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Cultural Importance Indices of the Endemic Plants in Egypt

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ETHNOBOTANY has improved dramatically in recent decades and become a widely recognized scientific discipline after the usage of mathematical methods. Cultural importance index (CI) is considered a tool for evaluating the use-value (UV) of plants. It become an essential quantitative method in many ethnobotanical studies. The present study evaluates the cultural significance of different Egyptian endemics using four indices (UR: number of use reports, RFC: relative frequency of citation, RI: relative importance and CV: cultural value) depend on informant report. Each index intends to evaluate the CI of plant taxa and its statistical analysis. Ethnobotanical information was collected from summer 2018 to Spring 2020 through monthly visits to the study area. CI was applied on 41 endemic plants recorded in the Egyptian flora. Medicinal species were the most represented group (40 taxa), then grazing (25), and human food (14). Ranking of CI index according to the contribution of each species indicating that *Rosa arabica* was the first-ranking (6 out of 9 groups), followed by *Origanum syriacum* subsp. *sinaicum* (5 groups) and *Sonchus macrocarpus* (3 groups). High positive linear correlation was detected between CI-RFC (0.96), CI-RI and CI-CV (0.98); while weak correlation between number of uses (NU) and RFC (0.47) at $P<0.05$ (n=41).

Keywords: Consevation, Egyptian flora, Endemism, Ethnobotanical indices, Quantitative ethnobotany.

Introduction

Endemism is a work of the spatial scale used to illustrate the restriction of specific taxa to a limited-sized area (Laffan & Crisp, 2003). The red data list includes the majority of endemic species. Habitat specificity and unique distribution areas led these taxa to be potentially threatened (Crisp et al., 2001). Forty-one species were recorded as endemic taxa in the Egyptian Flora belonging to 20 families and 36 genera (El-Khalafy et al., 2021; El-Khalafy, 2023).

Plants are fundamental resources and provide an great effect on ecosystems and a vital role in the socio-economic conditions of the people (Bocuk et al., 2009; Ahmad et al., 2010; Shaltout & Ahmed, 2012). Plants were universally considered as a vital costitutent of global sustainability and biodiversity (e.g. plants provide medicine, food, fuel and fiber). Plant diversity is a suitable indicator for healthy ecosystems, which provide the processes and conditions which keep life and are necessary to the livelihoods of all humankind (Wilson, 1992).

Ethnobotany is known as the interactions study between plants and humans; however, the current use of this description implicit the study of native or traditional uses of plants. It includes the indigenous knowledge of plant classification, cultivation, and use as food, medicine and shelter, especially ethnomedicinal knowledge related to many drug industries (Faruque et al., 2018; Ahmed et al., 2020). Prance et al. (1987) preferred using the expression “quantitative ethnobotany”.

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Strenuous efforts are made in enhancing the traditional compilation-style of ethnobotanical studies by integrating quantitative research methods in data collection, processing, and interpretation of results (Höft et al., 1999). There were different procedures regarding measurement equations (Hoffman & Gallaher, 2007).

Recently, the use of quantitative ethnobotany has increased steadily. Researchers have advanced and applied quantitative techniques to ethnobotanical information for testing numerous hypotheses about the interaction between humans and plant taxa (Reyes-Garcia et al., 2006). Anthropologists and ethnobotanists have proposed numerous indices to assess the cultural significance of plant taxa for people. For example, cultural significant index was proposed by Turner (1988), which drew on the intensity, quality, and plant uses exclusivity. The previous index has been modified by Stoffle et al. (1990) by integrating a variable to measure the current use of different plant taxa. Recently, some cultural variables were proposed for assessing the value of plants fit for consumption (Pieroni, 2001).

Different indices have been constructed by ethnobotanists for measuring the UV of plant species. For example, UV is the relation between the number of conducted interviews and the number of uses recorded in these interviews (Phillips & Gentry, 1993a, b). The most frequent plants mentioned were assigned more use value than plants reported with less frequency. During survey interviews, Begossi (1996) suggested applying ecological diversity indices to collected ethnobotanical data. According to this method, Ethnobotanists have calculated indices of diversity using the number of participant's data who mentioned a plant species during meetings (Figueiredo et al., 1997; Rossato et al., 1999).

The CI, as a tool to calculate the UV of plants, is a growing trend in quantitative ethnobotanical research. Recently, ethnobotanists have taken an interest in the deficiency of information on the relative importance and cultural significance of useful plants (Moerman, 1994). The present manuscript depended on previous methods dealing with quantitative ethnobotany to develop a recent method for evaluating the cultural importance of different Egyptian endemic taxa. The main aim of this study is to evaluate the cultural significance of different Egyptian endemic taxa using four indices (UR, RFC, RI and CV) depending on informant reports. Each index intends to evaluate the CI and UV of plant taxa and its statistical analysis suitability.

Study area

Egypt lies in the northeastern region of Africa and extends to Asia (Sinai Peninsula). It is considered one of the driest regions in North Africa, in which desert characteristics dominate the country (Wickens, 1992). Egypt is divided into four geographical regions: the Western Desert, with Mediterranean coastal region (681,000km²), Eastern Desert, including the Red Sea coastal belt (223,000km²), Nile land (25,000km²) and Sinai Peninsula (61,000km²), with its special climate (Zahran & Willis, 2009) (Map 1).

