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INVESTIGATING THE FLORA AND SPECIES DIVERSITY OF WEEDS IN GREEN SPACE

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ABSTRACT

One of the influential factors to maintain and increase the per capita of green space and to achieve the global standard level is properly management of weeds in the green space. Thus, a study was conducted in District 10 parks of Tehran city in 2014 for evaluating and determining the diversity, density, abundance of weeds in a research grass. Sampling was carried out in the summer season. Then, weeds were identified and counted separately in terms of genus and species by using the systemic W method. Ultimately, frequency, uniformity, and mean density of plants and abundance index were calculated. In total, 17 weed species from 13 plant families were identified at the level of Tehran city. In terms of density of weeds, Rezvan Park with 11.28 plants per square meter and Etemad Park with 9.39 plants per square meter had the highest and lowest weed density, respectively. In this investigation, 17 weed species of 13 plant families were identified. Plant families of Poaceae, Asteraceae, Chenopodiaceae, and Amarantaaceae with 3, 2, 2, and 2 species had the highest species diversity, respectively. In total, they included 52.92% of the total weed species. In terms of life cycle, 7 perennial species (42%) and 10 annual species (58%) were identified in District 10 parks of Tehran city. Among the species identified in this study, 13 species had broad leaves (76%) and 4 species had narrow leaves (24%). In terms of abundance index (AI), weeds of Taraxacum officinale L., Polygonum patulum M. Bieb, and Cynodon dactylon (L.) Pers were identified as the most abundant weeds in Distract 10 in Tehran city, respectively.

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Introduction

Weeds are plants growing in unwanted locations. These plants compete with ornamental species in parks and gardens, and urban green spaces in terms of uptake of water, nutrients, light, and space. Considering the fact that beauty of these places relies on vitality of the ornamental species, the cleanliness, uniformity of these places, lack of controlling the weeds will lead

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into weakened trees, flowers and other ornamental species, reducing the beauty of these spaces. Damage caused by weeds to green spaces is in two forms of direct and indirect. Direct damages caused by weeds to these spaces include reduced growth of ornamental species and forest trees, reducing the beauty of landscape and losing the uniformity and vitality of these spaces. Moreover, weeds are considered as appropriate and desired host for pathogens and harmful insects. The weeds in urban parks and green spaces have provided the conditions for increased population of living damaging factors, and thereby, caused indirectly damage to these spaces. Turf grasses infected with problematic weeds (such as clover) destroy all efforts of workers, leading to waste of costs, and dissatisfaction of visitors. Lack of paying attention to weeds in these places for long time leads to stabilization of these species and, in some cases, removing them will be possible just by destructing, preparing, and re-construction of green spaces [1] . The first step in in managing the weeds of a park or green space is identifying the type and distribution of weeds in the considered place to take step for managing the weeds with an open vision and accurate planning .Therefore, identifying and recognizing the weeds is a base to control them, and until adequate knowledge has not been gained on weeds available in the place, using various control methods will not have any useful impacts. Gaining information on density, type and distribution of weeds in each place can be successful in short-term and long-term management of weeds in that place and prevents weed distribution from one area to another area [2]. Esmaili and Salehi [3] investigated the weed diversity of turf grasses of Shiraz University. They identified 14 weed species belonging to 9 plant families. The most important broad-leaf and narrow-leaf weeds were reported Taraxacum officinale L and Cynodon dactylon L. Pers, respectively. In their investigation on weeds flora of 115 fields of Vaccinium angustifolium in the Navascottia area in 1984 and 1985, McCully et al [4] identified 119 weed species and they studied the distribution of these species .Bourdot et al [5] investigated weeds flora of wheat and barley fields in New Zealand's Canterbury during 1990 to 1993. They identified and investigated the weed density in 39 wheat fields and 45 barley fields. They reported more than 50 species of weeds belonging to more than 49 different genera of 23 plant families. Thus, given the importance of green space and the importance of managing the weeds in big cities, this study was carried out in 2014 to evaluate the diversity, density, and abundance of weeds in turf grasses in District 10 parks of Tehran

