On the base of our research it was found out that from the 8 species of Adjara flora region ferns, 7 have the ability to develop spores which are cropped up and as a result the species are renewed and multiplied. *Adiantum cunneatum* Langst. et. Eish., *Onoclea sensibilis* L., *Pteris serrulata* Forssk can multiply as by spores as well vegetatively; *Nephrolepis exaltata* (L.) Schott is mainly multiplied vegetatively by the mean of root, however its multiplication by spores is also possible. From these last three species the fastest are multiplied the following species: *Onoclea sensibilis* L., *Nephrolepis exaltata* (L.) Schott and *Hypolepis punctata* (thumb.) Mett ex Kuhn.

As a result of our research it was revealed that ***Hypolepis punctata*** (thumb.) Mett ex Kuhn, is most widely distributed from sub-spontaneous species of Adjara ferns. This is the newest fern species for Adjara and whole Georgia and it is recorded for the South Caucasus for the first time. We suppose that the species is adventive (pic.6).

pic 1. *Hypolepis punctata*

Random non-indigenous plants the introduction of which was made by human activity, are also adventive (Kikodze 2010).

Hypolepis punctata (Thunb.) Mett. ex Kuhn, Fil. Afr.: 120. 1868; Tardieu & C.Chr., Fl. Indo-Chine 7(2): 101, f. 11.1 & 11.2. 1939; Holttum, Rev. Fl. Malaya ed. 1, 2: 318. 1955 [‘1954’]; Ching, Fl. Reipubl. Popularis Sin. 2: 248. 1959; Tagawa & K.Iwats., SouthE. Asian Stud. 5: 73. 1967; Tagawa & K.Iwats., Fl. Thailand 3: 124, f. 9.1–9.3. 1979; Boonkerd & Pollawatn, Pterid. Thailand: 39, 86. 2000. – *Polypodium punctatum* Thunb., Fl. Jap.: 337. 1784. This is the perennial, fern, roots with the height up to 1, 5-2 m; the diameter of the root is 0,5mm, and they are long, prostrated and covered by red-brownish hairs. The composition of leaf is beige and it is darkened at the bottom 35-50 mm. the leaf plate is longish with sharpened tips and widened at the root with triple, quadruple wings 4070 mm in length and 40 sm wide. The leaves are located on several tiers; leaves on the first lower tier are opposite with longish, triangle form, sharpened with the length of 30 sm and 20 sm at width; the size of upper tier leaves are redusing. Soros are roundish, light without covering.

It is grown up at the lower part of the forest zone mainly distributed on the road sides, alongside the channels, at the forest bags and abandoned places. Generally, they are met on red grounds in the nature; on the sunny, light places and very seldom at shadow ones. They create pure groups in the nature and also very often they are met with *Pteridium tauricum* at the place of its distribution, which they are similar to. The area of distribution: Batumi botanical garden and nearby territory, Bobokvati, Gonio, Sarp, Sakhalvasho until Keda district.

The general distribution: Cambodia, Japan, Korea, Laos, Malaysia, Australia, Tropical America (pic. 7).

სურ. 2. *Hypolepis punctata* (Thunb.) Mett. ex Kuhn.

Systematic Structure of Adjara Ferns

On the base of the literature and the results of our research, according to the modern classification of the plants (Theplantlist.org, 2014), pteridophyte flora of Adjara flora region is presented with 27 genus and 52 species of 14 families.

The leading families of ferns species in a view point of quantity are the following: *Dryopteridaceae* – 15, *Aspleniaceae* – 9, *Pteridaceae* – 8, *Ophioglossaceae – 3, Thelypteridaceae – 3, Athyriaceae – 2, Cystopteridaceae - 2, Dennstaedtiaceae*-2, *Onocleaceae* - 2, *Polypodiaceae – 2* species.

The leading genus in a view point of quantity are the following: *Dryopteris* – 9, *Asplenium - 7, Polystichum* – 5, *Pteris* – 3, and *Athyrium, Ophioglossum* და *Polypodium* –are represented by two species.

There are the families represented only one species: *Blechnaceae*, *Hymenophyllaceae, Osmundaceae, Woodsiaceae.*

Genus represented only by one species are the following: *Anogramma, Blechnum, Botrychium, Ceterach, Cryptogramma, Cystopteris, Hymenophyllum, Hypolepis, Notholaena, Cyrtomium, Gymnocarpium, Struthiopteris, Onoclea, Oreopteris, Osmunda, Phegopteris, Thelipteris, Phyllitis, Pteridium, Woodsia.*

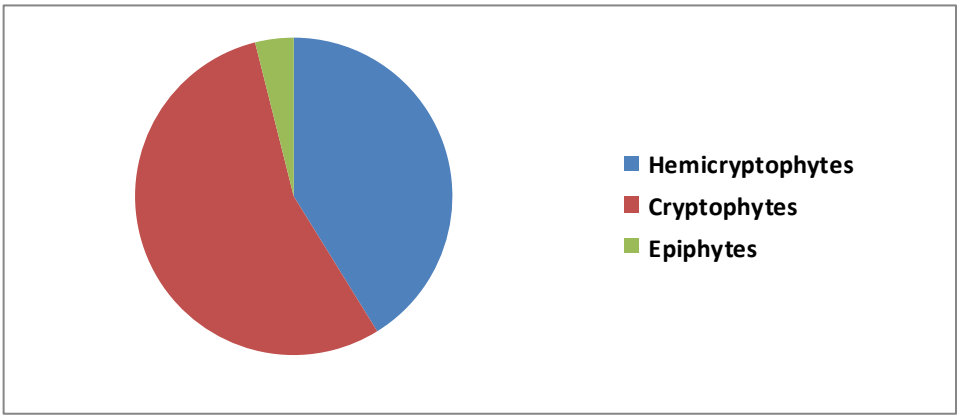
Systematic of Adjara flora region ferns: Table 2.

Phylum	1 - Polypodiophyta
Classis	2
Subclassis	1
Ordo	9
Family	14
Genus	27
Species	52

Biological Peculiarities of Adjara Pteridophyte Flora

Plant life forms and the generic variety of organs of the ferns are discussed under the biological peculiarities of Pteridophyte flora of Adjara.