Materials and Methods

Ethnobotanical survey and data collection

Ethnobotanical data about the endemic taxa in Egypt was collected from summer 2018 to spring 2021 through monthly visits to the study area for interviewing people in the local communities (including Saint-Catherine, Matrouh, Alexandria, Western Oases, Asiut and Aswan). Ethnobotanical uses of the recorded taxa were assessed on the information collected from local interviewers. One hundred person distributed in different regions allover Egypt were interviewed (their ages between 40-80 years old). The interviews include local inhabitants, herbalists, researchers and professors in universities and research centers. Numerous questions were asked about the endemic taxa used in the area in the previous and recent days. The same questions were asked to all interviewers to record the full knowledge of each informant in the different perspectives of plant use (Appendix 1).

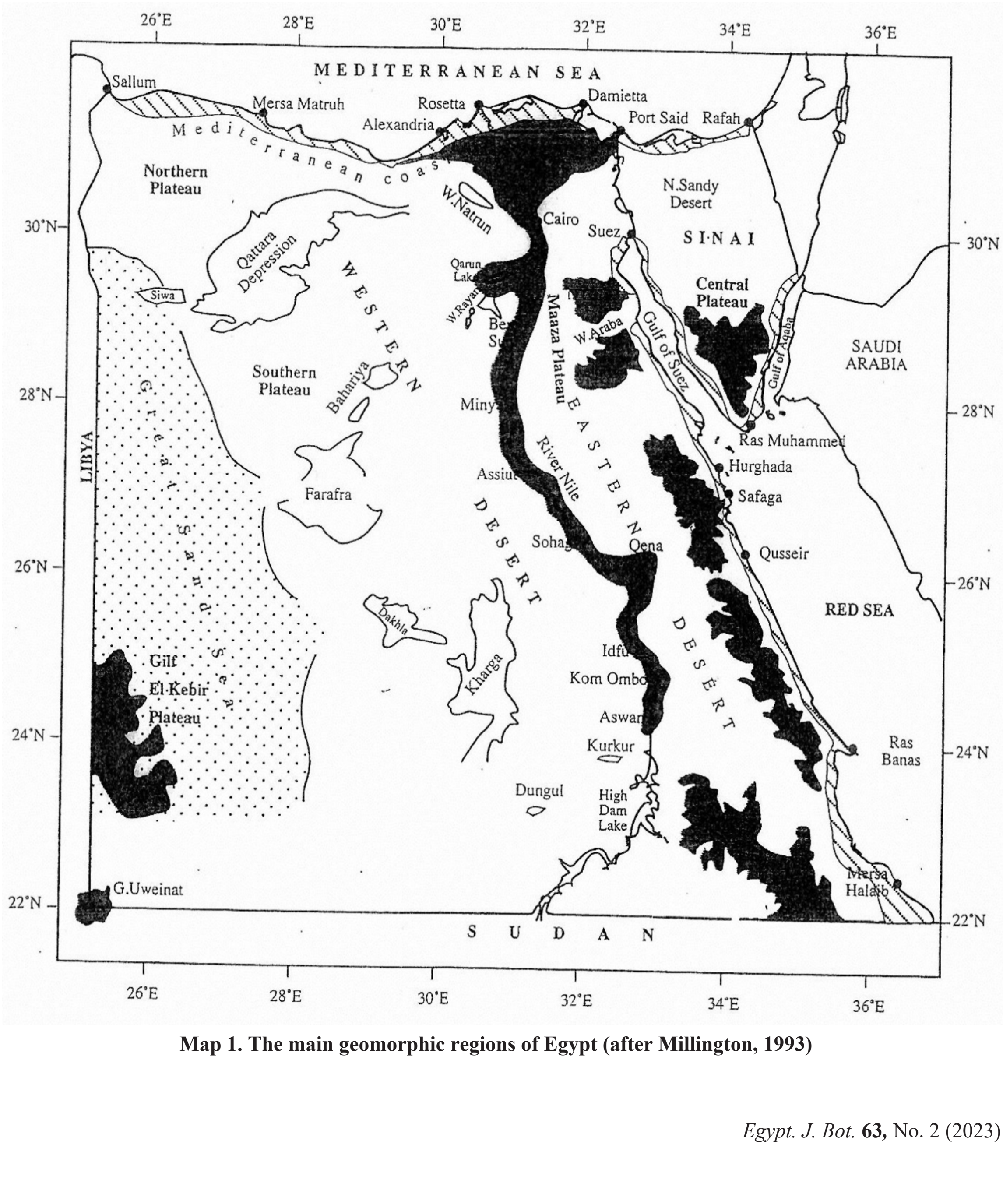
Key informants with a sound knowledge of traditional uses of wild plants were sought, the majority of whom were elder people who settled and worked in the area for long time. Interviews were a spontaneous and familiar setting which carried out in informant homes. Different trips in the region were managed to collect plant specimens in order to complete the uses of plants known by the interviewer. The plants are identified according to Boulos (2009) and IPNI website (https://www.ipni.org/) and their voucher specimens were kept in Kafrelsheikh (KFSUH) University and Tanta University herbaria (TANE).

Data analysis

Ethnobotanical indices are established on the basic structure of ethnobotanical information: informant "i" mentions the use of the species "s" in the use-category "u". This ethnobotanical information can be gathered in different methods with fixation to one or two of the variables. The Ethnobotanical indices are calculated as illustrated in Table 1.

