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ARTICLE REVIEW

ENDEMIC PLANTS IN TWO PHYTOGEOGRAPHIC SUB-REGIONS: MIDDLE SAHARO-SINDIAN AND MESOPOTAMIA IN IRAQ

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ABSTRACT

The study aims to update the records of endemic plant species within two phytogeographic sub-regions of Iraq, the Middle Saharo-Sindian and Mesopotamia regions. The update was conducted through a comprehensive review of scientific name validity, endemic status, and recently described species reported in previous studies, which collectively recorded 89 endemic taxa across these regions. The current results identify only 29 endemic taxa belonging to 22 genera and 15 families. The family Asteraceae and the genus *Anthemis* exhibited the highest number of endemic taxa. In terms of distribution, eight taxa were restricted to the Middle Saharo-Sindian region, thirteen to Mesopotamia, and eight were shared between both sub-regions. Additionally, the study provides an updated account of the distribution of endemic species across Iraq's physiographic districts. It discusses possible causes underlying the differences in the number of endemic taxa compared with previous reports. This information will help to provide a framework for research and focus conservation efforts for these endemic taxa.

Keywords: Asteraceae, Endemism, Irano-Turanian, Physiographic, Phytogeographical.

INTRODUCTION

An endemic taxon naturally found in any specific area and nowhere else; this is a relative term in that a taxon can be endemic to a small island, to a country, or a continent (IUCN, 2010). Wherever an endemic plant is a taxon that shows a limited distribution, or species with a small geographical range as a result of the characteristics of the plant, its seed dispersal, diastrophism, and isolation mechanisms (Vaishali and Janarthanam, 2004).

Iraq is a country located in southwestern Asia, covers a land area of about 438,320 km² (Ararat *et al*., 2011), and plant species richness is estimated to be ± 3300 species (Ghazanfar and McDanie, 2015). For the endemism status of plant species in Iraq, four studies have

discussed the issue, starting with Zohary (1950), who identified 190 endemic species, and divided them into three phytogeographic sub-regions: Irano-Anatolian, consisting of 132 species; Mesopotamia, with 49 species; and Middle Saharo-Sindian in Iraq, which consisted of 9 species. Guest (1966) in Flora of Iraq noted Zohary (1950) when he described the endemic plant species in Iraq, but in other volumes of the *Flora of Iraq* the status of endemism was mentioned within the distribution information for different plant taxa (Townsend and Guest, 1966, 1974, 1980 a, b, 1985; Townsend *et al*., 1968; Ghazanfar and Edmondson, 2013, 2016; Ghazanfar *et al*., 2019). Ghazanfar and McDanie (2015) analyzed the quantities and biogeography of the *Flora of Iraq* and mentioned that there are 181 species of endemic plants: 6 species in the desert region, 9 species in the steppe region, 113 in the mountain region, and 53 species in the alpine region, without reporting any lists of these endemic species. Youssef (2020) listed 174 endemic taxa to Iraq (153 spp. 11 subsp., and 10 var.) without details on their distribution, just mentioning that 14% of the annual endemic species were found in the steppes of the Mesopotamian and arid areas in western Iraq. Moreover, there are 2 new species discovered and described, collected from these two phytogeographic sub-regions: *Salvia arabica* Al-Musawi & Weinert, *Phelipanche umqasrensis* Al–Mayah & Al-Asadi, *Spergularia iraqensis* Haloob, Al-Musawi & Adeel (Al-Musawi and Weinert, 1989; Al-Mayah and Al-Asadi, 2016; Haloob *et al*., 2021).

There is a long-lasting interest concerning the ecological conditions that provide a template for differentiation and/or persistence of restricted endemic species (Durry, 1974). Zohary (1950) mentioned that the geographical position is inhabited by a heterogeneous phytogeographical character. The phytogeographical elements of the Mediterranean, the Irano-Turanian, the Saharo-Sindian, and the Eurosiberian-Boreoamerican are represented in the Flora of Iraq. Whatever, Iraq comprises parts of two phytogeographic regions only: (1) the Irano-Turanian region represented by the Mesopotamian and the Iano-Anatolian sub-regions, and (2) the Saharo-Sindian by the Middle Saharo-sandian sub-region (Guest, 1966).