The classification of Danish botanist Raunkiaer (1905; 1907) especially must be admitted from the many classifications of the plant life forms, which is formed on peculiarities of buds location on renewed ground in the unfavorable conditions and on peculiarities of buds protection cover. This classification is widely used for ecological and phytoceonelogical researches. Raunkiaer distinguished 5 types of plant life forms of plants: Phanerophytes; Chamaephytes; Hemicryptophytes; Cryptophytes and Therophytes. Ferns of Adjara are united in two of these types. It should also be mentioned that, from the above listed ferns some of them are **Epiphytes,** which are grown on different parts of the plant (stem, branches), but they do not get food from these parts, i.e. they are not parasites. From the Adjara ferns the typical Epiphytes are: *Polypodium australe* და *Polypodium vulgare*.



Daigram1. Correlation of plant life forms of Adjara Pteridophyte flora

The next famous and widely used classification belongs to Seberiakov (1965). The mentioned classification is based on peculiarity of above ground branching, the degree of timbering, life duration and fruitful peculiarities. According to this classification plant life forms are united in 4 groups: Coniferous, semi coniferous, grasses and water plants.

According to this classification all representatives of Adjara pteridophyte flora are united in grasses.

Poly-carpos plants are distinguished in the group of plant life forms itself which are multi fruitful and mono-carpos and their life cycles lasts only one or several years- the bloom one time, get fruitful and fade away.

According to our researches and on the base of the literature data it is revealed that all species of Adjara pteridophyte flora belong to grassy poly-carpos plants, i.e. to perennial grassy plants. The following is distinguished among them:

1. **Long Root, Non rosette and Rosette ferns,** -34 species of the ferns of our flora belong to this group: *Adiantum capillus veneris, A.raddianum, Athyrium filix - femina, A.alpestre, Cyrtomium falcatum, Cystopteris fragilis, Dryopteris atrata, D.filix-mas, D.affinis, D.austriaca, D.oreades, D.remota, D.alexeenkoana, D.liliana, D.carthusiana, Gymnocarpium dryopteris, Hymenophyllum tunbrigense, Hypolepis punctata, Matteuccia struthiopteris, Notholaena marantae, Onoclea sensibilis, Ophioglossum vulgatum, Oreopteris limbosperma, Osmunda regalis, Polypodium australe, P. vulgare, Polystichum aculeatum, P.braunii, P.lonchitis, P.setiferum, P.woronowii, Pteridium tauricum, Phegopteris connectilis,Thelypteris confluens.*

2. **Short Root, Non rosette and Rosette ferns,** -18 species of the ferns of our flora belong to this group: *Anogramma leptophylla, Asplenium viride, A.trichomanes, A.septentrionale, A.ruta-muraria, A.cuneifolium, A.pseudolanceolatum, Asplenium adiantum-nigrum, Asplenium scolopendrium, Blechnum spicant, Botrychium lunaria, Ceterach officinarum,* Cryptogramma crispa, *Ophioglossum lusitanicum*, Pteris cretica, *P.vittata, P.serrulata, Woodsia alpina*.

Sterile and fertile leaves are typical for ferns. Sporangium is not developed on sterile leaves. Sporal, i.e. fertile leaves are additionally developed on such ferns which are different from sterile ones. Exactly according to the variety of fertile leaves pteridophyte flora of Adjara is divided into three groups:

1. Ferns, which develop spores on the lower side of the leaf and in this case, sterile and fertile leaves are not different from each other; **they are represented with 43 specie**s.

2. Ferns with ear gathered spores, fertile leaves which are separately developed and are totally different from the sterile leaf, **are presented with 5 species.**

3. Ferns, the leaves of which are clearly divided into two parts: lower unfertile, green sterile and upper dark color spore parts, **are represented with 4 species.**

Geographic structure of Adjara pteridophyte flora

As a result of data processing it is revealed that, geographical structure of ferns is quite various for those distributed in Adjara flora region.

We guided by the scheme on phyto-geographic separation suggested by Gagnidze (Gagnidze 1996) in order to distinguish geographical groups of pteridophyte flora.

Gagnidze suggested the scheme where the earth is divided into phyto-geographic spheres and districts, according to which there are distinguished eight phyto-geographic world with its sub-world. If the fern is distributed in more than three phyto-geographic worlds, we united them in cosmopolitans.

Table 3.

Collation of Geographic groups of Adjara ferns

Geographic Group	Quantity	% from total amount of the species
Cosmopolitan	20	38.46 %
Holarctic World	8	15.39 %
Sub districts of Holarctic world and Palearctic one	14	26.92 %
Paleotropic World	2	3.84 %
The oldest Miditerranean Sea World	8	15.39 %
In total	52	100%

Ecological-Cenozoic Analysis of Adjara Pteridophyte flora

The most parts of ferns of Adjara flora region are characterized by diversity; the mentioned is expressed by the fact that one can meet the same species in totally different eco-type, forest or rocks. However, we put the species under the groups during ecological-Cenozoic analysis according to the species adaptation to this or that eco-type and according to fact where these species are frequently met. According to this the three groups were distinguished: 1. Forest ecotype species; 2. Petrophytes-lithophytes and Chasmophytes (types of rock species); 3. Valley Species.

Corallation between Ecologic-Cenozoic groups of the species of Adjara flora region is clearly expressed on the bellow given diagram (Diagrame 2).

