EFFECTS OF ELEVATION GRADIENT AND ECOLOGICAL REGION ON THE BILBERRY FLOWERING TIME IN NORTH-EAST ALBANIA

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Abstract

The present study is focused on the evaluation of bilberry flowering related to the evaluation gradient and ecological region. For the purpose of the study, we organized separately three-field missions in the region of Puka, Tropoja and Kukes. The study was conducted during May 2015 in Puka region (Terbuni Mountain), beginning of July 2015 in Tropoja region (Cerem area) and Kukes region (Gryke çaje). Observation was carried out in the range of 874 m – 1232 m elevation in Terbumi mountain, 1673 m – 2211 in Cerem (Tropoje) and 1580 m – 1715 m of elevation in Kukes region. The flowering and fruit ripening is shifted with one month comparing Puka and Tropoja, with Kukes region because of the elevation gradient differences and site exposition where bilberry is naturally grown. The plant populations were evaluated as per plant density, flowers per plant and flowering time. We used the Brown-Blaquet methodology for calculation of plant density. Plant density was higher in Tropoja region compare to Puka and Kukes region. Flowering time were determined within each population. As altitude increased, it was seen the significant changes in flowering time and growing season. Flowering across the altitude tends to be more obvious in Terbuni mountain compare to the explored sites in Kukes region. In Tropoja region, flowering shows differences across the elevation gradient and exposition sites. The early flowering in lower elevation areas was probably because of higher temperature compare to the higher elevation gradient and also due to the late snowmelt in the highest altitude.

Key words: *medicinal and aromatic plants, biodiversity, bilberry, flowering time*

1. INTRODUCTION

Bilberry plant is known as European bilberry and it's named differently in different European countries (Rey Upton 2001) such, Myrtillo nero (Italy), Blaubeere or Heidelbeere (Germany), Airelle myrtille (France), Blauberry (Holland), Bilberry or whortleberry (United Kingdom), Boronice (Albania).

European bilberry is distributed in the northern hemisphere (Rolf Nestby at al 2011). In Albania, high bilberry surface are found in the regions Puka, Dibra, Tropoja and Kukes etc.

Regarding the last studies, Puka region has the largest bilberry surface in the country then Dibra region and the third region in terms of bilberry surface is listed Tropoja region with 900 ha of wild bilberry (Gjon Fierza 2010).

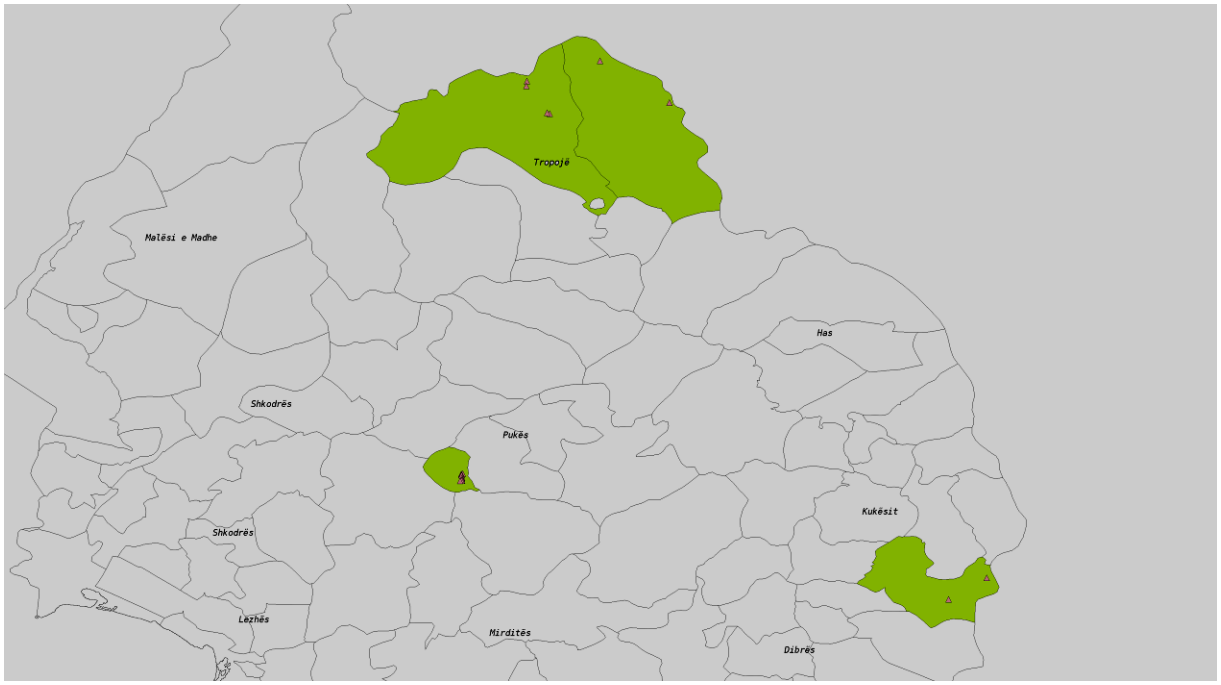
Within MAPs bilberry has a great economic importance as an income source for farmers who live in the disadvantages and remote areas and with the limited economical resources. With the resource, limitation and not appropriate attention from the respective institutions regarding bilberry management pants imply the needs for preservation of bilberry biodiversity and the monitoring genetic erosion as an important step toward sustainable conservation and use.