The same data has been summed (URs) but grouping them differently. Regarding CI index, UR grouping are summed by uses (the sum of the interviewers who cited each use) and then sum all these UR. However, in the case of the UV index, we first sum the UR grouping by informants (the sum of the uses cited by each informant) and then sum all these data (Albuquerque et al., 2006; Estomba et al., 2006; Monteiro et al., 2006). However, the Spearman linear correlation coefficient was used to compare the various indices since all the variables considered are not distributed normally (Tardyo & Santayana, 2007; Shaheen et al., 2017).

Cluster analysis could provide information about the classification groups of plants according to their cultural significance. Dendrogram resulted from agglomerative centroids used for culturally important plants in different clusters according to their closely relative members (CAP, 2007).



Map 1. The main geomorphic regions of Egypt (after Millington, 1993)

TABLE 1. Equations of ethnobotanical indices applicated from the survey

No.	Enthobotanical index	Abbreviation	Equation	Reference
1	**Number of use reports**	UR	$UR_s = \sum_{u_1}^{u_c} \sum_{i_1}^{i_n} UR_{ui}$	Kufer et al. (2005)
2	**Relative Frequency of Citation**	RFC	$RFC_s = \frac{FC_s}{n} = \frac{\sum_{i_1}^{i_n} UR_i}{n}$	Kufer et al. (2005)
3	**Relative Importance Index**	RI	$RI_s = \frac{RFC_{s\,(max)} + RNU_{s\,(max)}}{2}$	De-Santayana (2003).
3.1	Relative frequency of citation divided by the maximum	$RFC_{s\,(max)}$	$RFC_{s(max)} = FC_s/\max(FC)$	De-Santayana (2003).
3.2	Relative number of use-categories divided by the maximum	$RNU_{s\,(max)}$	$RNU_{s\,(max)} = \frac{NUs}{\max(NU)} = \frac{\sum_{u_1}^{u_c} UR_u}{\max(NU)}$	De-Santayana (2003).
3.2.1	Number of uses of the taxon	NUs	$NU_s = \sum_{u_1}^{u_c} UR_u$	De-Santayana (2003).
4	**Cultural Value Index**	CV	$CV_s = [NU_s/NC] \times [FC_s/n] \times \left[\sum_{u_1}^{u_c} \sum_{i_1}^{i_n} UR_{ui}/n\right]$	Reyes-García et al. (2006)
5	**Cultural Importance Index**	CI	$CI_s = \sum_{u_1}^{u_c} \sum_{i_1}^{i_n} UR_{ui}/n$	Tardyo & Santayana (2007)

Where, i_n: is the total number of informants (i_1, i_2, ………, i_n) and u_c is the total number of use-category (u_1,u_2, …………, u_c) for each species; n: number of informants (i) participating in the survey; NC: total number of use categories (u); FC_s: frequency of citation for each species (the number of informants who mention the use of the species)

Results

Forty-one endemic taxa belonging to 36 genera and 20 families were recorded in the present study (Appendix 2). All the endemic taxa were useful plants according to key informants. In the present study, data were categorized into nine categories based on the uses of plants (Table 2). These categories include medicinal uses (ME), grazing (GR), human food (HU), fuel (FU), oil production (OP), esthetic uses (EU), perfume uses (PU), wood industries (WI) and tobacco industries (TI). Family Asteraceae was the most used family, including six species with five use categories, followed by Fabaceae and Caryophyllaceae (each represented by five species) with three use categories. Medicinal category grouped 40 taxa, grazing 25 taxa, human food 14 taxa, esthetic uses 12 taxa, fuel 3 taxa, while other categories represented only by one taxon.

TABLE 2. Number of use reports (UR) and percentage of use categories

Categories	Code	Number of species	Use reports (UR)	Percentage (%)
Medicinal	ME	40	832	41.6
Grazing	GR	25	487	24.3
Human food	HF	14	274	13.7
Esthetic uses	EU	12	217	10.8
Fuel	FU	3	68	3.4
Wood industry	WI	1	39	2.0
Tobacco industry	TI	1	38	1.9
Perfume uses	PU	1	28	1.4
Oil production	OP	1	18	0.9

Comparison between different indices

Cultural importance index (CI) of endemic taxa and their contributions to each category of the nine major categories in the CI index were shown in Table 3. In general, medicinal use is the most culturally significant (CI=8.32), followed by grazing (CI=4.87), human food (CI=2.74), while oil production is the least important (CI= 0.18).

Depending on CI index, *Rosa arabica* (CI=1.97) is the most important species with six uses (NU) and 58 use reports (UR) and 45 frequency of citations (FC) (Table 4). Fuel use has the maximum CI value in *Rosa arabica* (0.41), then medicinal (0.40) and wood industries (0.39), while grazing has the lowest CI value (0.14). The second species is *Origanum syriacum* subsp. *sinaicum* (1.68), the most important uses are human food (0.43), esthetic (CI= 0.37) and medicinal uses (CI= 0.38), while perfume (0.28) and grazing (0.22) uses are less important. The third species is *Sonchus macrocarpus* (1.62); numerous informants cited it in three out of nine categories. The most important uses are medicinal (0.55), followed by human food (0.54) and grazing (0.53).

Rorippa integrifolia is less culturally significant according to the CI index (0.04). Four informants cited it in only one out of nine categories, followed by *Bellevalia salah-eidii* (0.08) with eight informants cited in one category, while *Muscari salah- eidii* and *Tephrosia kassasii* (each of 0.09), where two informants cited them in two use categories (Table 3). In general, at the level of all endemic taxa, medicinal use was the most culturally significant according to the CI index (8.32), followed by grazing (4.87) and human food (2.74); while oil production, perfume uses and tobacco industry are the less important (0.18, 0.28 and 0.38, respectively).