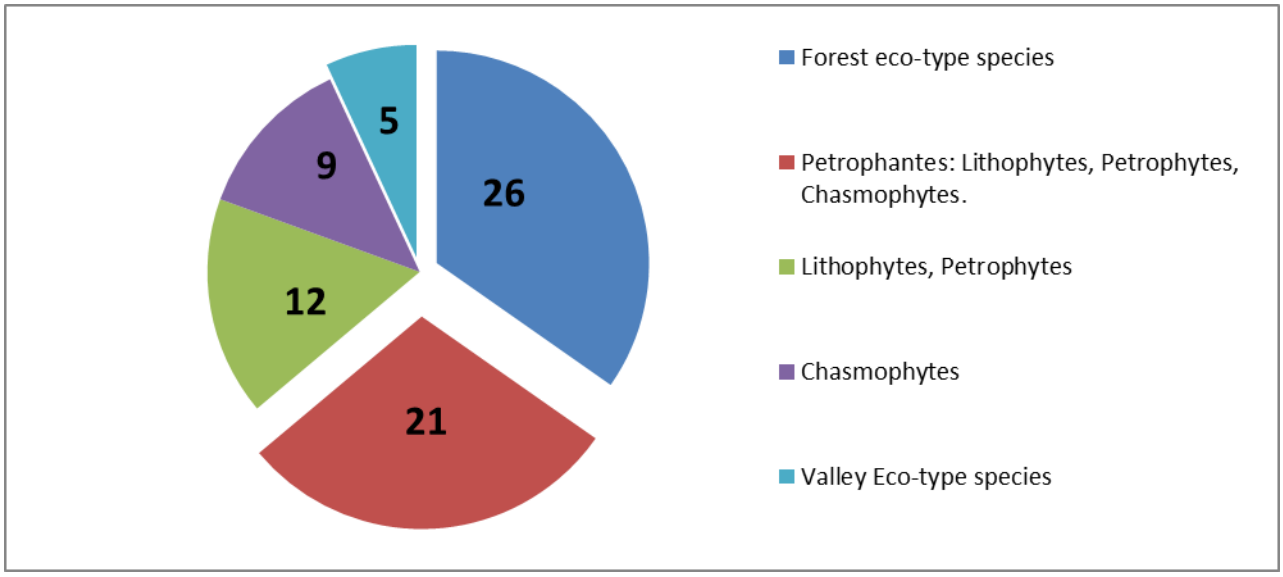


Diagram 2. Ecological-Cenozoic Analysis of Adjara Pteridophyte flora

We grouped ferns widespread in Adjara flora region according to their attitude towards the moisture and light on the base of literature data and expeditions arranged in Adjara flora region.

Moisture is one of the most vital components for ferns grow and development, as water is necessary component for spores to be formed as adult gametophyte.Although the research results showed that all ferns do not have the same attitude towards this factor. We put the ferns distributed in Adjara flora region into three groups according to their attitude towards moisture: Mezophytes-37; Higrophytes-5 and Xerophytes-10.

The researches clearly showed that dependence of representatives of Adjara pteridophyte flora is different towards the light, exactly this fact gave us the reason to distinguish three groups of ferns: 1. Light amateur (Heliophytes, hemi-heliophytes); 2. Crymophylactic (Hemisciophyets, Scioheliophytes); 3. Shadow amateur (Sciophytes).

Corallation of ecological groups of Adjara pteridophyte flora in dependance with the light is clearly shown on the bellow given diagram (Diagram 3).

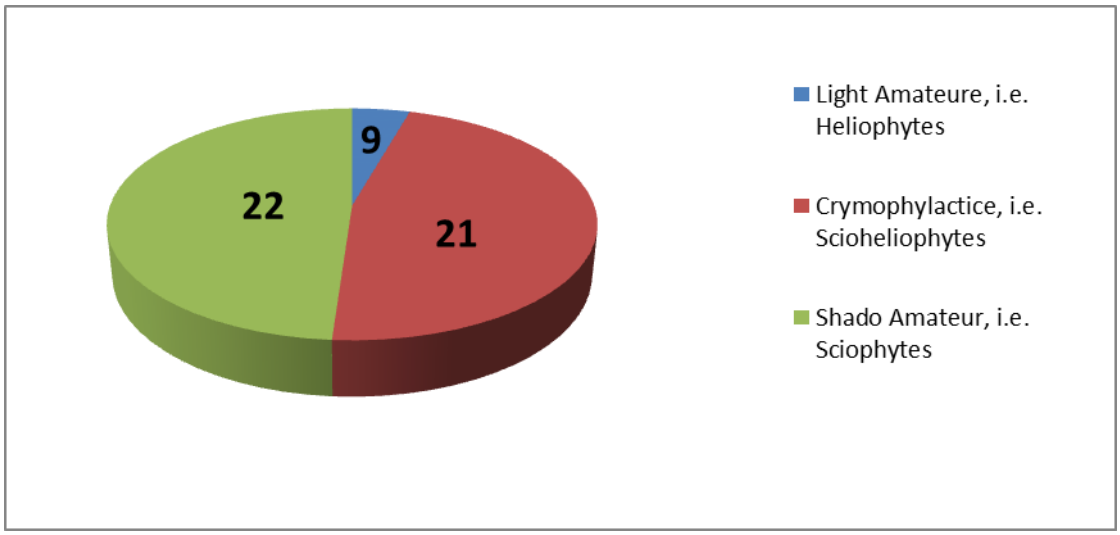


Diagram 3. **Correlation of ecological groups according to light dependence**

Warmth is one of the most important factor among the essential ecological ones for plant growing and development. The following is distinguished among the widespread ferns in Adjara Flora region according to the warmth dependence: microtherm, mesotherm and macrotherm groups.

The bellow given diagram clearly shows the dependence of the ferns on warmth (Diagram 5).

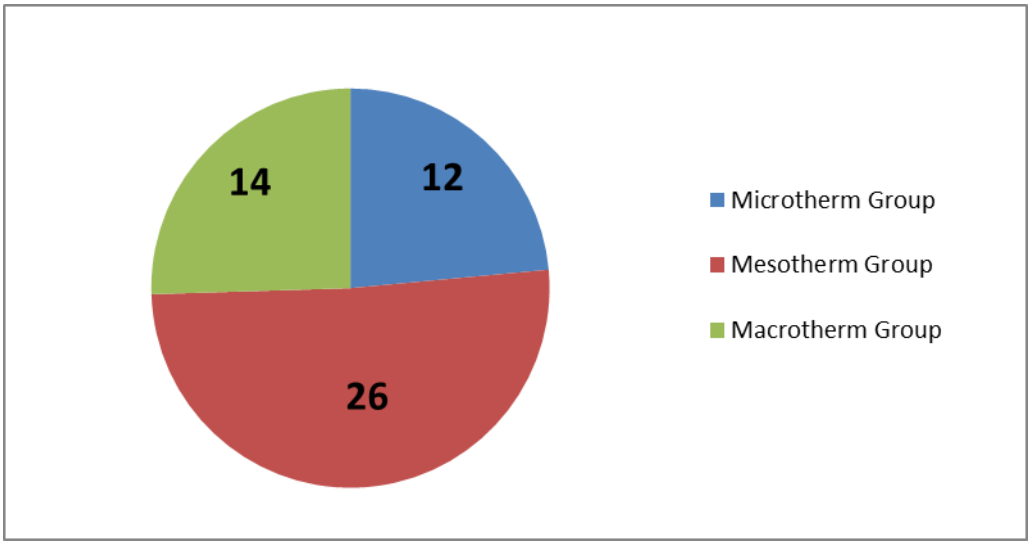


Diagram 4. **Correlation of ecological groups of ferns according to warmth dependence**

Vertical-Zone Analysis of Adjara Pteridophyte Flora

There are two versions of vertical zones due to significant peculiarity of nature-geographical conditions in Adjara:

I. Vertical climate of coastal vegetation in Adjara (The North and South expositions are mostly similar):

I.1. Low Coastal Vegetation from 0-till 15-25- above the sea level, where the vegeatation of coast sands, bogs and ponds are met. There are met 7 species in this vegetation from Pteridophyte flora of Adjara: *Adiantum cappilus veneris, Adiantum cunneatum, Asplenium scolopendrium, Cyrtomium falcatum, Blechnum spicant, Opioglossum lusitanicum, Ophioglossum vulgatum, Onoclea sensibilis, Osmunda regalis, Polypodium australe, Pteridium tauricum.*

I.2. Mixed deciduous polydominant foliage forest – is the lower step of forest zone (the lower zone of mountain) from 15-25 m up to 550-600 m of the sea level, represented mainly by: Hornbeam, Beech, Alder, Chesnutt, Diospyros, Common fig, Maple, Willow, Holly, Rhododendron ponticum, Prunus laurocerasus, Rhododendron luteum, Hedera, Smilax and Rubus fruticosus. The following fern species are distributed on this forest zone: *Asplenium scolopendrium, Asplenium trichomanes, Asplenium adiantum-nigrum, Athyrium filix-femina, Blechnum spicant, Dryopteris austriaca, Dryopteris alexeenkoana, Dryopteris liliana, Dryopteris filix-mas, Dryopteris affinis, Hymenophyllum tunbrigense, Hypolepis punctata, Matteuccia struthiopteris, Oreopteris limbosperma, Opioglossum lusitanicum, Ophioglossum vulgatum,*

Polystichum aculeatum, Polystichum braunii, Polystichum setiferum, Polystichum woronowi, Pteris cretica, Pteris vittata, Pteridium tauricum, Polypodium australe, Polypodium vulgare.

I.3. Chesnutt Forests – it is the middle step of the forest zone (middle zone of a mountain) from 500 up to 1100 m, with participation of: Hornbeam, Beech, Alder, Staphylea, Caucasus Diospyros, Maple, Holly, Rhododendron ponticum, Prunus laurocerasus, Hedera and Smilax. The following fern species are distributed on this sub-zone:*Athyrium filix-femina, Asplenium adiantum-nigrum, Asplenium scolopendrium, Asplenium trichomanes, Blechnum spicant, Dryopteris affinis, Dryopteris filix-mas, Dryopteris oreades, Dryopteris austriaca, Dryopteris alexeenkoana, Matteuccia struthiopteris, Oreopteris limbosperma, Phegopteris connectilis, Polystichum woronowi, Polystichum setiferum, Polystichum aculeatum, Polystichum braunii, Pteris cretica, Pteridium tauricum, Polypodium vulgare.*

I.4. Beech Wood Is the upper step of the forest zone (middle mountaneous zone) from 1200-1300 up to 2000-21000 m. with evergreen forests of Beech, Spruce, Abies nordmanniana, Maple, Birch, Viburnum, Hedera and evergreen sub-forest. The following fern species are presented here: *Athyrium alpestre, Athyrium filix-femina, Asplenium adiantum-nigrum, Asplenium scolopendrium, Asplenium septentrionale, Asplenium trichomanes, Blechnum spicant, Dryopteris austriaca, Dryopteris filix-mas, Dryopteris oreades, Dryopteris pseudo-mas, Dryopteris spinulosa, Gymnocarpium dryopteris, Oreopteris limbosperma, Phegopteris connectilis, Polystichum aculeatum, Polystichum lonchitis, Polystichum setiferum, Polystichum aculeatum, Polystichum braunii, Pteridium tauricum, Polypodium vulgare.*

I.5. Sub-alpine, forest-valley zone. Sub-Alpine zone (high mountainous), from 2000-2100 m up to 2300-2350 m from the sea level, with the participation of curved beech woods, Betula medwedewii, high mountainous Maple, Rowan, high grasses, various grassy valleys and evergreen Colchis sub-forest. The following fern species are presented here: *Athyrium alpestre, Asplenium pseudolanceolatum, Asplenium scolopendrium, Asplenium septentrionale, Asplenium viride, Blechnum spicant, Cystopteris fragilis, Cryptogramma crispa, Dryopteris austriaca, Dryopteris filix-mas, Dryopteris spinulosa, Gymnocarpium dryopteris, Oreopteris limbosperma, Phegopteris connectilis, Polystichum aculeatum, Polystichum lonchitis, Polypodium vulgare.*

I.6. Alpine Zone - Low grassy and granular carex valleys with the participation of woodlands and scrubs from 2350 m up to 2600 m above the sea level involving Rhododendron caucasicum, Empetrum, Vaccinium, Juniper, Rosa canina and Daphne. The following fern

species are presented here: *Asplenium septentrionale, Asplenium viride*, *Cystopteris fragilis, Gymnocarpium dryopteris, Oreopteris limbosperma*.

II. Internal Mountinous vertical Zone.

Vertical zone of the vegetation of internal mountainous and coastal Adjara vary from 150 m up to 2000 m of the sea level; The following is distinguished here:

II.1. a. Mixed deciduous polidominant, foliage, Colchis forest from 150 m au to 500 m from the sea level with representation of Chesnutt, Hornbeam, Alder, Chorokhi oak, Staphylea, Prunus laurocerasus, Rhododendron ponticum, Buxus, Hedera, Smilax, Prunus laurocerasus and Diospyros. The following fern species are presented here: *Asplenium adiantum-nigrum*, *Asplenium scolopendrium, Asplenium trichomanes, Athyrium filix-femina, Blechnum spicant, Dryopteris alexeenkoana, Dryopteris austriaca, Dryopteris liliana, Dryopteris affinis, Hymenophyllum tunbrigense, Hypolepis punctata, Matteuccia struthiopteris, Oreopteris limbosperma*, *Polystichum woronowi, Polystichum setiferum, Polystichum braunii, Pteris cretica, Pteridium tauricum, Polypodium australe, Ophioglossum vulgatum.*

II.1. b. Colchis Foliage Forest The following fern species are presented here: from 300 m up to 500 m from the sea level with the participation of Hornbeam, Chorokhi Oak, Chesnutt, Alder, Diospyros, Rubus fruticosus and Rhododendron luteum.

Matteuccia struthiopteris, Dryopteris pseudomas, Dryopteris austriaca, Dryopteris alexeenkoana, Oreopteris limbosperma, Polystichum setiferum, Polystichum aculeatum, Polystichum braunii, Athyrium filix-femina, Asplenium scolopendrium, Asplenium trichomanes, Asplenium adiantum-nigrum, Blechnum spicant, Hypolepis punctata, Pteris cretica, Pteridium tauricum, Polypodium australe, Polypodium vulgare.