Mesopotamian sub-region comprising the Irano-Turanian territories of the Syrian Desert, almost the whole of the Jazira, parts of the southern Anatolian plains, and some territory in the Iranian plateau. Characteristically, the vegetation comprises mainly steppe or sub-desert communities on grey calcareous desert soil, often gravelly or stony; there is no mountain vegetation exesis. The Mesopotamian element of the Iraqi Flora comprises about 145 species, representing 15% of the total Irano-Turanian Flora as then known in Iraq, and lists 49 species as endemic in Iraq in this sub-region. While the Middle Saharo-Sindian comprises Egypt, Sinai, parts of Lower Palestine, the greater part of central and southern Jordan, extra-tropical Arabia, and Lower Iraq, precisely the north border of this sub-region in Iraq stretches along a line drawn from east to west, Mendali through Bellad to Hit to Jabel Aneize. The characteristic vegetation has the best advantage in the northerly tracts of sub-desert and the borders of the steppe. The Middle Saharo-Sindian element of the Iraqi Flora comprised about 118 species, representing 6% of the total Flora of Iraq, and listed 9 species as endemic to this sub-region (Zohary, 1950; Guest, 1966).

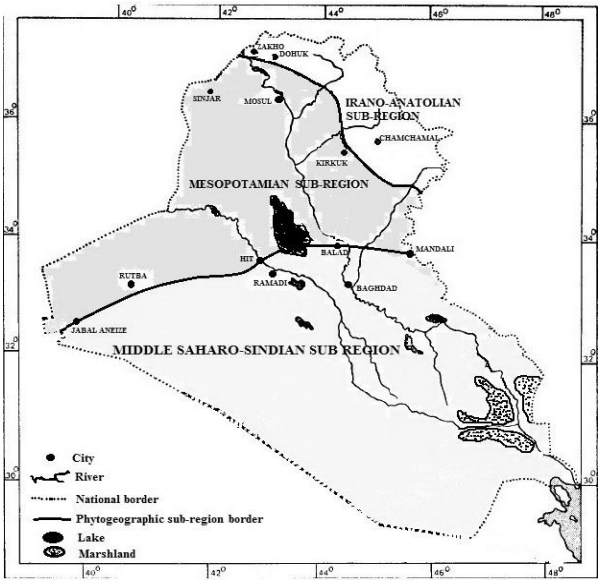
This study aims to update the data on endemic plants in the Middle Saharo-Sindian and Mesopotamian phytogeographic sub-regions of Iraq. The research also seeks to create a database of these species to be used in conservation efforts to protect them from extinction, especially given their restricted distribution. By checking the previous studies and newly discovered species, this work provides updated information on the endemic taxa, their scientific names, and their distribution. The current study data will contribute to future efforts to monitor the state of plant diversity and vegetation in Iraq, which is particularly crucial in light of ongoing climate change and the lack of a Red List assessment for the Flora of Iraq.

MATERIALS AND METHODS

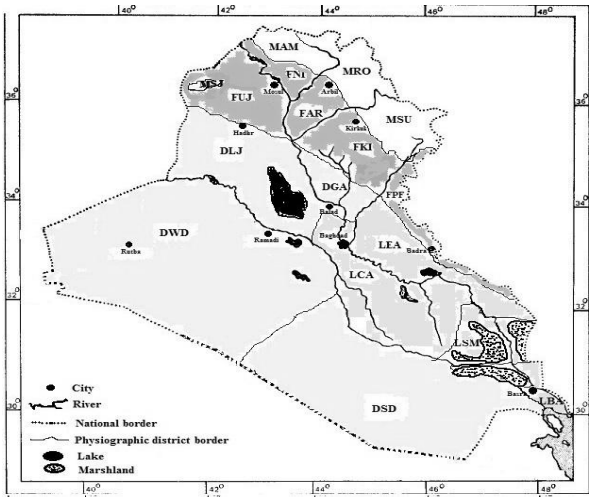
The study involved a comprehensive revision of previous reports documenting endemic plant species in Iraq (Zohary,1950; Townsend and Guest, 1966, 1974, 1980 a, b; 1985; Townsend *et al.*, 1968; Ghazanfar and Edmondson, 2013, 2016; Ghazanfar and McDanie, 2015; Ghazanfar *et al*., 2019; Youssef, 2020). The researcher personally reviewed these references and examined reports of newly described species from these two phytogeographic sub-regions. The scientific names were verified for validity and current acceptance using Plants of the World Online (https://powo.science.kew.org/) and World Flora Online (https://www.worldfloraonline.org/).

