



Ecological senotic analysis of woodfern in the northeastern part of the small caucasus

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Abstract

The article provides information on the ecological and cenotic analysis of pteridophyta in the north-eastern part of the Lesser Caucasus. It was found that most of the pteridophyta of the north-eastern part of the Lesser Caucasus have ecological plasticity, they spread in different ecotopes and found in the forest cenoses, as well as in the rocky cenoses. Ecological-senotic groups of the north-eastern part of the Lesser Caucasus have been studied by us. The article also analyses the ecological groups of pteridophyta and their light regimes.

Keywords: ecological group, silvant, lithophyte, hozmophyte, pratant, polyvalent

Introduction

The northeastern part of the Small Caucasus (within Azerbaijan) is one of the richest regions of the Caucasus in terms of biodiversity. There are many of the types of plant species encountered in Azerbaijan. Various research on flora and biodiversity of the Small Caucasus has been carried out. Works on high mountainous herbage of the area (Gadjiyev, 1990), high-spore plants (Askerov, 1977, 1983, 1990, 2001, Askerov, 2005, 2016) [2, 4], were written. However, systematic, ecobotanical features of woodfern in the Small Caucasus were not thoroughly studied.

Plants have adapted to all the complex conditions of the environment where they live and they have earned the signs against the complex effects of environmental factors. The environmental factors have a complex effect on organisms, adaptation of plants to the external environment indicates itself not only in physiological processes, but also in external morphological features. Adaptation of plants to all complex conditions of the environment gives rise to the life forms of plants. Therefore, as the manifestation of the general adaptation signs to the ambient conditions occurs in the evolutionary process over a long time, the life forms of plants are the general characteristics of vegetation and plant groups. Most of woodferns in the northeastern part of the Small Caucasus have ecological plasticity, spread across various ecotopes and they are found in rock synoses, as found in forested senos.

Materials and Methods

The material of the study is the materials collected during expeditions in the north-eastern part of the Small Caucasus in 2014-2016 and the herbariums are the herbarium copies which stored in the foundation of the Institute of Genetic Resources and the Botany Institute of ANAS. The collected materials were analyzed in a clarity. Here, comparative-morphological, systematic, ecological methods have been used. The International Botanical Code (2009) and A. Askerov's book "Conspect of Azerbaijan's Flora" (Askerov, 2011) [3], is based on the definition of the nomenclature issues. Macrotacon's were determined on the basis of some important sources of classification of woodferns (Pichi-

Sermolli, 1977 [19], Smith *et al.*, 2006 [20]; Maarten *et al.*, 2011) [18].

The Diva-Gis system was used to achieve environmental parameters in the study area. Hipsometric altitude and range coordinates were measured by Garmin eTex 20 model GPS. The study area covers the northeastern part of the Caucasus, geographically the area named as the North-East slope of the Small Caucasus [1, 7] and it is basically located in the "Small-Caucasus, northern" region of Azerbaijan's botanical-geographical zoning scheme [15]. However, then, the southern border of the "Small-Caucasus, northern" was slightly sought after and partly covered the central part of the Small Caucasus.

Our research area is bordered by areas 400-500 meters above sea level, characterized by wormwood, ephemeric-wormwood, white wormwood, desert and semi-desert plant species covering Kura plain. It extends from the East to the Murovdag Range, covering the boundaries of the Samukh and Goranboy administrative districts, surrounded by Murovdag and Shahdag ranges in the south and south-west and from the west - borders with Armenia.

The north-eastern region of the Small Caucasus covers the territories of Gazakh, Agstafa, Tovuz, Shamkir, Gadabay, Dashkasan, Goygol, Goranboy and partly Samukh administrative regions. In the northern part of the research area, at the altitudes of 600-700 m, the shrub with mixed composition and sometimes oak-hornbeam bushes developed on the background of the herbaceous plant. Alchagdag forests start at 600-700 meters above sea level. The inferior plant formations have developed in the places which are 800-1000 m altitude of destroyed forests. There are cornel, oak, hawthorn, hornbeam, buckthorn bushes in the shrubs of the areas where forest reproduction occurs. In some areas, especially on steep slopes and river valleys, oak woods or hornbeam forests and shrubs are encountered.

The dominant forests in the middle zone of the mountain forest belt are beech, beech-hornbeam and in the upper part beech and oak forests. In the zone of the beech forests of the mountain forest zone pure and mixed beech forests are mainly spread on the more humid and shady northern slopes of the mountain, it is very convenient for the spread of woodfern and it made beech-woodfern in many

places.hornbeam, oak-hornbeam forests dominated in eastern and western slopes, but oak forests are dominated in south. There are woodfern, holly fern spaces in clean and intense beech,hornbeam-beech forests. In the high-beaked native beech forests, the soil is always moist, and the surface is covered with dry leaves. There are spread other trees and bushes in the hornbeam-beech, hornbeam-oak and oak forests.