The classification of plants according to a dendrogram of cluster analysis indicated that the culturally important plants are grouped (at Euclidean distance of about 24) into 5 clusters at 5th level due to their closely relative members according to uses category and CI classification of similar uses (Fig. 1). Cluster **I** chracterized by *Rosa arabica*, II charaterized by *Sonchus macrocarpus*, III characterized by *Origanum syriacum* subsp. *sinaicum*, IV chracterized by *Hyoscyamus boveanus*, and V chracterized by 37 species. Furthermore, at the Euclidean distances of about 12, cluster V is classified into 3 subclustes on the bases of similar uses (V_1, V_2, V_3). The local name and the code of every species of plant, which corresponds to the number of species, can be seen in Appendix 2.

The ranking of species according to the calculated indices (CI, RFC, RI and CV) indicated clear differences in the species ranking yielded by the various indices set. The ranking of the species varies according to the selected index (Table 4). RI, CI and CV indices place *Rosa arabica* in the first ranking, while RFC index put it in the fifth ranking. *Origanum syriacum* subsp. *sinaicum* had the second ranking in CI and CV indices, while RI index placed it in the third ranking and RFC index in the sixth ranking. *Sonchus macrocarpus* was in the third ranking based on CI and CV indices, while in the first ranking based on RFC index and the fifth ranking based on RI index. On the other hand, *Rorippa integrifolia* had the last ranking based on RI and CI indices, *Brassica deserti* in the last rank based on RFC index and *Bellevalia salah-eiddi* was in the last ranking based on CV index.

The descriptive statistics in Table 5 obtained using the different indices and basic values. CI index has the highest mean ± SD values (0.48 ± 0.44) in relation to other indices, followed by RI index (0.42 ± 0.19). In contrast, CV index has the lowest values (0.06 ± 0.11). Regarding the basic values, UR had the highest value (35.22 ± 16.24), while NU has the lowest (2.37 ± 1.04) (Figs. 2, 3).

Spearman correlations among all the variables are shown in Table 6. All the investigated correlations are significant at $P < 0.05$ (n=41), with different strength. **CI** was highly correlated with FC (r = 0.96), followed by UR (r = 0.92) and NU (r = 0.66), **RFC** is fully correlated with FC (r = 1.00), followed by UR (r = 0.98) and NU (r = 0.47). In addition, **RI** is highly correlated with CI (r = 0.98) followed by FC and RFC (each of r = 0.93), and UR (r = 0.89). **CV** is highly correlated with CI (r = 0.98), followed by RI (r = 0.97), FC and RFC (each of r = 0.93) and UR (r = 0.90). In general, RI, CV and CI have the highest correlations with NU.

TABLE 3. Cultural importance index (CI) of the endemic taxa in the Egyptian flora, with the CI component of each use category. Regarding the total CI, maximum values are highlighted, while the minimum are underlined. The use categories ae coded as follows: ME: medicinal, HF: human food, GR: grazing, FU: fuel, OP: oil production, EU: esthetic uses, PU: perfume uses, WI: wood industries, TI: tobacco industry

Species	ME	HF	GR	FU	OP	EU	PU	WI	TI	Total CI
Allium mareoticum	0.20	0.18								0.38
Anarrhinum pubescens	0.23		0.27	0.16						0.66
Anthemis microsperma	0.17		0.12			0.15				0.44
Astragalus fresenii	0.10									0.10
Atractylis carduus var. *marmarica*	0.32		0.35	0.11						0.78
Ballota kaiseri	0.22		0.19		0.18					0.59
Bellevalia flexuosa var. *galalensis*	0.06	0.07								0.13
Bellevalia salah-eidii	0.08									0.08
Biscutella didyma var. *elbensis*	0.23		0.18							0.41
Brassica deserti	0.03	0.03	0.02							0.08
Bromus aegyptiacus	0.45	0.38	0.40							1.23
Buffonia multiceps	0.18		0.27							0.45
Dianthus guessfeldtianus	0.14					0.09				0.23
Echinops taeckholmiana	0.18		0.14							0.32
Fumaria microstachys	0.19					0.15				0.34
Glinus runkewitzii	0.10									0.10
Helianthemum schweinfurthii	0.19					0.12				0.31
Hyoscyamus boveanus	0.47								0.38	0.85
Ifloga spicata subsp. *elbaensis*	0.28		0.23			0.18				0.69
Limonium sinuatum subsp.*romanum*	0.26					0.34				0.60
Melilotus serratifolius	0.26	0.32								0.58
Micromeria serbaliana	0.17									0.17
Muscari albiflorum	0.08	0.05								0.13
Muscari salah- eidii	0.06	0.03								0.09
Origanum syriacum subsp. *sinaicum*	0.38	0.43	0.22			0.37	0.28			1.68
Pancratium arabicum	0.48	0.15	0.05			0.06				0.74
Persicaria obtusifolia	0.11		0.09							0.20
Polygala sinaica var. *sinaica*	0.24		0.21							0.45
Primula boveana	0.19	0.12	0.20			0.15				0.66
Rorippa integrifolia	0.04									0.04
Rosa arabica	0.40	0.31	0.14	0.41		0.32		0.39		1.97
Senesio belbeysius	0.15		0.08			0.12				0.35
Silene leucophylla	0.17		0.25							0.42
Silene oreosinaica	0.17		0.18							0.35
Silene shimperiana	0.19		0.23							0.42
Sonchus macrocarpus	0.55	0.54	0.53							1.62
Tephrosia kassasii	0.09									0.09
Thesium humile var.*maritima*	0.28		0.24							0.52
Trigonella media		0.08	0.09							0.17
Veronica anagalloides subsp. *taeckholmiorum.*	0.16		0.15			0.12				0.43
Vicia sinaica	0.07	0.05	0.04							0.16
Total	**8.32**	**2.69**	**4.87**	**0.68**	**0.18**	**2.17**	**0.28**	**0.39**	**0.38**	