To reassess the endemic status and distribution of taxa, floras of neighboring countries were reviewed, including Flora Iranica (Rechinger, 1963-2015), Flora of Turkey and the East Aegean Islands (Davis, 1965-1984), Flora oriental (Boissier, 1867- 1888), Flora of Saudi Arabia (Migahid, 1978), Flora of Syria, Palestine, and Sinai (Post, 1896), checklist of plants of the Hashemite Kingdom of Jordan (http://ww2.odu.edu/~lmusselm/plant/jordan/), Flora of Saudi Arabia - checklist (https://plantdiversityofsaudiarabia.info/flora-checklist-2/). Herbarium specimens were examined in the National Herbarium of Iraq (BAG) and verified through digital catalogues of Kew (https://apps.kew.org/herbcat/navigator.do), Edinburgh (http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php), and the Virtual Herbaria of Vienna (http://herbarium.univie.ac.at/database/search.php).

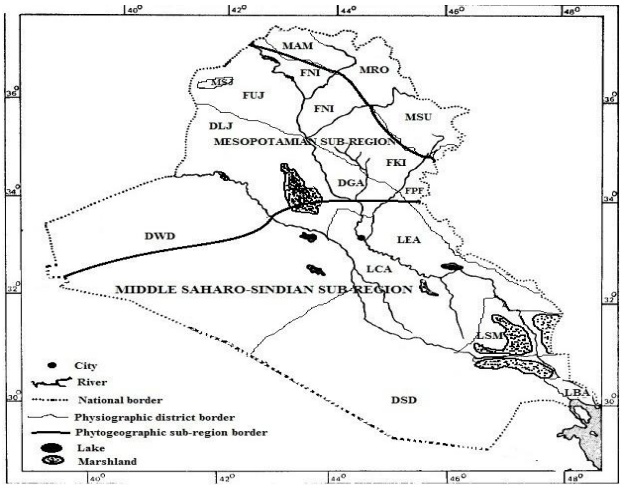
The phytogeographic framework followed Guest (1966), shown in Map (1), who divided Iraq to four main physiographic regions: Mountain, Upper Plains and Foothills, Desert plateau, and Lower Mesopotamian, each subdivided into several districts (Maps 1- 3). According to this classification, the Mesopotamian phytogeographic sub-region includes the Jabal Sinjar District (MJS) within the mountain region; most districts of the Upper Plains and Foothills region except the southern parts of the Persian Foothills District (FPF); the Lower parts of Jazira District (DLJ), and Ghurfa-Adhaim District (DGA); and the southern half of the Western Desert District (DWD) within the Desert plateau. The Middle Saharo-Sindian sub-region is represented by all districts of the Lower Mesopotamian region, the Southern Desert District (DSD) within the Desert plateau, and the southern parts of both the Western Desert District (DWD) and the Persian Foothills District (FPF). This framework was adopted to ensure accurate phytogeographic placement of endemic taxa within Iraq.



Map (1): The phytogeographic sub-regions in Iraq. (Guest, 1966)



Map (2): The physiographic regions in Iraq; Mountain regions: Jabal Sinjar District (MSJ), Amadiya District (MAM), Rowanduz District (MRO), Sulaymaniyah District (MSU); Upper Plains and Foothills regions: Upper Jazira District (FUJ), Nineveh District (FNI), Arbil District (FAR), Kirkuk District (FKI), Persian Foothills District (FPF); Desert regions: Lower Jazira District (DLJ), Ghurfa-Adhaim District (DGA), Western Desert District (DWD), Southern Desert District (DSD); Lower Mesopotamian: Eastern Alluvial Plain District (LEA), Central Alluvial Plain District (LCA), Southern Marsh District (LSM), Basra Estuarine District (LBA). (Guest, 1966).



Map (3): The two phytogeographic sub-regions: Middle Saharo-Sindian and Mesopotamia with physiographic districts in Iraq. Mountain regions: Jabal Sinjar District (MSJ), Amadiya District (MAM), Rowanduz District (MRO), Sulaimaniya District (MSU); Upper Plains and Foothills regions: Upper Jazira District (FUJ), Nineveh District (FNI), Arbil District (FAR), Kirkuk District (FKI), Persian Foothills District (FPF); Desert regions: Lower Jazira District (DLJ), Ghurfa-Adhaim District (DGA), Western Desert District (DWD), Southern Desert District (DSD); Lower Mesopotamian: Eastern Alluvial Plain district (LEA), Central Alluvial Plain District (LCA), Southern Marsh District (LSM), Basra Estuarine District (LBA). (Guest, 1966).

