Journal of Applied Biological Sciences
Uygulamalı Biyoloji Bilimleri Dergisi
E-ISSN: 2146-0108 12 (2): 34-37, 2018

Geophytes of Pure Scots Pine Forest in Alpu (Eskişehir-Turkey) Region

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Received: 23 May 2018
Accepted: 10 August 2018

Abstract
This study aims to investigate the geophyte taxa, which are important from non-wood forest products point of view, of pure *Pinus sylvestris* forest in Alpu (Eskişehir-Turkey) region. Research area was divided into three altitude levels as 1200-1400 m, 1400-1600 m and 1600-1800 m. Total of 33 relevès were studied for the present study. As a result of the study, 28 geophyte taxa were identified in the study area. Vegetative and/or generative parts of these taxa used as non-wood forest products are explained in detail. In addition, with comprehensive phytosociological studies in the field, cover-abundance and sociability (or gregariousness) values of each taxa were determined according to B raun-Blanquet approach. Using this approach, the potentials of the taxa have been highlighted, together with their usage purpose(s) depending on the data obtained from field studies. In particular, considering CITES, the possibilities of benefiting from the taxa within the conservation and utilization equilibrium were discussed in detail.
Key words: Geophyte, non-wood plant product, Eskişehir.

INTRODUCTION

Since immemorial times, herbaceous plants have been used in virtually every culture all over the world as a source of folk medicine [1, 2]. Medicinal plants are intensively used in folk medicine while garlic is one of the well-known of them [3]. Plant taxa, which have been used in this purpose, is a source of research for many years. Usage of some vascular plant taxa for medical purposes is as old as humankind itself. Some of these plants have still been used for the treatment of various diseases. In addition to their importance as ornamental plants, geophytes are also very attractive with their medicinal properties. One of the most important medicinal plants are Colchicum species [4]. Colchicum is a valuable genus whose species are rich in alkaloids especially colchicine [5, 6, 7, 8, 9].

Depending on the health problem of processed food, natural products are getting worth to attention day by day. Natural forest ecosystems of Anatolia are rich in such kind of native vascular plant products including geophytes. In Turkey, these plants have not been used enough because of different reasons [10]. One of the most important reasons of the present situation may be the lack of inventory data. Braun-Blanquet approach is a commonly used method in both Anatolia and Europe. This vegetation investigation method classified the vegetation mainly as plant associations with its floristic composition, structure, development and distribution. In order to determine "cover-abundance" and "sociability (or gregariousness)" values of plants (including geophytes), this approach serves immensely amount of data in order to predict the natural potentials. This classification of vegetation is based on the ecological-floristic criteria.

In this study, geophytes of pure stands of Scots pine forests, which are important from non-wood forest products point of view, were investigated in Alpu (Eskişehir-Turkey) region using Braun-Blanquet approach.

MATERIALS AND METHODS

This study was carried out in 2014 during the vegetation period between April and October. During this period, more than 100 specimens were collected. At least one sample for each taxon was prepared and deposited at Herbarium of Karadeniz Technical University Faculty of Forestry (KATO). Plant specimens were identified using "Flora of Turkey and the East Aegean Islands" [11]. CITES and IUCN categories of each taxa were indicated in Table 1 [12, 13].

Research area was divided into three altitude levels such as 1200-1400 m, 1400-1600 m and 1600-1800 m. Because the distribution of plant taxa are extremely related to the altitude and the elevation between 150 and 200 meters have the important effect on the plant taxa. For that reason, relevès were distributed 200 meter steps in this study. Total of 33 relevès were studied for the present study. Vegetative and / or generative parts of these taxa which have been used as non-wood forest products are explained in detail. Furthermore, the usage purpose(s) of each taxon and their potentials are explained. In addition, with comprehensive phytosociological studies in the field, cover-abundance and sociability (or gregariousness) values (each value with the frekansity number of relevès) of each taxa were determined according to Braun-Blanquet approach.

Table 1. The usage part and purpose of each taxon and their conservation category and altitude levels (1200-1400 m (1), 1400-1600 m (2), 1600-1800 m (3))