TABLE 4. Evaluation of economic importance of the endemic taxa in the Egyptian flora, using four quantitative indices. FC: frequency of citation, UR: number of use-reports, NU: number of uses, CI: cultural importance, RFC: relative frequency of citation, RI: relative importance, CV: cultural value

Species	Basic vlue			Index				Ranking			
	FC	UR	NU	CI	RFC	RI	CV	CI	RFC	RI	CV
Allium mareoticum	23	38	2	0.38	0.23	0.36	0.0194	22	22	25	24
Anarrhinum pubescens	30	47	3	0.66	0.30	0.51	0.0653	10	15	10	10
Anthemis microsperma	19	28	3	0.44	0.19	0.41	0.0278	17	26	21	20
Astragalus fresenii	10	20	1	0.10	0.10	0.17	0.0011	36	34	38	38
Atractylis carduus var. *marmarica*	38	45	3	0.78	0.38	0.85	0.0988	6	7	2	6
Ballota kaiseri	28	40	3	0.59	0.28	0.49	0.0551	12	18	12	11
Bellevalia flexuosa var. *galalensis*	12	20	2	0.13	0.12	0.27	0.0034	34	32	33	33
Bellevalia salah-eidii	8	13	1	0.08	0.08	0.15	0.0007	40	37	40	41
Biscutella didyma var. *elbensis*	28	37	2	0.41	0.28	0.41	0.0255	21	18	21	21
Brassica deserti	3	5	3	0.08	0.03	0.28	0.0008	40	41	32	40
Bromus aegyptiacus	45	54	3	1.23	0.45	0.64	0.1995	4	5	6	4
Buffonia multiceps	31	44	2	0.45	0.31	0.43	0.0310	16	14	18	16
Dianthus guessfeldtianus	17	35	2	0.23	0.17	0.31	0.0086	28	28	29	29
Echinops taeckholmiana	21	37	2	0.32	0.21	0.35	0.0149	26	25	27	27
Fumaria microstachys	21	32	2	0.34	0.21	0.35	0.0158	25	25	27	26
Glinus runkewitzii	10	24	1	0.10	0.10	0.17	0.0011	36	34	38	38
Helianthemum schweinfurthii	23	32	2	0.31	0.23	0.36	0.0158	27	22	25	26
Hyoscyamus boveanus	49	63	2	0.85	0.49	0.59	0.0925	5	2	7	7
Ifloga spicata subsp. *elbaensis*	36	47	3	0.69	0.36	0.56	0.0828	8	9	8	8
Limonium sinuatum subsp.*romanum*	37	50	2	0.60	0.37	0.49	0.0493	11	8	12	12
Melilotus serratifolius	35	54	2	0.58	0.35	0.47	0.0451	13	10	13	13

TABLE 4. Cont.

Species	Basic vlue			Index				Ranking			
	FC	UR	NU	CI	RFC	RI	CV	CI	RFC	RI	CV
Micromeria serbaliana	17	24	1	0.17	0.17	0.23	0.0032	31	28	35	34
Muscari albiflorum	8	15	2	0.13	0.08	0.24	0.0023	34	37	34	35
Muscari salah- eidii	6	13	2	0.09	0.06	0.22	0.0012	38	39	36	36
Origanum syriacum subsp. *sinaicum*	43	61	5	1.68	0.43	0.79	0.4013	2	6	3	2
Pancratium arabicum	48	59	4	0.74	0.48	0.75	0.1578	7	3	5	5
Persicaria obtusifolia	16	25	2	0.20	0.16	0.30	0.0071	29	30	30	30
Polygala sinaica var. *sinaica*	29	37	2	0.45	0.29	0.42	0.0290	16	16	19	19
Primula boveana	23	29	4	0.66	0.23	0.53	0.0674	10	22	9	9
Rorippa integrifolia	4	7	1	0.04	0.04	0.12	0.0144	41	40	41	28
Rosa arabica	45	58	6	1.97	0.45	0.89	0.5910	1	5	1	1
Senesio belbeysius	17	23	3	0.35	0.17	0.40	0.0198	24	29	22	23
Silene leucophylla	33	47	2	0.42	0.33	0.45	0.0308	20	12	16	17
Silene oreosinaica	26	38	2	0.35	0.26	0.39	0.0202	24	19	23	22
Silene shimperiana	32	43	2	0.42	0.32	0.44	0.0291	20	13	17	18
Sonchus macrocarpus	58	65	3	1.62	0.58	0.75	0.3132	3	1	5	3
Tephrosia kassasii	9	14	1	0.09	0.09	0.16	0.0009	38	35	39	39
Thesium humile var.*maritima*	34	51	2	0.52	0.34	0.46	0.0392	14	11	14	14
Trigonella media	13	20	2	0.17	0.13	0.28	0.0049	31	31	32	31
Veronica anagalloides subsp. *taeckholmiorum.*	23	36	3	0.43	0.23	0.45	0.0329	18	22	16	15
Vicia sinaica	8	15	3	0.16	0.08	0.32	0.0042	32	37	28	32

