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Sami Youssef, Ali Galalaey, Ahmed Mahmood, Honar Mahdi, Errol Véla. Wild orchids of the Kurdistan Region areas: a scientific window on the unexpected nature of the North-Western Zagros. 2019. hal-02048904

HAL Id: hal-02048904

<https://hal.science/hal-02048904>

Submitted on 6 Mar 2019

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1. General introduction on Orchidaceae

1.1. Biological and ecological elements

Orchids (Şepirza in Kurdish, Al-sahlabyat in Arabic) are easily distinguished from other plant taxa by having specific flower traits (Dressler & Dressler, 1990): the flower always has bilateral symmetric shape “zygomorphic flower”. They also possess spectacular specific petals called “labellum”; It is generally similar to animal shapes (e.g. Bees, spiders, lizards, monkey-like...). This superb labellum plays an important role in

pollination. Their anthers produce one to eight large pollen-masses, known as “pollinia”. The ovary is composed of three united carpels and contains numerous ovules forming seeds after pollination. It produces thousands of very small seeds as dust-like which are mostly dispersed by the wind. The unusual beauty of the orchid flowers has always attracted the attention and the curiosity of botanists, naturalists, ecologists, and horticulturists (Figure 1). As a consequence, orchids thereby had been represented since antiquity in various mythologies, particularly in Roman and Greek mythology as a symbol of fertility and sexuality (e.g. Baumann, 1993; Kumbaric et al., 2013). From the standpoint of the etymologists, the name of the genus

Orchis is originated from the Greek meaning testicles, indicating the resemblance of their specific tuber shapes among the most orchids taxa (Kretzschmar et al., 2007).

The Orchidaceae is one of the most diversified and cosmopolitan flowering families. It occurs in all territories except glaciers and real desert areas. It has a wide ecological niche range founding in diverse habitats types with a centre of diversity in the tropical rainforest. Most of the tropical and subtropical orchids are perennial epiphytes (grow anchored to trees on branches and bark) while temperate terrestrial ones are mostly terrestrial and occupied forest and grassland habitats (Atwood et al., 1986; Cozzolino et al., 2005). Almost all orchids develop a specific mutualistic symbiotic association called “mycorrhiza”. They co-evolve a specific life history strategy via trade-offs between dispersal and germination capacity: their seeds dust-like have an efficient dispersal in patchy environments. By contrast, they have driven an obligate mycorrhiza to enhance their germination capacity and seedlings survive (Arditti & Ghami, 2013). These orchids are myco-heterotrophic during germination and early seedling growth while they are photosynthetic during adult plants. In some specialized cases, there are indirectly saprophytic orchid taxa unable to photosynthesize because of the lack of chlorophyll e.g.

the Paleotemperate *Neottia nidus-avis* obtains its nutrients by parasitizing soil fungi.

The orchids flowers-pollinators interactions (pollination niche) fascinate the evolutionary biologists, which led to a greater understanding of co-evolution and diversity in this group. Recently, Joffard et al. (2018) conclude that the specialisation in orchids flowers-pollinators interactions depends on pollination strategy and breadths of orchids spatial/temporal distributions. All the orchid taxa, except for self-pollinating ones, are exclusively insect pollinating, but require precise pollination mechanisms. In this circumstance, orchid flowers have developed a particular life history strategy in response to evolutionary selective pollinator pressures (Jersáková et al., 2006). Their pollinia are composed of numerous massulae containing each one hundreds of pollen grains. Then, each pollination event brings together consequently thousands of pollen grains with as many ovules that supplies many visits by pollinators and assure the easy production of numerous seeds. Furthermore, the pollinators usually are attracted by a combination of the bright colour of the flower, fragrant aroma, the presence of nectar, and more spectacularly by floral structure and coloration, and sex pheromones mimic to their female e.g. wasp, bee (Figure 2).



Figure 1: Some splendid and marvellous flowers of the orchid species from Kurdistan Region areas.



1.2. Nomenclature and systematics

1.2.1. Classifying species

Typically, each species is attached to a genus and several similar genera are grouped in one same family, here named “Orchidaceae” for orchid family. Initially, these assemblies were made on the basis of morphological evidences only. Each generation of botanists provides new subtle criteria and proposes a new hierarchical system for criteria analyses. Thus, each botanist can interpret the morphological data with his/her own reading and classify one species into a genus or another. This debate still existed and the naming changes induced also.

As an example, several marsh orchids were long-time classified within the genus *Orchis*, with a lot of other terrestrial species. But a subtle morphological feature, based on subterraneous tubercle shape, allowed some authors like Klinge in 1898 to create a subgenus within *Orchis* for those who have digitate tubercles and to name it “*Orchis* subgenus *Dactylorchis*” (which means “digitate orchids”. After him, Necker & Nevski in 1937 upgraded this peculiarity to the genus rank and name it *Dactylorhiza* (which means “digitate root”). It is why a species like *Orchis umbrosa* first described in 1842 by Karelín & Kirilov

was later reclassified and renamed *Dactylorhiza umbrosa* by Nevski in 1935. This old classification only based on morphology is now called “classical” classification.

More recently, with the advent and generalisation of molecular phylogeny based on DNA sequencing, a new category of criteria is systematically used and compared to the classical morphological ones. These molecular criteria are considered more reliable because of less subject to evolutionary convergences. A temporal dynamic approach of the morphological evolution of the species is now possible. Then, the classification depicts not only the hierarchical similarities but also the history of natural transformations having resulted in current assemblies now observed by us. This new classification mainly based on phylogeny but also supported by morphology is named “phylogenetic” classification.

To continue the previous example, some other marsh orchids own obovate tubercles and were still classified in the genus *Orchis*, like *Orchis laxiflora*, first described by Lamarck in 1778. Based on phylogenetic studies, Bateman et al. in 1997 proven this species and several closely related ones are not “true *Orchis*” but more close to *Anacamptis*, previously considered as monospecific genus considering the

unique *Anacamptis pyramidalis*. They opted for enlargement of the genus *Anacamptis*, incorporating and renaming henceforth *Anacamptis laxiflora* and other related species. But some authors like Tyteca & Klein in 2008 prefer to restrain “true *Anacamptis*” to be monospecific and regroup all displaced species in a new genus named *Herorchis* creating among others the combination *Herorchis laxiflora*. Immediately after them, Delforge in 2009 proposes not to consider all displaced species in the same genus, but each monophyletic group as a distinct genus, creating then the new genus *Paludorchis* for grouping *Paludorchis laxiflora* and allies. But we do not necessarily want to consider that the last one who spoke is right. Our analyses, in conformity with Bateman et al. and a lot of contemporaneous authors, suggests that a single but large genus for all displaced *Orchis* and the historical *Anacamptis pyramidalis* is more adapted. The main argument is that all the species from all these groups are able to hybridise when growing together, while they never hybridise with true *Orchis* nor with *Dactylorhiza*. Considering each natural group within *Anacamptis* sensu lato as a peculiar small genus would increase not only the intergeneric hybrids combination but also encourage to split in as many small genera in each other diversified genus of

Figure 2: Example of the pollinator insect (Coleoptera Cetoniidae) on an *Androrchis anatolica* flower.

the family. To end with a cutter-example, around half of the remnant *Orchis* are belonging to a separated phylogenetic clade, harbouring morphological uniformity among them but distinctiveness with the “true *Orchis*” clade and they can all hybridise among clades but never between clades. This exaggerated situation encouraged us to consider the genus *Androrchis* (created by Tyteca & Klein in 2008) including *Androrchis anatolica* as a distinct genus separated from the true *Orchis* “sensu stricto” including *Orchis simia*.

1.2.2. Classifying variations

Classifying variations within species falls under the same problematics and generates the same difficulties. In this book, we consider the following guidelines to characterise and classify natural variations among or between species:

- The individuals genetic or morphogenetic abnormalities are not considered taxonomically and do not merit any formal name. They are just a biological phenomenon that can be described and named with a common language: hyperchromy vs. hypochromy when the global colour system is exaggerated vs. weakened; lusus when the morphogenetic intermediate stages didn't take place normally etc. Sometimes botanists used the controversial

rank of “forma” (e.g. *Limodorum abortivum* f. *trabutianum*, not yet known in Kurdistan Region areas (KRAs, see section 3.2.6. for a detail explication about the definition and use of this term).

- The population variations, more or less genetically fixed and/or regularly selected by environmental filters, are the basis of evolutionary processes it is why they merit to be considered and named. Unfortunately, they are understudied in the Middle East area, still mainly based on morphology, and cannot all be known and understood. But if necessary, peculiar cases easily recognisable can be considered ecotypes or chemotypes and named under the rank of variety (e.g. *Anacamptis pyramidalis* var. *tanayensis*, not yet known in the Middle East).
- When a particular population or group of populations is geographically, phenologically and/or caryologically isolated, at least partially, from the other ones, it can be considered as a subspecies. This controversial rank is nevertheless widely used to consider evolutionary processes that will generally lead to a complete speciation after a longer or shorter period of time. Cross-breeding with other subspecies is strongly reduced if not stopped artificially and/

or temporarily by non-genetic and/or not autonomous barriers. The most common case is that of species that have developed several geographical subspecies, each in a given biogeographic context (e.g. the Middle-East *Androrchis spitzelii* subsp. *latiflora* replace the South-European *A. s. subsp. spitzelii*).

Howsoever, when the isolation is complete and more or less ancient, the variation is considered definitively autonomous and is assigned the rank of species. It was initially an intuitive concept, and despite endless controversies to try to define it scientifically; it is still the most used and considered at the basic unit for biodiversity counts. Typically, a species can occasionally still hybridise with another species from the same genus (or the same clade within a genus) but the descendants are sterile or impaired chimeras and condemned to disappear quickly. Nevertheless, in some cases a reincorporation within the genetic pattern of one or both parental species is possible: this phenomenon is named introgression. And to finish, some cases of hybridisation are so successful that they can develop themselves and lead to the emergence of a new autonomous species. This mode of speciation based on hybridisation is not infrequent in the realm of vascular plants and can be facilitated

by allopolyploidisation: the number of chromosomes is doubled because each parental genome is added in full instead of being recombined.

1.2.3. Naming species and variations

In the binomial system developed in 1753 by the Swedish naturalist Linné, each species receives a double name, composed by a generic name (beginning with a capital) and a specific epithet (fully in lowercases). In case of variations considered belonging to the same species, a third name could be added as an infraspecific epithet. In case of a reclassification of the species under another genus, the specific epithet is conserved but combined to the newly considered genus. In case of unavailable or forbidden names (rare exceptions), the epithet has to be changed.

The fragrant orchid initially described as a species by Ciro Pollini in 1811 under the name *Orchis fragrans*. But this orchid is often considered as a subspecies of the stink bug orchid, another species described by Carl von Linné (abbreviated as L.) in 1753 under the name *Orchis coriophora*. In this case, we have to conserve the epithet “*fragrans* Pollini” and subordinate it to the priority because oldest specific epithet “*coriophora* L.” as follows: “*coriophora* subsp. *fragrans* (Pollini) K.Richt.”, where K.Richt. is the abbreviation of Karl Richter, the first

botanist who proposed to consider this nomenclatural combination in 1890. If then some authors like Richard M. Bateman and collaborators want to include the (*Orchis coriophora* species under another genus as *Anacamptis*, they have to recombine the specific epithet as follows: *Anacamptis coriophora* (L.) R.M.Bateman & al.. Automatically, all the infraspecific taxa have to be transferred into the new genus and combinations have to be created as follows: *Anacamptis coriophora* subsp. *fragrans* (Pollini) R. M. Bateman & al..

1.3. Ethnobotanical uses “Salep”

The orchid species have a major economic importance. They include many unusual plants which are highly prized by gardeners for their wonderful and strange flowers beside of their high values for perfumery and medicine uses (see Dixon et al., 2003). In Levant countries, the underground tubers of some orchid taxa, especially those of *Orchis mascula*, are dried and ground to a powder and used for cooking. They particularly consume by local people as in the hot beverage Salep or in the Levant frozen treats “Dondurma”. Recently, it has been demonstrated that the tubers- collecting activities concern rather various genera and species than prospected (e.g. *Orchis*, *Anacamptis*; *Himantoglossum*; *Ophrys*). These ethnobotanical activities are considered as one of the most important threats to orchids in Zagrosian area

as a part of the Levant (Sezik, 2002; Kreutz, 2004, Loki et al., 2015). In KRAs, diverse orchid species are threatened not only by the destruction of their habitats (deforestation, overgrazing, recreation activities, habitat loss, and fragmentation...) but also by over-collecting of their tubers (Figure 3). Local people sell the powder, perhaps its price reaches to 800 \$/kilo, mostly destined to Turkish traders who in turn sell it to traditional Turkish markets. In KRAs, due to the occurrence of diverse rare/threatened species, it is urgent to apply a regional/national strategy program for biodiversity conservation and to apply the Washington Convention (CITES) which prohibits all transnational traders’ activities.

1.4. Orchids as bioindicator species

Species survival, as well as population fitness, is influenced by ecological, biological and evolutionary historical factors which in turn determine species biogeographic distribution



Figure 3: Underground tubers of some orchid species used for Salep in Levant countries.

patterns and ecological niche regeneration (Grubb, 1977; Hampe, 2004; Youssef et al., 2011, Muhamed et al., 2018). In this ecological evolutionary context, diverse biological organisms are often used as bioindicator species to assess the habitats suitability for regeneration. For example, diverse plant species have been used as a bioindicator for the climate changes, habitat loss, forest destruction and also human anthropogenic activities (Rose, 1999; Tsiftsis et al., 2008; Youssef et al., 2009; Baumel et al., 2013; Akhalkatsi et al., 2014). In the context of maintenance of endangered species, such information is crucial to set priorities for habitat management and conservation. Orchid species are usually considered as a bioindicator of the health and biodiversity of the natural forest due to their high sensitivity to shifts of the microclimate. Indeed, orchids have a symbiotic relationship with soil



Figure 4: Destruction or disturbance of the orchids habitats by infrastructures (e.g. road construction) and industries (e.g. oil exploitation).

mycorrhiza fungi and their specific pollinators are more vulnerable to deforestation and anthropogenic activities than other flora. Akhalkatsi et al. (2014) have recently reported that anthropogenic activities (cf. deforestation and grazing) displayed negative impacts on both the diversity of orchid species and their pollinator bees, which depend on the density and height of the surrounding vegetation. Furthermore, Youssef (2015) have suggested the high value of the orchids diversity as a bioindicator for the health and conservation status of the natural Oak and Pine forest in KRAs vis-a-vis the exploitation of the petrol and gases (Figure 4). Besides that, in KRAs, orchid species are threatened not only by the destruction of their habitats (deforestation, overgrazing, recreational activities, etc.) but also due to over-collecting for Salep products (see section 1.3.). In such circumstances, implementing



national strategies for biodiversity conservation will play an important role in finding a suitable balance between biodiversity management and decreasing the high influence of the anthropogenic activities.

