



International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)

(Open Access, Double Blind Peer-reviewed, Refereed and Indexed Journal)

www.iasir.net

A systematic study on the genus *Erodium* in Kurdistan of Iraq

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Abstract: Sixty two specimens of *Erodium* were loaned by Howler Botanical Garden herbarium to RNG herbarium at the University of Reading, UK, beside quite many living taxon that naturally found in the fields of Kurdistan. Morphological studies were conducted on the vegetative part of the specimens in accordance of neighbor countries flora such as Turkey, Iran, Syria, and Palestine in addition to the Mediterranean flora. RNG herbarium specimens were also used for comparison and for verification. It has been found that these specimens are related to nine species of *Erodium* that will be described for the first time in Kurdistan. It was found that these species mostly occur in and within neighboring countries with a high variance in geographical distribution. A key for species identification of *Erodium* has been forwarded. Undoubtedly this paper will praise others in this aspect as it is part of a series of successive coming papers on other genera in order to enrich flora of Kurdistan in near future.

Keyword: Systematic, Study, *Erodium* , Kurdistan ,Iraq

I. Introduction

Kurdistan in general , particularly Kurdistan region of Iraq is considered as one of the world's hotspot for biodiversity as it is situated within irano–anatolian climate in Turkish side and Irano-turanian climate from Iran side (Townsend and Guest 1966, Rozoska 1980, Maulood *et al* 1992 and Mittermeier *et al* 2004). Ultimately the existing of high level of biodiversity and endemism raised up to record more than 3000 species in this part of the world (Townsend and Guest 1966 – 1985). Documenting plant species in this area and establishing flora of Kurdistan is becoming an urgent need to fill up the existing gap of the knowledge in respect to the flora in this part of the world.

In fact, soil fertility, climate and natural resources of Kurdistan support the diversity of the flora (Rozoska 1985). Since the region became the ground of political and military clearance within the past decades, the instability prevented any chance for botanists to establish flora of Kurdistan. However, huge numbers of species within Kurdistan flora have been included in neighbouring states flora. Still quite many sporadic floral studies were carried out in quite separate localities (Faris 1982, Mohammad 1989, Al mosawi 1992, Al Katb 1993 and Ahmad 2014, 2013).

Much more detail studies and projects are needed to register and identify different plant taxon in the area. Supporting and encouragement for such studies on floral diversity will undoubtedly lead to recognize quite many new records of flowering plants in the area that might be new to the world as well (Ahmad 2013). Nevertheless, this will be a contribution for a baseline information to establish flora of Kurdistan in future.

As a background information and knowledge on flora of Iraq or Kurdistan, the complexity of such studies may be reflected from papers of (Zohary 1946, Townsend and Guest 1966 – 1985, Rozoska 1980, Al mosawi 1992, Al katb 1994, Al Ani and Younis 2013). Throughout the last century, the total number of known species in Iraq raised up from more than 3000 taxa in eighteens to more than 5000 taxa nowadays (Al-shehbaz 2015, personal communication).

The present investigation represents a beginning of a series of papers on different floral genera and species in Kurdistan. In addition to be an important baseline information for the becoming goal to establish the flora of Kurdistan which is not exist so far.

II. Description of the area

Kurdistan of Iraq located between 42 to 46 longitudes and 34.6 N to 37.22 N latitude, share border with Turkey, Iran, Syria and middle part of Iraq in the south. Topography of the region varies from largest fertile plane land of whole Iraq to quite wavy plateau in the middle with successive mountain and plane from south to highest highland mountain in Halgourd area. It has a height that exceeding 3600 m, the elevation of the area start from around 100m above sea level throughout khanaqeen and Kefri district. The soil of the area is calcareous and alkaline still

patch of serpentine soil also found around Penjeweene when magnesium is dominant. Limestone is the main part of the rock in the area still sandstone and marmalade with igneous rocks also been recorded in the area (Davis 1965, Buringh 1964). Rain and temperature range between 375 – 725 mm and below 0 temperatures to 45C⁰ respectively with dry hot summer to rainy cold winter.

