Vegetation Survey of the Forest Floor in the Sarabtaveh Region of Boyer-Ahmad County (Kohgiluyeh and Boyerahmad, Iran)

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Abstract

This study was conducted in the Sarabtaveh forest stand in Boyer-Ahmad County, Kohgiluyeh and Boyer-Ahmad Province. One-hectare vegetation was selected and sampled using a nested design comprising four 100 m² macro-plots for general survey, with detailed cover assessment in twenty 1 m² micro-plots distributed. The density of species in the sample plots, as well as species frequency, were then determined and reported. In the next stage, biodiversity indices were calculated based on the density of plant species in the sample plots. The results show, the ground vegetation cover at the time of sampling in the Sarabtaveh site was 45.50%. In the region 24 plant species were identified. The Poaceae family with 7 species, and the Fabaceae and Ranunculaceae families, each with 2 species, were the largest plant families in the studied area, respectively. More than half (54%) of the species in this habitat were annual plants (Therophytes), while 21% were Hemicryptophytes, 4.2% were Chamaephytes and Phanerophytes, 8.3% were Geophytes (Cryptophytes), and 12.5% were Phanerophytes. The total number of plants counted in the 20 micro-plots was approximately 1,864 individuals, with an average of about 93 plant individuals per square meter. The highest number of counted individuals belonged to the species *Bromus tectorum* (1,084 individuals), followed by the species *Bromus sterilis* (163 individuals). In other words, over 60% of the plant density in the studied sample plots was attributed to these two short-lived annual species. The abundance of plants from families such as Poaceae, Fabaceae, and Ranunculaceae in the region can be related to vegetation degradation caused by human activities and excessive livestock grazing, a pattern that has also been observed in other vegetation studies conducted in areas with intense human impact. This quantitative baseline is essential for evaluating the long-term effects of coppice management and grazing in the Zagros forests and can inform regional conservation strategies.

Keywords: Poaceae, Species frequency, Therophytes, Vegetation, Yasouj

Introduction

Identifying vegetation cover and floristic composition constitutes the basis of ecological research. It also provides strategies for

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assessing ecosystem capabilities from multiple perspectives. Furthermore, it serves as an effective factor in assessing and evaluating the current status and predicting the future condition, playing a significant role in implementing management practices in the region (Qahremaninejad and Nafisi, 2011). Studies on the vegetation of Iran, given vegetation capabilities rich plant biodiversity, have a long history. Examining the history of floristic studies indicates that the cornerstone of modern floristic studies in Iran dates back to the research of the German explorer Kaempfer in 1684 AD, who collected plants from areas of Isfahan, Shiraz, and other parts of Iran (Jafari and Zarifian, 2015).

Vegetation cover plays a role in soil formation and water and soil conservation through its above-ground and below-ground parts, controls gaseous exchanges and the water and nutrient cycles (Ferretti and Fischer, 2013). The structure it creates affects wildlife habitat and fertility (Schulz et al., 2009). In recent decades, human and natural disturbances have impacted the functioning of natural ecosystems, highlighting the necessity of assessing the current status, understanding the trends of changes, and the future outlook. The most common concerns that have been considered as international criteria for assessing the sustainability of forestry activities are the changes in species composition and diversity, structural diversity, and the abundance of non-native species (Willis and Whittaker 2002; Schulz et al., 2009). Biodiversity plays a significant role in the function of forests, and assessing it based on various indices is essential for understanding forest ecology and constitutes the foundation of forest conservation (Ravanbakhsh et al., 2024). In forestry studies, species diversity is usually examined, and indices such as diversity, species richness, and evenness are extracted (Lessa derci et al., 2020). Species richness refers to the number of species, and evenness is related to how individuals are distributed among species (Ejtehadi et al., 2004). In a study of plant species biodiversity in natural stands and western Hyrcanian forests, it was found that the Simpson and Shannon-Wiener diversity and the Margalef richness indeces were not statistically significant, while the Menhinik richnessand the Camargo and Smith-Wilson evenness indices showed significant differences (Bazyari et al., 2021).