1.5. Orchids of Kurdistan Region areas:

1.5.1. Actual status and floristic analyses

In the Flora of Iraq (Wood, 1985), Flora Iranica (Renz, 1978) and Flora of Turkey (Renz & Taubenheim, 1984) orchid family is represented as a whole by 22 species for Iraq territories. According to World checklist (Govaerts et al., 2017), 28 taxa are cited for Iraq. Unfortunately, in this document, no bibliographical data is available and cannot justify the added or deleted taxa. In the most complete European and Middle- East field guide to orchids (Baumann et al., 2006), only the regional endemism are explicitly cited for N-Iraq and/or KRAs, namely 13 taxa. But in this work widely distributed species are not clearly cited for each country. During our botanical field surveys on orchid species from 2013 to 2018, we found four new records in KRAs and for Flora of Iraq as a whole. The database of orchid species based on both literature documents and field observations

led us to present an elementary floristic analysis of this family (see Figure 5): At KRAs scale, we found 26 orchid species (with their infraspecific identification, see section 4) belonging to 10 genera. The largest genera are *Ophrys* and *Anacamptis* with 6 and 5 species respectively while *Cephalanthera*, *Limodorum*, and *Neotinea* are only presented by one species. Nearly half (46%) of orchid species are rare and/or very rare species (They often have been founded once or only a few times in KRAs) while 35% and 19% are considered as occasional and common. This rarity status of orchid species in KRAs will rapidly raise the urgent need to carry out a regional conservation program, especially in light of high threats pressures such as the ethnobotanical activities and habitat destructions (see section 2.6).

These orchid species, like almost plant species, differ in their both optimum and amplitude altitudinal distribution in KRAs. As can be seen from the figure 5, the almost orchid species are found from 500 to 1500 m asl. In contrast, a very few species have been occurred at low (> 500 m asl) and high (< 2000 m asl) altitudinal range. Another important finding has been that some species have a wide altitudinal range such as *Limodorum abortivum* which occurs from 900 to 2100 m

asl; whereas others have a very restricted one only known from one locality such as *Dactylorhiza romana* subsp. *georgica*. Beside climatic conditions, this difference of the altitudinal amplitude distribution of orchid species can give rise to their unequal diversity distribution by physiographical region. Interestingly, the mountainous district mostly under Mediterranean climatic conditions (MAM, MRO, MSU, see section 3.2.6), are the most orchid species-rich, including about 90% of the total orchid species occurrences. Surprisingly, any orchid species had been reported for the MJS district. This finding was unexpected and suggested that the MJS are not well been prospected in term of floristic investigation! As consequence, we can assign the interesting MJS district, like the most of the KRAs' physiographical region, as a floristic cold spot for floristic knowledge. However, areas under xerothermic Mesopotamian foothill and plain are the poorest region for the occurrence of orchid species like FUJ and FKI. Besides that, the flowering period of orchid species in KRAs is spreading from March to July, with a peak during April. This approximately wide flowering period can be explained by the various habitat types where orchids occur in KRAs such as meadows, marsh, steppic forest, etc.

1.5.2. Orchids field guild as a proxy towards a new floristic paradigm and future prospects horizon

Flora of Iraq, up to now, remains the unique basic foundation for describing the plant biodiversity of Iraqi territories and the ability to communicate about it. Unfortunately, it stills incomplete and outdated, where a lot of new taxa and/or new records remain to be discovered. The incessant scientific progress and informatics technique development to floristic researches triggers the beginning of transforming the classical floristic concept toward a new paradigm one (sensu Heywood, 2002). This new floristic paradigm is essentially characterised by the satisfaction of a wide range of taxonomists and naturalists users, high-quality outputs data, accessibility and consistent in its methods and procedures. This revolutionary floristic development has actively participated to identify the biological conservation priorities in the megadiverse countries (Heywood, 2004; Victor, 2015). From this new paradigm standpoint, the necessity of completing floristic inventories has become an evident key player to update permanently the existent floras. In this context, an implication of this illustrated orchids field guide is the possibility to add permanently new data as a continuum of the

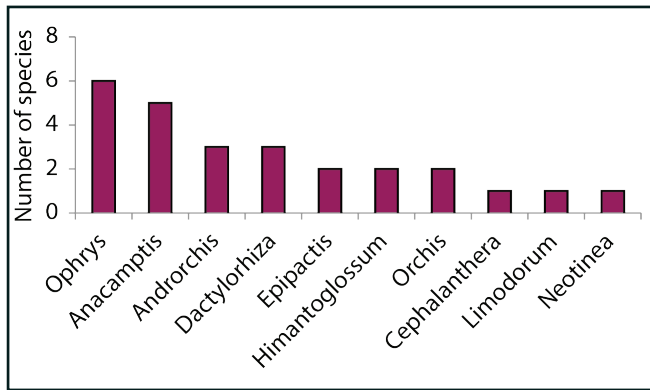


Figure 5.a:
Number of species per genus of orchids found in Kurdistan Region areas.

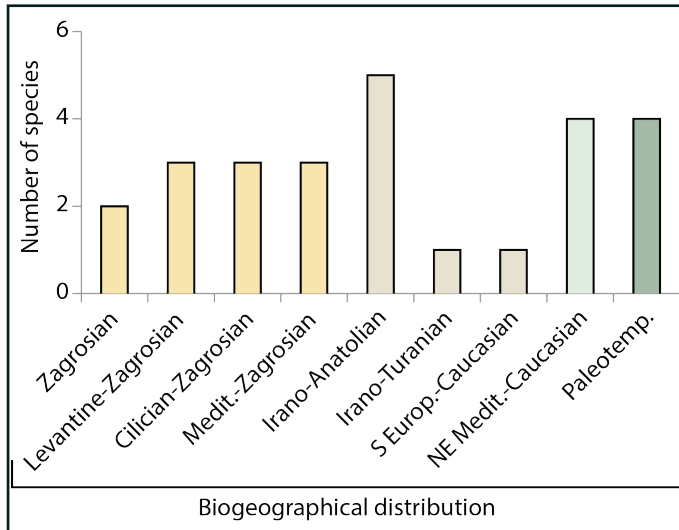


Figure 5.b:
Number of orchids species found in Kurdistan Region areas per biogeographical distribution.

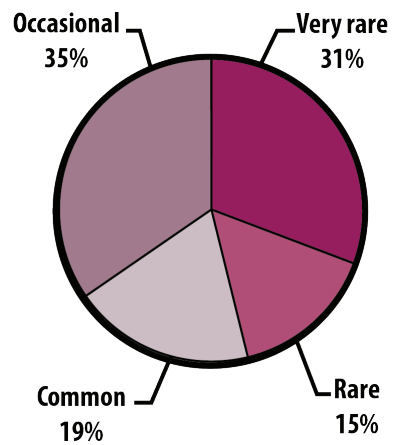


Figure 5.c:
Rarity of the orchids species found in Kurdistan Region areas

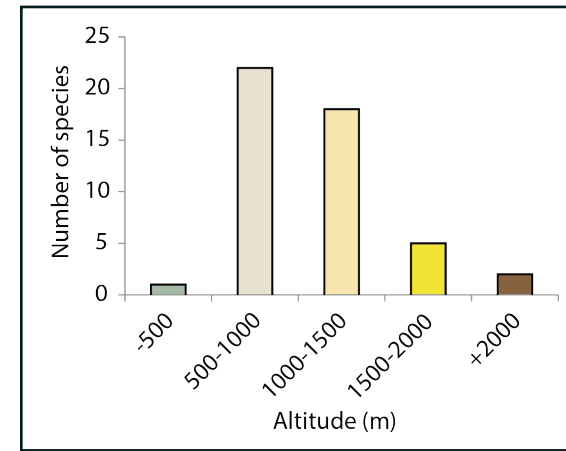


Figure 5.d:
Altitudinal repartition of orchids species found in Kurdistan Region areas.

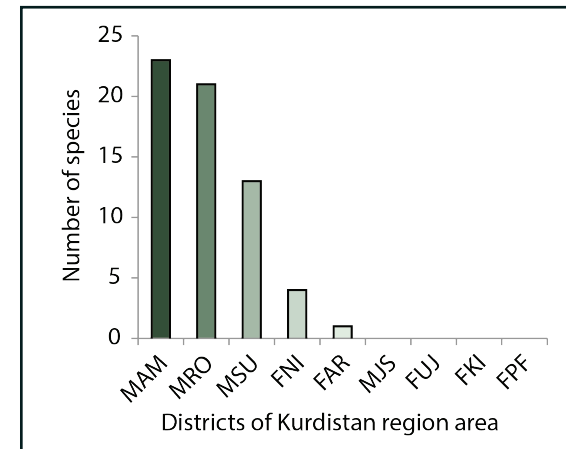


Figure 5.e:
Repartition of orchids species in districts of Kurdistan Region areas.

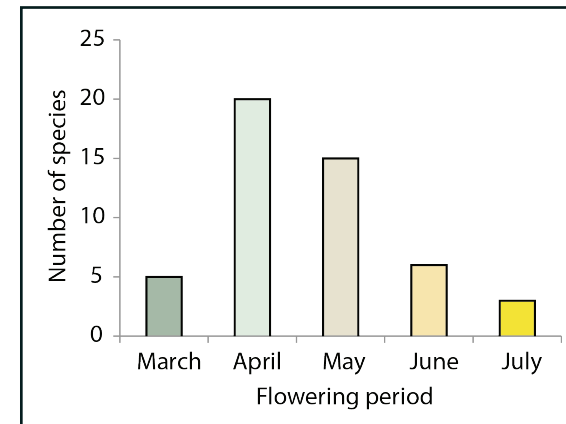


Figure 5.f:
Number of orchids species by flowering period.

Figure 5: Floristic analysis of the orchid family in Kurdistan Region areas.

updating the existence floristic ones via:

- Updating the list of orchid species that occur in KRAs by adding all new records recently discovered;
- Updating the nomenclature status (accepted names, synonyms...);
- Trying to satisfy a wide range of users "taxonomists, naturalists, botanists" via providing a quality outputs data (photograph illustrations, geographical coordinates, occurrences, threatens, population size...);
- Initiate an online accessible orchids database.

The present orchids field guide will arguably contribute to highlight the urgent need to regional biodiversity conservation program. Therefore, it would be interesting to assess the effects of the increasing anthropogenic activities (e.g. over-collecting edible plants, overgrazing, land use changes...) biodiversity management in KRAs.

2. Biodiversity of Kurdistan Region areas

KRAs belong to Irano-Anatolian hotspot which harbours at least 6,000 plant species approximately 2,500 of them are endemic and is designated as a territory of

high biological diversity values (Mittermeier et al., 2004). It is located on a key intersection between Mediterranean, Temperate, Arid and semi-arid biogeographical regions. As referred by Mittermeier et al. (2004) this region has served as both contact and tension zone favouring, therefore the hybridization, colonization and speciation process of species from varying origins. In addition, the number and diversity of local and regional endemism suggest a strong role of climatic and habitat refugia during Quaternary oscillations and Neolithic transition. Indeed, the wide range of bioclimatic zones (from hot semi-arid to cold alpine e.g. mean annual precipitation varies from about 200 to up 1500 mm; mean annual temperature is ranging between 0 to +25°C) and the topographic feature diversity (from Mesopotamia's plains to high mountains about 3600 m asl including north or south slopes, cliffs and gorges...) give rise to high biological diversity richness value (Figure 6).

Thus, the area includes an important number of rare, endemic, threatened and remarkable plant and wild animal species originated from diverse biogeographic region e.g. Irano-Anatolian, Mediterranean basin, Arabic peninsula. Furthermore, KRAs is considered as one of the richest irreplaceable sources of natural resources of economic importance as

crops, medicinal, aromatic and edible plants (Al-Rawi, 1964; Townsend & Guest, 1966-1985; Chakravarty, 1976; Koyuncu, 2002). Despite its formidable floristic richness, it remains designated as a coldspot of knowledge! The most likely causes of this coldspot status are poor recent floristic inventories on the field and the outdated and incomplete Flora of Iraq. A possible explanation for the non-achievement of these floristic investigations might be due to the chronic instability of the geopolitical situation including armed conflicts. Consequently, small territories, mostly in mountainous areas, are still mined and/or inaccessible. Indeed, the strong lack in taxonomists and/or naturalists or they lack autonomy

on the field cannot allow filling the gaps of floristic data on an unexplored area such as many local mountainous areas (e.g. Barzan area, Barwarya-Bala, and Nirwayi areas near Turkish border...). However, some punctual advances have been made in the last decade insight of new contribution to the Flora of Iraq (see National Report on Biodiversity in Iraq, 2010; Ahmad, 2013; Véla, et al., 2013; Shahbaz, et al., 2015; Youssef, et al., 2015; Ahmad, 2016; Youssef, et al., 2017 a & b; Youssef, et al., 2018). These interesting previous works should be perceived as spotlight intention on some aspect of the remarkable biological diversity and human connection with the particular natural ecosystem in KRAs.



Figure 6: Diverse plant species highlighting the high biological diversity richness of Kurdistan Region areas.

2.1. Landscape diversity and structure

Through this illustrated field guide, we give an account of and the reasons for the unexpected and splendid landscape diversity of KRAs. It essentially comprises a mixture of foothills at different levels, steppic grasslands, cultivated alluvial plains and valleys, foothills, deep valleys and mountain chains that generally run in a west to east direction (Figure 7). Therefore, the key aspect of these landscapes features falls under the following main types:

2.1.1. Steppic grasslands

It includes broadly the plains extend from the north-east of Zakho, throughout Mesopotamian plains, to the foot of the Jabal Hamrîn, which extend from the Diyala to southern Kirkuk Province. This steppic area comprises mainly the triangles “Nineveh-Duhok-Erbil” and “Kirkuk-Erbil-Sulaymaniyah” plains. This relatively moist steppe zone is mostly flat with altitudinal ranging from 200 to 500 m asl and characterized by its diversity richness in therophytes and geophytes.

2.1.2. Cultivated alluvial plains and valleys

It is mostly recognized by its extensive and wide crops field cultivation, for as far as they can see. These cultivated

plains and valleys can be illustrated as a green belt separating broadly the pseudo-steppe grassland from foothills and mountain zones. These plains and valleys are well known for their exceptional soil fertility where the agricultural activities had been carried out since the Neolithic period (see section 2.4.2.).

2.1.3. Foothills zone

The transition from the cultivated plains and steppic grassland to the mountains is particularly marked by a wide foothill zone. They are often called “the guardian foothills” that protect the major towns of the Kurdistan Region. By way of illustration, Zakho and Duhok towns are globally encompassed by Bekhair foothills. The general elevation of the foothills zones lies in the range 300 to 1000 m asl.

2.1.4. Mountains zone

As part of the Zagros area, the main part of KRAs is a mountainous zone where alternate high summits and deep valleys even gorges. It extends broadly from the north-western parts near Zakho to south-eastern of Sulaymaniyah town, and pass through Rewanduz and Barzan mountains in Erbil district. The elevations are approximately ranging from 1500/2000 m asl (Mateen, Gara, Safin, Karox, Hindrîn, Haji Ibrahim, Sakri-Sakran mountains, Asos,

Qandil, Pîra Magrum, Qara Dag, Hewraman Mountains...) to 3607 m asl at Halgurd peak including Hassari Rost mountains summits. This mountainous region is extremely crumpled and traversed by many deep ravines where streams have eroded sharply into the limestone rock.

