



## Morphological Study and Conservation Status of JUNCAGENACEAE in Kurdistan Region, Iraq

Sakar Y. Hama<sup>1</sup> , Rubar Hussein M.Salih<sup>2</sup> , and Saman A. Ahmad<sup>3\*</sup> 

<sup>1,2</sup>Department of Biotechnology and Crop Sciences, College of Agricultural Engineering Sciences, University of Sulaimani, Kirkuk Road, Sulaimani, Kurdistan Region, Iraq.

<sup>3</sup> Kurdistan Botanical Foundation, Sulaimani, Kirkuk Main Road, the American University of Iraq-Sulaimani,

\*Corresponding Author.

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### Abstract

This study was conducted on the Juncaginaceae family in Iraq, which is a small monocot family of mostly coastal and wetland annual and perennial herbs of almost cosmopolitan distribution and represented by four genera, which are *Triglochin*, *Lilaea*, *Maundia*, and *Tetroncium*. There are approximately 25–35 species in the world. In Iraq, the family is represented by a single species, *Triglochin palustris* L. The *T. palustris* is characterized by perennial herbs, rhizome short, clothed with sheaths of old leaves. Stems are simple, erect or ascending, and 30–35 cm tall. Leaves are narrowly linear and semi-terete, inflorescence racemes, flowers are dark purple. Fruit is closely appressed to the scape, clavate, rachis, or ascending, with the ripe carpels separating from the base upwards. The species is widespread in Asia and extremely rare in Iraq, only found twice near the Persian frontier in the central sector of the lower thorn-cushion zone in the Rawanduz district (MRO), Haji Umran area, and Sakran Mountain. According to IUCN criteria, this family is critically endangered (CR) in Iraq. The process of identification and writing descriptions depended on the examination of all specimens and checking the various flora and guides. The main goal of this study is to rediscover and revise *T. palustris* and identify the conservation status of the family in Kurdistan, Iraq.

**Keywords:** *Triglochi*, Juncaginaceae, Morphological study, Conservation status, Kurdistan region, Iraq.

### 1. Introduction

The Irano-Turanian region is one of the great phytogeography zones of arid and semi-arid lands in the world, and it has a great role in terms of plant richness, diversity, and conservation [1, 2]. Sakran mountain is part of the Qandil range (a part of the extensive Zagros mountain system), and it is located in Choman District, which is the third highest mountain in Iraq after Chekhidare and Halgurd Mts. and reaches 3,587 m [3]. Alismatales is a great order; it has 14 families, including nearly 4490 species [4], one of the earliest-diverging lineages of monocotyledons [5], mainly in aquatic and semi-aquatic plants. While several groups of Alismatales have received considerable attention (e.g., seagrasses [6 7], Araceae [8, 9]), some smaller families of the order



have not been studied in detail. One of these is the Juncaginaceae (Arrow-Grass family), part of the so-called aquatic clade [10] or core Alismatales [4, 10]. The APG II system of 1998 and 2003 [11, 12] also demonstrated the family's position in the order of Alismatales in the monocot's clade. The family Juncaginaceae has a worldwide distribution, with around 25–35 annual or perennial species belonging to the four genera *Triglochin*, *Lilaea*, *Maundia*, and *Tetroncium* [4, 13]. Even though the family is small, it has a high level of ecological variety. However, because of its non-exclusive connection, APG IV (2016) [14] eliminated the genus *Maundia* and elevated it to the monogeneric family Maundiaceae [15].

Members of the Juncaginaceae are grass-like, wind-pollinated plants that grow in brackish water, salt marshes, and fresh water environments (bogs, fens, and slow-flowing rivers), as well as seasonally wet terrestrial locations (e.g., *T. Bulobsa* L., annual *Triglochin*). The family has a nearly global distribution, with Australia serving as the hub of species diversity. Therefore, during the past several decades, the majority, or most taxonomists, has recognized the family [16]. Juncaginaceae has three genera in the temperate regions, two of which are confined to the southern hemisphere, and it is represented by one genus and single species in Kurdistan, Iraq. The floristic study and taxonomy in addition to the flora of Iraq since 1966 depended mostly on the research that has been done by MSc. and Ph.D. studies at the university; however, most of these works are still on the thesis, and they were not published in the local scientific journal nor the international journals [17–20].