II.2. a. The North exposition-Polydominant Colchis Forest -from 500 m up to 1100 m of the sea level, with the representation of: Chesnutt, Colchis and Chorokhi Oaks, Beech, Alder, Hornbeam, Maple, Spurus, Tilia, Staphylea, Slimax, Hedera, Rubus fruticosus and Colchis low wood. The following fern species are met here: *Asplenium adiantum-nigrum, Asplenium scolopendrium, Asplenium trichomanes, Athyrium filix-femina, Blechnum spicant, Dryopteris austriaca, Dryopteris alexeenkoana, Dryopteris filix-mas, Dryopteris liliana, Dryopteris affinis, Matteuccia struthiopteris, Oreopteris limbosperma, Phegopteris connectilis, Polystichum aculeatum, Polystichum setiferum, Polypodium australe, Polypodium vulgare, Pteris cretica, Pteridium tauricum.*

II.2.b. Exposition of the South –Oak and Pine woods from 500 up to 1100 m of the sea level with the participation of Colchis and Chorokhi Oaks, Pinus sosnowskyi, Juniperuc sabina, Ostrya, Arbutus, Crataegus, Cistus, Rhododendron luteum, Roza canina and Rubus fruticosus. From the ferns here are presented the following species: *Asplenium adiantum-nigrum, Athyrium filix-femina, Asplenium scolopendrium, Asplenium trichomanes, Dryopteris affinis, Dryopteris austriaca, Blechnum spicant, Matteuccia struthiopteris, Notholaena maranthae, Oreopteris limbosperma, Phegopteris connectilis, Polystichum aculeatum, Polystichum setiferum, Pteris cretica, Pteridium tauricum, Polypodium vulgare.*

II.3. Beech woods from 1100 m up to 1800 m of the sea level, with re representation of Rhododendron ungerni, Rhododendron ponticum of smirnow and pontos, Holly, Chesnutt, Pontic oak, Vaccinium, Ruscus hypophyllum, Rubus fruticosus and Hedera. *Asplenium adiantum-nigrum, Asplenium septentrionale, Asplenium scolopendrium, Asplenium trichomanes, Athyrium alpestre, Cystopteris fragilis, Dryopteris filix-mas, Dryopteris oreades, Dryopteris austriaca, Dryopteris carthusiana, Gymnocarpium dryopteris, Phegopteris connectilis, Polystichum aculeatum, Polystichum lonchitis, Pteridium tauricum, Polypodium vulgare, Thelipteris oreopteris*.

II.4. Dark Coniferous forest zone, from 1800 up to 2200 m of the sea level with the representation of Spurus, Abies, Birch, Rhododendron ponticum, Maple, Rhododendron luteum and Rubus fruticosus. The following ferns are distributed in this zone: *Asplenium septentrionale, Athyrium alpestre, Cystopteris fragilis, Dryopteris carthusiana, Dryopteris filix-mas, Gymnocarpium dryopteris, Polystichum lonchitis, Polystichum aculeatum, Polypodium vulgare, Phegopteris connectilis, Thelipteris oreopteris, Woodsia alpina.*

By the vertical-zonal analysis of Adjara pteridophyte flora it is found out that the large amount of ferns are spread in the forest zone-32 species; a bit less number of ferns are distributed in sub-alpine zone-14 species and in the Alpine zone ferns are represented only with 6 species.

As a result of comparison of fern distribution in interna mounatneous and coastal Adjara vegetation it is found out that ferns: *Adiantum cappilus veneris, Osmunda regalis, Hymenophyllum tunbrigense, Opioglossum lusitanicum* - only distributed in coastal Adjara.Also, all sub-spontaneous ferns are distributed inly in costal Adara region (*Onoclea sensibilis, Cyrtomium falcatum, Adiantum cunneatum, Dryopteris atrata, Pteris vittata, Pteris serrulata,*

Hypolepis punctata). In turn, Xerophyte species, tipical for this zone in distributed only in internal mounetious Adjara: *Notholaena maranthae, Asplenium ruta-muraria, Asplenium woronowii,* which are not met in coastal Adjara region.

Rare Ferns of Adjara

Adjara region is densely populated resort and transit land. The unity of these factors affect the wild flora of the region, causing partial or in some cases even total violation of habitats and this is the precondition of dying out of some species.

Nowadays, 52 fern species are distributed in Adjara Flora region. According to literature sources, data of herbariums of Batumi botanical garden and Tbilisi institute as well as on the base of conducted expedition analysis by us it was found out that 14 fern species are rare form 52 ones in Adjara flora region. More of them are only met in narrow, local places and they are under threat of extinction. The ferns which are met only by single species must be especially protected. Some ferns are only indicated in the literature sources and they are not met in wild flora of Adjara region.

Majority of fern species are characterized with wide ecological valence, accordingly, they are very sensible towards the changes of environment conditions and exactly this fact causes the decrease of their number and puts them under the threat of extinction.

On the base of the literature data and after the result analysis of our research it was established that the rare ferns are 14 species from 10 genus and 6 families: *Adiantum capillus-veneris, Anogramma leptophylla, Asplenium ruta-muraria, Botrichium lunaria, Dryopteris alexeenkoana, D.liliana, D. remota, Notholaena maranthae, Polystichum woronowii, Hymenophyllum tunbrigense, Ophioglossum lusitanicum, Ophyoglossum vulgatum, Osmunda regalis.* Unfortunately, the most part from these species are neither protected nor used in the culture and some of them re only known by literature and they were not found by our research.

Eco-type, Status and the reasons of reduction of the rare ferns are discussed bellow:

1. ***Adiantum capillus-veneris*** L. (pic.3.).

Distribution: The lower zone of the forest. Between Sarp and Gonio on the rock.

On the walls of Gonia fotress, Botanical garden, Tsikhisdziri.

Eco-type: Moisture shadowed ravines, Sea coastal rocks.

Status: protected by IUCN - ,,Red List" LC ver 3.1.

Causes of reduction: Road Construction works.

Note: The quantity of the fern has been decreased in recent years, it is necessary to sow it manually in the areas of its distribution and its implementation in the culture is also needed.

Pic. 3. ***Adiantum capillus-veneris*** L

2. ***Anogramma leptophylla*** (L.) Link (Pic. 4.).

Distribution: The lower zone of the forest, Gonio areas.

Eco-type: Moisture shadowed ravines, Sea coastal rocks.

Status: Entered the "Red Book" of Georgia.

Causes of reduction: Natural rarity; Habitat violation due to road and resort construction works.