In the high mountain forest zone, the main types of trees are eastern beech and eastern oaks. In this zone, the upper

boundary of the forests fell considerably (at least 300-400 m) under the influence of the anthropogenic factor.

Results and their analysis

The main materials for ecological and phytosynthetic researches are the herbarium materials collected by the author from nature in the 2014-2016, as well as the geobotanical images we carry in the Botanical and Genetic Resources (AGRI) institutes of ANAS.

Table 1: Coordinators and ecological indicators of some species collected from the study area

Date of collection and date	Name of species	Quantity of rain (mm)	Temperature (oC)			Geographical latitude and longitude, altitude (m)	Water regime	Slope shape	The main rocks	Relief	Mechanical composition of soils	Area of collected territories
			T _{min}	T _{max}	T _{oi}							
Ganja, Hajikend; 23.06.2015	<i>Asplenium trichomanes</i>	544	4,7	15,9	5,6	N40° 30, 594' E 46° 20,494' H 1086	FR	PA, RS, GR	B	O5	SA, LO, GR, SC	5
Ganja, Hajikend; 23.06.2015	<i>Cystopteris fragilis</i>	544	4,7	15,9	5,6	N40° 30, 594' E 46° 20,494' H 1086	FR	PA, RS, GR	B	O5	SA, LO, GR, SC	5
Tovuz, Asrik 24.06.2015	<i>Polypodium vulgare</i>	554	5,7	1,4	4,2	N40° 47, 462' E 45° 35,636' H 1209	FR	RS, WL WS	B, OT	O5	CY, GR, ST	5
Tovuz, Asrik 24.06.2015	<i>Phyllitis scolopendrium</i>	554	5,7	14	4,2	N40° 47, 462' E 45° 35,636' H 1209	FR	RS, WL WS	B, OT	O5	CY, GR, ST	5
Tovuz, Asrik 24.06.2015	<i>Polystichum Aculeatum</i>	554	5,7	14	4,2	N40° 47, 462' E 45° 35,636' H 1209	RF	RS, WL WS	B, OT	O5	CY, GR, ST	5
Tovuz, Asrik 24.06.2015	<i>P. x illiricum</i>	554	5,7	14	4,2	N40° 47, 462' E 45° 35,636' H 1209	FR	RS, WL WS	B, OT	O5	CY, GR, ST	5
Tovuz, Asrik 24.06.2015	<i>Cystopteris fragilis</i>	554	5,7	14	4,2	N40° 47, 462' E 45° 35,636' H 1209	FR	RS, WL WS	B, OT	O5	CY, GR, ST	5
Tovuz, Asrik 24.06.2015	<i>Asplenium trichomanes</i>	554	5,7	14	4,2	N40° 47, 462' E 45° 35,636' H 1209	FR					

Table1. Topographical and climatic characteristics of the species (rainfall (mm) *Max and Min* Temperature (oC) *Tmin1 / Tmax7*, average annual temperature (oC) *Toi*; ecological information on collection locations - geographical latitude and longitude circles, altitude above sea level: FR - free, without drainage, with slopes: SE - north - east, source: roadside, mainland: B - mixed; relief: O 5 - foothills 16-30%; mechanical composition of soil: SA - sandy, LO - gray, GR - gravel, SC - sandy - clay area; collection area: 5 -> 100 m²

The woodfern of northeastern part of the Small Caucasus is studied by us and divided into the following ecological-synoptic groups: silvants (commonly found in the forests, petrophants, lithophytes and xazophytes (species found in rock and rocks), pratans (species found in meadows), paludians (water and swamp types).

Silvants. As a rule, the woodfern is a plant in the forest fields are pretty broad-leaved plants. The climate of microclimate in the forest environment has caused great morphological differences among these species. Because of their relationship with humidity, these plants are divided into different groups, such as mesophytes and mezohighophytes and for their relationship with sunlight, they are shady and shadowy.

Such species include plants such as *Phyllitis scolopendrium*, *Athyrium filix-femina*, *Cystopteris fragilis*. Some of these

plants have the ability to develop in rock and stone substrates. Such plants include *Gymnocarpium robertiana*, *Cystopteris fragilis*, *Polypodium vulgare*.

Lithophytes or petrophites. Some of the woodfern species are adapted to survive on stones and rocks. Lithophyte plants are mainly whitlow-formed, spreading plants. *Adiantum capillaris-veneris* *Asplenium viride*, *Polystichum lonchitis* and other species include to Lithophytous plants which have a root system. Hasbophytes. Some types of woodferns are plants that are adapted to survive in stone and rocks. Typically, the metabolites have long roots to reach soil particles accumulated in rocks and stones. These plants are characterized by high temperatures and resistance to water, humidity and nutritional deficiencies. Because of its ecologic characteristics, they are pioneers of the plants, since they are developed in a very difficult environment for other plant species. *Asplenium ruta-muraria*, *Polypodium vulgare*, *Notholaena marantae* species include to woodfern. Pratans. There are very few woodferns species in the meadows in the north-eastern part of the Small Caucasus. These species are not only elements of high mountains, subalpine and alpine meadows, but also found in shrubs and forests. These plants include *Botrychium lunaria* and others.