In a comprehensive flora collection project, Jafari Kukhdan (2013) reported as part of a research project to collect, identify, and establish the herbarium of the provincial flora under the former Jahade Sazandegi, collected about 10,0000 plant samples and reported 95 families, 350 genera, and 900 plant species from all over Kohgiluyeh and Boyer-Ahmad Province. Furthermore, in a report on the status of native plants in the Central Zagros as part of the international project for biodiversity conservation in the Central Zagros landscape, covering an area of 2.5 million hectares in the provinces of Chaharmahal Bakhtiari, Isfahan, Kohgiluyeh and Boyer-Ahmad, and Fars, 2560 species were introduced (Jafari Kukhdan, 2013). Hamze et al. (2008) in a floristic and phytosociological study of the Chaharzabar forests in Kermanshah, identified 161 species and infraspecific units belonging to 124 genera and 40 families, and described the plant

community *Astragalus tortousi – Quercetum persicae* with two sub-communities. In this area, therophytes were the dominant life form, and from a chorological perspective, most species belonged to the "Irano-Turanian" region. Dehshiri et al. (2019) in a floristic study of the Eslamabad-e Gharb area in the Central Zagros, stated that about 65% of the flora belongs to the Irano-Turanian region. Additionally, in an ecophytosociological study of the western Dena protected area, while introducing the plant communities of the region, 65 families, 400 genera, and 750 species were identified (Jafari Kukhdan, 2003). In similar studies in the eastern Dena protected area, 67 families, 256 genera, and 410 species were reported, and from the Del protected area, 67 families, 174 genera, and 224 plant species were collected (Hosseini, 2014). According to studies by Jafari and Zarifian on Mount Savior, 295 species from 202 genera belonging to 62 plant families were reported, of which 47 were endemic to Iran, 47 were rare, 60 were medicinal, and 52 were toxic (Jafari and Zarifian, 2015). Studies by Karimian et al. (2012) on identifying the medicinal and industrial properties of forest species in Kohgiluyeh and Boyer-Ahmad Province showed that 41 species from 23 families have medicinal applications. Besides, 16 species having a tree growth form and 25 being shrubs which form these, 10 identified species fell within the Rosaceae family (Karimian et al., 2017). From the protected areas of Kuh-e Khayiz and Kuh-e Sorkh, with an area of approximately 32,232 hectares, 71 families, 208 genera, and 278 species, and 43 families, 90 genera, and 116 species were reported, respectively. From the protected area of Sulk, covering about 2,322 hectares, 40 families, 92 genera, and 184 species were reported (Jafari Kukhdan, 2011).

Despite these numerous regional studies, long-term monitoring using permanent plots in the specific forest under study is still lacking. Therefore, this study aims to establish permanent sample plots for periodic monitoring of forest floor vegetation, as no permanent sample plots had been previously established for long-term and periodic studies in these forests. Furthermore, this research investigates the floristic composition, cover, and species diversity of plants within the monitoring sample plots in the studied forest.

Material and methods

Initially, through a forest reconnaissance walk and utilizing the expertise of specialists, a one-hectare sample plot was selected in the Sarabtaveh forest habitat in Boyer-Ahmad County. Within this sample plot, 20 of 1 m^2micro-plots were established and surveyed using a specific pattern to study the forest floor cover (Figure 1).

According to the European ICP Forests program (2016), a 400 m^2 sampling area for vegetation cover is recommended, described as a feasible and realistic compromise among various methods. This area can be achieved from several smaller sampling units without restrictions on their shape or number (Figure 1). This size 400 m^2, composed of four 100 m^2 sub-plots was adopted for the sample plots in the vegetation cover study of this project.