Note: According to literature data it was distributed on the moisture walls of Gonio-Sarp, we couldn't find it during our field expeditions.

Pic 4. ***Anogramma leptophylla*** (L.) Link (Università degli studi di Trieste)

3. ***Asplenium ruta-muraria*** Pappe & Rawson (Pic.5.).

Pic 5. ***Asplenium ruta-muraria*** **Pappe & Rawson**

Distribution: Is grown in lower and middle mountainous zones.

Eco-type: Rocky gaps, Stone rocks, rubbles and stone heavy rocks, mainly on limestone.

Status: Is not protected

Causes of reduction: Natural rarity; destroy of rocks.

Note: According to literature data, it was distribute on the walls of Gonio fortress. Unfortunately, it was not found in these places in recent years and we could not find either. During one of our expedition, we discovered its new location-the areas of village Makhuntseti, the ravine of river Adjaristskali. On the South exposition walls in Makhuntseti areas (N41^0 35′224″, E41^0 43′443″, H=430). (Pic.6.).

Pic 6. ***Asplenium ruta-muraria*** - GPS Data

1. ***Asplenium woronowii*** (Christ) Fraser-Jenkins (Pic.7).

Pic. 7. ***Asplenium woronowii***

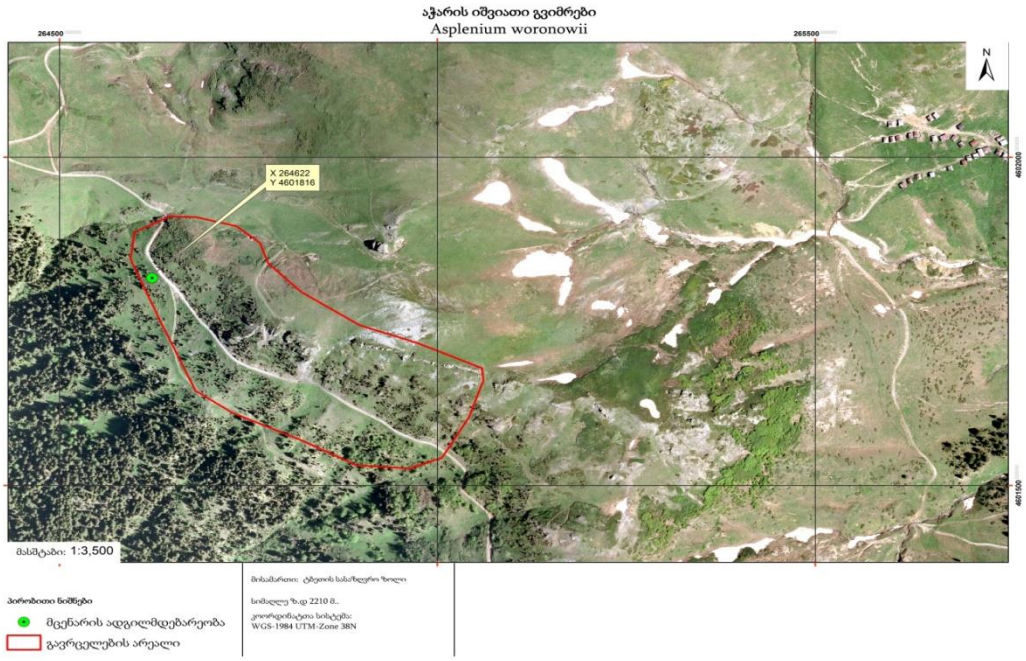
Distribution: Sub-alpine and alpine zones, 2000-2400 m above the sea level, Adjara-Imereti ridge, Sarbiela mountain-2400m.

Eco-type: Shadowed rocks, mainly limestone gaps.

Status: Is not protected, Caucasus endemic, relict.

Causes of Reduction: Natural rarity; violation of rocks.

Note: We noticed the species on Shavsheti ridge, Shuakhevi region, in the border line of mountain Tbeti (N41°10'53", E42°10'53", H-2210), on the Western exposition in the gap of shadowed rock. (Pic.8.).



Pic 8. *Asplenium woronowii* - GPS Data

5. *Botrychium lunaria* (L.) Sw. (Pic.9).

Distribution: In the upper forest, sub-alpine and alpine zones, mountain Somlia, Sakornia, Adjara-Shavsheti ridge, Matskvalta pastures, various grassy valley near Dekiani.

Eco-type: Valleys, sometimes among bushes and grassy slopes of sparse woods, mostly on moisture soils.

Status: Not protected

Causes of reduction: Natural rarity; Graze.

Pic. 9. ***Botrychium lunaria*** (L.) Sw.

***6. Dryopteris alexeenkoana* Fomin** (Pic.10).

Distribution: Upper zone of forest, Kintrishi ravine, forest ravines up to 1300m sarp, Gonio, Botanical garden, coastal ravines.

Ecotype: Broadleaf and Spruce-Abies woods, lower and middle forest zones.

Status: Not protected. Colchis endemic.

Cause of reduction: Natural rarity; Destruction of natural vegetation and human agricultural activities.

Pic 10. *Dryopteris alexeenkoana* Fomin

***7. Dryopteris liliana* Golitsin** (Pic.11.).

Distribution: Tsikhisdziri, mountain Erge, Chakvistavi, near Khino; Dagva ravine-village Dagva. River Dekhva, Mtirala Mountain.

Ecotype: Moisture woods, Rhododendron ponticum woods and shadowed rocky gaps, mainly alongside the ravines of lower forest zone.

Status: Not protected, Colchis endemic.

Cause of Reduction: Natural rarity, Destruction of natural vegetation and human agricultural activities.

Pic. 11. *Dryopteris liliana* Golitsi

***8. Dryopteris remota* (Döll) Druce** (Pic.12).

Distribution: Khelvachauri, near village Sarp, at the stream bank, areas of village Chakvistavi, Gonio, Sarp, Botanical garden.

Ecotype: Sea coastal forest slopes and ravines.

Status: Not protected. Colchis endemic.

Cause of reduction: Natural rarity, destroy of natural habitats, anthropogenic factor.

Pic. 12. *Dryopteris remota* (Döll) Druce

9. *Notholaena maranthae* (L.) R.Br. (Pic.13).

Pic. 13. *Notholaena maranthae* (L.) R.Br.

Distribution: Middle forest zone, River Acharistskali ravine. Shuakhevi, village Chanchkhalo, river Chirukhistkali ravine.

Ecotype: Rocky slopes, Abies-oak sparse wood.

Status: Not protected. Relict.