Over thirty five years ago various floristic study had been conducted on some different mountains and areas of Kurdistan Iraq, such as vascular plants of Sinjar mountain by Khalaf (1980), yields 284 plant taxa recorded as a new species to the studied area [21], vascular plants of Pramagroom mountain by Faris (1983) and yields about 341 taxa [22], vascular plants of Haibat Sultan mountain, by Fatah (2003) yields 349 taxa [23]; Vascular plants of Hawraman mountain and yield about 1.084 taxa, with 18 species new to Iraq and four species new to sciences [19]; the floristic study of Azmar-Goizha by Ahmad & Salih (2016), yields 666 taxa [24]; floristic study of Qaradagh mountain by Ahmad & Salih (2019) and yields 965 species, with 12 species new to sciences [25], vascular plants of Gmo mountain by Hama (2020), yields 738 taxa [20]; floristic study of Qaiwan mountain by Ahmad & Salih (2021) and yields 670 taxa which includes of 200 genera and 64 different families [26], and vascular plants study of Makok mountain by Mwrada (2022) and yields 351 plant taxa from 243 genera and 65 various families [27]. However, in those periods, we had no chance to collect a single sample of this plant because this plant is very rare and grows in a very restricted geographical range in Iraq. In Iraq, no comprehensive study has been carried out on this family to clarify the status and comprehensive molecular study on Juncaginaceae members, except the single record in the flora of Iraq made by Gillett [28] and the second collection of it during the Halgurd-Sakran project (2021), which is involving the Haji-Umaran area. The main objective of this study is to rediscover and identify the conservation status of the family in Kurdistan, Iraq.

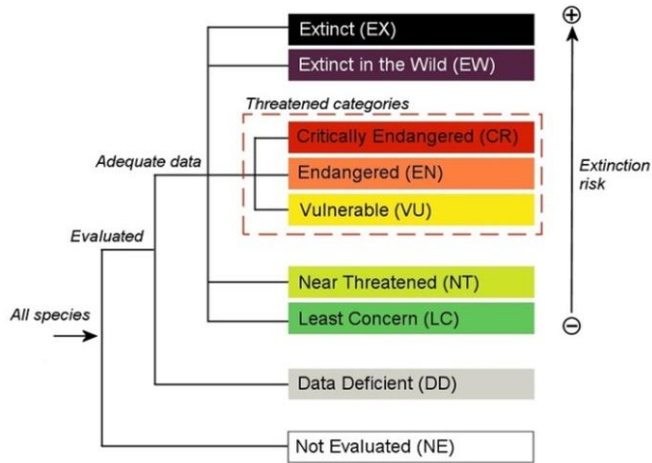
## 2. Materials and Methods

During the years 2019–2021, the team of the Kurdistan Botanical Foundation (KBF) conducted extensive fieldwork in the Sakran mountains as a part of a floristic study of the Halgurd-Sakran (involving the Haji Umaran area) project. The process of identification and writing descriptions depended on the examination of all specimens and the checking of various floras, such as the flora of Iraq and neighboring countries. Detailed morphological characteristics and geographical distribution GIS maps are investigated for the species. Furthermore, assess the family according