A. *Erodium* L Herit

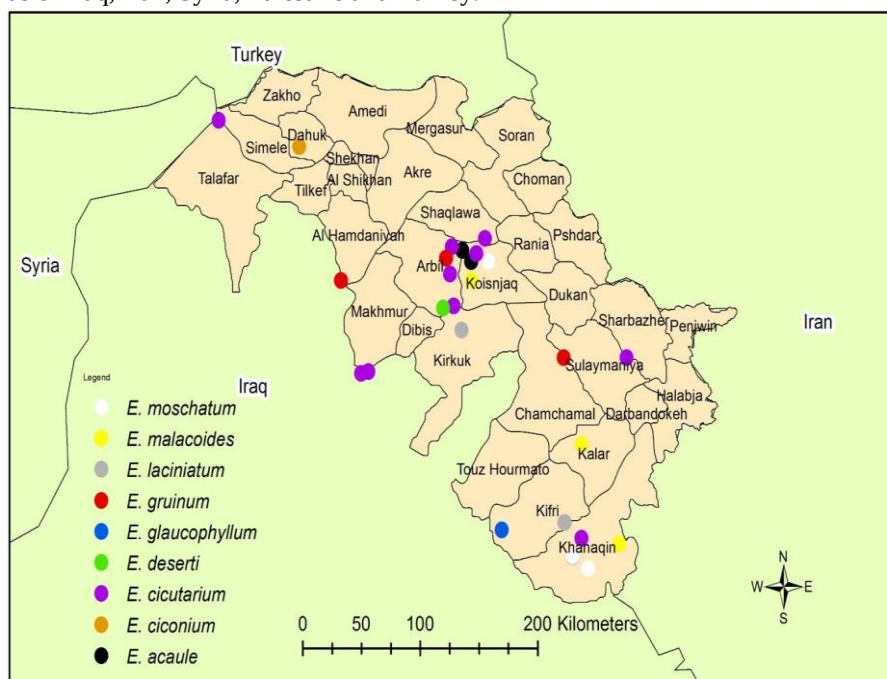
The genus *Erodium* belongs to the family geraniaceae. The fruit and flowers are the main distinct characters. Flower possessing 5 stamens is the main comparison factor to distinguish *Erodium* from other related genera. General morphology, fruit, flowers of the plant can be found in any textbook of taxonomy (Porter 1959). However, *Erodium* as a genus is within a large genus of flowering plants. Its species found in different climate zones within our planet, still it is found in arid and semi-arid zones in Syria and Iraq (although it has not been referred to in flora of Iraq by guest and Townsend 1966-1985), also in the wet and cool regions of Turkey and Iran . In other word it's quite widespread in Mediterranean area including Kurdistan part of Iraq in particular. (Figure 1)

III. Plant collection and identification.

Plant collection for the sake of the present study involves samples that were collected throughout intensive survey during 2013. Five to six sampling were carried out in various parts and districts of Kurdistan (Map 1). Plant samples were collected, notes of morphology, habitat, location, and GPS data were recorded. Photographs of plant samples were used to obtain and illustrate floral and vegetative characters which are necessary for more accurate identification. Contrast and comparison between plant themselves in the field and the dried specimens in herbarium were dealt with and studied in detail. All samples were pressed in the field and then after dried and preserved within Howler herbarium in H. B. G. Sixty two specimens of *Erodium* were loaned to RNG Herbarium at the university of reading in UK, beside hundreds of living specimen noticed in the area. Species of *Erodium* have been reviewed based on the various informative web sites, using herbarium library materials in addition to accurate examination of the samples by dissecting microscope to get more detail properties of any parts of plant needed to be taken in consideration (Plate 1). Habitat and plant species distribution within Iran and Turkish flora were the guide line for this study. Characters of each single species were reviewed based on the literature and available herbarium material. The previous factors were used for contrasting and comparing different species in order to distinguish and separate various species of *Erodium* in Kurdistan.

IV. Results

Out of total 62 of *Erodium* herbarium specimens and quite many natural living samples observed and photographed in the area. Nine species of *Erodium* were identified and classified. The identification of the plant specimens depending on available taxonomic and systematic botanical references were carried out (porter 1959, Ali 2014, Rechinger 1964, Breckle and Rafiqpoor 2010), then after they have been checked against published neighbour floras of Iraq, Iran, Syria, Palestine and Turkey.



Map 1: shows the distribution of nine species of *Erodium* in kurdistan region of Iraq.

Description of the genus may be summarized as the following:

Leaves pinnately nerved, beak of the fruit becoming spirally twisted, stamens 5 alternating with 5 staminoids. Annual or perennial herbs with or without woody stock, Leaves alternate or opposite, pinnately lobed or dissected. Inflorescence usually umbellate, Flowers actinomorphic occasionally zygomorphic; sepals 5, petals 5, alternating with glands, the two upper often differing from the 3 lower. Stamens 5, antisepalous. Ovary 5 lobed with long subterminal style. Fruit long- beaked (shizocarp) , the outer part of the style separating into 5 long awns , becoming spirally twisted below mericarp provided with 2 apical pits (foveoles) which may have one or more furrows below them . (Figure 1)



(Figure 1) *Erodium* from Kurdistan showing 5 stamens and other characters

However, the following nine species have been recognized and recorded. The detail character may be found throughout the following proposed key for *Erodium* species identifications in Kurdistan. The proposed key is accompanied with photographs for illustration.