For knowing the phenology of flowering time related to the elevation gradient we initiated this study. Flowering time it response to climate, temperature (Blionis et al 2001, Abraham 2009) and the elevation gradient

2. MATERIALS AND METHODS

The study was carried out in north east part of Albania in three most important regions for bilberry population such as Puka, Tropoja and Kukes. In the three respective regions, we explored respectively Puka region 9 sites (Elevation gradient 874 – 1232 m), Tropoja region 6 sites (Elevation gradient 1673 - 2211 m), and 2 sites in Kukes region (Elevation gradient 1581 - 1715 m). At Puka region, we explored the natural population of bilberry plant in Terbuni mountain, in Tropoja near Qerem, Doberdol and Sylbece area and in Kukes near Çaje commune. (Map no 1 using DIVA gis tool)

Map No 1. *Studied areas/Sites*



Bilberry coverage per plot area has been calculated based on Brown-Blanquet method (Westhoff et al 2014) which is referring to the five-point (1-5) scale for calculation plant coverage per plot and for each site, we counted the total flower for 2x2 m. Regarding the direct measurement of sample area, we determined the total flowers.

For observing the flowering time of bilberry plant, we carried out two field missions in Puka region. The first mission we carried out at 28th of April 2015 and the second mission we carried on 10th of May 2015. In Tropoja and Kukes region we did one mission for each region in the duration 02-05 July 2015.

The research was focused in the areas with similar condition but with different altitudes gradient. The sample plots were chosen based on the occurrence of bilberry plant in the area related to the flowering stage.

3. RESULTS AND DISCUTIONS

In this study, we present the flowering range of bilberry plant across the elevation gradient in the following three regions:

1. Puka region

The observed sites in Puka region is steep slope. On each site we randomly spot 2 m^2 and count the flowers per each plant related to early flowering (April) and late flowering (May).

The selection of the site it was done because specie abundance in the region. The altitude 874 m -1232 m it correspond to the specie distribution. During field examination, we could not find bilberry plants outside that border.

The geographical coordinates, bilberry population coverage, number of flowers per plant are presents in the table no 1.