2.2. Climatic, bioclimatic and biogeographic patterns

2.2.1. The Middle East climate

As defined by Daget (1997 a & b) and Roumieux et al. (2010), The Mediterranean Climate Envelop includes the whole Middle-East, except the Pontic-Transcaucasian area and the South-Arabian one. The Middle-East area is naturally extending eastwards the Mediterranean basin itself, reaching the Turanian area (Turkestan). This envelope is defined mainly by the seasonality of rain: summer is the least rainy season, in which it differs from the continental temperate climates and the tropical ones. A second criterion is the global aridity of the summer, which also excludes the oceanic temperate climates in Europe. The Saharo-Sindian limits are generally correlated with the drastic dryness and dimming or even inversion of seasonality. The Köppen-Geiger climate classification (Kottek et al., 2006) is summarising in

details this variation.

The rainfall seasonality in the Middle East is dominated by winter followed by spring then autumn, while summer is usually completely dry. It differs from the Mediterranean coast where autumn is the second rainy season on the southern and eastern side and the first one on the north-western coast.

2.2.2. The bioclimatic classifications

The Mediterranean bioclimate is generally subdivided into categories, classified by annual rainfall, temperature and/or thermal amplitude. Around the Mediterranean coast, the thermal amplitude is globally low (oceanic influence of the sea) and the subdivisions are mainly driven by rainfall and winter temperature. In retreat from the coast, the thermal amplitude grows rapidly (continental effect of the inland masses). Outside the Mediterranean basin, like the Middle East, the thermic continentality is very strong but the rainfall seasonality is conserved. This kind of bioclimate is generally called “accentuated Mediterranean”. Emberger (1955) then Sauvage (1963) have developed a useful index for classifying the variation of Mediterranean bioclimates.

In the Mesopotamian-Zagrosian context, the mediterraneity of climate is strongly constraint by two

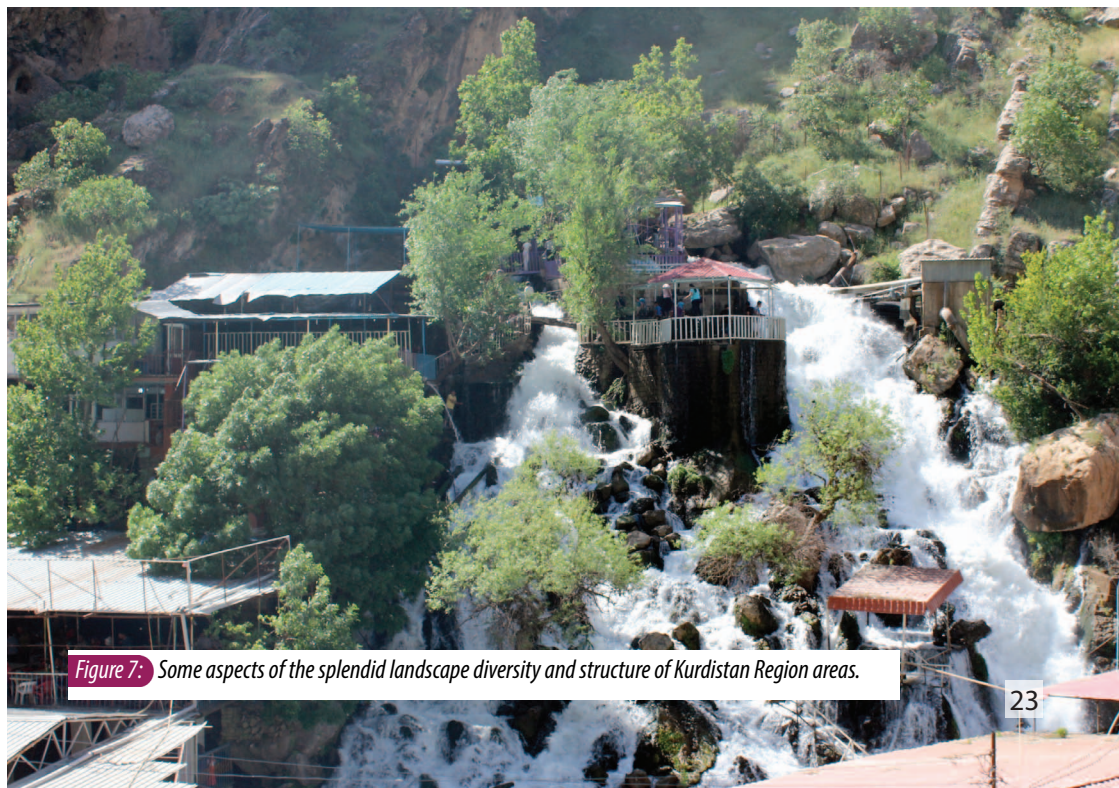
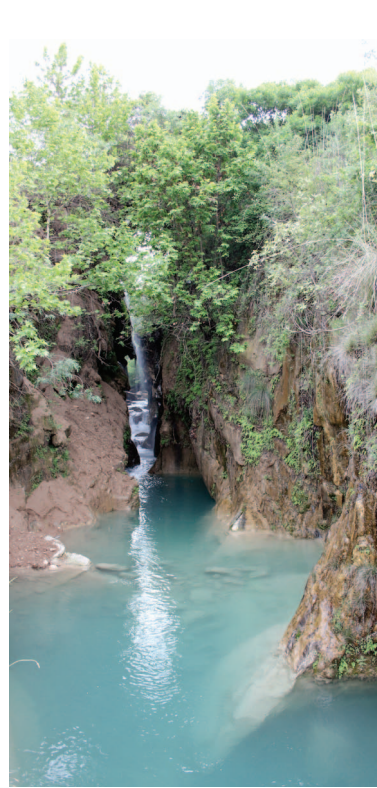


Figure 7: Some aspects of the splendid landscape diversity and structure of Kurdistan Region areas.

extremes: southwards in the plain, the rarity and weakness of rainfall bring the bioclimate into the Saharian categories; northwards with altitude, the intensity and duration of the cold season bring the bioclimate into the Mountainous categories. Within these two limits, temperatures and precipitations vary concomitantly in relation to altitude. Thus, bioclimate follows a continuum but it is possible to summarise dividing it into three to five main categories (see figure 8):

1) Below 500 m alt., the annual rainfall is generally under 400 mm, the summer is very hot (mean daily max over 40°C) and the frost is rare and nocturnal: this bioclimate can be named Xero-thermo-Mediterranean and correspond to the BSh sensu Köppen (arid – steppe – hot arid);
 2) Between 500 and 2000 m alt., the rainfall can reach or exceed 1000 mm/year, the summer is lesser and lesser hot and the winter begins to be more and more snow covered: these bioclimates can be named as Mediterranean and correspond to the Csa sensu Köppen (warm temperate – summer dry – hot summer);

- 500-1000 m: annual rainfall between 400 and 700 mm; winter mean daily min around 0°C; snow infrequent; mean daily max under 40°C; the bioclimate is semi-arid with fresh winter sensu Emberger & Sauvage.

- 1000-1500 m: annual rainfall around 1000 mm; winter mean daily min above 0°C; snow-cover frequent; mean daily max under 35°C; the bioclimate is sub-humid with cold winter sensu Emberger & Sauvage.

- 1500-2000 m: annual rainfall around 1000 mm; winter mean daily between -5 and -10°C; several months snow-covered; mean daily max under 30°C; the bioclimate is humid with very cold winter sensu Emberger & Sauvage.

3) Above 2000 m alt., the rainfall decrease below 700 mm/year and the summer max around 25°C: the bioclimate can be named oro-cryo-Mediterranean and correspond to the Dsb sensu Köppen (snow – summer dry – warm summer).

2.2.3. The biogeography of Zagros mountains and Mesopotamian plains

According to the bioclimatic forces and to the continental macroecology, the biogeography patterns of orchids and other vascular plants can be summarised as follow:

a) The xerothermic Mesopotamian plains are dominated by strong steppic Irano-Turanian and/or Saharo-Sindian influences. The dominant vegetation is herbaceous, mainly annual and completely dry in summer. Some bulbous or

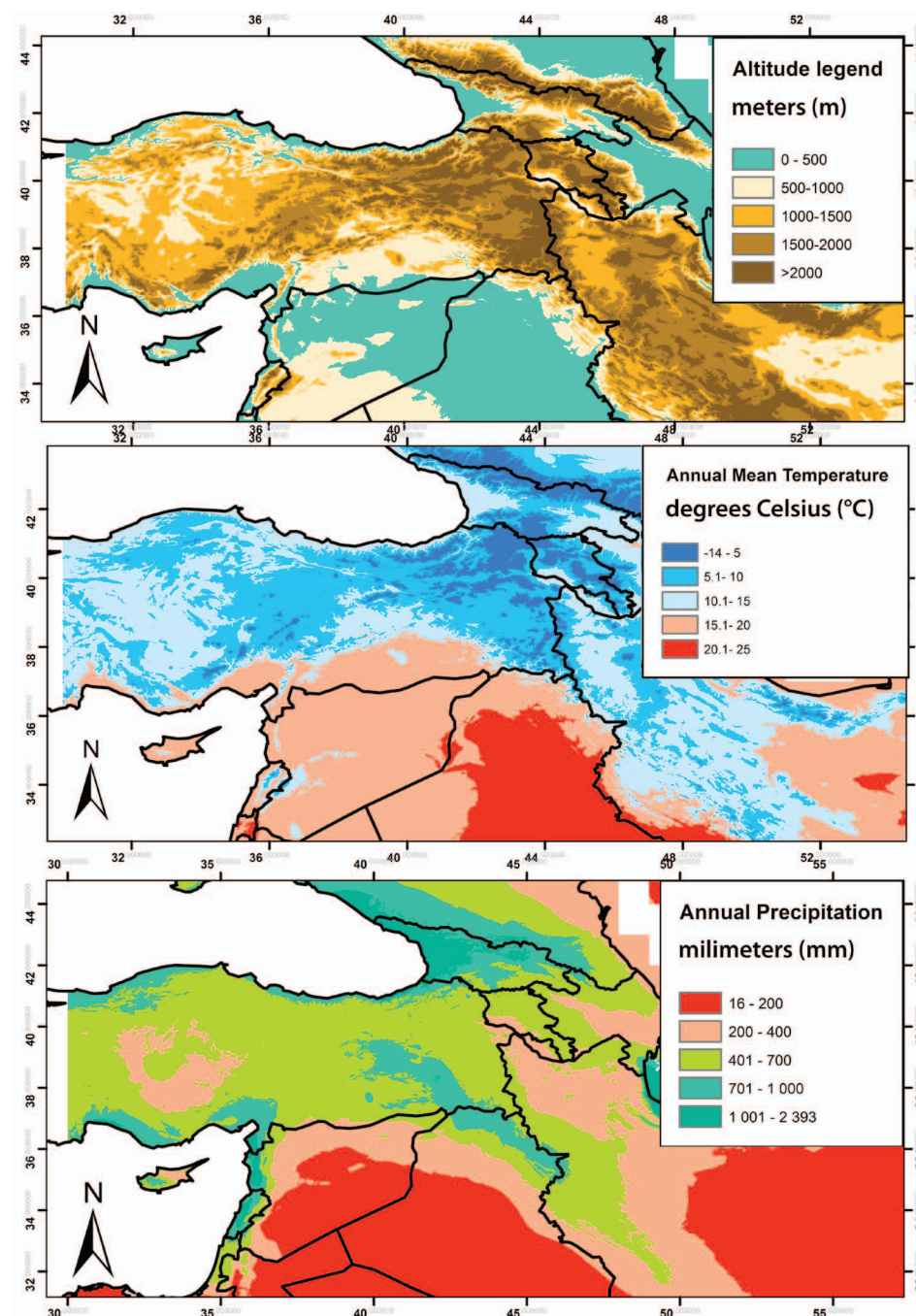


Figure 8: Mesopotamian-Zagrosian bioclimatic and altitudinal maps. (Source : WorldClim-Global Climate Data)

rhizomatous geophytes can flower in late autumn, during winter or in early spring but generally without orchids.

b) The accentuated Mediterranean zone which affects the Zagros slopes, foothills and valleys receive various Mediterranean and/or Paleotemperate influences. The vegetation is characterised by steppe-forests with an open tree-cover with a dominant summer-dry herbaceous undergrowth. It hosts a lot of spring or autumn bulbous or rhizomatous plants, mainly eastern-Mediterranean elements at lowest altitudes and Irano-Anatolian at higher altitude. In the densest forests with humus and litter, the undergrowth hosts some Eurasiatic element like mycoheterotrophic orchids.

c) The oro-cryogenic Zagros summits are dominated by strong Irano- Anatolian and/or Euro-Siberian influences. The dominant vegetation is perennial herbaceous mixed with thorny-cushion chamaephytes. A lot of herbaceous are hemicryptophytic or spring-leaved geophytes, including orchids, are growing on slopes, pastures, and spring swamps.

2.3. Geological aspects of Kurdistan Regions areas

The actual geological structural patterns of KRAs are strongly influenced by the two Phanerozoic

geotectonic units: Arabian peninsula as a part of the African platform and the Asian branches of the Alpine-Himalayan geosyncline (Hijab et al., 1996; Buday & Jassim, 1987). Jassim & Goff (2006) had provided a detailed pattern of the geology and lithology of Iraq territories including KRAs.

Therefore, we give rise here a greatly simplified description of the geology as well as the soil structure and composition as a key factor to the distribution and structure of the plant communities. The major aspect of the geology of KRAs generally reflects the morphological topographic aspect which can be divided into four main zones, from SW to NE:

- (i) The undeformed Mesopotamian basin which consists of plains in the northern part of the Arabian plate, covered by young sediments accumulation (Quaternary and Neogene period of the Tertiary/Mesozoic) where the Quaternary sediments were mostly deposited by Tigris and affluent rivers forming alluvial and floodplains;
- (ii) The Zagros foothills belt which consists of anticlines of Zagros foreland sediments (sand, gravels, and gyps) dating from the Neogene (Upper Miocene) to Quaternary/Pleistocene, lying parallel along the Mesopotamian plains, that are

associated with the thrust of the Arabian plate against the Bitlis-Zagros suture zone;

- (iii) The Zagros folded belt which consists of a mountainous region as southern parts and piedmonts of Bitlis-Zagros suture units, is an unstable shelf unit, which characterised by harmonic folds with Secondary/Mesozoic (Trias, Jurassic, and Cretaceous) and Tertiary (Paleogene plus Neogene) limestone and/or dolostone.
- (iv) The High Zagros suture unit is the last geomorphological boundary and the more complex, which consist of a leading thrust materialising the collision of the Arabian plate on the Iranian micro-plate, elevating the original crust of the ancient Neotethys ocean. Actually, along Turkish-Iranian borders, there are thrust sheets of sedimentary, metamorphic and igneous rocks which were emerged and/or transformed during the uprising of the Neotethyan oceanic domain. As a particular case, the Penjawi igneous complex (covering about 35 km²) represents an ophiolitic sequence of serpentine rocks. This variety of crystalline rocks can be from acidic to ultrabasic chemistry.