In each sample plot, the percentage of forest

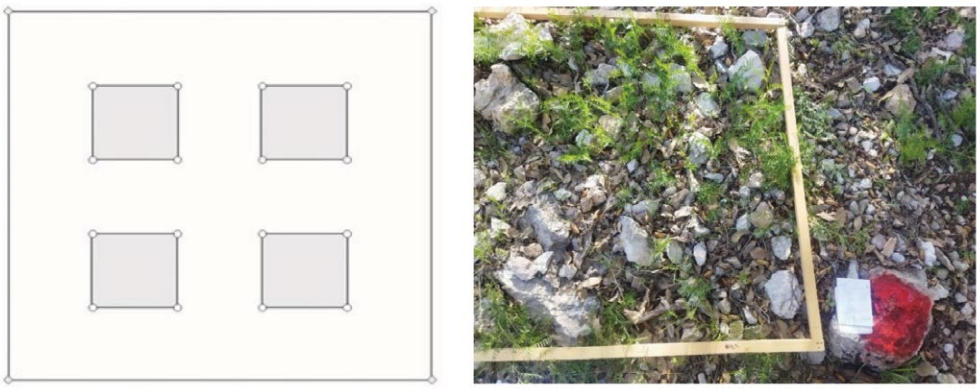

Fig. 1. Sampling design consisting of four 100 m² sample plots with the implementation of 20 micro-plots

floor cover was first recorded. Subsequently, environmental data for the plots were meticulously documented, including topographic status (slope, aspect, and elevation), soil erosion status (surface/low erosion, rill erosion/moderate, rill-gully erosion/significant), spatial location, percentage of litter, and percentage of bare soil (ICP Forests, 2016). All existing plant species were separately measured and recorded based on the characteristics of density (count within the sample plot) and life form. Table 1 was used to record species density when counting certain species was impossible due to their high abundance and density.

In addition to the micro-plot studies, a comprehensive floristic survey was conducted across the entire one-hectare plot to record all plant species present. For this general survey, only species presence was noted, documented either on a separate form or on the form of the nearest micro-plot. Following field collection, plant species were identified using the authoritative references *Flora of Iran* (Assadi et al., 1988–2019) and *Flora Iranica* (Rechinger, 1963-2005). A descriptive floristic list was compiled, including plant family distribution, biological life forms (following Raunkiaer's classification), and observed phenology at the time of sampling. Species density (within micro-plots and for the total area) and frequency were calculated. To quantify biodiversity, standard indices were computed based on species density data. These included: richness (Menhinick and Margalef), evenness (Pielou and Shel-

Table 1. Summary of the Braun-Blanquet (1964) abundance-dominance scale

Scale (Class)	Frequency range	N individual/ m^2
1	Rare	1- 4
2	Low frequency	5-14
3	Moderate frequency	15-29
4	Many individuals	30-99
5	Very numerous individuals	>100

don), and diversity (Shannon-Wiener and Simpson) indices. This suite of indices was chosen to provide a multifaceted assessment of the vegetation's taxonomic structure, as is standard practice in comparative forest ecology (Magurran, 2004). Recent observations (Duelli and obrist, 2003) have shown that when undergraduate biodiversity students in entomology lectures have to choose one of the two communities shown in Figure 2 (without seeing the text below them) they consider to be more diverse, more than half of them decide for the left population, because they consider evenness to be of greater importance than species numbers. When individuals from other disciplines were asked during lectures and seminars, particularly conservationists and extension workers in agriculture and forestry, species numbers are decisive. In recent years, indices involving evenness have essentially fallen out of favour, mostly because they are difficult to interpret (Gaston, 1996). Particularly in agriculture and forestry, standardized methods frequently result in the collection of large numbers of numerous single species. This causes a sharp decline in evenness, thereby yielding low diversity values notwithstanding relatively high species richness.

The software packages Excel 2007 and SPSS 22 were used for the analysis of quantitative and qualitative variables, while PAST version 3 was employed for calculating the biodiversity indices. To assess data normality, the Kolmogorov-Smirnov test was employed, and the homogeneity of variances was checked using Levene's test.

Results

A total of 24 plant species were identified, belonging to 16 genera and 14 plant families. The Poaceae family with 7 species, followed by the Fabaceae and Ranunculaceae families, each with 2 species, were the highest plant families in the studied area, respectively (Figure 3).

According to the obtained results, more than half (54%) of the species present in the Sarabtaveh site were therophytes (annual plants), 21% were hemicryptophytes, 4% were chamaephytes, 12.5% were phanerophytes, and 8% were geophytes (cryptophytes) (Figure 4).