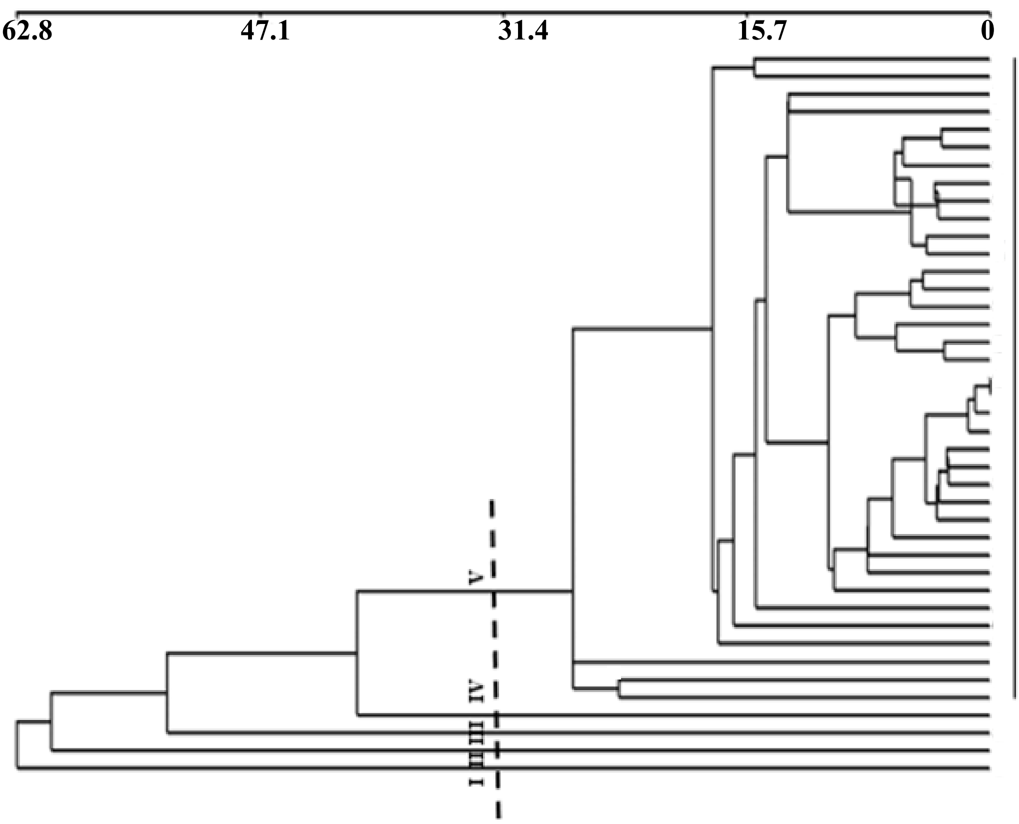


Fig. 1. Cluster analysis results, in the form of a dendrogram, which presents the classification of the endemic taxa in the Egyptian flora

TABLE 5. Descriptive statistics of the results obtained with four quantitative indices. FC: frequency of citation, UR: number of use-reports, NU: number of uses, CI: cultural importance, RFC: relative frequency of citation, RI: relative importance, CV: cultural value

Variable	Basic value			Index			
	FC	UR	NU	CI	RFC	RI	CV
Mean	24.8	35.2	2.4	0.48	0.25	0.42	0.06
Minimum	3	5	1	0.04	0.03	0.12	0.01
Maximum	58	65	6	1.97	0.58	0.89	0.59
Standard deviation	13.9	16.2	1.4	0.44	0.14	0.19	0.12

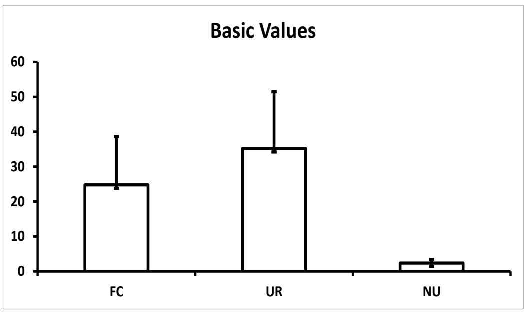


Fig. 2. Mean and standard deviation for basic values. FC: frequency of citation, UR: number of use-reports, and NU: number of uses

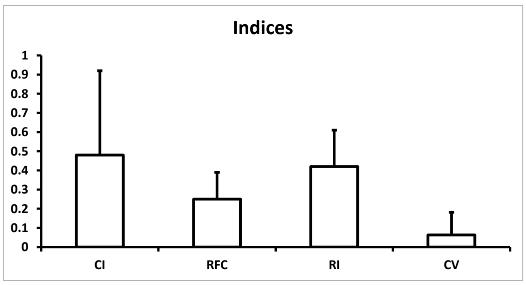


Fig. 3. Mean and standard deviation for different indices. CI: cultural importance, RFC: relative frequency of citation, RI: relative importance, and CV: cultural value

TABLE 6. Spearman rank-order correlation among all the variables: basic values and indices. FC: frequency of citation, UR: number of use-reports, NU: number of uses, CI: cultural importance, RFC: relative frequency of citation, RI: relative importance, CV: cultural value. Bold values are significant at P ≤ 0.01