2.4. Vegetation community structure

The vegetation structure of Iraqi territories was widely described, essentially on basis of visual observations, by Guest & Al-Rawi (1966) and then recently resumed by Ghazanfar & McDaniel (2015). So far, however, their descriptive vegetation analyses do not take into account the natural regeneration process (*sensu* Grubb, 1977) nor do they examine practical cases in large scale. Throughout this book, we attempt to highlight the main elements of the vegetation structure in KRAs (Figure 9). Nevertheless, the review of the plant community structures in details may be the topic for further ecological studies. The vegetation illustration is essentially based on our botanical field-work experience in NW Zagros area. We simultaneously consult the major local and international important papers and reports on this topic. Therefore, the main aspect of the vegetation community structure can be described as follow.

2.4.1. Steppe grassland communities

It uniformly consists of open plant communities limited by contrasted climatic conditions (arid and very hot in summer, rainy and cold in winter) and intense grazing activities concentrated



Figure 9: Main aspects of the vegetation structure in Kurdistan Region areas.

during early spring. These sparse short grassland communities are essentially dominated by geophytes species (e.g. *Muscari sp.*, *Bellevalia sp.*, *Prospero sp.*, *Ornithogalum sp.*, *Allium sp.*, *Gagea sp.*, *Anemone coronaria...*) and annual or annual-like herbs (e.g. *Carex sp.*, *Poa bulbosa*, *Aegilops sp.*, *Avena sp.*, *Hordeum sp.*, *Stipa sp.*) that disappear completely during the summer ((Figure 10). While, perennials hemicryptophytes (*Salvia sp.*) including thistle-like spiny species (*Silybum marianum*, *Centaurea sp.*) and low size chamaephytes (e.g. *Teucrium sp.*, *Artemisia herba-alba*, *Achillea sp.*, *Astragalus sp.*, *Thymus sp.*) are found in particular micro-habitats localities (cf. Youssef, et al., 2018).

2.4.2. Segetal plant communities

Segetal plants are used here in its broad sense to refer to most annual weeds ("non-crop" plant species) found in cultivated areas, particularly which coexist with cereal winter crops. The local agricultural communities treated these species as undesirable weeds due to their "negative" effect on the precious cereal yield. In the cultivated area of KRAs, the most frequent segetal plants include: *Adonis sp.*, *Aegilops sp.*, *Allium noeanum*, *Centaurea sp.*, *Galium sp.*, *Gladiolus sp.*, *Gundelia tournefortii*, *Hordeum sp.*, *Lathyrus sp.*, *Lolium sp.*, *Loncomelos sp.*, *Papaver sp.*, *Poa sp.* (Figure 11). Despite these

segetal species have redoubtable plant life history strategies (e.g. short lifespan, produce a huge amount of long-time viable seeds, deep bulb resisting to fragmentation), however, their diversity species has been dramatically reduced in intensive modern agricultural countries like Europe. Their rarefaction is associated with both the intensive cultivation methods and the uses of various herbicides treatments. Consequently, it has been recently demonstrated that these segetal plant species are increasingly among the most threatened plants (Storkey et al., 2012; Solé-Senan et al., 2014). To deal with this real risk, divers conservation strategies are therefore rising worldwide (Byfield & Wilson, 2005; Walker, et al., 2007). Knowing that a major part of these segetal species in Europe and the Mediterranean are probably originated from the Middle East (see section 2.7.).

2.4.3. Open forest formation

A major part of vegetation community structure in KRAs consists largely of open forest with a dense ground cover of herbaceous species. This open forest formation mostly occurs in the foothill and mountainous areas. In favourable habitats, the Oak trees form local close forests (*Quercus libani*), especially in relatively inaccessible places (deep valleys) where the soil

is deep and moist (northern faces), and which still host wild animals like bears and wolves. However, in less favourable habitats (near villages, grazing areas, etc.) young Oak trees may be scattered sparsely as an open forest with some vestiges of old oak trees. This mono-specific structure could indicate the original climax forest formation that has been lost as a result of anthropogenic disturbance (Townsend and Guest, 1966). The vegetation community transition between these two structures might be seen at several locations in this forested zone. The most frequent trees and shrub species found are: Oak (*Quercus aegilops* and *Q. infectoria*), Pistachio (*Pistacia sp.*), Almond (*Prunus amygdalous*), Pine (*Pinus brutia*), prickly Juniper (*Juniperus oxycedrus*), Azarole Hawthorn (*Crataegus azarolus*), oriental Blackberry (*Rubus sanctus*), Briar Rose (*Rosa sp.*), Montpellier Ash (*Acer monspessulanum*) etc.. The Zagros region is well known under the name "the Pistachio-Almond territory" due to the wide ethnobotanical uses of both wild and cultivated Almond and Pistachio trees.

These regional formations are original by the contrasting colours and living forms in each season. During winter and early spring, the undergrowth his completely green and covered by herbs and bulb flowers, while the canopy is completely defoliated

which make it very inconspicuous. During summer and early autumn, the undergrowth is completely dried senescent which makes it yellowish-brownish dominated, while the canopy is brightly green (Figure 12). From an ecological standpoint, the open forests can be classified into the following formations:

a) Mountain Riverain Forest:

The arborescent species commonly found alongside mountain streams in the forest zone are: *Salix sp.*, *Platanus orientalis*, *Fraxinus syriaca*, *Populus euphratica* and *Juglans regia* (cultivated old Walnut trees). Among the shrubs and herbaceous species, *Rubus sanctus*, *Rosa canina s.l.*, *Nerium oleander*, *Mentha longifolia*, *Juncus sp.*, *Carex sp.*, *Typha domingensis*, *Phragmites australis*, *Arundo donax*, and *Cyperus longus* are also very common. Recently, the black Poplar (*Populus nigra s.l.*) is being widely cultivated near streams throughout the northern mountains. These non-indigenous poplars produce high wood yields sold in the markets through the country (Shahbaz, 2010).

b) Oak forests:

b1) Low sub-zone of the Oak Forest: In the lowest and driest sub-zone of the forest, *Q. aegilops* is the dominant tree. It is frequently associated with other trees such as *Pistacia sp.*, *Prunus sp.*, *Crataegus sp.*

b2) Medium sub-zone of the Oak Forest: *Quercus infectoria* and *Q.*

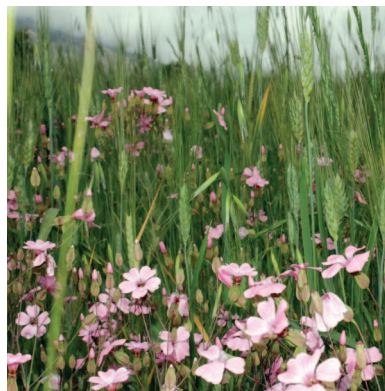


Figure 10: Steppic grassland communities' structure between Duhok city and Mosul dam, upper Mesopotamian region.

Figure 11: Some segetal plant species in cultivated cereal fields, upper Mesopotamian region.

aegilops are co-dominant in this association, while the first species is often locally dominant in this medium zone. It is worth noting that *Q. infectoria* is ecologically intermediate between *Q. libani* and *Q. aegilops* and is usually found between the altitudes of 700-1400 m asl.

b3) High sub-zone of the Oak Forest: In the higher parts of the mountain forest zone, *Quercus libani* is the dominant tree species from 1200-1800 m asl. Lebanon Oak is frequently associated with *Acer monspessulanum* and *Lonicera arborea* with a high herbaceous vegetation cover dominated by *Paeonia mascula*. On the other hand, *Quercus macranthera* constitutes a small population of about 4-5 hectares in Sari Hassan Bag (MRO). It founds at 1950- 2200 m asl altitude, just below the thorn cushion zone.

c) Pine Forest: *Pinus brutia* forest occurs in a

restricted locality around Zawita and Atruş towns of the Duhok Governorate (MAM). This forest covers about 100 km² at altitudes of 700-1200 m asl (Muhamed, et al., 2018). This Mediterranean Pine constitutes a small population which found at the extreme eastern limit of the species. In Zawita area, it remains the dominant species associated with some Oak and prickly Juniper trees.

2.4.4. Thorn-cushion zone

This sub-alpine zone is an open shrub formation characterized by the dominance of dwarf thorn-cushion vegetation forms such as *Astragalus sp.*, *Onobrychis sp.* and *Acantholimon sp.*. This formation occupies a clearly-marked zone above the timberline in the mountains from about 1750 to 3000 m. These cushion species are frequently associated with erect shrubs characteristic of the higher parts of the forest zone such as *Daphne acuminata*, *Lonicera arborea*

and various species of *Cousinia sp.*, and the famous edible herbaceous species *Rheum ribes* ("Rivaz").

2.4.5. Alpine zone

This zone situated at high elevation and above the tree line often on the summit of the northern-eastern mountain chains. It founded on an altitudinal range from 2750 to 3610 m asl. It is characterized by a typical vegetation "alpine plant community" which mainly include perennial grasses (e.g. *Carex sp.*) dwarf and rupicolous plants (e.g. species from *Asteraceae*, *Brassicaceae*, *Fabaceae*, *Lamiaceae*, and *Plumbaginaceae...*), mosses and lichens. These Alpine plants are well adapted to the harsh environmental conditions (short growing season, low temperatures and high ultraviolet radiation).

2.5. Protected area status in KRAs

In broad ecological terms, the protected area is generally understood to often mean natural land that is restricted from most development and is set aside for environmental protection. The International Union for Conservation of Nature (IUCN, <https://www.iucn.org>), defines it as "defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem

services and cultural values"; while for the Convention on Biological Diversity (CBD, <https://www.cbd.int>) it is "A geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives". The World Database on Protected Areas uses both definitions to determine whether a site should be labeled as a protected area. While the worldwide number of protected areas increases, the Kurdistan Regional Government (KRG) currently still not widely applied an efficient protected area concept. Indeed, there isn't a real active scientific regional/national program of work. Despite the ratification of the CBD in 2009, there is almost none elaborating regional/national document on biodiversity conservation based on scientific principles. However, several wild animal protections exist such as wild Goat in addition to some areas locally protected and/or of natural interest.

2.5.1. Halgurd-Sakran national park

It is officially the unique national park in all over the KRAs. It is a part of the Zagros mountainous range, located near the key biogeographic triple point of Iraq, Iran and Turkey borders. It covers about 1100 km² making it one of the biggest mountain protected area in Irano-Anatolian region. It represents one of the most



Figure 12: Contrasted colours of the vegetation during winter and early spring versus summer and early autumn in Barzan region.

beautiful and biological richness of Zagros areas. It is located about 120 km north-eastward of the capital city of Erbil. It is characterized by a wide altitudinal range (~900 to 3610 m asl) including the highest mountain in Iraq. The peak of the Halgurd mountain is quasi-permanently covered by snow throughout the year. There are many springs and lakes around the mountain that give an attractive view to the area. It is visited by tourists from all over Iraq and other foreign countries to spend an enjoyable time in the adventure (Figure 13). However, there are no active national wildlife conservation strategies in this important area!

2.5.2. Barzan protected area

In Barzan region, the local authority, as follows the spirit of Sheikh Ahmed Barzani (1896–1969), intends continuously to protect the wildlife and natural values by establishing a system of the traditional protected area. This mountainous area is mainly famous for their spectacular valleys and gorges runs through the impressive mountain range. The Barzan tribe is well-known for his love and close relationship with nature, at least attested from the Neanderthal period (see section 2.7.). Moreover, thanks to the long period of nature conservation, Barzan district is the unique area across the Zagros region where we can approach closely the wild Goat

without frightening it (Figure 14). Furthermore, Barzan region is an Eden garden for naturalists which are at least botanically still unexplored by scientific researchers.

2.5.3. Important Plant Areas (IPAs)

In Iraqi territories, a basic survey fieldwork has been carried out to identify Key Biodiversity Areas (National Report on Biodiversity in Iraq, 2010). The report designates diverse Important Plant Areas (IPAs) in the KRAs and assesses their conservation status. So far, however, the international IPA database has not integrated these preliminary results <http://www.plantlifeipa.org/reports.asp> [accessed August 11, 2017]. Furthermore, the report has tended to focus on animals (mainly birds) and few plant species (mainly common) and only carried out in a small number of local areas. Indeed, it does not take account of all real anthropogenic threats nor does it examine the implication of the local people as a part of the ecosystems. Consequently, this report may be regarded as a first step towards nature protection, but there is still insufficient field data for designate IPAs. In this context, there is a real need for creating more and more protected area, national park, nature reserve area networks that should be expanded and better managed. Furthermore, biodiversity conservation strategies and action

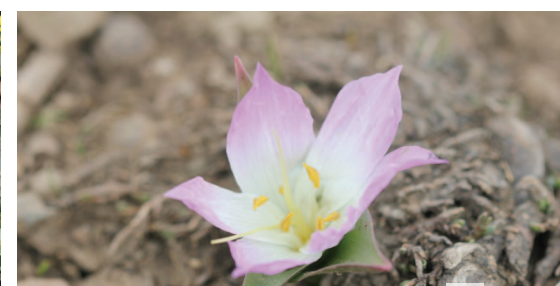


Figure 13: Halgurd-Sakran national park as the high Eden garden.



Figure 14: Some aspects of the vegetation and landscape structure of the Barzan protected area.

plans might offer an option for national/international collaboration and cooperation for a better scientific advancement and achieve a lasting peace in this field.

2.6. Human activity and Ecosystem services

The interaction between humans and their environment can certainly improve the well-being of humanity via the exploitation of natural resources (Blondel et al., 2010;

Elmqvist et al., 2013). The KRAs, as a part of Zagros and Mesopotamian areas, were so widely cultivated and grazed for millennia. The natural vegetation of the territory has been greatly altered as the result of intense anthropogenic activities: fertile plains and moist valleys changed in favour of agriculture; many low and middle forest zone destroyed in favour of agroforestry; natural riverain vegetation largely destroyed to cultivate mostly common Walnut (*Juglans regia*). In

these circumstances, conservation strategies will play an important role in finding a suitable balance through conserving the high richness biological diversity and decreasing the high impacts of anthropogenic exploitation. Therefore, this field guide tries to illustrate diverse anthropogenic activities features in KRAs.

2.6.1. Agroforestry activity and irrigation systems

The greatest threat to the Kurdistan's biodiversity heritage is the permanent ancient- new pressure of human activities that have significantly influenced the structure and composition of its vegetation (Harris, 1998; Smith, 1998; Prance, 2005). A thousand years ago, ancestral hunter-gatherers exploited the natural resources. They influenced the forms of actual agriculture, cultivable land, urban civilization, and ethno-culture. On the other hand, nowadays the greatest threat to biodiversity is the development of irrigation systems associated with infrastructure development e.g. dams and reservoirs, road and highways. By way of illustration, the excessive use of water for irrigating the field crops has led to the significant decrease in the groundwater in steppe areas and fertile plains. For instance, the upper Mesopotamian area is

cultivated mostly for winter cereals, such as wheat and barley, and somewhat less for forage crops (e.g. *Fabaceae* legume herbs such as *Medicago sp.* and *Trifolium sp.*), sunflowers and maize. While the foothill and mountainous areas are cultivated with orchards dominated by vines and various fruit trees. This latter type of agriculture activity is named agroforestry ('taking the farm into the forest' or 'farming the forest'). These Agroforestry systems are multipurpose: productive (i.e. crop production) and protective (i.e. retaining of soil and water and conserving the biodiversity). It is considered as a dynamic ecologically and natural resources based management system that integrates fruit-trees and crops in forest land while sustaining production for increased social, economic and environmental benefits (Leaky, 1996, 1997). On other hand, in foothills zones, there are many examples of permanent natural riverain vegetation (cf. *Platanus orientalis*, *Salix sp.*, *Populus euphratica*, *Phragmites australis*, *Arundo donax*, *Typha domingensis*) that have been largely destroyed to cultivate mostly common Walnut (for its high price value of nuts) and black Poplars for their high productivity of wood (Figure 15).