Cause of reduction: Destroying of natural vegetation and human agricultural activities.

Note: New location of this species is found out by us-the ravine of river Chirukhistskali (N41^0 36′230″, E41^0 36′230″, H-527). (Pic.14).

Pic.14. *Notholaena maranthae* GPS Data

10. *Polystichum woronowii* Fomin (Pic.15).

Distribution: Botanical garden; Gonio-Sarp, Dagva, Chakhati, Khala, Dagva, Erge.

Ecotype: Lower and sometimes middle zone broad leaves forests, especially in ravines.

Status: Not protected

Cause of Reduction: Destroying of natural vegetation and human agricultural activities.

Pic. 15. *Polystichum woronowii* Fomin

11. ***Hymenophyllum tunbrigense* (L.) Smith.** (Pic.16).

Pic 16. *Hymenophyllum tunbrigense*

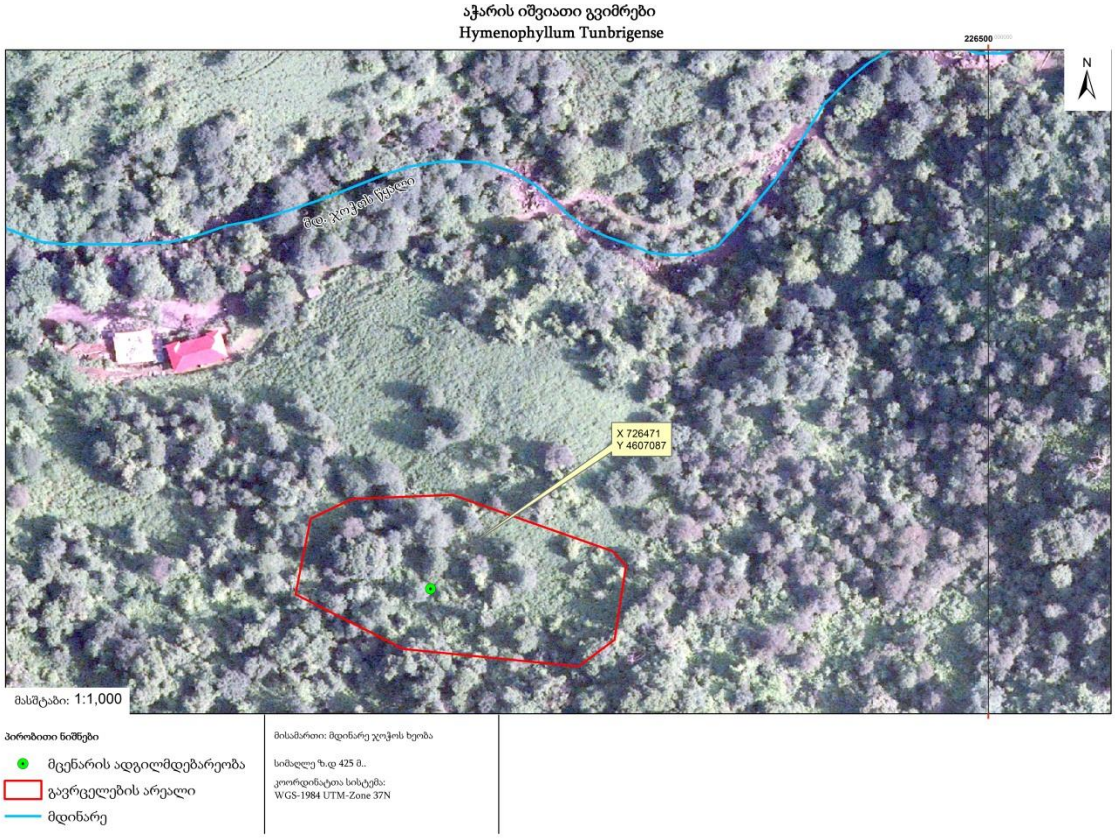
Distribution: This species is met in Georgia, only in one place-Adjara, 100-700 from the sea level, Sarp, Charnali, Dagva, Khala, Akhalsheni, Korolistkali, Ravine of the river Kintrishi, Dekhva.

Ecotype: Sea coastal moisture ravines. Is grown on the mossy branches of bushes (Buxus, Chesnutt).

Status: Not protected. Relict.

Cause of Reduction: Destroying of natural vegetation and human agricultural activities.

Note: The new location of this species was found out by us-the ravine of the river Jochostskali, (N41⁰ 35'203", E41⁰ 43'500" H-425) (Pic. 17). The ravine, in difference of th eother ones is grown not on Chesnutt trees and ground but on Alnus.



Pic.17. *Hymenophyllum tunbrigense GPS Data*

***12. Ophioglossum lusitanicum* L.** (Pic.18).

Distribution: This is the hardly noticeable plant; randomly met in the collections; there are the following distribution areas: sea coastal lowland and foot-hill, Kobuleti tea plantations, Korolistavi.

Ecotype: It is grown on damp or temporary wet rocky soils on the lowlands.

Status: Protected by "Red List" LC ver 3.1. of IUCN.

Cause of Reduction: Destroying of natural vegetation and human agricultural activities.

Pic. 18. *Ophioglossum lusitanicum* L.

***13. Ophioglossum vulgatum* L.** (pic.19).

Distribution: In the lower and middle forest zone, Green Cape, Chakvi, Khelvachauri, Kobuleti tea plantations, Adjara Shavsheti ridge, Matskvalta mountain, river Kekhnara areas.

Ecotype: In the damp, mainly on the mossy valley soils, on forest valleys, between the bushes, on hill roads and in the forest, on sea coastal lowlands and on foot hill, on grassy slopes and shrubs.

Status: Not protected.

Causes of Reduction: Destroying of natural vegetation and human agricultural activities.

Pic. 19. *Ophioglossum vulgatum* L.

***14. Osmunda regalis* L.** (Pic.20).

Distribution: River Adjaristskali banks, Keda, Batumi Botanical garden. Kobuleti region, Kintrishi ravine.

Ecotype: Moisture, boggy places. Sea coastal lowlands and peaty bogs.

Status: It is protected by "Red list" LC ver 3.1. Of IUCN; also it is recorder in "Georgian Red Book", and protected on Kobuleti protected areas.

Causes of Reduction: Destroying of natural vegetation and human agricultural activities.

Pic 20. *Osmunda regalis* L.

On the base of literature data it is found out that, rare species of fern *Marsilea quadrifolia* L., Used to grow up on wetlands and ponds of sea coastal Adjara and at the areas of Gonio, which was recorded in census with the formation of Trapeta. Despite the multiple expeditions arranged by us, we couldn't find the species.