The phenological stage of the species in the

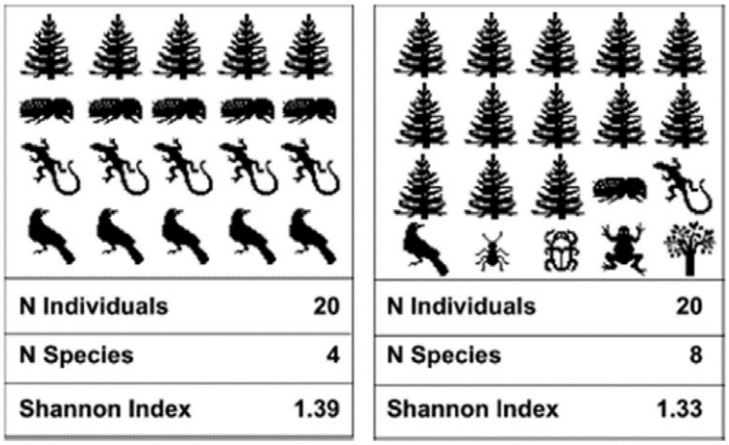

Fig. 2. Comparing differences among populations for biodiversity evaluation (Duelli and Obrist, 2003).

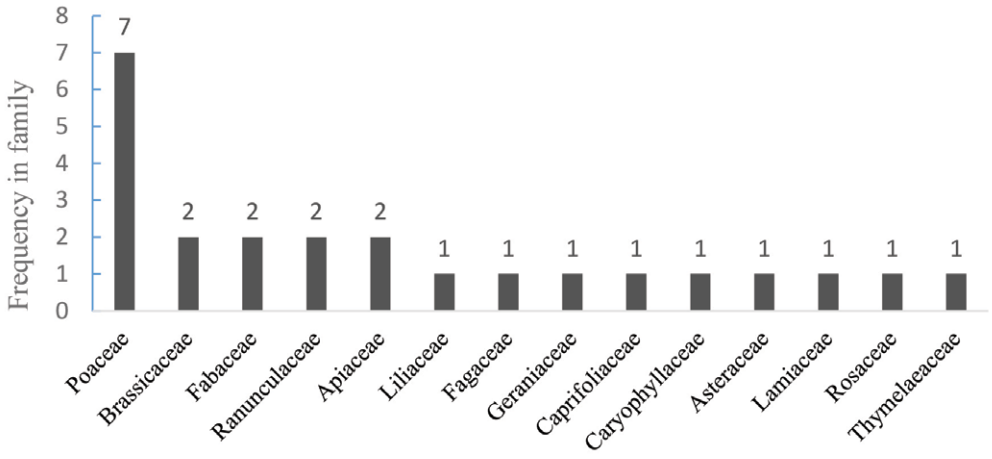

Fig. 3. Species frequency distribution in plant families

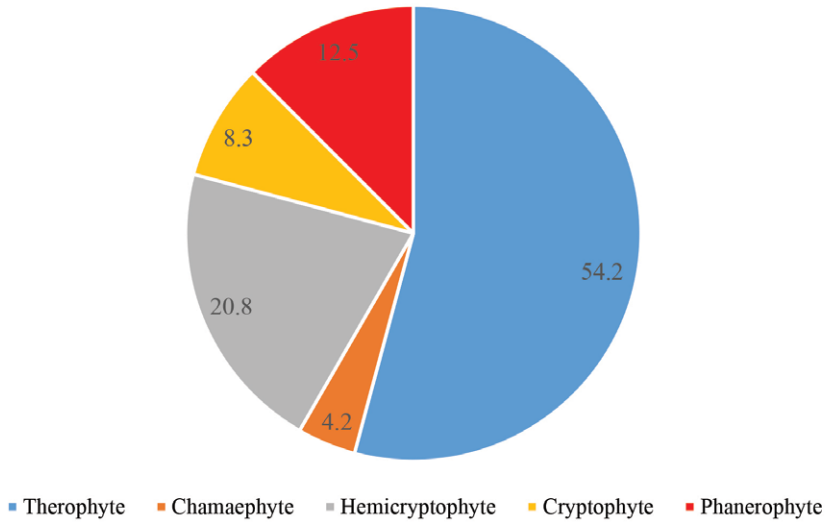

Fig. 4. The life form of plant species in the region based on Raunkiaer's classification (Raunkiaer, 1934).