RESULTS

The total number of endemic plant taxa described in the previous reports in the Mesopotamia and Middle Saharo-Sindian phytogeographic sub-regions in Iraq was 89 taxa, belonging to 23 families and 59 genera. Zohary (1950) mentioned that there were 58 taxa endemic to these two phytogeographic sub-regions: 9 taxa were found in the Middle Saharo-Sindian sub-region, and 49 taxa were found in Mesopotamia. The Flora of Iraq noted that 32 taxa were endemic to these two phytogeographic sub-regions: 6 taxa in the Middle Saharo-Sindian region, and 26 taxa were identified in Mesopotamia. 18 taxa from the total number of endemic plant taxa mentioned in the two previous reports were synonyms (Tab.1).

The study found 29 taxa (26 species, 1 subspecies, and 2 varieties) were endemic to the Mesopotamia phytogeographic sub-region and the Middle Saharo-Sindian phytogeographic sub-region in Iraq. These 29 endemic taxa belonged to 22 genera and 15 families. The Asteraceae recorded 10 taxa, which was the highest number of taxa among the plant families in these regions, and the genus *Anthemis* also recorded 7 endemic taxa, which was the highest among genera. *Halothamnus iraqensis* var. *hispidulus* Botsch. was the most widespread taxon recorded in 7 different districts. Additionally, researchers collected 16 endemic taxa from a single district, each with an extremely narrow distribution range (Tab. 2).

Table (1): Endemic plant taxa listed in (Zohary, 1950) and Flora of Iraq (Townsend and Guest, 1966, 1974, 1980 a, b, 1985; Townsend *et al*., 1968; Ghazanfar and Edmondson, 2013, 2016; Ghazanfar *et al*., 2019).

No.	Taxa	Family	Zohary (1950)	Flora of Iraq
Middle Saharo-Sindian sub-region				
1	*Atriplex belangeri* (Moq.) Bioss. (1879) = *Atriplex thunbergiifolia* (Boiss. & Noë) Boiss. (1879)	Amaranthaceae	*	
2	*Climacoptera khalisica* Botsch. (1982)	Amaranthaceae		*
3	*Halothamnus iraqensis* var. *hispidulus* Botsch. (1981)	Amaranthaceae		*
4	*Picris babylonica* Hand.-Mazz. (1913)	Asteraceae	*	
5	*Sphaeranthus strobiliferus* Boiss. & Noë (1856)	Asteraceae	*	
6	*Lithospermum babylonicum* Zohary (1950)	Boraginaceae	*	
7	*Astragalus sieberi* DC. (1825) = *Astragalus zubairensis* Eig. (1955)	Fabaceae	*	
8	*Bromus haussknechtii* Boiss. (1884)	Poaceae	*	*
9	*Eragrostis boriana* Launert (1964)	Poaceae		*
10	*Calligonum eigii* Zohary (1950)	Polygonaceae	*	
11	*Pteropyrum naufelum* Al-Khayat (1993)	Polygonaceae		*
12	*Polygonum corrigioloides* Jaub. & Spach (1845)	Polygonaceae	*	
13	*Haplophyllum tuberculatum* (Forssk.) A.Juss. (1825) = *Haplophyllum propinquum* Spach. (1849)	Rutaceae	*	
14	*Eremurus rechingeri* Wendelbo (1962)	Xanthorrhoeaceae		*
Mesopotamia sub-region				
15	*Allium chrysantherum* Boiss. & Reut. (1882)	Amaryllidaceae	*	
16	*Allium macrochaetum* Boiss. & Hausskn. (1882)	Amaryllidaceae	*	
17	*Allium Olivieri* Boiss. (1882)	Amaryllidaceae	*	
18	*Allium sindjarense* Boiss. & Hausskn. (1875)	Amaryllidaceae	*	
19	*Allium vinicolor* Wendelbo (1973)	Amaryllidaceae		*
20	*Ferula sphenobasis* Townsend (1966)	Apiaceae		*