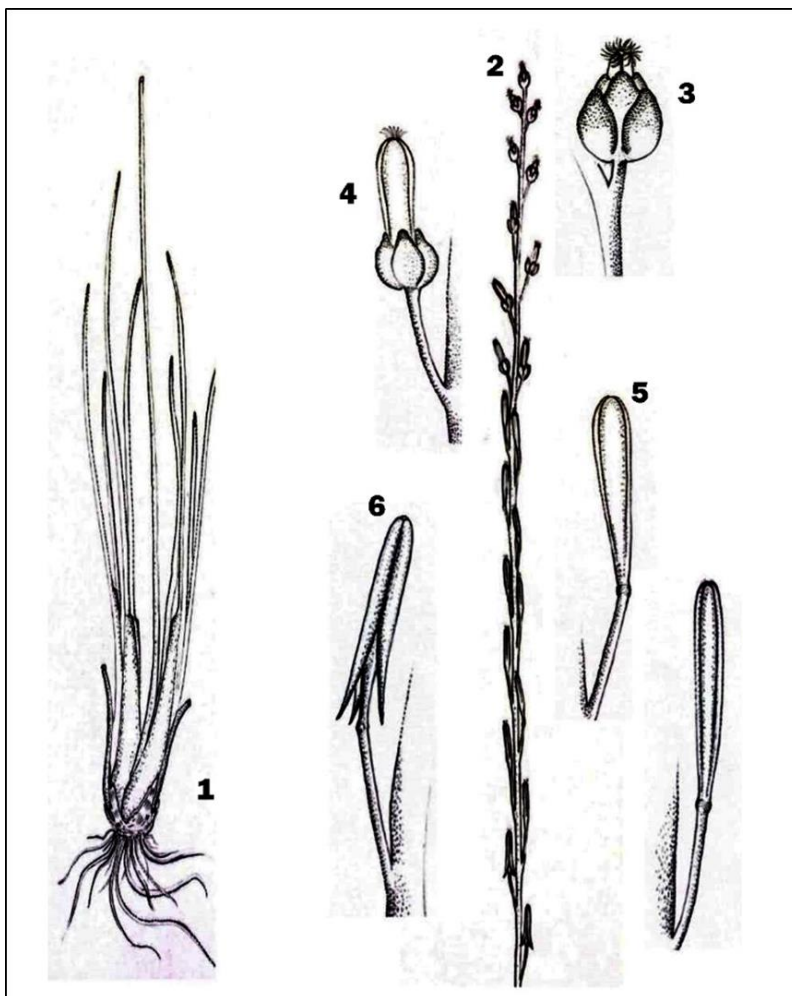
to IUCN criteria.

### 3. Results and Discussions

Juncaginaceae, J. E. Dandy, J. Hutchinson. Fam. Fl. Pl. ed. 2: 2: 548 (1959). Herbs are annual or perennial. Stems are erect, ascending, with short rhizomes, 30–35 cm tall (in Kurdistan, Iraq). Leaves are mostly basal, simple, alternate, entire, sessile, and sheathed at the base. Inflorescence spike or raceme, 18–22 cm long. Flowers actinomorphic, bisexual or unisexual; perianth greenish to purplish, segments similar, 2–6(–8), in 1–4 series; stamens 3–6, free, anthers subsessile, bilocular, extrorse opening by longitudinal slits; ovary superior; carpels 3–6, free or partly connate, 1-ovulate, styles short or absent. Fruit is apocarpous or syncarpous. Seeds are very small. *Triglochin* L. Sp. Pl. ed. 1: 338 (1753); Gen. Pl. ed. 5: 157 (1754). Herbs are annual or perennial. Rhizomes densely root at nodes. Stems are erect or ascending. Inflorescence spikes or racemes on leafless scapes (without bracts) are 18–22 cm long, flowers bisexual; perianth 6 segments; stamens 6; opposite with perianth segments. Fruits 6, mostly 3, are fertile connate. Fruits are syncarpous, dehiscent by the separation of the carpels from the persistent central axis, seeds without endosperm. There are about 15 species, some of which are almost cosmopolitan, but half of them are endemic to Australia and are represented in Kurdistan, Iraq, by a single species. *Triglochin palustris* L., Sp. Pl. ed. 1: 338 (1753); Fl. Orient. 5: 13 (1882); Fl. Pal. ed. 2, 2: 539 (1933); Fedchenko in Fl. U.R.S.S. 1: 277 (1934); Rawi in Dep. Agr. Iraq Tech. Bull. 14: 180 (1964); Dandy in Fl. Iran. 82: 2 (1971). Basionym of: *Juncago palustris* (L.) Moench, Methodus 644 (1794). **Figure (1)**. Herbs perennial Rhizome short, clothed with sheaths of old leaves. Stems are simple, erect or ascending, and 30–35 cm tall. Leaves are narrowly linear, semi-terete, 4–14 × 1–1.5 cm. Inflorescence racemes, 18–22 cm long, flowered. Flowers dark purple, 2–5 mm long; pedicels 1–4 mm long, scarcely elongating after anthesis; perianth segments 6, purplish or greenish, broadly elliptic, 2–2.5 mm long. Fruit closely appressed to scape, clavate, 5–9 × 1–1.5 mm, appressed to the rachis or ascending, the ripe carpels separating from the base upwards. Habitat: mountainside, high forest zone, among grass and wetland near the stream, slope steep, 1700–2000 m. Flowering time: June – August Collections: Gillett 12440!, MRO, Haji Umaran; S. A. Ahmad 21-2025 with G. Hiwa, S. Rahim, and R. Faraidun, KBF herbarium, AUIS. Figure (2). Distribution: Kurdistan, Iraq, Iran, Turkey, Syria, Palestine, Jordan, N. & C. Europe, Armenia, Azerbaijan, Georgia, C. Asia, W. Pakistan, Afghanistan, Siberia, India, China, Japan, and N. & S. temperate America. Occurrence and conservation issues: The species is widespread in Asia and extremely rare in Kurdistan, Iraq, only found twice near the Persian frontier in the central sector of the lower thorn-cushion zone in the Rawanduz district (MRO), Haji Umran area, and Sakran mountain (36.5949°N, 44.9968°E; 36.648°N, 44.993°E) [28]. The Juncaginaceae are under the impact of the different threats in Iraq, and the major threats are agriculture expansion, pesticides, urbanization, climate change, logging, drought, and overgrazing [30]. However, based on the International Union for Conservation of Nature's (IUCN) criteria (B) for a very small or restricted population and (C) for small population size and decline, the entire family is critically endangered (CR) in Iraq and will disappear in the near future if the local government doesn't take the real actions to protect and conserve it.