studied area at the time of data collection the first week of Khordad 1400, late May 2021, has been determined. In total, 4.8% of the present species were in the seed dispersal stage, 20% were at the stage of flower formation where the plant was dry but still green, 33.3% had completed their vegetative and reproductive stages and were fully dried, and 43% were in the vegetative stage with only visible leaves (Figure 5).

Plant species density in the forest floor sample plots

The total number of plants counted in the 20 micro-plots was approximately 1, 864 individuals, resulting in an average density of about 93 plant individuals/ m^2. Among the species, *Bromus tectorum* (1,084 individuals) and *Bromus sterilis* (163 individuals) exhibited the highest counts (Figure 6).

In other words, over 74% of the plant density in the studied sample plots was attributed to these three short-lived annual species (Table 2).

Out of the total 1,864 individuals counted in the micro-plots of the Sarabtaveh site, 95.8% belonged to species with the therophyte life

form, 3.3% to hemicryptophytes, and less than 1% to chamaephyte and cryptophyte life forms (Figure 7).

Plant species diversity in the habitat

The species richness, evenness, and diversity indices for the forest floor micro-plots in the Sarabtaveh region are presented in Table 3. According to the results, the number of species per micro-plot, as a simple index of species richness, averaged 5.1 species/ micro-plot/per square meter. The maximum species richnesswas 11 species/micro-plot, while the minimum was one species/ micro-plot.

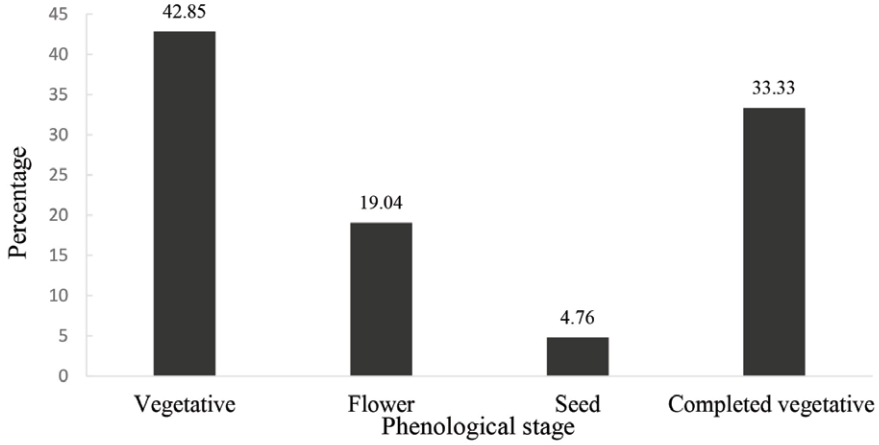

Fig. 5. The overall phenological status of different species in the region

Fig. 6. The species *Bromus tectorum* (left side) and *Bromus sterilis* (Schematic image)

Table 2. Number of species related to different density classes (average of all sample plots)

Density class (Individual/ m^2)	species Number/class	Ratio (%)
1-4	5	23.8
5-14	4	19.04
15-29	5	23.8
30-99	1	4.76
> 99	6	28.57