2.6.2. Ethnobotanical and Pastoralism activities

The Kurdistan Region areas harbour important and irreplaceable natural resources notably for medicinal, aromatic, agroindustrial and edible plants (Al-Rawi, 1964; Townsend & Guest, 1966-1985; Chakravarty, 1976; Koyuncu, 2002; Youssef et al., 2017). Collecting and using the wild edible plants is - according to Kurdish folks - an important link to our past. In this context, the ethnobotanical study focused on how plants are used, managed, perceived across human societies. However, progressive over-harvesting and increasing demands on edible wild plants by local people threatens some native plant species. Furthermore, the impacts of the increased human population have induced an obvious decline in many species of wild edible plants. For example, many bulbs and wild edible plants from genera such

as *Gundelia*, *Allium*, *Malva*, *Arum*, *Anchusa*, *Echium*, *Adiantum*, *Rhus*, etc. have declined dramatically (Figure 16). From an ethnobotanical conservation standpoint, the ancestral relationship of Kurdish-nature presents as a bioindicator for understanding how local society function vis-a-vis the biological conservation of its natural heritage. In this circumstance, the priority of the KRG politics should be the development of conservation action plan of the living ethnobotanical practices e.g. research, education and communication programs permitting to maintain ecosystem services.

Pastoralism, as extensive livestock production in the rangelands, plays a major role in enhancing the food security and livelihoods of rural people. For the Zagros villages, one of the most important economic activities is livestock breeding. Generally, cultivation of field crops



Figure 15: Divers aspect of agroforestry activities in Kurdistan Region areas.

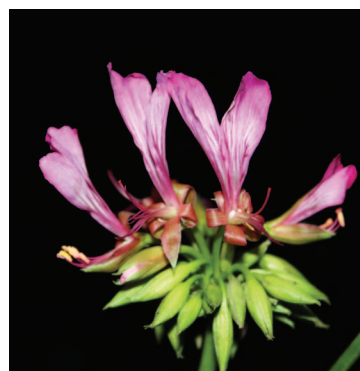


Figure 16: Some edible plants which are frequently collected and used according to Kurdish ethnobotanical activities.

(i.e. wheat, barley, maize, legumes) is only destined for the household and animal consumption. In the upper Mesopotamian area, the pastoralism is based on transhumance and is essentially semi-nomadic: only part of the family group will move with the flocks depending on the season (the sheep and goats are based in the villages of the plain in winter and ascend the mountain pastures in summer). In contrary, the Kocher tribute of the foothill and mountainous Zagrosian areas is completely nomadic and accompanying permanently their herds.

Pasture and grazing may drive either positive or negative ecological effects on natural ecosystems: The primary role of grazing livestock (which simulates the essential role of wild grazing animals) is the maintenance of the biodiversity and enhancement of the vegetation community structure. For instance, in the Euro-Mediterranean region, appropriate levels of grazing are applied to restore and maintain the high biodiversity in mountainous regions that have been disturbed by either overgrazing or a lack of grazing (Véla, 2002; Saatkamp et al., 2010). In contrary, the negative effects of overgrazing include increased soil erosion, changes in water quality and a loss of biodiversity (Rook et al., 2003). In KRAs, pastoral activities are mainly characterised by overgrazing

risk due to the ongoing expansion of grazing activities. It is driven by increasingly income of livestock essentially from the semi-arid plains of surrounded region e.g. Nineveh plain. These over-pastoral activities could threaten the remarkable biological diversity of Kurdistan's mountainous areas (Figure 17).

2.7. Kurds as the first flower people

Kurds today are the product of millennia of human cultural-society evolution, which inhabit the Zagros mountains and upper Mesopotamian plains named "Fertile Crescent" (e.g. Halfaian ~8000 BC, Hurrians~4300 BC, Mittanis~2000 BC, Medes~1200 BC) (see Izady, 2015). Over the past thousands of years, our hunter-gatherers ancestors have well exploited natural resources which in turn influenced the forms of actual agriculture, cultivable land, urban civilization and culture (Prance, 2005). The archaeobotanical sites that have yielded the earliest evidence of agriculture are concentrated in the Fertile Crescent around the upper Mesopotamian lowland to the southern foothills of the Zagros mountains including a major part of KRAs (Harris, 1998; Smith, 1998; Prance, 2005). For example, in Jarmo archeological site (Chamchamal / ÇemÇemal, between Kirkuk and Sulaymaniyah towns), has been discovered one of the first agricultural



Figure 17: Some aspect of pastoralism and grazing activities in Kurdistan Region areas.

settlements about 8th millennium BC in proto-farming situated in foothills of Zagros mountains (Braidwood, 1960). Furthermore, in Tell Abu Hureyra archaeological site (between Aleppo, Raqa, and Kobanê, N-Syria) has provided very early evidence for the beginnings of cereal cultivation in upper Mesopotamian plains including a wide range of wild plants such as native cereal grasses and herbaceous legumes about 12,000 years ago. These ancient agricultural

activities have been confirmed with the discovering of others small farming villages situated in the upper Mesopotamian region in archaeological sites of Rojava Kurdistan (NE-Syria) such as Tel Leilan (5000 BC) and Urkesh (4000 BC). In consequences, the most actual familiar vegetables, cereals and fruits of our gardens and/or our fields are the descendants improved by cultivation, breeding, and selection of ancestral wild edible plants that

men and women who first learned the secret of their nutritiousness “ancestral knowledge”. Besides, long before our Neanderthal ancestors had often occupied grotts and caves as refuge places in the foothills and mountains. The Shanidar cave, near Erbil, is an anthropological print confirming the passage of the Neanderthal throughout the Zagros mountains. The impressing history is to have found the pollen of some wildflowers associated with burial skeletons (about 43000 years ago) leading researchers to formulate the hypotheses that Neanderthals adorned their dead with ornamental wildflowers and explaining why Kurds gained their name as “the first flower people” (Solecki, 1971). This remarkable mutual Nature love is ceaselessly among Kurds’ people highlighting the important maintaining of these new-ancient traditional cultural practices!

3. Origin of the project

As botanists and evolutionary naturalists at (or in collaboration with) universities of Duhok and Erbil (Kurdistan Region of Iraq) and Montpellier (France), interested in the biological conservation of threatened plant species in Mediterranean and Zagrosian areas, we have initiated three majors axes of researches. These are on: wild geophytes, conservation

of ethnobotanical knowledge, illustrated nature guides of touristic sites. One important characteristic of KRAs, besides to its high biological diversity, is that the high anthropogenic activity pressures in most natural sites (agropastoralism, recreation, infrastructure development...). This complex situation is arguably the unique opportunity for both botanists and biodiversity managers to asses urgently the issues and challenges of nature conservation. Interestingly, with our first botanical field joint survey in spring 2013, it has been rapidly realised that far too little attention has been paid to discover the biodiversity of this Eden garden. Questions have been immediately raised and we have decided to initiate an international research program on bulbous species in general and orchid species in specific. Criteria for selecting this topic were as follows: 1/The precious collaboration of both expert in Mediterranean geophytes species, evolutionary ecologist and local Kurdish researchers having a good field experience; 2/ Bulbous species often are under threats as they are most attractive plant species (ornamental, edible, medicinal...); 3/ And the flora of Iraq volumes concerning Monocotyledons families had been published (contrarily to some other dicotyledonous families), but seem

already obviously outdated!

This collaborative project has successfully started by actively adding new contributions to the Flora of Iraq: on orchids of Duhok province (Véla et al., 2013; Youssef et al., 2015; Youssef et al., 2017b); on the amaryllidaceous genus *Sternbergia* (Youssef et al., 2017a) and the jacinth-like genus *Prospero* (Youssef et al., 2018); on ethnobotanical living practices in Zagros area (Youssef et al., 2017c); on IUCN assessment of strictly endemic plant species (Véla et al., 2017). The second phase of the main topic of this project was to edit a book on wild orchids of the Kurdistan Region areas as a scientific window on the unexpected nature in the north-western Zagros belt. This has been made possible after completion of a good experience in fieldwork in Kurdistan Region from Zakho (MAM district) to Hajî Umaran (MRO district) with several fieldwork locations in Sulaymaniyah governorate (MSU district). In the spirit of widening the action for all KRAs, the initial project started at Duhok university was recently enlarged to the Salahaddin University of Erbil, and we invite the local researchers from others Kurdish universities to join us. This is an important issue to provide a robust national biodiversity conservation strategy and implementation.

3.1. Study area

The botanical field-surveys were made in connection with others naturalist surveys during 2013-2018. At this step, the field survey has been limited to the Duhok, Erbil (Hewlêr), and Sulaymaniyah governorate. Within these three governorates, the main districts explored are those of Amidiyê mountains called **“MAM”** (Duhok, Amidiyê, Kanî-Masî or “Ain Nuni”, Zawita, Zakho, Domîz, Atruş-Çemankê, Dêraluk, Akrê, Sersing); Rewanduz mountains called **“MRO”** (Şeqlawa, Barzan, Hujran Basine, Qalla Snja, Şîrwan Mezin, Rewanduz, MirgaSor (Pîran), Seri-Bardi (Sidakaan), Kanî Xumaar, Halgurd area, Galala, Rost Valley, Wallaash, Mirga, Nawanda, Gunda Jor, Allana, Çoman, Hajî Umaran); Sulaymaniyah mountains called **“MSU”** (Darband Faqara, Deileizha, Jafran (near Sargrma mountain), Kamalaan, Maawat, Qalla-Chollan, Qara Dagh, Shaar-Bazheir, Shexi trşaka, Smaaqa, Pîra Megrun mountain). In these investigated areas, we have explored a maximum of diverse habitats and landscape locations: Upper Mesopotamian plains, pseudo-steppe grassland, Oak and Pine forests of foothills and mountains, thorn-cushion vegetation and alpine zones. However, further botanical field surveys in all KRAs are required to determine exactly the actual distribution maps of each orchid species.

3.2. Notes on Field guide and how to use it

3.2.1. Nomenclature, synonyms, etymology*

In order to name all orchid species, we have to choose one valid scientific names between those that have been employed. The nomenclatural aspects of scientific names we use are strictly based on the World checklist of selected plant families (WCSP, <http://apps.kew.org/wcsp/home.do>) developed by Kew Botanical Garden (Govaerts et al., 2017). In added, synonyms, basionyms and etymology were principally done according to scientific orchid name used in Levant countries' floras i.e. Flora of Lebanon and Syria (Mouterde, 1966), Flora Iranica (Renz, 1978), Flora of Turkey (Renz & Taubenheim, 1984) and Flora of Iraq (Wood, 1985). To increase the reliability of the process, we consult regularly all scientific papers and books concerning the orchid species.

3.2.2. Systematic remarks

In the present field guide, the taxonomical identification of orchid species was carried out thanks to illustration photos. Initially, the identification process followed Wood (1985), Renz (1978) and Renz & Taubenheim (1984); and then was systematically verified according to the orchid books on Turkish or Euro-

Mediterranean orchids by Kreutz (1998), Kreutz & Çolak (2009) and Baumann et al. (2006), especially for systematic verification/precision of species/subspecies status. For the genus *Anacamptis*, *Neotinea* and *Orchis* the recent monograph of Kretzchmar et al. (2007) has been preciously used and for the group of *Dactylorhiza romana* the revision of Pedersen (2006) utilized.

3.2.3. Orchids description and characteristic features

To provide a wide aspect of description for each orchid species, a systematic review of floras and literature has been done. For the purpose of characteristic features, several recognisable morphological traits have been specifically chosen and **put in bold** within the text. These **characteristic features** are useful keys guiding a wide range of users (naturalists, botanists...) towards the identification of the species in question.

3.2.4. Ecological niche in KRAs

During our botanical orchids field investigations, maximum information about their ecological niche, occurrences, and population size have been undertaken. These field data are primordial to facilitate the species identification and/or to bring information during the impact assessment.

3.2.5. Biogeographical distribution of orchid species

We attempted to provide a logical system of biogeographical distribution for each species according to their global distribution. They are:

- Medit. = Mediterranean: a taxon distributed only around the Mediterranean Basin, penetrating the Middle East strictly within the Mediterranean bioclimatic area of the Levantine countries;
- Zagrosian: a taxon only distributed through Zagros mountain (SE Turkey, NE Iraq, SW Iran);
- Irano-Anatolian: a taxon distributed on the Irano-Anatolian plateau and adjacent mountain ranges (Talish–Alborz–Aladagh, Lesser Caucasus, Zagros–Taurus);
- Irano-Turanian : a taxon distributed from the Irano-Anatolian area until Western Himalaya through the Central Asiatic mountains;
- Paleotemperate: a taxon widely distributed through the Old world temperate area consisting in the whole European-Siberian area and the whole Mediterranean basin (including northern Africa and western Asia);

- SE-Europ.: a taxon distributed mainly in mountainous and thermophilous parts of the South-Eastern Europe (Apennine, Balkans) and adjacent areas;
- Levantine-Zagrosian: a taxon restricted to the Mediterranean and/or mountainous part of the Levant (eastern Mediterranean countries, i.e. Israel/Palestine, Jordan, Lebanon, Syria, Amanus/Hatay province in S-Turkey) and the Mesopotamian-Zagrosian belts (from SE-Anatolia until SW Iran);
- Cilician-Zagrosian: a taxon restricted to the Taurus-Bitlis-Zagros mountain range;
- Caucasian: a taxon distributed across the Greater Caucasus and its natural bioclimatic extensions (the Pontic area westwards, the Hercynian area eastwards, and the Transcaucasian area southwards).

Combined categories (like Medit.-Zagrosian) and partial categories (like NE-Medit.) have been used when appropriated.