21	*Ducrosia flabellifolia* Boiss. (1844)	Apiaceae	*	
22	*Arum hainesii* Agnew & Hadac ex Riedl (1981)	Araceae		*
23	*Alrawia nutans* (Wendelbo) Press. & Wendelbo (1979)	Asparagaceae		*
24	*Bellevalia mosheovii* Feinbrun (1939)	Asparagaceae	*	
25	*Ornithogalum iraqense* Feinbrun (1941)	Asparagaceae	*	
26	*Ornithogalum neurostegium* subsp. *neurostegium* Boiss. & C.I.Blanche = *Ornithogalum ulophyllum* Hand.-Mazz. (1914)	Asparagaceae	*	
27	*Anthemis corymbulosa* Boiss. & Hausskn. (1875)	Asteraceae		*
28	*Anthemis wettsteiniana* Hand.-Mazz. (913) = *Anthemis deltawensis* Eig. (1938)	Asteraceae	*	
29	*Anthemis wettsteiniana* Hand.-Mazz. (1913) = *Anthemis deserti-syriaci* Eig. (1938)	Asteraceae	*	
30	*Cota brevicuspis* (Bornm.) Holub. (1974) = *Anthemis feinbruniae* Eig. (1938)	Asteraceae	*	
31	*Anthemis leptophylla* Eig. (1938)	Asteraceae	*	
32	*Anthemis handel-mazzettii* Eig. (1938)	Asteraceae	*	*
33	*Anthemis homalolepis* Eig. (1938)	Asteraceae	*	*
34	*Anthemis microlepis* Eig. (1938)	Asteraceae	*	
35	*Anthemis plebeia* Boiss. & Noé (1875)	Asteraceae		*
36	*Anthemis microlepis* Eig. (1938) = *Anthemis singarensis* Eig. (1938)	Asteraceae	*	*
37	*Anthemis wettsteiniana* Hand.-Mazz. (1913)	Asteraceae	*	
38	*Centaurea alveicola* Rech. f. (1959)	Asteraceae		*
39	*Centaurea regia* Boiss. (1846)	Asteraceae	*	
40	*Centaurea singarensis* Boiss. et Hausskn. (1875)	Asteraceae		*
41	*Cousinia wesheni* Post (1891) = *Cousinia chaborasica* Bornm. & Hand.-Mazz. (1912)	Asteraceae	*	
42	*Echinops haussknechtii* Boiss. (1875) = *Echinops armatus* Boiss. & Hausskn. (1875)	Asteraceae	*	
43	*Echinops descendens* Hand.-Mazz. (1913)	Asteraceae	*	

44	*Jurinea mesopotamica* Hand.-Mazz. (1913)	Asteraceae	*	
45	*Onopordum heteracanthum* C.A.Mey. (1831) = *Onopordum canum* Eig. (1942)	Asteraceae	*	
46	*Scorzonera deserti-syriaci* Eig. (1938)	Asteraceae	*	
47	*Scorzonera abdulazizii* Eig. (1950)	Asteraceae	*	
48	*Sphaeranthus strobiliferus* Boiss. & Noë (1856)	Asteraceae		*
49	*Arnebia deserti-syriaci* Zohary (1946)	Boraginaceae	*	
50	*Odontarrhena singarensis* (Boiss. & Hausskn.) Španiel, Al-Shehbaz, D.A.German & Marhold (2015) = *Alyssum singarense* Boiss. & Hausskn. ex Bioss. (1888)	Brassicaceae		*
51	*Erysimum oleifolium* J.Gay (1842) = *Erysimum strophades* Boiss. (1849)	Brassicaceae	*	*
52	*Hesperis novakii* subsp. *Mirabilis* Dvořák (1968)	Brassicaceae		*
53	*Gypsophila pallida* Stapf (1886)	Caryophyllaceae	*	
54	*Convolvulus euphraticus* Bornm. (1906)	Convolvulaceae	*	
55	*Convolvulus sarothrocladus* Boiss. & Hausskn. (1875)	Convolvulaceae	*	
56	*Astragalus caryolobus* Bunge (1868)	Fabaceae		*
57	*Astragalus obtusifolius* DC. (1825)	Fabaceae	*	
58	*Astragalus sarae* Eig (1955)	Fabaceae		*
59	*Chesneya rytidosperma* Jaub. & Spac (1842) = *Chesneya oliveri* Jaub. & Spach (1842)	Fabaceae	*	
60	*Hedysarum singarense* Boiss. & Hausskn. (1872)	Fabaceae		*
61	*Lathyrus bijugus* Boiss. & Noe (1856)	Fabaceae	*	*
62	*Onobrychis haussknechtii* Boiss. (1872) = *Onobrychis bicolor* Bornm. (1924)	Fabaceae	*	
63	*Onobrychis ptolemaica* (Delile) DC. (1825) = *Onobrychis olivieri* Boiss. (1872)	Fabaceae	*	
64	*Onobrychis lunata* Boiss. (1843)	Fabaceae		*
65	*Vicia singarensis* Boiss. & Hausskn. (1872)	Fabaceae		*