Many scientists used to talk about the decomposition of the species habitats and area of reduction even decades ago. The reason of decomposition of habitats of *Marsilea quadrifolia* L.- is mainly anthropogenic factor. As it is revealed from the literature sources (Machutadze 2003), many water pants and *Marsilea quadrifolia* among them dyed out because of heavy pollution of water reservoirs and ponds and as well for Alnus deforestation. According to current situation, wetland valleys and ponds in Gonio areas are represented by the following species- *Typha, Sparganium*, *Arundo*, and the surface of polluted water is covered by the species *Lemna minor*, which seems to be the competitor of *Marsilea quadrifolia.* Supposedly, the strong multiplication and distribution of the mentioned species is related with the dying out of *Marsilea quadrifolia.*

Thus, among the distributed ferns in Adjara flora region rarely are met **14 species** of ferns, from **10 genus** and **6 families**. Three species are protected by the "Red List" of IUCN and two species are recorded in "Red Book of Georgia". The two species are not found according to the latest researches: *Anogramma leptophylla, Marsilea quadrifolia.*

Conclusions:

While studying historical and current conditions of Adjara pteridophyte flora and on the base of studying its composition, geographical distribution, systematic structure, hypsometer and ecological-cenoses distribution peculiarities we can conclude the following:

1. As a result of long standing researches and literature sources, pteridophyte flora of Adjara region is represented by 52 species of 27 genus and 14 families which is 2, 83% of total flora composition of the whole Adjara. There are the following leading species in a view point of quantity: *Dryopteridaceae* – 15 species; *Aspleniaceae* – 9 species, *Pteridaceae* – 8, *Ophioglossaceae – 3, Thelypteridaceae – 3, Athyriaceae – 2, Cystopteridaceae - 2, Dennstaedtiaceae*-2, *Onocleaceae* - 2, *Polypodiaceae – 2* species.

There are the following leading genus in a view point of quantity: *Dryopteris* – 9 species, *Asplenium – 7* species, *Polystichum* – 5 species, *Pteris* – 3 species, and *Athyrium, Ophioglossum* and *Polypodium* – are represented by two species.

The families represented by one species are: *Blechnaceae*, *Hymenophyllaceae, Osmundaceae, Woodsiaceae,*

The genus represented by one species are: *Anogramma, Blechnum, Botrychium, Ceterach, Cryptogramma, Cystopteris, Hymenophyllum, Hypolepis, Notholaena, Cyrtomium, Gymnocarpium, Struthiopteris, Onoclea, Oreopteris, Osmunda, Phegopteris, Thelipteris, Phyllitis, Pteridium, Woodsia.*

2. Nowadays, we could record nonindigenous (adventive-invasion) ferns with 8 species and 7 families in the flora region of Adjara. All these species are perennial grassy plants. As a

result of our research the following was found out: from the 8 fern species of Adjara flora region, 7 can develop fertile spores, causing their multiplication and distribution.

3. New fern species ***Hypolepis punctata*** (thumb.) Mett ex Kuhn,was discovered by us as a result of our research as for Adjara region as well for all Georgia. We suppose that the species is adventive.

4. According to Raunkiar classification and plant life-forms, ferns in Adjara are united in two types in a view point of bud location and bud protecting cover peculiarities in disadvantageous conditions, These two types are: **Hemicrophytes (23 species), Criphtophytes (28 species).**

According to Serebriakov classification, all the species of Adjara pteridophyte flora belong to polycarpic grasses i.e. perennial vegetation, the following are among them: **long root rosette and without rosette ferns-34 species,** and **short root rosette and without rosette ferns-18 species.**

5. Cosmopolitan-geographical group is leading in a view point of quantity-37.26%, the second place hold, sub-districts of Holarctic and palearctics-27.45%, the third one belongs to paleo tropic world-15.69%; and paleo tropical world is represented with the least species-3.92%.

6. Three groups were distinguished as a result of ecological-Cenozoic estimation of pteridophyte flora: 1. Species of forest ecotypes-26 species, 2. Petrophantes-lithophytes and Chazmophytes (rock species)-21 species, 3.valley-5 species**.**

7. Ferns in Adjara flora region are united in three groups according to attitude towards moisture: Mezophytes-38 species, hygrophytes-4 species and Xerophytes-10 species.

8. Attitude of Adjara pteridophyte flora representatives towards the light is different and on this fact we could distinguished three groups of ferns: 1. Light amateurs (helophytes, hemi-helophytes)-9 species; 2. Shadow tolerant plants (hemisciophytes, scioheliophytes) -21 species; 3. Shadow armateurs (sciophytes-22 species).

9. The following groups are detected in Adjara flora region in the view point of warmth dependence: microthermal- 12 species are united here, mezothermal-the largest group and 26 species are united there and macrothermal-14 species.

10. As a result of vertical-zone analysis of Adjara flora region it is found out that, the most quantity of ferns are distributed in forest zone-32 species, in a less amount they are found in sub-alpine zone-14 species and in alpine zone-6 species.

11. From 52 fern species from Adjara flora region, rarity is tipical for **14 species ferns of 10 genus and 6 families**: *Adiantum capillus-veneris, Anogramma leptophylla, Asplenium ruta-muraria, Botrichium lunaria, Dryopteris alexeenkoana, D.liliana, D. remota, Notholaena maranthae, Polystichum woronowii, Hymenophyllum tunbrigense, Ophioglossum lusitanicum, Ophyoglossum vulgatum, Osmunda regalis.* The most part of fern species are characterized by narrow valence, accordingly they are very sensible towards the environment factors and exactly the fact causes their reduction in number and puts them under the threat of extinction.

12. 3 species are protected by "The Red List" of (IUCN) from 14 ones of Adjara flora region: *Osmunda regalis L. LC ver 3.1; Adiantum capillus-veneris L. LC Ver 3.1; Ophioglossum lusitanicum L. LC Ver 3.1.* Two species *Anogramma leptophylla* and *Marsilea quadrifolia* are not found according to the latest data.

13. Pteridophyte flora of Adjara can be used by various reasons. In literature, for example there are known 5 species used in pharmacology. 17 species are used in folk medicine, 3 species, among them are used in Adjara as well.

14. Ferns are characterized with high decorative values. In the greenery of Adjara gardens and parks we can used 11 fern species from the wild flora of Adjara. 5 fern species can be planted in wetlands and shadowed places and for greening and decoration at rocky, stony and dry places 6 fern species can be used.