**Figure 1.** Structure of the IUCN Red List Categories (IUCN, 2022).



**Figure 2.** *Triglochi palustris* L. 1. Basal parts; 2. Fruiting raceme; 3 & 4. Flower; 5. Fruit indehiscent; 6. Fruit dehiscent.



Figure 3. *Triglochin palustris* L. - photograph of the specimen at KBF herbarium, collected 2021.

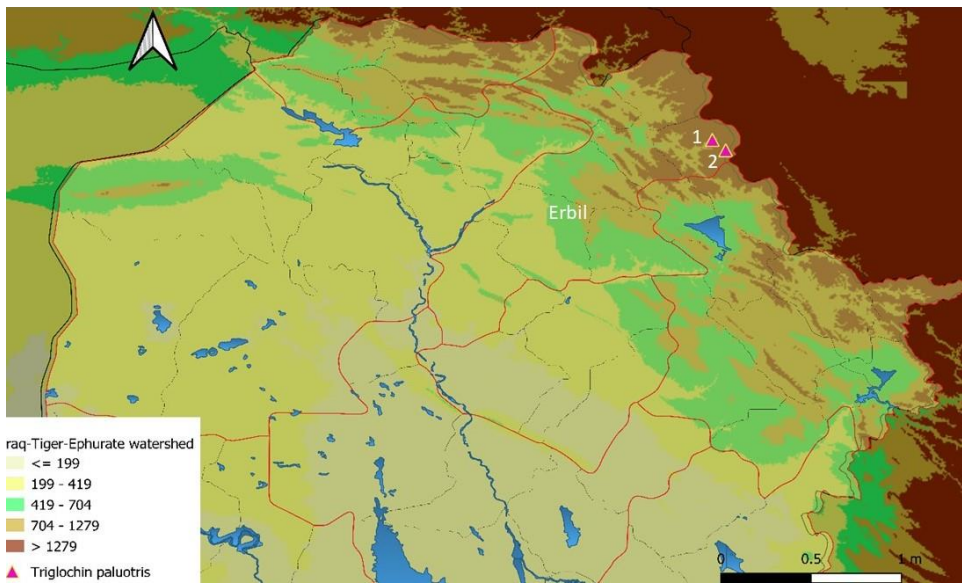


Figure 4. Map of Kurdistan region showing distribution of *Triglochin palustris* L.; 1. Haji Umeran; 2. Sakran Mountain. QGIS (3.32.3) software used to visualize and process the geographical data.

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**Conflict of Interest**

The authors declare that they have no conflicts of interest.

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