Key to the *Erodium* species:

- A. Leaves pinnate, with distinct leaflets.
 1. Pits of mericarp glandular inside 2
 1. Pits of mericarp not glandular inside 3
 2. Leaflets pinnatisect , cauline leaflets deeply pinnatifid ,
 Sepals whitish *E. deserti* (Fig 2)
 2. Leaflets pinnatifid, cauline leaflets divided into less than half way, sepals not whitish
 *E. moschatum* (Fig3)
 3. Perennial peduncles arising directly from the caudex, flowering stem leaflets
 *E. acaule* (Fig4)
 3. Annual flowering stem leafy *E. cicutarium* (Fig5)
- B. leaves sometime pinnatisect, or pinnatifid not divided into distinct leaflets, more or less lobes.
 4. Flowers large , more than 2 cm in diameter , beak of fruit ≥ 6 cm 5
 4. Flowers small , less than 2 cm in diameter , beak of fruit ≤ 6 cm..... 7
 5. Leaves sub glabrous, sometimes hairy, often somewhat fleshy, filaments glabrous
 *E. glaucophyllum* (Fig6)
 5. Leaves and filaments not above like 6
 6. Leaves deeply pinnatisect , beak of fruit 8 -10 (12 cm) , sepals 5 -8 mm , foveoles without furrow beneath
 *E. ciconium* (Fig7)
 6. leaves lobed but not pinnatisect , beak of fruit 6 – 8 (10) cm , sepals 8 -10 mm with double furrows
 beneath the foveoles *E. gruinum* (Fig8)
 7. Leaves not distinctly glandular below, beak of fruit 4 – 5 cm, mericarp without furrow beneath the
 foveoles *E. laciniatum*
 7. Leaves distinctly glandular below, beak of fruit 2 – 3 cm, mericarp with furrow beneath the foveoles
 *E. malacoides* (Fig 9)



*Plate 1: Plate 1: illustrate some feature characters of fruits in *Erodium* species (Mericaip, faveoles, furrows)
**1, *E. gruinum* 2, *E. laciniatum* 3, *E. malacoides* 4, *E. moschatum* 5, *E. acaule*
6, *E. ciconium* 7- *E. cicutarium* 8- *E. deserti***

Erodium glaucophyllum was not obtained.

V. Discussion

Erodium as a genus, its distribution and taxonomy have not been referred in flora of Iraq so far (Guest and Townsend 1966-1985, Ghazanfar 2016). However, it is a quite widespread species in Iraqi Kurdistan. It was recorded almost in all locations that were covered throughout this investigation (Map 1). Nine species belong to this genus have been recognized and recorded throughout the present study. They include a quite wide spread ones such as *E. cicutarium* (figure 5) and *E. moschatum* (figure 3) according to flora of neighboring countries (Breckle and Rafdiqpoor 2010, Davies 1967, Vargas *et al.* 2006). In contrast a very rear species *E. deserti* (figure 2) was also recorded through the present survey in Kirkuk Provence. *E. acaule* (figure 4) is another interesting species of *Erodium* has been also observed and recorded, a species that was not common in this area (Ali 2014). *Erodium* species distributions in Kurdistan in comparison to other close countries in the area have been tabulated as follows:

Countries	Iran	Turkey	Cyprus	Syria	Palestine	Iraq	Kurdistan
No. of <i>Erodium</i> species	15	21	8	15	18	---	9

Detailed and precise examination of the specimens of *Erodium* has been focused on, then after a proposed key has been established, in order to be used for identification of the different species of *Erodium* particularly in Kurdistan

of Iraq.

This paper will highlight on *Erodium* genus that has not been considered so far in the area. The forwarded key for species identification will hopefully activate and lead to more investigations on other widespread genera of geraniaceae and other plant families. This will assist in establishing the flora of Kurdistan that is not exist so far. However Kurdistan flora has been included partly by flora of neighbouring countries. Therefore, undoubtedly part of the existing gap will be fulfilled in respect to taxonomic and systemic studies of flora in this part of the world through this and coming papers.



Figure 2: *Erodium deserti*



Figure 3: *Erodium moschatum*



Figure 4: *Erodium acaule*



Figure 5: *Erodium cicutarium*



Figure 6: *Erodium glaucophyllum*



Figure 7: *Erodium ciconium*



Figure 8: *Erodium gruinum*



Figure 9: *Erodium laciniatum*



Figure 10: *Erodium malacoides*

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