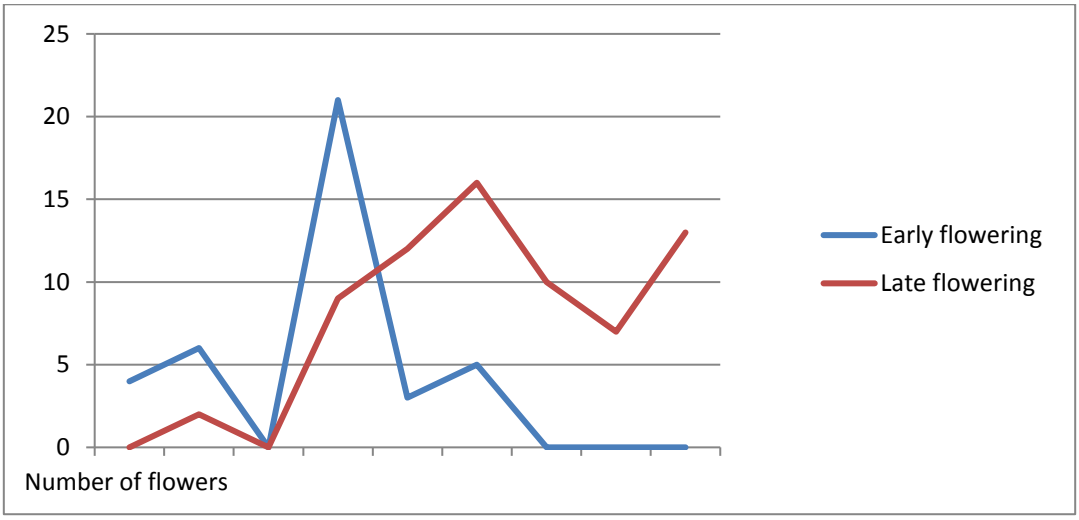
Table no 1. *Recorded date from on the spot evaluation*

Sites	Latitude	Longitude	Elevation	Population density/coverage	No of flowers per plant		Open /Shadow
					Early flowering 27 April	Late flowering 10 May	
Puka							
1	420125	195452	874	> 5 %	4	0	Open
2	420124	195446	894	> 5 %	6	2	Shadow
3	420121	195447	942	> 5 %	0	0	Shadow
4	420118	195447	980	5 % - 25 %	21	9	Semi Shadow
5	420106	195449	1146	> 5 %	3	12	Open
6	420104	195448	1164	> 5 %	5	16	Open
7	420056	195449	1196	> 5 %	0	10	Open
8	420055	195447	1210	> 5 %	0	7	Open
9	420053	195440	1232	> 5 %	0	13	Open

In Puka region the flowering started late Aprill and finished on May as shown in the table no 1. Regarding the last inventory of medicinal plants (IFPR 1988) Puka region has been with the highest bilberry surface in Albania (5000 ha) but nowadays that surface id reduced drastically because of uncontrolled fires and bilberry harvesting practices in the region. Also the bilberry population coverage is very low coverage which is represented by no 1 in the 5 scale points of Brown-Blanquet method.

As shown in the graph no 1 the peak magnitude related to flowering date is shifted with 14 days for each 200 m of elevation. Regardin the site no 3 which no flowere were counted is because bilberry plant are under the beech trees which may reduce the light intensity to reach the bilberry canopy.