	UR	NU	CI	RFC	RI	CV
FC	0.978	0.470	0.964	1.000	0.929	0.931
UR	-	0.426	0.916	0.978	0.892	0.900
NU	-	-	0.659	0.470	0.734	0.663
CI	-	-	-	0.964	0.977	0.977
RFC	-	-	-	-	0.92	0.931
RI	-	-	-	-	-	0.973

Discussion

Endemism from a bio-geographical perspective is the restriction of the natural range of taxon to a defined geographical distribution or habitat type, with political boundaries of a country (Anderson, 1994; Gaston, 1994; Shaltout et al., 2018). In the present study, forty-one endemic species were recorded in Egypt by El-Khalafy et al. (2021). These species were investigated for their economical uses. The result showed that families Asteraceae, Fabaceae and Caryophyllaceae have the most use categories, as obtained before by Toro (2018). Forty endemics (recorded in 832 use reports with about 42%) have medicinal uses. For example, the flowers of *Hyoscyamus boveanus* (CI= 0.47) are mixed with tobacco (*Nicotiana sp*.) and smoked for its intoxicating effects (Omar et al., 2017). *Atractylis carduus* var. *marmarica* (CI=0.32) showed significant anti-inflammatory activity (Melek, 1992; Ahmed, 2009). *Silene leucophylla* (CI= 0.17) is used to treat leprosy, diarrhea, heal cuts and inflamed wounds; its roots show hepato-protective function (Omar et al., 2017).

Grazing species are 25 species as recorded in 487 reports with 24.5%. *Anarrhinum pubescens* and *Buffonia muticeps* (CI= 0.27) considered as pastoral plants (Khafagi et al., 2012; Omar et al., 2013; Omar, 2017). *Bromus aegyptiacus* (CI = 0.40), *Atractylis carduus* var. *marmarica* (CI = 0.35) and *Veronica anagalloides* subsp. *taeckholmiorum* (CI= 0.15) have economic importance in grazing processes (Ahmed, 2009; El-Khalafy, 2018). *Silene oreosinaica* (CI= 0.18) was grazed by wild and domestic animals (Rabei et al., 2017). Fourteen species are used as human food (274 reports with a percentage of about 14%). Among them, *Sonchus macrocarpus* (CI= 0.54), *Melilotus serratifolius* (CI= 0.32) and *Allium mareoticum* (CI=0.18) are used as human food by local inhabitants (Ahmed, 2009; Shaltout & Ahmed, 2012).

Twelve species are used in esthetic concerns (217 reports with 11%) such as *Limonium sinuatum* (CI=0.43) which is an ornamental plant due to its flower colors and long vase life (Brullo & Pavone, 1981; Mori et al., 2021). Three species are used as fuel (*Anarrhinum pubescens, Atractylis carduus* var. *marmarica* and *Rosa arabica*). *Anarrhinum pubescens* (CI= 0.66) and *Atractylis carduus* var. *marmarica* are collected for traditional treatment and fuel by local communities (Shaltout & Ahmed, 2012; Moustafa et al., 2014).

Seven species are multipurpose (has three uses or more). Species ranking produced by the various indicated that RI and CV indices ascribe greater importance to the multiple uses and the NU categories (Tardyo & Santayana, 2007). The first ranking species which has the highest CI, RI, and CV is *Rosa arabica* (Use category = 6, CI= 1.79, RI= 0.89 and CV= 0.59). Its flowers and leaves were used as an analgesic for menstrual pain, and also has an ethno-veterinary use. The whole *Rosa* plant was used to treat reproductive troubles in sheep, goats, equines, and camels (Pieroni et al., 2006). The extractions of its leaf, flower and fruit have significant medicinal uses due to their active constituents (Shamso et al., 2019), phenolic compounds (Mostafa et al., 2017) and as fuel (Omar & Nagy, 2015). In addition, as *R. arabica* belongs to Rosaceae; the rose is important in the ornamental flower industries. Initially used as a fragrance and for medical purposes. Roses are the most important crop in the floriculture industry as flowers have different sizes, and their petals are showy with different colours ranging from white, yellow, pink and red and large (Chahar, 2016).

The second-ranking multipurpose species

is *Origanum syriacum* subsp. *sinaicum* (Use category = 5 with CI= 1.68 and CV= 0.4013). It is a popular edible and medicinal plant which is used in treatment of numerous fungal skin diseases, abdominal pain, throat infection and cough (Shehadeh et al., 2019). It is a good analgesic for joint pain; chewing the leaves relieves both gum and toothache. When rubbed upon chest it relieves bronchitis, it has a beneficial effect on the liver and stomach and a strong anthelmintic effect and its woody stem may be collected for fire (Tóth et al., 2012).

The third-ranking multipurpose species is *Sonchus macrocarpos* (Use category = 3 with CI= 1.62 and CV= 0.3132). Its extract relieves fever, inflammation, and wound healing (Li & Yang, 2018). *S. macrocarpus* has economic importance in grazing processes (Ahmed, 2009). Also, its young green leaves maybe eaten by humans as a salad (Ahmed, 2009).

Descriptive statistics and standard deviation were used to summarize and describe the data and measure its dispersion. CI and RI indices have the highest values in relation to other studied indices. This finding follows Tardyo & Santayana (2007) and Shaheen et al. (2017). The high values of CI and RI may be related to that RFC and the relative number of use-categories are normalized by dividing by the maximum value, ranging from 0.04 to 1.97 (Tardyo & Santayana, 2007). CI index, with a mean (0.48) and standard deviation (0.44) can be used to describe the species. It corresponds an interest in describing the particular uses of plants that better reflect the cultural aspects of plant utilization.