Methodology

During one-year sampling conducted in 2014, 4 parks in District 10 of Tehran city were selected. Sampling was performed in parks of 22 Bahman, Rezvan, Etemad and Hezar Shahid. Sampling was performed in summer season by using a systemic W method. Sampling was performed at any point by a quadrat at dimensions of 1×1 m, and weeds were identified and counted separately in terms of species and genus. It noteworthy that GPS receiver was used to determine the latitude, longitude, and altitude of the sea level were determined in each park. Then, Thomas equations [6] were used to calculate the frequency, uniformity and mean density of the plants. Frequency (F) reflects the ratio of park with certain species of wild to the total number of parks, stated as percentages (Equation 1).

equation 1 $$(F_k = \left(\sum \frac{X_i}{n}\right) \times 100)$$

In this equation, FK IS THE frequency of species K, Yi indicates the presence (1) or absence (zero) of species k in park numbered i, and n is the number of parks investigated.

Uniformity (U) shows the percentage of sampled frames infected with K species, which is an indicator of the occupied space by weed (Equation 2).

equation 2 $$(U_k = \left(\sum\sum \frac{x_{ii}}{m_i}\right) \times 100)$$

In this equation Uk is the park uniformity for species k, Xij is presence (1) or absence (zero) of species k in the number i frame at the point of study j, n is number of studied parks, and m is number of frames cats.

Density (D) represents the number of single-species subjects per square meter (Equation 3).

equation 3 $$(D_{ki} = \left(\sum \frac{Z_i}{m_i}\right) \times 4)$$

In this function, Dk is density (number of plant per square meter) for species k in park number i, Zj is number of plants in the frame, and m is number of frames cast.

Mean density (MD) shows the mean number of plants per square meter in the park studied (Equation 4).

equation 4 $$(MD_{ki} = \left(\sum \frac{D_{ki}}{n}\right))$$

In this equation, D_{ki} is the density in each park and n is the total number of studied parks. To study the abundance of weeds, the equation (AI) presented by Minbashi et al [7] was used (Equation 5).

equation 5 $$(AI = F + U + MD)$$

In this equation, AI is the abundance index, U is uniformity, F is frequency and MD is the mean density of species.

We also used Shannon Wiener (H ') species diversity index to investigate the weed diversity in each park (Equation 6).

equation 6 $(H' = \sum[Pi(\ln Pi)])$

In this equation, Pi is the relative frequency of the species i), which is calculated as Pi = ni / N, and Ln is a natural logarithm. After calculating the Shannon Weiner index for each park, the index of uniformity (E) of was calculated (2).

equation 7 $(E = \frac{H'}{\ln S})$

In this equation, H' is the same Shannon Weiner and index, and S represents the number of weed species seen in each park. Ln was used in this equation.

Cluster analysis was used to compare and classify the parks (in terms of uniformity index and Shannon Wiener index) through SPSS software .In investigating the weed populations, two populations can have the same diversity, but they consist of different species. Therefore, it is necessary that weed populations of different areas to be investigated in terms of similarity. Some of the similarity indices include similarity coefficients of Jaccard (Sj) and Sorenson (Ss) [8].

In Jaccard similarity coefficient of Jaccard (Sj), we consider number of species shared in two societies.

equation 10 $S_j = j/(a+b+j)$

J: Number of species in both populations

a: Number of species found only in population a (shared species of two populations are excluded).

b, Number of species found only in population b (shared species of two populations are excluded)

Similarity coefficient of Sorenson (Ss) is modified form of Jaccard similarity coefficient (Sj), while shared species of the two populations are emphasized greater in the Sorenson similarity coefficient (Ss) compared to Jaccard similarity coefficient.

equation 11 $S_s = 2j/(a+b+2j)$

Using similarity indices of Jaccard and Sorenson, the level of similarity among different parks in District 10 in Tehran city was found.

Results And Discussion

In this investigation, 17 weed species belonging to 13 plant families were identified. In this investigation, 17 weed species of 13 plant families were identified. Plant families of Poaceae, Asteraceae, Chenopodiaceae, and Amarantaaceae with 3, 2, 2, and 2 species had the highest species diversity, respectively. In total, they included 52.92% of the total weed species (Figure 1). In terms of life cycle, 7 perennial species (42%) and 10 annual species (58%) were identified in District 10 parks of Tehran city. Among the species identified in this study, 13 species had broad leaves (76%) and 4 species had narrow leaves (24%) (Figure 3).