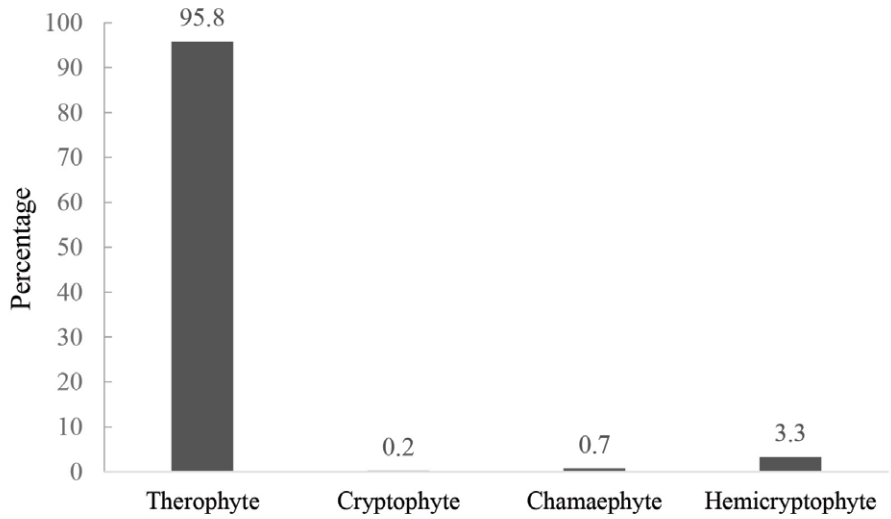

Fig. 7. Biodiversity form of plant species in the region

Table 3. Biodiversity indices of forest floor cover in the sub-sample plots of the region

Plot	Micro Plot	Pilou uniformity	Sheldon uniformity	Margalef richness	Menhinik richnesss	Shannon	Simpson	Dominance index	N individual	N spieses
1	1	0.79	0.62	1.62	0.63	1.82	0.79	0.21	255.00	10.00
	2	0.66	0.52	1.27	0.66	1.29	0.64	0.36	111.00	7.00
	3	0.58	0.36	2.16	1.09	1.38	0.57	0.43	102.00	11.00
	4	0.72	0.58	1.43	0.86	1.40	0.66	0.34	67.00	7.00
	5	0.59	0.45	1.18	0.55	1.16	0.61	0.39	164.00	7.00
2	1	0.63	0.41	2.09	1.00	1.50	0.63	0.37	121.00	11.00
	2	0.62	0.54	0.85	0.48	0.99	0.57	0.43	109.00	5.00
	3	0.68	0.60	0.88	0.52	1.09	0.61	0.39	92.00	5.00
	4	0.74	0.63	1.06	0.57	1.33	0.65	0.35	110.00	6.00
	5	0.78	0.67	1.11	0.63	1.39	0.71	0.29	90.00	6.00
3	1	0.41	0.52	0.41	0.26	0.45	0.23	0.77	138.00	3.00
	2	059	1.00	0.00	0.20	0.00	0.00	1.00	25.00	1.00
	3	0.68	0.80	0.32	0.43	0.47	0.30	0.70	22.00	2.00
	4	0.30	0.38	0.70	0.47	0.42	0.18	0.82	72.00	4.00
	5	0.63	1.00	0.00	0.13	0.00	0.00	1.00	60.00	1.00
4	1	0.53	0.52	0.64	0.39	0.74	0.39	0.61	105.00	4.00
	2	0.54	0.53	0.74	0.53	0.75	0.38	0.62	58.00	4.00
	3	0.44	0.68	0.26	0.30	0.30	0.17	0.83	44.00	2.00
	4	0.77	0.78	0.44	0.31	0.85	0.50	0.50	93.00	3.00
	5	0.56	0.62	0.61	0.59	0.62	0.33	0.67	26.00	3.00
Mean		0.61	0.61	0.89	0.53	0.90	0.45	0.55	93.20	5.10

Discussion

The establishment of permanent plots in the Sarabtaveh coppice forests has provided a foundational dataset, recording a total vegetation cover of 45.5%. This value falls within the reported range for similar Zagros oak forests under coppice management (Mirzaei et al., 2008 reported ~40-50%). Shokrollahi et al. (2012) in the highland pastures of Polur region, and Askari and Mirdavoudi (2023) studied the effect of slope aspect on vegetation of Astragalus cover density in the Central Zagros. The predominance of the coppice growth form across the stand strongly indicates a history of recurrent cutting or browsing; a common anthropogenic influence in the Zagros region.