Graph no 1: *Early and late flowering time*



2. Tropoja/Kukes region

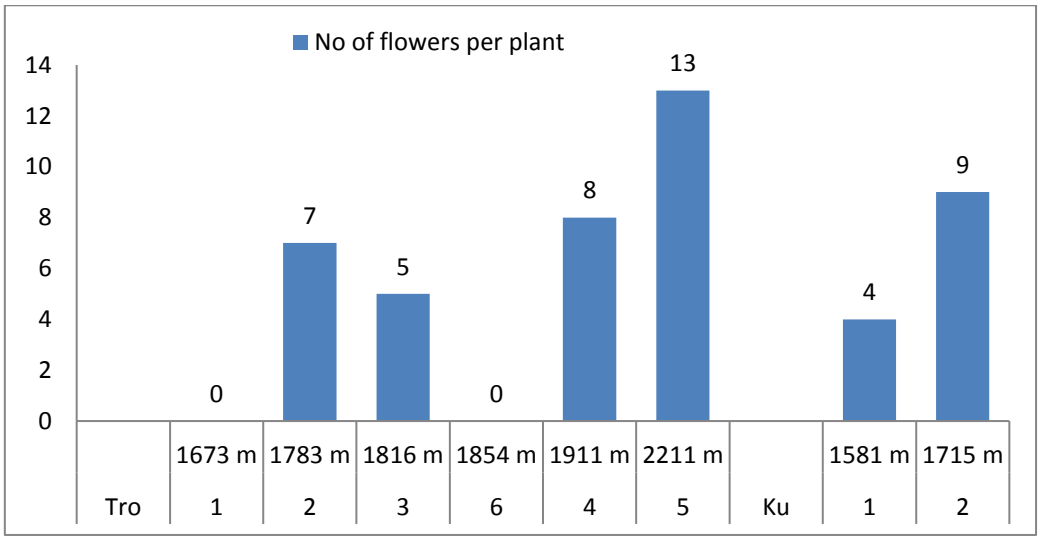
Tropoja and Kukes region are the two most important regions in terms of bilberry production in Albania. For studying the bilberry flowering we selected 6 sites in Tropoja region which represents the highest coverage area in hole region and also two region in Kukes area. The geographical coordinate's population density and number of flowers per plant are listed in the table

Site	**Latitude**	**Longitude**	**Elevation**	**Population density/coverage**	**No of flowers per plant**	**Open /Shadow**
Tropoja (02 July 2015)						
1	423028	195974	1673 m	> 5 %	0	Open
2	422994	195969	1783 m	5 % - 25 %	7	Shadow
3	422789	200148	1816 m	25 % -50 %	5	Open
4	422796	200128	1911 m	50 % - 75 %	8	Open
5	423179	200530	2211 m	50 % - 75 %	13	Open
6	422870	201058	1854 m	25 % -50 %	0	Open
Kukes (05 July 2015)						

1	425111	203147	1581 m	25 % -50 %	4	Open
2	415345	203441	1715 m	25 % -50 %	9	Open

The biggest numbers of flowers were counted in the highest altitude, which refer to the site no 5. The flowering at the site no 2, 3 and 4 the fruits were formed but still some flowers remains. The site no 6 resulted without flowers and fruits were matured this is maybe because of site exposition and early snow melt. The flower number for the site no 2 was high because the site was in pine shadows which contributed to the delay on the flowering time. As showed in the graph above the site no 1 and site no 6 no flower were counted because fruit formation was finished

Graph no 2: *Number of flowers related to the elevation gradient*



In Tropoja region, the flowering time is different regarding to the elevation gradient. The data shows the elevation gradient does effect bilberry abundance. In the highest elevation the flowering last 1-2 weeks. This can be seen from the flowers openings. The altitude correlates with the temperature and the late snowmen in the highest altitude this may be one determining factors for late flowering in the highest elevation. Also in the shadow areas the flowers per plant are less than in open areas.

3. CONCLUSIONS

- Statistical data on Bilberry surface in Puka region need to be revised according the real situation of bilberry distribution in the region based on the real findings.
- The study found out also the connection of habitat related to the bilberry plant flowering. Mainly in pine tree habitat the plants were rather bigger compare to the plants in open areas exposed directly to the soon.
- Over different range of altitudes above the sea level, we examined the flowering related to the other plant presence such as pine trees. Where the bilberry plants occurs with

beech trees the flowering is inexistent maybe connected to the light intensity which is minimized to the bilberry canopy. This phenomena we have seen in the site no 3 in Puka region. One site after were the bilberry plant were associated with pine trees the flowers were in the higher number per plant.

- The flowering period is shifted from 3-4 weeks due to the different factors such as temperature (linked with elevation gradient), snow melt, site exposure and plant association

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