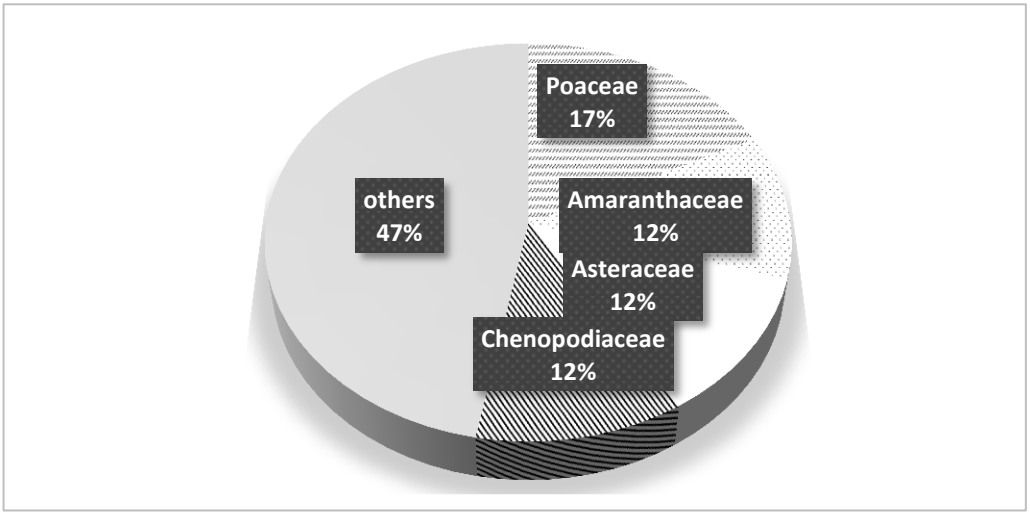


Figure 1- Plant families and percentage of weeds in these families in turfgrass

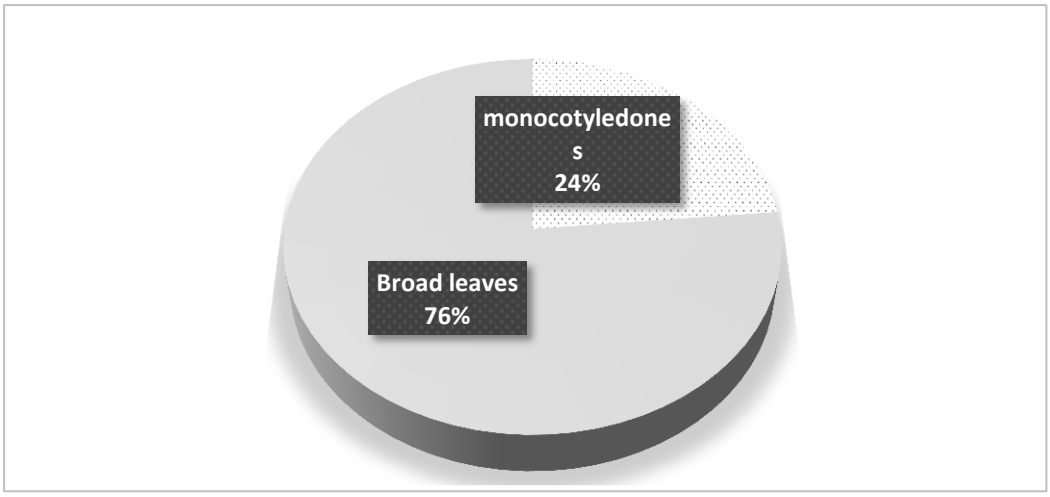


Figure2- Weeds in turfgrass of Tehran city (plant type)