66	*Hypericum Olivieri* Boiss. (1867)	Hypericaeae	*	
67	*Moraea sisyeinchium* (L.) Ker Gawl. (1804) = *Iris maculata* Baker (1890)	Iridaceae	*	*
68	*Iris aucheri* (Baker) Sealy (1950) = *Iris sindjarensis* Boiss. & Hausskn (1882)	Iridaceae	*	
69	*Alcea chrysantha* (Sam.) Zohary (1963) = *Althaea chrysantha* Sam. (1953)	Malvaceae	*	
70	*Glossostemon bruguieri* Desf. (1817)	Malvaceae	*	
71	*Glaucium cuneatum* Cullen (1968)	Papaveraceae		*
72	*Glaucium grandiflorum* subsp. *refractum* (Nábelek) Mory (1879) = *Glaucium refractum* Nábelek (1923)	Papaveraceae	*	
73	*Aeluropus lagopoides* (L.) Thwaites (1864) = *Aeluropus mesopotamicus* Nábelek (1929)	Poaceae	*	
74	*Henrardia pubescens* (Bertol.) Boiss. (1964) = *Lepturus pubescens* (Bertol.) Boiss. (1884)	Poaceae	*	
75	*Parapholis gracilis* Bor. (1963)	Poaceae		*
76	*Stipa assyriaca* Hand.-Mazz. (1914)	Poaceae	*	
77	*Calligonum tetrapterum* Jaub. & Spach (1855)	Polygonaceae	*	
78	*Nigella deserti* Boiss. (1841) = *Nigella assyriaca* Boiss. (1867)	Ranunculaceae	*	
79	*Reseda haussknechtii* Müll.Arg. (1868)	Resedaceae	*	*
80	*Plocama olivieri* (A.Rich. ex DC.) M.Backlund & Thulin (2007) = *Neogaillonia Olivieri* (A.Rich. ex DC.) Linch. (1973)	Rubiaceae		*
81	*Haplophyllum tuberculatum* (Forssk.) A.Juss. (1825) = *Haplophyllum chesneyanum* Boiss. (1867)	Rutaceae	*	
82	*Haplophyllum tuberculatum* (Forssk.) A.Juss. (1825) = *Haplophyllum glabrum* Bornm. (1911)	Rutaceae	*	

Table (2): Endemic plant taxa restricted either to the Middle Saharo-Sindian or Mesopotamia phytogeographic sub-regions or both. (Zohary, 1950; Rechinger, 1963; Guest, 1966; Riedl, 1967; Townsend *et al*., 1968; 1974; Townsend and Guest, 1980a; 1980b; Rechinger, 1982; Townsend and Guest, 1985; Ghazanfar and Edmondson, 2013, 2016; Podlech and Iranshahr, 2015; Ghazanfar *et al*., 2019).

No.	Taxa	Family	District
Middle Saharo-Sindian sub-region			
1	*Climacoptera khalisica* Botsch. (1982)	Amaranthaceae	LCA
2	*Sphaeranthus strobiliferus* Boiss. & Noë (1856)	Asteraceae	LCA & LSM
3	*Heliotropium lasianthum* Riedl (1979)	Boraginaceae	DWD
4	*Lathyrus bijugus* Boiss. & Noë (1856)	Fabaceae	LCA
5	*Salvia arabica* Al-Musawi & Weinert (1989)	Lamiaceae	FPF
6	*Phelipanche umqasrensis* Al–Mayah & Al-Asadi (2016)	Orobanchaceae	DSD
7	*Eragrostis boriana* Launert (1964)	Poaceae	LCA & LEA
8	*Eremurus rechingeri* Wendelbo (1962)	Xanthorrhoeaceae	FPF
Mesopotamia sub-region			
9	*Anthemis leptophylla* Eig. (1983)	Asteraceae	FPF, FNI & FUJ
10	*Anthemis hamrinensis* Iranshahr (1981)	Asteraceae	FPF & DGA
11	*Anthemis microlepis* Eig. (1938)	Asteraceae	FUJ & FKI
12	*Centaurea singarensis* Boiss. et Hausskn. (1875)	Asteraceae	FUJ & MJS
13	*Jurinea mesopotamica* Hand.-Mazz. (1913)	Asteraceae	FUJ
14	*Podonosma sindjarensis* (Riedl) L.Cecchi & Hilger (2021)	Boraginaceae	MJS
15	*Hesperis novakii* subsp. *Mirabilis* Dvorak (1968)	Brassicaeae	MJS
16	*Spergularia iraqensis* A. haloob, Al-Musawi & H, Adeel (2021)	Caryophyllaceae	FPF
17	*Vicia singarensis* Boiss. & Hausskn. (1872)	Fabaceae	MJS
18	*Thymus syriacus* var. *edentatus* Jalas (1982)	Lamiaceae	FAR
19	*Glaucium cuneatum* Cullen (1968)	Papaveraceae	FKI
20	*Reseda haussknechtii* Müll.Arg. (1868)	Resedaceae	FUJ, FPF & MJS