3.2.6. Physiographic district of KRAs

In the field of geopolitical language, various definitions of Kurdistan are found. Classical examples of these are Kurdistan, Great Kurdistan, Kurdistan Region, Bashor Kurdistan, etc. Meanwhile, the Kurdistan

or Great Kurdistan in its broad sense refer to a well-defined geo-cultural area wherein the Kurdish people form a prominent majority population including south-eastern Turkey (Bakur or Northern Kurdistan), northern Syria (Rojava or Western Kurdistan), northern Iraq (Başur or Southern Kurdistan), and western Iran (Rojhilat or Eastern Kurdistan). On another hand, the Kurdistan Regional Government (KRG), Iraqi Kurdistan or Southern Kurdistan is the official Kurdish autonomous region of northern Iraq with three governorates (Duhok, Erbil, and Sulaymaniyah). Throughout this illustrated guide, it is necessary to clarify exactly what is mean by Kurdistan Region areas (KRAs). The term KRAs is generally understood to design all Iraqi territories where Kurdish people are the actual dominate population. It includes both the three official governorates under the control of KRG and others “disputed” Kurdish areas which legislatively and/or administratively under the control of Iraq government (e.g. Kirkuk, Touzkhormato, and Sinjar areas well illustrate this disputed point). As Kurdish researchers, we have used KRAs term to avoid all kind of confusion and far from any political implication. According to physiographical regions divisions defined by Townsend & Guest (1984), KRAs broadly correspond

to the nine following districts: MJS (Jabal Sinjar), MAM (Amidiyê District), MRO (Rewanduz District), MSU (Sulaymaniyah District), FUJ (Upper Jazira District), FNI (Nineveh District), FAR (Arbil District), FKI (Kirkuk District), FPF (Persian Foothills District) (Figure 18).

About distribution of each orchid species in KRAs, we have provided a robust simplified guide.

This can be illustrated briefly by the following concrete example:

MJS	MAM	MRO	MSU	
FUJ?	FNI	FAR	FKI	FPF

Words in bold such as **MAM** and **MRO** mean that we have observed this species in the field during our 6-years survey (2013-2018). Normal words such as MJS, FNI, FAR, FKI and FPF refer to reporting their occurrence according to classical Floras (i.e. Flora of Iraq and Flora Iranica). The question mark (e.g. FUJ?) means that the occurrence of the species had been reported or presumed for FUJ district in the Flora of Iraq but we are unconvinced by a statement. This uncertified status, linked to outdated and imprecise in some cases of Flora of Iraq that should be verified and/or approved by recent floristic investigations. Whereas an empty box indicates that the species is absent from this district.

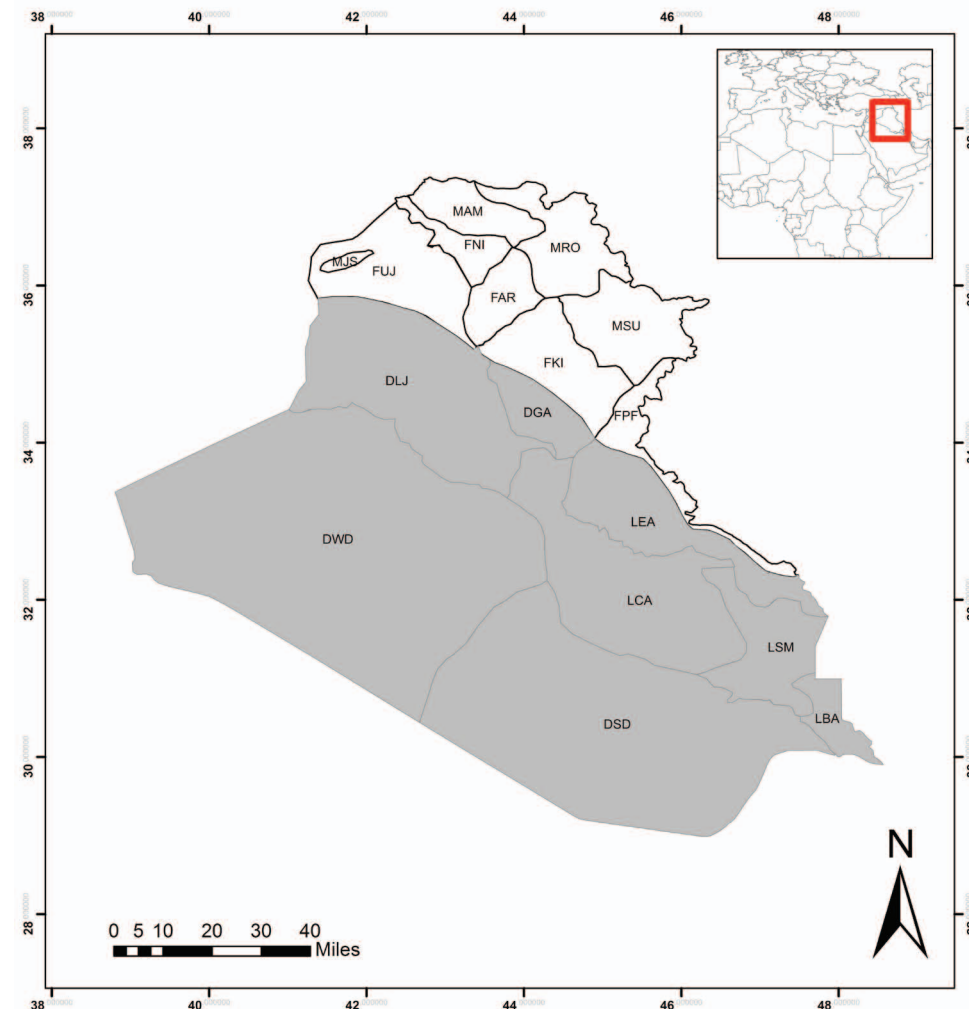


Figure 18: Physiographic districts of Kurdistan Region areas KRAs, in white (modified from Guest & Al-Rawi (1966).

3.2.7. Flowering period

A guide is given to the period in which the orchid is likely to be in flower. This flowering period initially was based on Floras information. Then, in order to be closest to the reality, we have adjusted these flowering periods according to our field observations.

3.3. Limitation and recommendations

Due to diverse constraints (time, logistic, funding...), an important number of limitations need to be considered. First, orchids observations were made using the simple botanical method based on the visual prospecting the sites and photographing all living specimen. Furthermore, the current botanical field investigations were mainly limited to MAM, MRO and MSU districts because of the recent instability of the southern areas like Sinjar / Mosul / Kirkuk. Even within these fieldwork areas, it has been impossible to prospect all localities and sites due to diverse constraints: 1/ The remaining parts of landmines in some mountains e.g. Gara mountain and Halgurd-Sakran area; 2/ Geopolitical tension with neighbouring countries preventing us to explored diverse localities near Turkish and Iran borders e.g. Qandil mountains and Berwariya-Bala locality; 3/ Without any funding

program supporting our botanical field-work surveys our territorial prospects were limited.

Through this illustrated field guide to orchid species, we attempt to spotlight on peculiar opportunities and challenges for biodiversity studies in Kurdistan Region areas. The easiness to find new records and localities during a short period of botanical surveys and in a limited area confirms that KRAs and more the whole Zagros mountain range is a hotspot for plant diversity but coldspot for naturalistic knowledge. The evidence of this emerging issue suggests that other discoveries can be achieved in the future. Consequently, the findings of this field guide have therefore two important implications for future practice:

1/ Stimulating scientific researchers and naturalists to do more botanical field survey in KRAs which in turn will update the Flora of Iraq and/or towards initiating a regional Flora of KRAs;

2/ Emphasising the national and international collaboration and cooperation between the scientific researchers on the one hand, while on the other hand local managers and administrators should achieve a national/regional biodiversity conservation strategy.

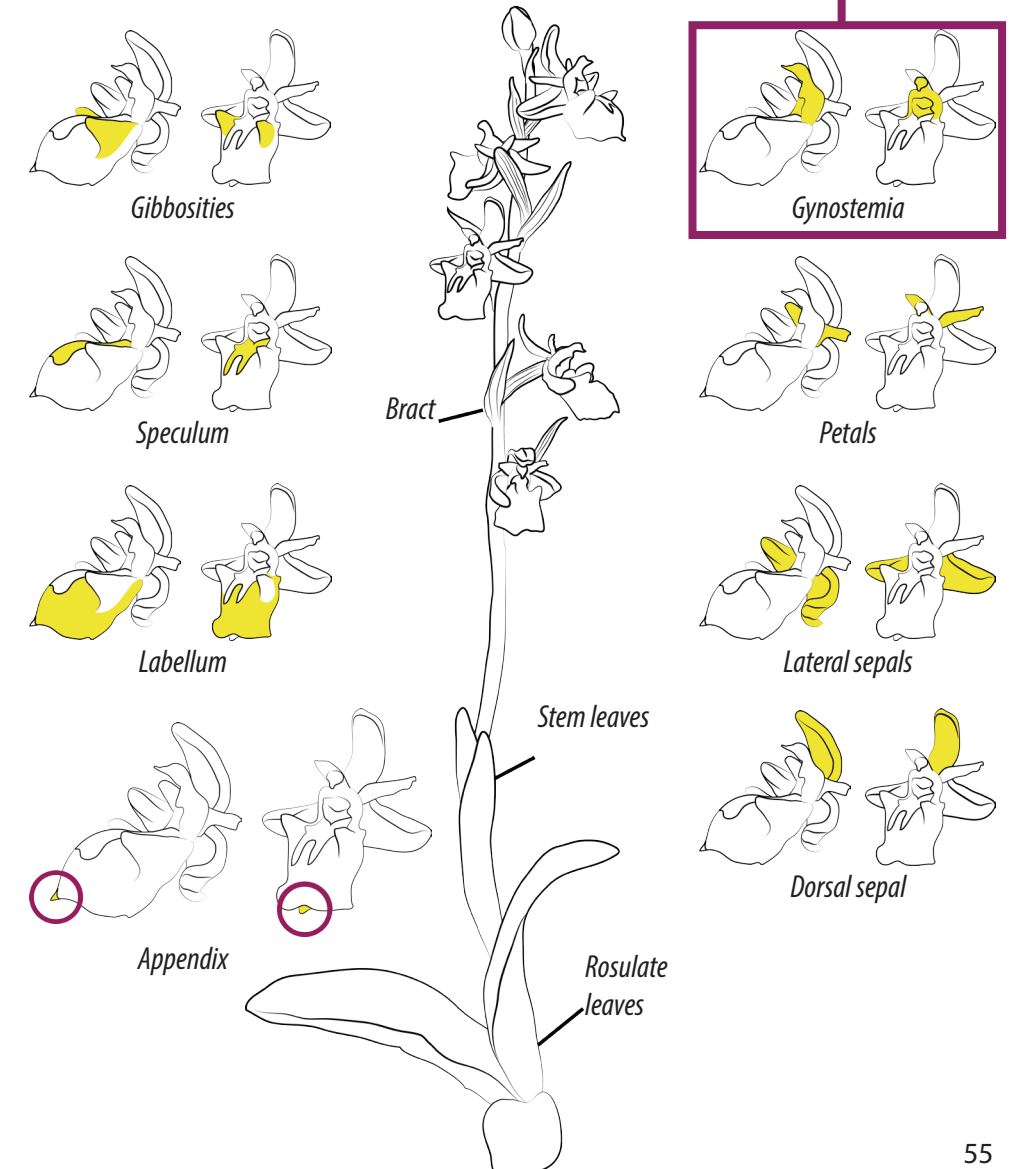
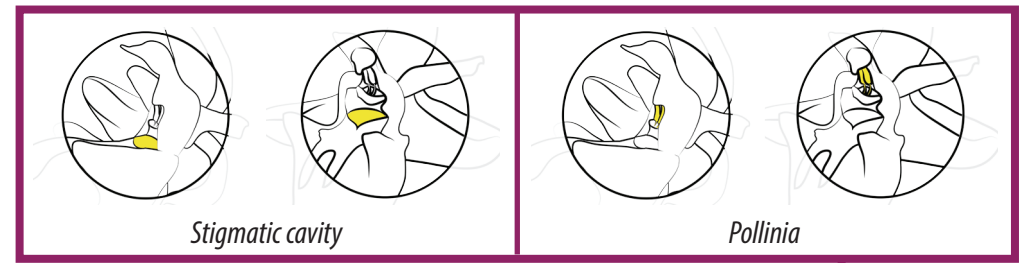
3.4. Acknowledgment

We are highly grateful to the local people of Merguê, Harikê, Biduhê, Banko-Ariza, Çemankê, Diyana, Dostaka, Halgurd-Sakran area villages for their warm welcome, friendly cooperation and assistance helps during our botanical field surveys. We would like to express our deepest gratitude and sincere thanks to the staff of the Faculty of Agriculture and the University of Duhok, for their supporting encouragements for our botanical field surveys. The authors wish especially to thank PAUSE program (National program for the urgent aid and reception of scientists in exile) of the Collège de France for funding the post-doctoral researches of Sami Youssef at University of Montpellier and allowing us to finalise the first edition of the orchid project book. We also extend our warmest thanks to Shéhérazade Azizi and Shiyar Mohammad for the effort that they have put on proofreading the English language of the manuscript. We thank Philippe Geniez for his critical review of a draft version of the document. We don't forget to thank Roland Martin, president of the Société Méditerranéenne d'Orchidologie (SMO), who gave us an ISBN for this e-book. Finally, we want to thank all those involved directly/indirectly in this project for their commitments and participation/facilitation of field surveys and make it possible for us to do our botanical works.





4. Illustrated monograph of orchid species



Anacamptis collina

Nomenclature, synonyms, etymology*:

Anacamptis collina (Banks & Sol. ex Russell) R.M.Bateman, Pridgeon & M.W.Chase, Lindleyana 12: 120 (1997).

≡ *Orchis collina* Banks & Sol. ex Russell, Nat. Hist. Aleppo, ed. 2, 2: 264 (1794).

***Hill orchid** (refers to the altitudinal range at which the species mainly occurs).

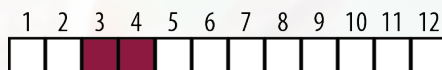
Biogeographical distribution:

Medit.-Zagrosian

Distribution in KRAs:

	MAM	MRO	MSU	
FUJ?	FNI			

Flowering period:



Systematic remarks:

In flora of Iraq (Wood 1985) and other regional floras (Iran, Turkey, Syria) this species is treated under the synonymic name of *Orchis collina* Banks et Sol.. Its assimilation into the genus *Anacamptis*, closely to *A. papilionacea* s.l., is based on molecular evidences but some authors recently rehabilitated the genus *Vermeulenia* to consider the whole group separately (cf. Section 1.2).

This species varies typically in colour intensity, concerning all parts of plants but especially inflorescence (stem summit, bracts, sepals and petals, labellum), varying from hypochromic individuals (mainly greenish/whitish) until hyperchromic individuals (mainly purplish/brownish) along with a continuum and without infraspecific taxonomical consequences.

Description and characteristic features:

It is a relatively small robust plant (10-40 cm) with often coloured, red-brown to purplish stem in the area of the inflorescence. It has a rosette with 3 or 4 leaves plus 1 to 4 elliptic spreading leaves. The flowers (4 to 20) are relatively large and densely arranged in cylindrical inflorescence. Flowers are highly variable in colour, ranging from purple-violet, brownish-reddish green to pale green or dirty white. **Dorsal sepal is connivent with the petals to form a loose helmet while lateral sepals are drawn up on both sides. Labellum furrowed at the basis, long obovate, globally entire, apex weakly crenulated. Spur saccate, broadly cylindrical, half as long as the ovary, white or rarely bright pink, green at the apex.**



Anacamptis collina

Ecological niche in Kurdistan Region areas:

It was considered as a rare species in Iraqi territories because it was only found three times on the lower forest and moist steppe zones respectively, without any precision of its altitudinal range (Wood, 1985). During our field investigation on orchids in Kurdistan Region (2013 to 2018), we found other small populations in different localities (e.g. Zawita, Atrush, Bakrman, Rowendez, Choman areas). In conclusion, it occurs occasionally in open habitats on the lower and middle Oak and Pine forests at 800-1200 m asl.