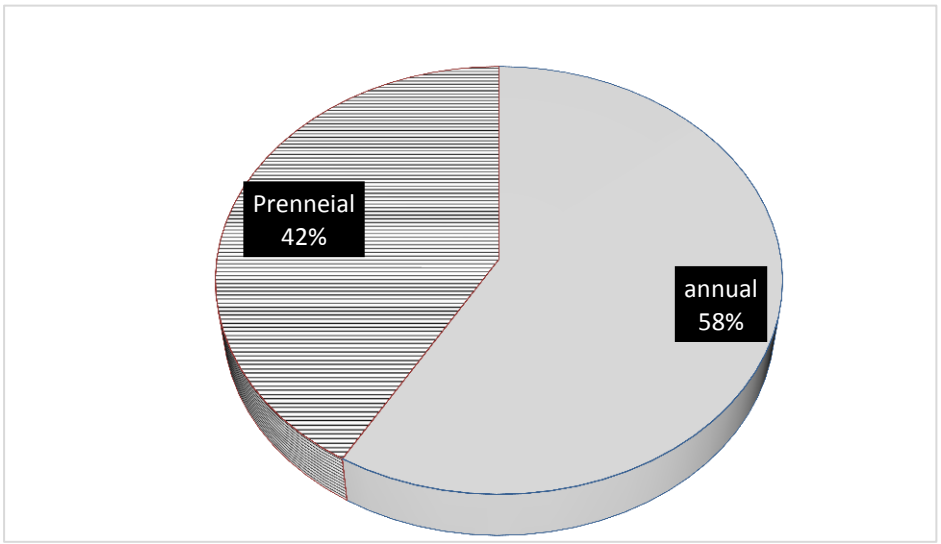


Figure 3-Weeds in turfgrass of Tehran city (life cycle)

Abundance index (AI) presented by [7] was used to rank the problematic weeds in District 10 in Tehran. Findings obtained by calculation of this index revealed that the weed of Taraxacum officinale L. with abundance of 155.50 was the most abundant weed in District 10 of Tehran, followed by weeds of Polygonum patulum M Bieb and Cynodon dactylon L. pers, respectively. Taraxacum officinale L is a perennial plant propagated by seed. This weed is native weed of Europe and Asia [9] and it was originally introduced in United States as a food product [10]. Taraxacum officinale L has been considered as invading weed in North America [11]. It is also an important weed in agriculture, imposing considerable economic damages considering pollution in many products throughout world. This weed has wide distribution and can be observed more often in parks and turf grasses. This plant is found in forests and pastures throughout Europe [12]. Its seeds survive in seed bank for many years. One study revealed that its seeds can germinate after 9 years. This plant produces large number of seeds. Producing 154-172 seeds per inflorescence and per plant, it can produce more than 5000 seeds per year. It is estimated that more than 97000000 seeds per hectare can be produced by a population of Taraxacum officinale L grown densely [13]. Weeds of C. dactylon LPers, Plantago major L., Polygonum patulum M. Bieb, Taraxacum officinale L. and Oxalis corniculata L. were found in all parks of District 10 in Tehran city. Thus, the emergence and growth of 5 weed species mentioned above in all parks of District 10 demand adopting precise and continuous management actions to combat and decrease the damage caused by these 5 species to all parks of District 10.

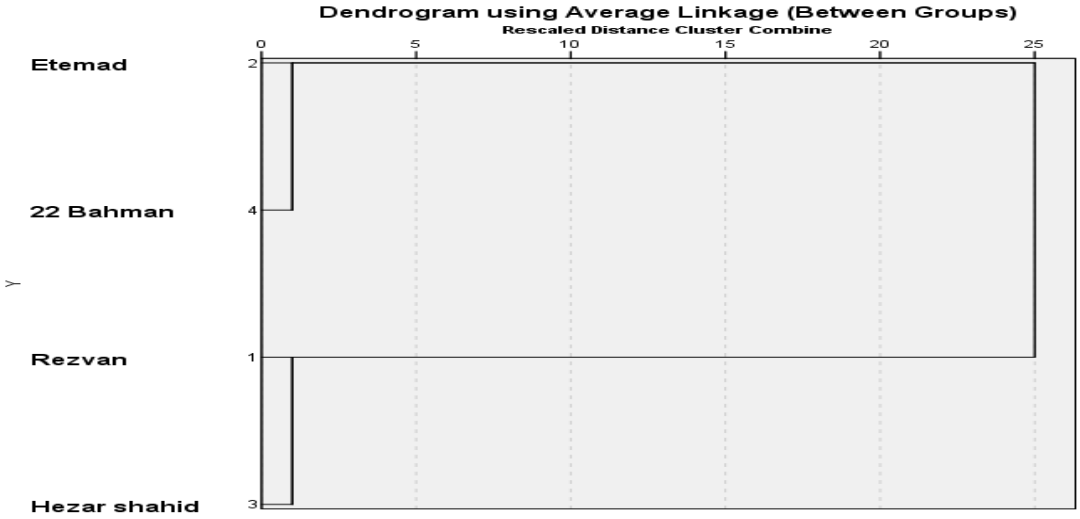
Table 1- Scientific name, family name, frequency (F), uniformity (U), mean density (MD), abundance index (AI) of turfgrass weeds in the Tehran´s parks.