The Spearman correlation coefficient between the FC and NU is quite high (0.47), meaning that a versatile species is more preferred to be mentioned by a larger number of informants (Tardyo & Santayana, 2007). This relationship also is shown in the scatter plot of Fig. 4. The close high correlation between CI and FC indices (0.96) may be due to the large number of species used in only one-use category (6 taxa =14.63%) or two-use categories (20 taxa= 48.78%) (Tardyo & Santayana, 2007). Most of the endemic taxa in Egypt have few uses (three or less); only four taxa (9.75%) of the endemics are multipurpose. Also, strong positive correlations between RFC versus CI (0.96) and CI versus RI (0.98) refer to the fact that the higher RFC value is, the higher the CI value will be, as CI is the percentage of informants who mention uses of various plant species. As the informant number increases, the knowledge about plants must also increase (Shaheen et al., 2017).

Ethnobotanical publications usually describe plant uses in tables or lists where species group the information, indicate their uses, and normally record the informant number who mentioned them. This method is a more sensible means of classifying and assessing the value of each plant taxa by cultural concerns (Shaheen et al., 2017).

The interest of using a cultural importance index

Some authors have expressed misgivings regarding the interest in a CV index. Reyes-García et al. (2006) stated that the CV of a plant species, obtained through questions using a free-list method, does not essentially correspond to its real value, using observational data. They observed that some species repeatedly mentioned in interviews are rarely used because they were used almost to extinction. This finding is clear in the endemic taxa in Egypt, which become rarely used because most of them become rare and exposed to extinction.

CI index gives valid information about the benefits of plants and uses for comparing the importance of plants from the same or different areas (Sõukand et al., 2013). CI index indicates which plants are used extensively by the people in each culture. This index may be helpful for decision-makers to detect which species needs to be protected at threatened sites (Shaheen et al., 2017). This advantage is very useful for protecting endemic taxa, especially in Nile Delta and Mediterranean region. For example, the trade of medicinal plants is an essential source of economic income in different regions of Egypt, such as the northwestern desert and Sinai (Shaltout & Al-Sodany, 2002). The respect for natural resources by old people is obvious, while many of these traditional practices have been lost by the young generations. For example, the collection of fuel wood by older people is focused mainly on dry and dead plants; while the young generations and people from the surrounding urban settlements do not differentiate between green and dry plants (Shaltout & Ahmed, 2012).

Conclusion

This study was based entirely upon the economic use of endemic plants in Egypt. In the present study, data were categorized into nine categories based on the uses of plants. The medicinal category was the most represented (40 taxa), followed by grazing (25 taxa), human food (14 taxa) and esthetic uses (12 taxa). Depending on CI index, *Rosa arabica* (CI= 1.97) is the most important species with 6 uses, followed by *Origanum syriacum* subsp. *sinaicum* (CI= 1.68), and *Sonchus macrocarpus* (CI= 1.62). There are clear differences in the ranking of species yielded by the various indices depending on the selected indices (CI, RFC, RI and CV). The authors recommended that the CI index relates with interest in designating the specific uses of plants that better reflect the cultural aspects of plant utilization. The useful plants in Egyptian Flora need urgent attention especially endemic species.

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مؤشرات القيمة الاقتصادية للنباتات المتوطنة في مصر

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توسع استخدام علم النبات الطبي في العقود الاخيرة خاصة بعد ادخال الاساليب الرياضية والاحصائية، ويعتبر معامل الأهمية الثقافية (CI) من أهم المؤشرات لتقييم قيمة الاستخدامات المختلفة للنباتات (UV)، والذي اصبح من طرق التقدير الكمي في العديد من الدراسات.تهدف الدراسة الحالية إلى تقييم الاستخدامات المختلفة للنباتات المتوطنة في مصر اعتمادا على اربعة معاملات: عدد مرات الاستخدام (UR) والتردد النسبي للاقتباس(RFC) والأهمية النسبية (RI) والقيمة الثقافية (CI) وذلك اعتمادا على الاستبيانات والتقارير المعدة لذلك. تم جمع المعلومات واستيفاء التقارير ابتداءا من صيف 2018 وحتي ربيع 2020 وذلك من خلال رحلات شهرية لمناطق مختلفة علي مستوي مصر. تم تقييم القيمة الثقافية لعدد 41 نبات متوطن في مصر. أثبتت النتائج أن مجموعة النباتات الطبية هي الأكثر تمثيلا (40 نبات)، يليها النباتات الرعوية (25 نبات)، ثم النباتات التي تستعمل كغذاء للانسان (14 نبات). كما أظهرت النتائج أن نبات الورد البري (*Rosa arabica*) في المرتبة الأولى من حيث النباتات متعددة الأهمية الاقتصادية (6 استخدامات من أصل 9)، يليه نبات الزعتر (*Origanum syriacum* subsp. *sinaicum*) (5استخدامات) ، ثم نبات (*Sonchus macrocarpus*) (3استخدامات). وقد أوضحت نتائج معامل الارتباط أن معامل الأهمية الثقافية يرتبط ارتباط معنوي مع كل من معامل التردد النسبي للاقتباس (.96)، وكذلك القيمة الثقافية (0.98).