In this research, 24 plant species were identified in the Sarabtaveh site. In this region, the Poaceae family with 7 species, followed by the Fabaceae and Ranunculaceae families, each with 2 species, were the dominant plant families in the studied area. In studies on the diversity of herbaceous plant species in the Mid-Zagros (part of the forests north of Ilam), Poaceae reported as the largest family in the studied area (Mirzaei et al., 2008). In a study by Hamze et al. (2008) in Chaharzabar, Kermanshah, the largest families were Poaceae, Fabaceae, and Asteraceae, respectively. Besides, in the Educational-Research Forest of Razi University, Kermanshah, the Asteraceae, Poaceae, Rosaceae, and Fabaceae families were reported as the dominant families (Heidari et al., 2019). In the Zagros forests in Baneh county, the highest number of species belonged to the genus Astragalus, and the largest families were Asteraceae, Fabaceae, Apiaceae, and Poaceae (Shakeri et al., 2021). The low number of plant species in the enclosed area compared to the typical habitat is probably related to the shrub understory cover; in this regard, over 70% of the forest floor in the enclosed area is covered by various Astragalus species.

Overall, annual herbaceous species played a significant role in the forest vegetation of the region. Based on the obtained results, more than half (54%) of the species in this habitat were therophytes (annual plants), 21% hemicryptophytes, 4.2% chamaephytes, 12.5% phanerophytes, and 8.3% geophytes (cryptophytes). In studies by Mirzaei et al. (2007) and Dehshiri (2020) on the forest vegetation of Mid-Zagros forests, therophytes were also reported as dominant. In the coppiced stands of the northern Zagros, most species belonged to the therophyte life form, while in the forest relics, they belonged to phanerophytes (Shakeri et al., 2021).

At the time of sampling during Khordad 1401/late May-early June 2022), in the Sarabtaveh site, 43% of the species were in the vegetative stage, and 57% were in reproductive and fruiting stages or had dried.

In the studied area, the average number of species per sample plot was 8.7, and the average number of individuals per sample plot was 126.5. Our recorded Shannon index of 1.56, which is lower than values from less-disturbed stands (e.g., Mirzaei et al., 2008) and comparable to managed stands (Heidari et al., 2019), supports this intermediate disturbance hypothesis. The dominance of therophytes (54%) and the significant shrub understory cover further suggest our site is in a secondary successional stage

following moderate historical disturbance (coppicing), consistent with the 'minor intervention' phase of the model we propose.

In the forests of Piranshahr, enclosure did not have a significant effect on the richness of woody species, but the Shannon diversity index increased significantly (Rashe Shaeri et al., 2014). In studies of Dinar-Kuh in Ilam, the Menhinick and Margalef richness indices and the Simpson diversity index did not alter significantly under enclosure and management practices, while significant changes in the Shannon diversity index was observed (Azizi et al., 2022). Furthermore, studies in the forests of Eyvan Gharb county, Ilam, showed that species richness was higher in the control area than in the degraded area, and evenness was higher in the degraded area (Azami et al., 2018). Results from studies in the semi-steppe rangelands of the Central Zagros indicated that with increasing grazing intensity, the Shannon-Wiener diversity and Margalef richness indices decreased, but the Menhinick index and evenness were higher in the heavily grazed area (Gholami et al., 2020). In a study in the Sar-Khalaj forests of the Mid-Zagros, vegetation diversity indices were significantly lower in the heavily grazed area compared to the enclosed area, while the indices in the moderately grazed area had higher values than in the heavily grazed area.

Briefly, it can be stated that with minor intervention in the climax ecosystem (limited tree removal or limited grazing), reduced competition, canopy opening, and decreased litter depth and coverage create conditions for the establishment of new species and increased species richness. However, through continious degradation and the extensive tree cutting, overgrazing and soil degradation, removal of the litter layer, soil erosion, and increased evaporation and severe soil dryness, species richness and diversity decrease significantly. It seems that various results of studies are attributed to differences in the level of degradation and the specific stage of succession. In the present study, the non-enclosed areas were not under severe degradation. On the other hand, the difference in conditions between the enclosed and non-enclosed sample plots was not very pronounced overall are due to the incomplete and non-strict implementation of enclosure.

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