21	*Albraunia psilosperma* Speta (1982)	Scrophulariaceae	FKI
Taxa extent in the Middle Saharo-Sindian and Mesopotamia sub-regions			
22	*Halothamnus iraqensis* var. *hispidulus* Botsch. (1981)	Amaranthaceae	FPF, DLJ, DWD DSD, LCA, LEA & LSM
23	*Arum hainesii* Agnew & Hadac ex Riedl (1981)	Araceae	FPF & LEA
24	*Anthemis handel-mazzettii* Eig (1938)	Asteraceae	DWD & DSD
25	*Anthemis homalolepis* Eig (1938)	Asteraceae	DGA & DWD
26	*Anthemis plebeia* Boiss. & Noé (1875)	Asteraceae	FPF, DWD & DSD
27	*Anthemis wettsteiniana* Hand.-Mazz. (1913)	Asteraceae	FPF, DGA, DWD & LCA
28	*Centaurea alveicola* Rech. f. (1959)	Asteraceae	FPF
29	*Convolvulus euphraticus* Bornm. (1906)	Convolvulaceae	DWD

The endemic taxa are distributed in phytogeographic sub-regions as follows: 8 taxa were restricted to the Middle Saharo-Sindian phytogeographic sub-region; they belonged to 8 genera and 8 families. There were 13 endemic taxa recorded restricted to the Mesopotamia phytogeographic sub-region, belonging to 11 genera and 9 families. Asteraceae consisted of 5 taxa, which was the highest number of taxa among other families. While there were 8 endemic species recorded in both the Middle Saharo-Sindian phytogeographic and Mesopotamia phytogeographic sub-regions in Iraq, belonging to 5 genera and 4 families, again, Asteraceae consisted of 5 taxa, which was the highest number of taxa among other families distributed in both sub-regions.

On another hand, the endemic taxa were distributed in physiographic regions as follows: the highest concentration of endemic taxa was recorded as 17 taxa in the Upper Plains and Foothills physiographic region, followed by 9 taxa in the Desert Plateau physiographic region, 7 taxa in the Lower Mesopotamian physiographic region, and the lowest physiographic region recorded 5 taxa in the Mountain physiographic region (Jabal Sinjar). The study had to note that all the districts have recorded endemic plants except Basra Estuarine District (LBA), while the Persian Foothills District (FPF) was the richest with 11 endemic taxa, and the Nineveh District (FNI), Arbil District (FAR), Lower Jazira District (DLJ), and Southern Marsh District (LSM) were the poorest districts, which recorded one endemic taxon (Tab. 2).

DISCUSSION

The previous studies that dealt with the endemic plant taxa in the Middle Saharo-Sindian and Mesopotamia phytogeographic sub-regions in Iraq, the acceptance of the scientific names, and the number of endemic plant taxa needs to be updated, specially the volumes of the *Flora of Iraq* that aren't complete and published yet, so there was a lack that made the *Flora of Iraq*

not full information about all endemic plant taxa in these phytogeographic sub-regions. This study aims to update and document the information about the endemic plant taxa in these phytogeographic sub-regions in one study.

The study found a difference in the number of endemic plants taxa in the Middle Saharo-Sindian and Mesopotamia phytogeographic sub-regions in Iraq compared with the two previous studies; Zohary (1950) listed 9 endemic species for the Middle Saharo-Sindian and 49 endemic species for Mesopotamia sub-region, *Flora of Iraq* described 6 taxa as endemic to the Middle Saharo-Sindian and 26 taxa as endemic to the Mesopotamia sub-region (Townsend and Guest, 1966, 1974, 1980 a, b, 1985; Townsend *et al*., 1968; Ghazanfar and Edmondson, 2013, 2016; Ghazanfar *et al*., 2019). This study recorded 8 and 13 endemic plant taxa to these sub-regions and 8 endemic taxa distributed between them. The reason for this discrepancy in numbers is that some species are considered synonymous. In addition, some taxa that were indicated as endemic to Iraq in previous studies were later recorded in other countries. Therefore, this study did not consider them as an endemic plant.