Row	Scientific name	Family	F	U	MD	AI
1	Amaranthus blitoides S. Wats	Amaranthaceae	18.18	6.66	0.06	24.91
2	Amaranthus retroflexous L.	Amaranthaceae	36.36	10	0.13	46.49
3	Chenopodium album L.	Chenopodiaceae	36.36	16.66	0.13	53.16
4	Convolvolus arvensis L.	Convolvulaceae	63.63	30	0.8	94.43
5	Cynodon dactylon (L.) pers.	Zygophyllaceae	90.90	33.33	1.6	125.84
6	Digitaria sanguinalis (L) Scop	Poaceae	54.54	20	0.53	75.07
7	Echinochloa crus galli (L.) Beauv	Poaceae	9.09	3.33	0.06	12.49
8	kochia scoparia (L.) Schrad.	Chenopodiaceae	63.63	30	0.46	94.10
9	Malva neglecta Wallr	Malvaceae	9.09	6.66	0.2	15.95
10	Oxalis corniculata L.	Oxalidaceae	63.63	26.66	0.73	91.03
11	Plantago major L.	Plantaginaceae	36.36	33.33	1.33	71.03
12	polygonum patulum M. Bieb.	Polygonaceae	72.72	53.33	1.33	127.39
13	portulaca oleracea L.	Portulacaceae	18.18	6.66	0.13	24.98
14	Sonchus oleraceus L.	Asteraceae	45.45	36.66	0.2	82.32
15	Setaria viridis (L.) P. Beauv.	Poaceae	27.27	20	0.33	47.60
16	Taraxacum officinale (L.) Weber ex F. H. Wigg	Asteraceae	90.90	63.33	1.26	155.50
17	Trifolium repens L.	Fabaceae	18.18	10	0.73	28.91

Table2- Shannon-wiener, number of species and uniformity of species for weeds in turfgrass

Row	District 10 parks	Shannon-wiener index	Number of species	Species uniformity
1	Rezvan	2.21	17	0.77
2	Etemad	1.99	12	0.65
3	Hezar Shahid	2.17	16	0.75
4	22 Bahman	2.01	13	0.69

Biodiversity is considered as one of the important concepts in ecology and vegetation management. Species diversity is composed of two components, which the first one is related to number of species called as species richness. The second component of diversity is uniformity, which is relates to the distribution of species. Species diversity is not merely based on the number of subjects of number of species, but diversity can also be defined in terms of crown coverage or biomass weight of species [14]. In investigating weed population based on Shannon Weiner (H ') species diversity index, parks of District 10 were classified in two clusters at the similarity level of 95%. Rezvan and Hezar Shahid with 2.21 and 2.17, respectively, were placed in one cluster and they had the highest diversity. Etemad and 22 Bahman parks were placed in second cluster and with 1.99 and 2.01, respectively, had the lowest diversity (Table 2 and Figure 5). In terms of species uniformity, parks of District 10 were grouped in two clusters at the similarity level of 95%. Rezvan and Hezar Shahid parks with values of 0.77 and 0.75, respectively, have the highest levels of species uniformity and they were placed in the first cluster. Etemad and 22 Bahman parks with values of 0.65 and 0.69, respectively, had the lowest levels of uniformity, and they were placed in the



second cluster (Table 2 and Figure 6).