Paludants. Some species of woodferns are spread in dried waters, wet and damp areas. *Thelypteris palustris* belonging

to the Small Caucasus pteridoflora is the only species found in the paludants found in the area. This plant is found in humid meadows, humid areas of forests and even on the edges of the pool.

It is one of the most important environmental factors in the life of water plants and has a great impact on the distribution of plants in different climates and grouping in certain areas. The adaptation of plants to the areas with different degrees of humidity distinguish them from one another to another. As the most important environmental factor, water is very important for the growth and development of woodferns and these plants are closely linked with water in their developmental cycles, from aging to gametophyte. In the same way as in other plants, woodferns are separated into three large groups, which include hygrophytes, mesophytes, and xerophytes.

These plants are mainly spread in the forests, bush, subalpine and alpine areas. For this reason, woodferns spread in the north-eastern part of the Small Caucasus are divided into the following ecological groups: Xerophytes, Mesophytes, Submecofites, Hydromezophytes, and Hydrophysics.

Table 2: Ecological groups of woodferns in northeastern part of the Small Caucasus

№	Ecological groups	Quantity of species	By total number, %
1. 1	Xerophytes	7	17,94
2. 2	Mesophytes	24	61,53
3. 3	Submucophytes	4	10,25
4. 4	Hydromesophytes	2	5,12
5. 5	Hydrophysics	2	5,12
Total		39	100

Xerophytes. This group includes a small number of woodferns. These plants are plants of open rocky areas and are well adapted against strong water deficit. These species are ancient Mediterranean origin, and their leaves are well adapted to reduce water loss and water shortages. Water requirements of plants living in this environment are conditioned by two reasons:

1. The lack of rainfall limits the reach of water to the soil;
2. The amount of water consumed by the plant during transpiration is greater than the amount of water it takes.

Both causes are eliminated by the different adaptations of plants against drought.

Their leaves are solid, the bottom is haired and the leaves are twisted in an unfavorable condition. These plants are the plants spread on rocky slopes in the eastern part of the Small Caucasus and they are well adapted to terrestrial drought. This group includes plants *Notholaena marantae* and *Ceterach officinarum*, etc.

Submucophytes. The species included in this ecological group are found in open areas or in shady rocky areas. Submechetic plants include *Aspleniaceae adiantum nigrum*, *A.ruta-muraria* and *A.eptentrionale*.

Mesophytes. This group plants belong to woodfern of the north-eastern part of the Small Caucasus. These species are plants that are well adapted to normal humidification conditions. These plants can be found in forest areas and in the normal wetlands of rocks. These plant species include *Phyllitis scolopendrium*, *Dryopteris Filix-mas*, *Polystichum braunii*, *Cystopteris fragilis*, *Polypodium vulgare*, etc.

Hydromesophytes. The species representing this group have been extensively damp in areas found on the ecotopes in different parts of their range. These species include the *Dryopteris expansa*, *Athyrium alpestre*, from the woodfern northeastern part of the Small Caucasus.

Hydrophysics. This group, which includes only a small number of woodfern in the area, includes *Adiantum capillus-veneris*, *Thelypteris palustris* species. These species are more commonly found in wetlands, wetlands, wetlands and meadows.

Typically, woodferns tend to be in shady places. However, research suggests that woodferns are also sensitive to light. From this point of view, the distribution of the woodferns in the region can be divided into groups below the light regime. 1. light-loving plants, 2. shadow resistant plants, 3. shade-loving plants.

Table 3: Analysis of light regime of woodferns of the north-eastern part of the Small Caucasus

№	Light regime	Quantity of Pteridophyta species	By total number, %
1. 1	Light-loving plants	7	17,94
2. 2	Shadow resistant plants,	23	58,97
3. 3	Shade-loving plants.	9	23,07
Total		39	100

Light-loving plants. It is the least number of woodferns. Heliophytes are open area plants and ecological optimal are located in full sunlight. These plants are xerophyte possesses qualities plants and they have xerophytic symptoms. This group includes *Asplenium ruta-muraria*, *Ceterach officinarum*, *Notholaena marantae*, *Woodsia alpina* and others.

Shadow-resistant plants. Although plants that grow in full-light areas are well-adapted to poor light areas. These plants (hemissiphites) have a broad environmental amplitude against light. They are spread in the eastern part of the Small Caucasus. These plants fit into full sunny areas and shady areas. *Asplenium viride*, *Athyrium alpestre*, *Oreopteris limbosperma*, and others include in this group.

Shadow-loving plants (Ssiophytes). These plants are the species that prefer to end in less light areas. *Dryopteris filix-mas*, *D.caucasica*, *D.pseudorigida*, *Polystichum aculeatum*, etc. some species are from this group of plants. Destruction of forests in the area can lead to the destruction of these species.

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