Plant Taxa	Altitude levels (m)	Cover-abundance and gregariousness	Endemic	IUCN	CITES	Used part(s)	Usage	Ref.
Allium sieheanum	1, 2	+.1 (2)	E	LC	+	Bulb	Used as a traditional remedy for most health-related disorders and used as a food ingredient-spice and aphrodisiac	[14]
Anemone blanda	1, 2 , 3	+.1 (3), 1.1 (5)			+	Tuber	Toxic only if large quantities eaten. Causes severe pain in the mouth if eaten.	[15]
Cephalanthera rubra	1, 2, 3	+.1 (5), 1.1 (1)			+	Whole plant	Used to treat fever.	[16, 17]
Colchicum triphyllum	2	+.2 (4), 1.2 (2)			+	Corms	Used the treatment of cancer and infections	[18]
Corydalis solida	2, 3	+.1 (4), 1.1 (3)			+	Tuber, herb	Used in treatment of memory dysfunction in folk medicines	[19, 20]
Crocus ancyrensis	1, 2	+.1 (3)	E	LC	+	Corm	Fresh corms are eaten after removing the outer skin.	[21]
Crocus chrysanthus	1	+.1 (7)			+	Corm, flowers	Corms are eaten and also flowers used for animal feed	[22, 23]
Crocus flavus subsp. *dissectus*	2	+.1 (3), 1.1 (3)	E	VU	+	Corm	Corms are eaten	[22]
Crocus olivieri	2	1.1 (4)			+	Flowers	Used for animal feed	[23]
Dactylorhiza romana	1, 2	+.1 (5)			+	Tuber	Used to make Sahlep	[24]
Dactylorhiza saccifera	1, 2	+.1 (3)			+	Tuber	Used to make Sahlep	[25]
Fritillaria pinardii	3	+1 (1)			+	Bulb	Used pharmacology	[26]
Gagea bohemica	2, 3	1.2 (7)			+	Bulb	Used pharmacology	[27]
Gagea villosa var. *hermonis*	2	1.2 (11)			+	Bulb	Used pharmacology	[27]
Limodorum abortivum	1, 2	+.1 (4)			+	Rhizome	Used to make Sahlep	[28]
Muscari neglectum	1, 2	1.2 (13), 2.2 (3)			+	Flower	Used for rheumatism	[29, 30]
Orchis mascula subsp. pinetorum	3	+.1 (5)			+	Seeds	Used as a food	[31]
Orchis pallens	2, 3	+.1 (3)			+	Bulb	Used to make Sahlep	[32]
Orchis purpurea	2	+.1 (4)			+	Tuber	Used as a food	[33]
Ornithogalum alpigenum	3	1.2 (7)	E	NT	+	Aerial parts, bulb	Used as a food, bulb is used in drug production	[34, 35, 23, 36, 37]
Ornithogalum comosum	2	1.2 (8)			+	Aerial parts, bulb	Used as a food	[34, 35]
Ornithogalum lanceolatum	1, 2	1.2 (7), 2.2 (6)			+	Aerial parts, bulb	Used as a food	[34, 35]
Ornithogalum montanum	1, 2	1.2 (8)			+	Aerial parts, bulb	Used as a food	[34, 35]
Ornithogalum oligophyllum	2	1.2 (5), 2.2 (1)			+	Aerial parts, bulb	Used as a food	[34, 35]
Ortnithogalum orthophyllum	2	1.2 (3), 2.2 (4)			+	Aerial parts, bulb	Used as a food, bulb is used in drug production	[34, 35, 23, 36, 37]
Ornithogalum sigmoideum	3	1.2 (2), 2.2 (2)			+	Aerial parts, bulb	Used as a food, bulb is used in drug production	[34, 35, 23, 36, 37]
Polygonatum orientale	2, 3	1.3 (1), 2.3 (2)			+	Whole plant	Used for medical	[23]
Scilla bifolia	1, 2, 3	+.1 (11)			+	Whole plant	Ornamental, animal feed, bulb is used medicinal wound healing andherniated disc disease	[38]

RESULT AND DISCUSSION

In this study showed that 28 geophytes were identified from 33 relevės and they are given in Table 1. The results showed that the distribution of geophytes are most related to altitudes.

Dry conifer forests understory habitats, typically support widespread species with rhizomes as storage organs [39]. This study showed that the coherence with this situation. Habitat destruction is the most important factor for both geophytes and the others, so, forest practitioners should recognize these geophytes both in planning and implementation process.

Geophytes have specific structure about morphologically and physiologically. They have an underground storage organ, which allows the plant to die back to the ground and go dormant during unfavorable seasons for growth. Renewal buds associated with the storage organs allow a new cycle of leafing and blooming when favorable conditions return [40]. Traditionally these plants are used for food and they have ethnobotanical and ethnomedicinal importance.

The digging of underground parts of plant for food is a common activity in the world. For example, some people gather the wild onions (*Allium* spp.) with a digging stick, then release the lateral daughter bulbs to perpetuate the plant [41, 42]. Like the individuals people doing, conservation and utilization equilibrium must be observed. And than sustainability of these plant using will be achieved.

In particular, considering both CITES and IUCN regulations, the possibilities of benefiting from these plants within the conservation and utilization equilibrium have importance. The IUCN Red List has served to highlight species at greatest risk of extinction and to guide the conservation responses of these plants [43, 44, 45]. In this study, 4 endemic taxa (*Allium sieheanum*, *Crocus ancyrensis, Crocus flavus* subsp. *dissectus* and *Ornithogalum alpigenum)* were determined. According to IUCN threatened catagories, 2 of these taxa are Least Concern (LC), 1 is Vulnerable (VU), and 1 is Near Threatened (NT).

In general, decrease in species richness of all organism groups according to upper altitude were known for a long time [46]. In contrast, the proportion of geophytes significantly increases with altitude. In addition, of this situation geophytes are very well represented in the upper altitude [47]. It is revealed that the upper altitude (especially 1400-1600 m) is more suitable than the lower alltitude for geophytes in the present study. 12 plant taxa (42,85%) (1) at 1200-1400 m, 23 plant taxa (82,14%) (2) at 1400-1600 m and and 11 plant taxa (39,28%) (3) 1600-1800 m at altitudes were found.

Anderson (1997) was stated that tubers and bulbs were harvested in the spring before flowering, during flowering, and during seeding. The cultivation of geophytes by harvesting after seeding is an important issue in comprehensive indigenous land management systems.

Utilizing natural geophytes of Scots pine stands require the attention for their potentials in nature. For insufficient natural potential of these plant taxa, way of agricultural production should be followed. Tissue culture is one of the recommended methods for rare geophytes. This method not need to obtain lots amount of living plant materials from the natural habitats.

ACKNOWLEDGEMENTS

The study was published as a summary text on abstract book of 1st International Congress on Medicinal and Aromatic Plants: “Natural and Healthy Life”, TABKON’17. As well, this study is a part of PhD thesis of corresponding author.

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