Figure 5- Cluster analysis in diversity of Tehran turfgrass by Shannon-wiener Index

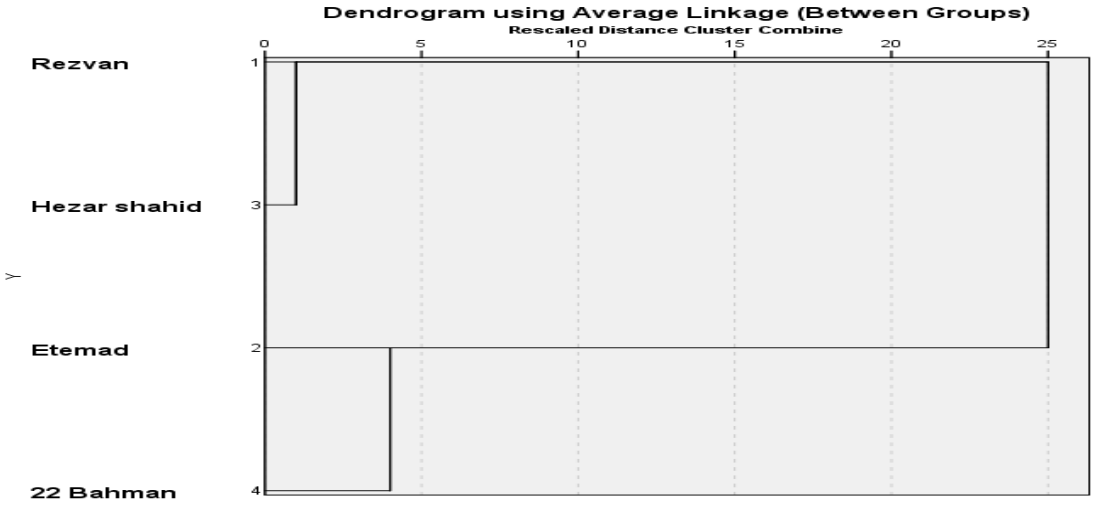


Figure 6- Cluster analysis of Tehran turfgrass in uniformity of species.

Investigations conducted in turf grasses in District 10 revealed that the highest level of Sorenson similarity coefficient was between Rezvan and Hezar Shahid parks was value of 0.78. The highest level of jacquard similarity coefficient was also found between Rezvan and Hezar Shahid parks with the value of 0.62. The lowest level of Sorenson similarity coefficient was found between Etemad and 22 Bahman parks with a value of 0.57 and the lowest level of jacquard similarity coefficient was found between Etemad and 22 Bahman parks with value of 0.47 (Tables 3 and 4). Hasannejad et al [15] investigated the

diversity of alfalfa field weeds in East Azarbaijan province cities. They reported that the highest weed similarity was found between weed population of alfalfa fields of Marand city and Julfa based on the Sorenson index (0.76) and two cities of Hashtrood and Malekan had the lowest similarity. They also reported these findings in Jaccard similarity coefficient.

Table 3 - Sorenson similarity coefficient to investigate the similarity of parks in District 10 in Tehran in terms of the type of weed species in turf grasses

	Rezvan	Hezar shahid	Etemad	22 Bahman
Rezvan		0.78	0.57	0.63
Hezar shahid			0.59	0.61
Etemad				0.74
22 Bahman				

Table 4-Jaccard similarity coefficient to investigate the similarity of parks in District 10 of Tehran in terms of the type of weed species available in turf grasses

	Rezvan	Hezar shahid	Etemad	22 Bahman
Rezvan		0.62	0.47	0.51
Hezar shahid			0.48	0.51
Etemad				0.61
22 Bahman				

Conclusion

In general, given identification of 17 different weed species based on the number, type, life cycle and distribution at the level of turf grasses in District 10, a precise planning, classification, and management of weeds based on type and life cycle seem to be necessary. For example, because of finding seven perennial weed species in Tehran, precise planning to decrease the damage of perennial weeds in different seasons of the year is demanded. In addition, precise planning and management to control winter and summer annual weeds is essential. Comparing various parks of District 10 showed that more attention and emphasis is required on management of weeds in Rezvan and Hezar Shahid parks, which have the highest species diversity of weeds. In addition, C. dactylon LPers, Plantago major L., Polygonum patulum M. Bieb, Taraxacum officinale L. and Oxalis corniculata L weeds were found in all parks of District 10 of Tehran. Thus, the emergence and growth of 5 weed species mentioned above in all parks of District 10 demand adopting precise and continuous management actions to combat and decrease the damage caused by these 5 species to all parks of District 10 by a central department monitoring.

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