Anacamptis coriophora subsp. *fragrans*

Nomenclature, synonyms, etymology*:

Anacamptis coriophora subsp. *fragrans* (Pollini) R.M.Bateman, Pridgeon & M.W.Chase, Lindleyana 12: 120 (1997).

≡ *Orchis fragrans* Pollini, Elem. Bot. 2: t. Ultima, t. 2 (1811).

≡ *Orchis coriophora* subsp. *fragrans* (Pollini) K.Richt., Pl. Eur. 1: 268 (1890).

– *Orchis coriophora* L., Sp. Pl.: 940 (1753), sensu Fl. Iran.

***Fragrant orchid** (refers to the pleasant scent smell similar to vanilla).

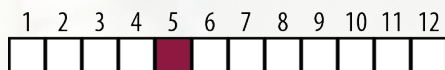
Biogeographical distribution:

Medit.-Zagrosian

Distribution in KRAs:

	MAM	MRO	MSU	
	FNI			

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) treated this species under the name *Orchis coriophora* subsp. *fragrans* while Kretzschmar et al. (2007) considered it, more recently, a part of the genus *Anacamptis* thanks to the phylogenetic data, but both reported the species in a large sense consists in two subspecies: subsp. *coriophora* and subsp. *fragrans*. The taxonomic position of both subspecies has been discussed controversially in the botanic literature for a long time due to the difficulty of separation on both morphological bases and sympatric distribution of the subspecies. Kretzschmar et al. (2007) mentioned that subsp. *fragrans* settles on middle and low-level regions that are influenced by the Mediterranean climate, whilst subsp. *coriophora* mostly found in the mountains or areas with lasting snow cover in winter. Furthermore, Wood (1985) reported only the presence of subsp. *fragrans* in mountains of Kurdistan Region. We found it only under the Mediterranean climate and the morphological features confirm the identification as subsp. *fragrans*. However, the others mountainous localities (>1500 m asl) mentioned in Flora of Iraq (i.e. Haji Umaran (MRO), Pira Magrun (MSU) and Qaradg (MSU)) could be concerning the subsp. *coriophora* and need a deeper field investigation.



Anacamptis coriophora subsp. *fragrans*

Description and characteristic features:

It has a robust straight erect stem (15-60 cm) with 4 to 7 ± lanceolate unspotted leaves. Narrow cylindrical inflorescence carrying various coloured (from greenish to light-brown and through pink with intensely red spots) flowers which have a rather vanilla scent. Sepals connivent with the petals forming an **erected pointed helmet**. **The labellum is trilobed with right and entire edges, spotted around the center; the mid-lobe distinctly longer than the lateral lobes in the subspecies.**

Ecological niche in Kurdistan Region areas:

It is commonly found under relatively Mediterranean climate in open meadows and grassy places on the lower Pine forest zones e.g. Zawita (450-1000 m). It is found often in damp meadows and grassy places among trees and shrubs such as *Pinus brutia*, *Quercus aegilops*, *Pistacia eurycarpa*, *Juniperus oxycedrus*, etc. The vegetation densely covers the ground with grasses. We often found its populations on small-scale areas that temporarily collect rainfall as a sort of temporary marshlands not far from permanent stream and spring.



Anacamptis laxiflora subsp. *dielsiana*

Nomenclature, synonyms, etymology* :

Anacamptis laxiflora subsp. *dielsiana* (Soó) H.Kretzschmar, Eccarius & H.Dietr., *Orchid Gen. Anacamptis Orchis Neotinea*, ed. 2: 98 (2007).

≡ *Orchis laxiflora* subsp. *dielsiana* Soó, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 911 (1926).

– *Orchis laxiflora* Lam., *Fl. Franç.* 3: 504 (1779), sensu *Fl. Turk.*

– *Orchis palustris* Jacq., *Collectanea* 1: 75 (1787), sensu *Fl. Irak.*

***Losse-flowering dielsiana orchid** (refers to the honour of the German botanist F. Diels, the director of the Botanical Garden Berlin-Dahlem).

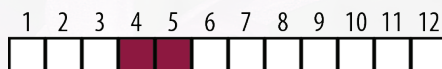
Biogeographical distribution:

Irano-Anatolian

Distribution in KRAs:

	(MAM)	MRO	(MSU)	

Flowering period:



Systematic remarks:

Anacamptis section *Laxiflorae* includes two sister species (*A. laxiflora* and *A. palustris*) morphologically close (Kretzschmar et al., 2007) but phylogenetically clearly separated (Bateman et al., 2003). In Levant countries including Zagrosian area, the co-occurrence of both *A. laxiflora* (subsp. *dielsiana*) and *A. palustris* (subsp. *elegans*) complicates the identification task to botanists, especially where there are eventual hybrids between the two species (Kretzschmar et al., 2007). That is probably why the presence of *A. l.* subsp. *dielsiana* was confused with *A. p.* subsp. *elegans* by Wood in *Flora of Iraq* (1985). However, the two previous taxa are distinguishable by the following characteristic features: dense arrangement of the flowers for *A. palustris* s.l. but lax for *A. laxiflora* s.l., while in our peculiar case subsp. *A. l. dielsiana* has an unspotted lip generally white in the center but a strong spotting arranged in lines for *A. p.* subsp. *elegans*. *Anacamptis laxiflora* includes three subspecies: subsp. *laxiflora* in western and southern Europe; subsp. *dielsiana* eastward (mostly in Irano-Anatolian region); subsp. *dinsmorei* on the eastern Mediterranean coast (Levant).



Anacamptis laxiflora subsp. *dielsiana*

Description and characteristic features:


It is a robust plant, having an erect stem (60-80 cm), green below, often reddish-purple above. It has often up to 8 green leaves, developed from the base, linear to lanceolate; The uppermost leaf is much shorter resembling the bracts.

Inflorescence, often elongated often more than 25 cm harbouring numerous small flowers. **They are with intense red-violet colour.** The labellum is slightly trilobed: **the centre of the lip is white into the base without mottled and much shorter than the side lobes; lateral lobes always strongly reflexed (lip folded).** Spur approximately is half as long as ovary, often flattened and slightly notched at apex.


Ecological niche in Kurdistan Region areas:

It occurs occasionally in the upper forest zone but rare in the lower parts. We found it at 1200 m asl in Merga area (MRO). It prefers quite a wet habitat such as marsh meadows, seasonally flooded places and damp places near streams.




 Picture taken in Turkey



 Picture taken in Turkey



 Picture taken in Turkey



Anacamptis papilionacea subsp. *schirwanica*

Nomenclature, synonyms, etymology*:

Anacamptis papilionacea subsp. *schirwanica* (Woronow) H.Kretzschmar,

Eccarius & H.Dietr., *Orchid Gen. Anacamptis Orchis Neotinea*, ed. 2: 174 (2007).

≡ *Orchis schirwanica* Woronow, *Izv.Kavkazsk.Muz.* 4(4): 263 (1909).

≡ *Orchis papilionacea* subsp. *schirwanica* (Woronow) Soó, *Bot. Arch.* 23: 36 (1928).

= *Orchis caspia* Trautv., *Trudy Imp. S.-Peterburgsk. Bot. Sada* 2: 484 (1873).

– *Orchis papilionacea* L., *Syst. Nat.* ed. 10, 2: 1242 (1759), sensu Fl. Turk.

***Şirvan Butterfly orchid** (papilionacea = butterfly-like; schirwanica = “Şirvan” area where the type sample was found in the Eastern Caucasus.

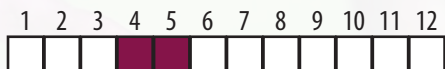
Biogeographical distribution:

Irano-Anatolian

Distribution in KRAs:

	MAM	MRO	(MSU)	

Flowering period:



Systematic remarks:

In classical floras (e.g. Flora of Turkey, Flora iranica...) this taxon was treated under the genus *Orchis*. Like *A. collina*, it has been proposed to be considered in the enlarged genus *Anacamptis* (Kretzschmar, et al., 2007; Véla & Viglione, 2015) but some other specialists propose to place it in the small separated genus *Vermeulenia* (e.g. Löve and Löve, 1972; Delforge, 2016). Kretzschmar et al. (2007) reported six subspecies mainly distributed in Mediterranean Region except one in Irano-Anatolian Region: subsp. *schirwanica* is given for Azerbaijan and SE-Anatolian Turkey territories (cf. Kretzschmar, et al., 2007; Kreutz, 1998). In flora of Iraq (Wood, 1985) and all other literature (Renz, 1978; Renz & Taubenheim, 1984; Kretzschmar, et al., 2007; Kreutz and Çolak, 2009), *A. papilionacea* has never been indicated for Iraq territories. We found it for the first time in Silé waterfall in Akre province (Youssef et al., 2017b), thanks to which we have confirmed the subsp. *schirwanica*: lip shape conform to the plants from Azerbaijan excluding the subsp. *palaestina*, and density of inflorescence excluding the typical subspecies from Italy. Actually, its presence in Kurdistan region of Iraq is not really surprising because it belongs to the same mountain chain extending westward until SE-Turkey. Hence, the research finding extends the geographical distribution south-eastward into Iraqi territories, only 100 km from the Iranian border.



Anacamptis papilionacea subsp. *schirwanica*

Description and characteristic features:

It is a robust plant, having an erect stem (15-30 cm); often with 2-8 lanceolate unspotted leaves. This subspecies is mainly quite stocky with inflorescences that are rich in flowers. Its flowers have a **spatula-shaped discreetly spotted crenelated lip**.

Ecological niche in Kurdistan Region areas:

This species has been discovered at 875 m asl in Silé waterfall locality, south exposure of Dostaka mountain in Akre province (Youssef et al., 2017b). It occurs in pseudo-steppe grassland habitats within Gall oak (*Quercus aegilops*) open forest on a southern piedmont. These herbaceous communities are dominated by herbs (e.g. *Bromus sp.*, *Carex sp.*, *Hordeum sp.*, *Stipa sp.*) and mainly geophytes species (e.g. *Anemone coronaria*, *Poa bulbosa*, *Allium sp.*, *Bellevalia sp.*, *Muscari sp.*, *Ornithogalum sp.*) which disappear completely during summer. The pseudo-steppe forest is characterized by sparse Gall oak trees and some shrubs (e.g. *Rhus coriaria* var. *zebaria*, *Prunus sp.*, *Juniperus oxycedrus s.l.*, *Pistacia khinjuk*). The climate of this site is typically accentuated Mediterranean (annual rainfall around 1000 mm, mean minimum temperature of the coldest month around 0 °C and mean maximal temperature of the hottest month around 40 °C). We found only one small population with a few disperses individuals (less than 20) occupying a small surface area (< 1 hectare). This location is threatened by high anthropogenic activities (high number of tourists due to its famous and wonderful waterfall). The region is also internationally well known by the over-collecting of the “Zebaria sumac fruit” used in diverse traditional Kurdish dishes (Shahbaz, et al., 2015). The over-harvesting of the others wild edible plants (e.g. *Gundelia sp.*, *Allium sp.*, *Arum sp.*, *Echium sp.*, *Rheum sp.*, etc.) leads to the degradation of many natural habitats. Consequently, this rare species needs an urgent planning strategy for biological conservation by regional Kurdish authorities.



Anacamptis pyramidalis subsp. *pyramidalis*

Nomenclature, synonyms, etymology* :

Anacamptis pyramidalis (L.)Rich., De Orchid. Eur.: 33 (1817) subsp. *pyramidalis*

≡ *Orchis pyramidalis* L., Sp. Pl.: 940 (1753).

≡ *Anacamptis pyramidalis* (L.) Rich., De Orchid. Eur.: 33 (1817).

***Pyramidal orchid** (refers to the pyramid shape of the inflorescence).

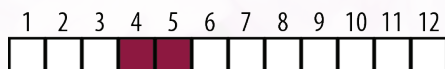
Biogeographical distribution:

Paleotemperate

Distribution in KRAs:

	MAM	MRO	(MSU)	

Flowering period:



Systematic remarks:

It was for a long time considered the only species for the monotypic genus *Anacamptis* until its enlargement according to phylogenetic data. It is widely distributed in Europe, W. Asia, and N. Africa. In Kurdistan region, the plants seen correspond to the typical subspecies with a flowering period from mid to late spring (April/May); while the early flowering subsp. *urvilleana* (Sommier & Caruana) Landwehr seems to be endemic to Malta and the summer flowering subsp. *tanayensis* (Chenevard) P.Quentin endemic to the Alps (cf. Véla & Viglione, 2015). It is why nor Wood (1985) neither Renz (1978) and Renz & Taubenheim (1984) had reported any infra-specific categories for Kurdistan Region of Iraq.

Description and characteristic features:

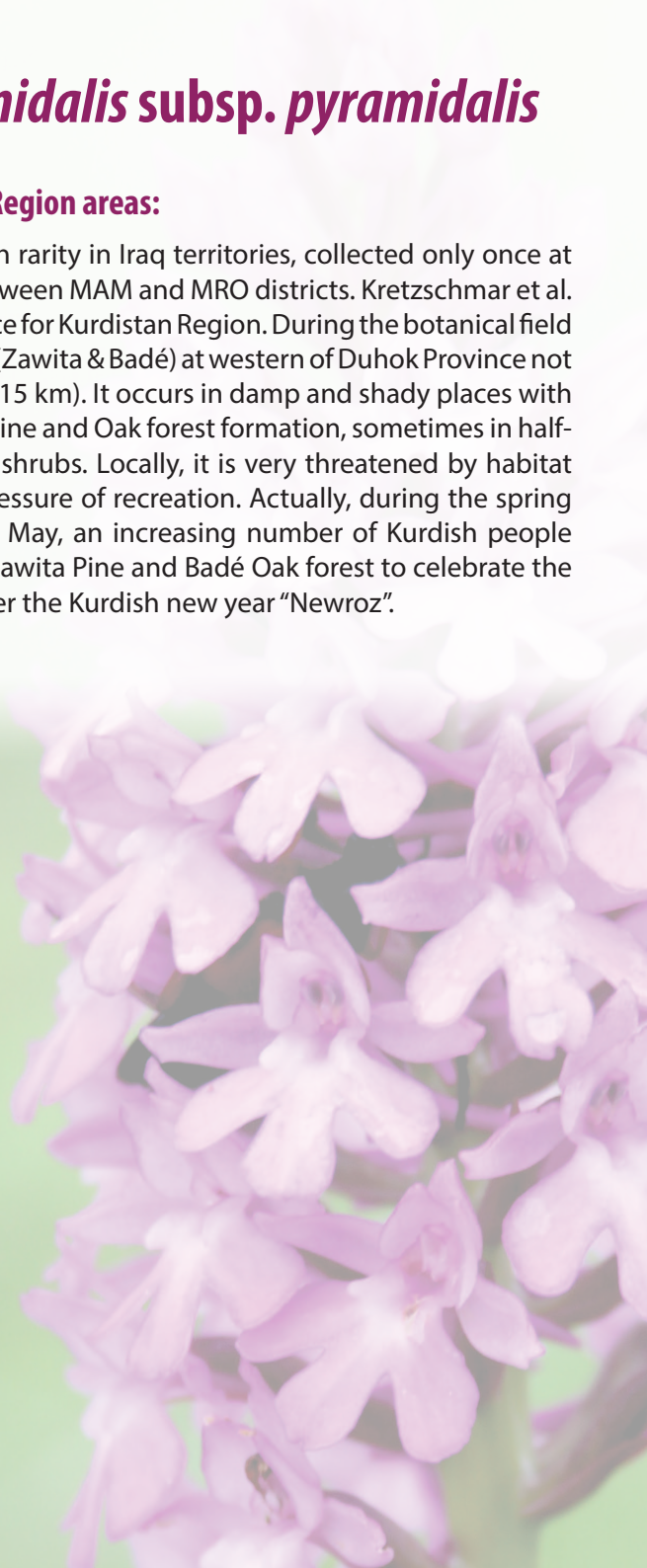
It has an erect stem (25-60 cm.), bearing 2-3 brownish basal sheaths and leaves towards the base and several ovate sheathing bracts above. Leaves rosulate during winter and cauline during spring. The pyramidal epithet characterises only the newly blossoming inflorescence in contrast to the later stages when the blossom is less conical and more oval and domed. **Flowers with uniform colour** from pale pink to dark reddish-pink, rarely bright blood-red or white. The flowers have a **very long and thin spur** that is tapering towards its end. **The labellum has three elongated lobes**. In addition, **labellum has 2 longitudinal ridges at the base**, extending from the narrow circular spur-entrance towards the centre.