The Mesopotamia phytogeographic sub-region is a narrow sub-region between two large phytogeographic sub-regions, the Middle Saharo-Sindian and Irano-Anatolian sub-regions, which makes the Mesopotamia phytogeographic sub-region represent a transition phytogeographic sub-region. This phytogeographic interference and transition make this phytogeographic sub-region richer in endemic taxa from the Middle Saharo-Sindian phytogeographic sub-region. In addition, the Upper Plains and Foothills physiographic region is a geographical extension between the Mountain physiographic region to the north and the Desert Plateau physiographic region and Lower Mesopotamian physiographic region to the west and south, that makes this region represent a transitional region between different habitat and vegetation types. This interesting habitat plays as a refuge for these endemic taxa, all these reasons probably explains why the Upper Plains and Foothills physiographic region have the highest number of taxa, compared to other physiographic regions, as well as the phytogeographic variation that exists in the Persian Foothills district (FPF) has reflected in richness of this district in endemic plant taxa. However, Asteraceae is the largest plant family of vascular plants with 432 taxa in Iraq (Ghazanfar *et al*., 2019), and it has the highest number of endemic plant species in Iraq with 44 species (Youssef, 2020). This is also compatible with the result that indicates the Asteraceae has the highest number of endemic taxa in the Middle Saharo-Sindian and Irano-Anatolian sub-regions in Iraq, even *Anthemis* genus, which is the largest genus belonging to the Asteraceae in Iraq, and it recorded the highest number of endemic taxa compared to other genera in studied phytogeographic sub-regions.

The history of the long evolution of Asteraceae dates back to ~83 million years ago (the Late Cretaceous) and the diversity in growth forms: herbs (annual, biennial, and perennial), shrubs, trees, and vines. In addition to the unique characters of inflorescence, it comprises a dense cluster of many florets surrounded by a compact bract that increases the chances of successful pollination, and the specialized structures (pappus) of the fruits (achenes) help in dispersal, allowing for extensive diversification and adaptation to a different environmental condition (Mandel *et al*., 2019; Vijverberg *et al*., 2021; Zhang and Elomaa, 2024).

The rare plants need more research and field studies. This study depended on herbaria specimens. However, in Iraq, there have not been many plant surveys conducted in the last 24 years, which reflects the lack of data on the rare and endemic plants in Iraq. Until now, there has been no Red List assessment for Iraqi plants. Even in the IUCN (2010) Red List, there are a few numbers of plant species distributed in Iraq that have been assessed, and almost all these species are from the Mountain physiographic region, so this study will help to begin the preparation of studies and put assessments on the Plant Red List in Iraq. As well as these endemic plant taxa, we should prioritize establishing national-level conservation strategies to save them from the different threats, and their conservation should be a priority.

CONCLUSIONS

Updating the taxonomic status of endemic plants in the Middle Saharo-Sindian and Mesopotamia phytogeographic sub-regions of Iraq revealed 29 taxa, compared to 89 taxa previously reported. This reduction highlights the importance of continuous taxonomic revision and monitoring. Endemic plants possess significant ecological value and require protection and further study, particularly as new species may yet be discovered in Iraq or recorded from neighboring countries.

CONFLICT OF INTEREST STATEMENT

"The authors declare no conflict of interest".

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النباتات المتوطنة في منطقتين جغر افيتين ثانويتين: منطقة الصحراء-السنديان المتوسطة ومنطقة ما بين النهرين في العراق

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الخلاصة

هدفت الدراسة الى تحديث سجلات الأنواع النباتية المتوطنة ضمن منطقتين فرعيتين جغرافيتين نباتيتين في العراق: منطقة الصحراء الوسطى-السنديان ومنطقة ما بين النهرين. وقد أجري التحديث من خلال مراجعة شاملة لصحة الأسماء العلمية وحالة التوطن والأنواع الموصوفة حديثاً التي اوردتها الدراسات السابقة، والتي سجلت مجتمعة 89 نوعاً نباتياً متوطناً في هاتين المنطقتين. اظهرت النتائج الحالية 29 نوعاً متوطناً ينتمي الى 22 جنساً و 15 عائلة. كانت العائلة المركبة Asteraceae و جنس *Anthemis* L.,1753 هما الأكثر انتشاراً. من حيث التوزيع، تبين ان ثمانية انواع محصورة في منطقة الصحراء-سنديان الوسطى، وثلاثة عشر نوعاً في منطقة ما بين النهرين، بينما اشتركت المنطقتان في ثمانية انواع متوطنة. كما تقدمت الدراسة تحديثا لتوزيع الأنواع المتوطنة ضمن المناطق الجغرافية الفسيولوجية وناقشت الأسباب المحتملة وراء الاختلاف في عدد الأنواع المتوطنة مقارنةً بالتقارير والدراسات السابقة.