Anacamptis pyramidalis subsp. *pyramidalis*

Ecological niche in Kurdistan Region areas:

Wood (1985) mentioned its high rarity in Iraq territories, collected only once at 500 m asl in the intersection between MAM and MRO districts. Kretzschmar et al. (2007) also confirmed its presence for Kurdistan Region. During the botanical field surveys, we found two localities (Zawita & Badé) at western of Duhok Province not very far from Duhok city (about 15 km). It occurs in damp and shady places with deep soil near streams in open Pine and Oak forest formation, sometimes in half-shaded places under trees and shrubs. Locally, it is very threatened by habitat degradation due to the high pressure of recreation. Actually, during the spring period, especially from April to May, an increasing number of Kurdish people do outdoor recreation in both Zawita Pine and Badé Oak forest to celebrate the coming of the sunny season after the Kurdish new year "Newroz".



Androrchis anatolica "sensu lato"

Nomenclature, synonyms, etymology*:

Androrchis anatolica (Boiss.) D.Tyteca & E.Klein, J. Eur. Orch. 40: 542 (2008).

≡ *Orchis anatolica* Boiss., Diagn. Pl. Orient. 5: 56 (1844).

***Anatolian orchid** (due to its discovering on Anatolian Region).

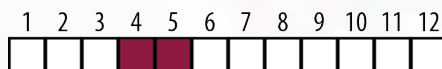
Biogeographical distribution:

NE-Medit.-Zagrosian

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	
	(FNI)			

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) treated this species under the synonym *Orchis anatolica* without any indication to the infraspecific categories. Whoever, Bornmüller named one of the Strauss collections from Iran (Kermanshah province) var. *taurica* Reichenb. which is characterized by having an entire labellum. Kretzschmar et al. (2007) have reported the moderate variability of this species, especially, for the flower colour and the length and position of the spur e.g. almost individuals have bright flowers while others have white flowers and lack the spotting at the rear of the lip. The fact remains that the taxonomy of the *A. anatolica* complex is not yet completely solved and that our plants need to be investigated deeper.

Description and characteristic features:

Anatolian orchid has a robust erect stem (15 to 40 cm.). It has 2 to 5 rosulate **leaves**, oblong to lanceolate, **usually spotted with purplish-brown**. The elongated inflorescence is up to 15 cm tall, consists of 2-15 lax and large flowers. Flowers are pink to purple, rarely whitish; two lateral sepals are spreading (not joining the petals), while the dorsal one and the petals form the helmet.



Androrchis anatolica "sensu lato"

Labellum, slightly 3-lobed, pale pink to purple, with a white central area spotted by numerous purple dots arranged in two lines in the centre of the labellum. The spur is narrowly-cylindrical (15 to 25 mm long), **1.5 to twice longer than the labellum, regularly attenuate until the apex.**

Ecological niche in Kurdistan Region areas:

It occurs mostly in semi-shaded places under pine and oak steppe forests and is found also on juniper scrubland area. It has a wide altitudinal range 700-1400 m asl. In Kurdistan Region, it occurs commonly in the N.W. sector of the middle and lower forest zones.



Androrchis mascula subsp. *longicalcarata*

Nomenclature, synonyms, etymology*:

Androrchis mascula subsp. *longicalcarata* (Akhalk., H.Baumann, R.Lorenz, Mosul. & Ruedi Peter) W.Foelsche & Jakely, J. Eur. Orch. 41: 350 (2009).

≡ *Orchis mascula* subsp. *longicalcarata* Akhalk., H.Baumann, R.Lorenz, Mosul. & Ruedi Peter, J. Eur. Orch. 37: 897 (2005).

—*Orchis mascula* subsp. *pinetorum* (Boiss. & Kotschy) E.G.Camus in E.G.Camus, P.Bergon & A.A.Camus, Monogr. Orchid.: 156 (1908), sensu Fl. Iraq, Fl. Turk., Fl. Iran.

***Male orchid** (due to the form of the two underground “testicle” tubers).

Biogeographical distribution:

Irano-Anatolian

Distribution in KRAs:

	MAM	MRO	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

The appearance of the species substantially changes within its wide geographical distribution range (from NW Europe to Caucasus region via Mediterranean and Irano-Anatolian region). Consequently, the botanists try to describe more and more subspecies. For example, Wood (1985) give for Iraq the subsp. *pinetorum* while Govaerts et al. (2017) retain for Iraq only subsp. *mascula*, because of inclusion of subsp. *pinetorum* as a taxonomic synonym. Nevertheless, Baumann et al. (2006) well reported the diagnostic characteristic separating both subspecies and given another subspecies *longicalcarata*. In our specimens, the length of spur, 1.5 or 2 times as high as the labellum, is characteristic of subsp. *longicalcarata*, according to Baumann et al. (2006) which is endemic to Caucasus and Zagrosian area (Georgia, Azerbaijan, Iran, Iraq). It is why the identification of *Orchis mascula* s.l. from SE-Turkey has been revised as subsp. *longicalcarata* (Kreutz & Çolak, 2009). Curiously, Kretschmar et al. (2007) don't recognize subsp. *longicalcarata*, including it in synonymy with subsp. *mascula*. Of course, we don't agree, and this misinterpretation is probably due to a misunderstanding of our taxa.



Androrchis mascula subsp. *longicalcarata*

Description and characteristic features:

It is a rootstock tuberous plant with an erect stout stem (20-45 cm.), pale green and often reddish-violet at the top, marked at the base with dark spots. Leaves are glossy green oblong-lanceolate unspotted. **The inflorescence is longly lax rose-purple many-flowered** (25-50 flowers). **Sepals and petals, entirely reddish to mauve**, the lateral sepal and the petals forming an **incomplete helmet**. Labellum marked with only a few spots towards the centre. **The spur, 1.5 or 2 times as high as the labellum, is generally straight and rounded at apex.**

Ecological niche in Kurdistan Region areas:

It occurs occasionally in high hills and middle mountains (700–1800 m asl), predominantly, in bright Oak and Pine steppic forest. It grows mostly in moist places such as meadows and damp woods of maple, hawthorns on mountain areas e.g. Barwarya Bala, Halgurd and Sakran, Hendrin, Korek, Qandil.



Androrchis spitzelii subsp. *latiflora*

Nomenclature, synonyms, etymology*:

Androrchis spitzelii subsp. *latiflora* (B.Baumann & H.Baumann) W.Foelsche & Jakely, J. Eur. Orch. 41: 352 (2009).

≡ *Orchis spitzelii* subsp. *latiflora* B.Baumann & H.Baumann, J. Eur. Orch. 37: 267 (2005).

—*Orchis spitzelii* Saut. ex W.D.J.Koch, Syn. Fl. Germ. Helv.: 686 (1837), sensu Fl. Iraq, Fl. Iran., Fl. Turk., Nouv. Fl. Lib. Syr..

***Spitzel orchid** (in honour of the German plant collector Anton von Spitzel).

Biogeographical distribution:

Levantine-Zagrosian

Distribution in KRAs:

	MAM	(MRO)	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

Classically treated in floras under the genus *Orchis* (until Kretzschmar et al., 2007), it has been recently proposed to be considered as *Androrchis* genus according to the contributions of morphological, biological and phylogenetical data on Orchidaceae family (Véla & Viglione, 2015). Kretzschmar et al. (2007) reported three subspecies: subsp. *cazorlensis* (distributed in the Iberian Peninsula), subsp. *nitidifolia* (endemic to the Crete island), subsp. *spitzelii* (the Pyrenees, Alps, Italy, Balkan Peninsula, Asia Minor, Caucasus, Levant and N. Africa); Baumann & Lorenz (2005) recently described subsp. *latiflora* from Lebanon. On basis of morphological traits, as Véla & Viglione (2015) for Lebanon, we considered our taxa as subsp. *latifolia* due to its largest and paler flowers with sepals and spur more spread out.

Description and characteristic features:

It is a tuberous plant with a cylindrical erect stem (20-40 cm. high). It has 2-5 oblong-lanceolate basal rosulate leaves. Inflorescence, lax, with many purple-pink flowers. It can be distinct from others related subspecies by its **large flowers with green but purple-spotted sepals** (lateral sepal 10x5 mm; petals 9x5 mm). **Labellum large**, broadly obovate (13-16 mm.) 3-lobed, with a lot of rose or purple dots mainly near the base. **Spur saccate** (relatively short and stocky), slightly curved and oriented downward.



Androrchis spitzelii subsp. *latiflora*

Ecological niche in Kurdistan Region areas:

It was found recently in open dwarf shrub and thorny cushion habitat at high altitude (above 1500 m asl) just above Lebanon Oak forest over limestone at north slope of Gara mountain. This habitat is characterized by cold winters rich in snow, as well as sufficient water supply in spring. It is a very rare species, founded only in a small population (< 10 individuals) in one locality at Iraq level (Youssef et al., 2015). Whoever, its presence in Kurdistan region it is not really surprising because already known in SE Turkey (Kreutz 1998, Kretzschmar et al., 2007) close to the KRAs border not very far from our Hariké locality (about 100 km). It is considered an endangered species due to the increasing ethnobotanical activities by local collectors of wild edible plants for its famous salep products.



Cephalanthera kurdica

Nomenclature, synonyms, etymology*:

Cephalanthera kurdica Bornm. ex Kraenzl., Bull. Herb. Boissier 3: 143 (1895).

***Kurdish Cephalanther** (refer to its discovering from a broad Kurdistan area).

Biogeographical distribution:

Cilician-Zagrosian

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

In Flora of Iraq, Wood (1985) well described the species without any indication of the presence of neither intraspecific variation nor hybrids. *Cephalanthera kurdica* is a Zagrosian vicariant of the eastern Mediterranean white-flowered *C. epipactoides*. Even if both species have sympatric distribution in S.W. Turkey, they provide very little hybrids taxa, suggesting an efficient isolation distribution mechanism (Kreutz, 1998).

Description and characteristic features:

Rootstock rhizomatous plant (10-70 cm high), often deeply submerged in the soil and/or the litter, bearing often regrouped straight erect stems. **It has 2-4 reduced elliptic leaves**, evenly distributed along the stem. Inflorescence elongate occupied more than the half of the stem (10-40 cm). It has many **bright pink** (exceptionally white), lax and/or dense flowers, **labellum clearly divided into a pale rose-pink hypochile and a whitish epichile, at the base with a distinct conical spur**.

Ecological niche in Kurdistan Region areas:

It occurs in mi-shaded to shaded habitat, in the calcareous substrate, among Oak and Pine trees and prickly juniper scrub. It has got a wide altitudinal range, founded mostly in the lower and middle (800-1350 m asl) mountains and found also occasionally in the upper forest and lower thorn-cushion zones (<2000 m).



Dactylorhiza iberica

Nomenclature, synonyms, etymology*:

Dactylorhiza iberica (M.Bieb. ex Willd.) Soó, Nom. Nov. Gen. *Dactylorhiza*: 3 (1962).

≡ *Orchis iberica* M.Bieb.ex Willd., Sp. Pl. 4: 25 (1805).

***Georgian Iberic orchid** (refers to its discovering in Caucasian Iberia, corresponding to oriental Georgia).

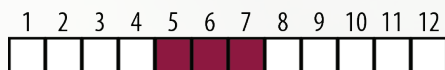
Biogeographical distribution:

NE-Medit.-Caucasian

Distribution in KRAs:

	(MAM)	MRO	(MSU)	

Flowering period:



Systematic remarks:

Dactylorhiza iberica is unique within the genus on account of its habit by producing stolons which enables it to form uniform populations via vegetative reproduction. It is considered as an isolated and ancestral species thanks to its particular morphological forms with the presence of the stolons. Moreover, the recent molecular analysis confirmed its ancestral position within the genus *Dactylorhiza* (Pillon et al., 2006).


Description and characteristic features:

Rootstock stoloniferous with weakly ridged erect stem (20-60 cm), bearing subterranean stolons at the base, just above the fusiform entire tubers. It has 3-7 cauline spreading, linear or lanceolate, unspotted leaves. Inflorescence ovoid then cylindrical, lax to dense often elongate, bearing many **pink to rose flowers**. **Sepals and petals connivent**, forming a loose helmet. Labellum spotted and flecked with dark purple, shallowly 3-lobed rarely entire, **spur** narrowly cylindrical, slender, ± acute, **shorter than the ovary**.


Ecological niche in Kurdistan Region areas:

It is considered as a very rare species which occurs in open marshland and wetland places on the calcareous substrate; It grows sometime in mi-shaded fresh grassland under Oak trees. Historically, it only found once in the central sector of the alpine (about 1700 m) region and thorn-cushion zones of Haji Umaran (MRO), not far from the Irano-Turkish borders.




 Picture taken in Lebanon




 Picture taken in Lebanon



 Picture taken in Lebanon



 Picture taken in Lebanon

Dactylorhiza romana subsp. *georgica*

Nomenclature, synonyms, etymology* :

Dactylorhiza romana subsp. *georgica* (Klinge) Soó ex Renz & Taubenheim, Notes Roy. Bot. Gard. Edinburgh 41: 271 (1983).

≡ *Orchis mediterranea* subsp. *georgica* Klinge, Trudy Imp. S.-Peterburgsk. Bot. Sada 17(1): 19 (1898).

≡ *Orchis romana* subsp. *georgica* (Klinge) E.G.Camus in E.G.Camus, P.Bergon & A.A.Camus, Monogr.

Orchid.: 172 (1908).

***Georgian Iberic orchid** (refers to its discovering from Georgian territories).

Biogeographical distribution:

Irano-Anatolian

Distribution in KRAs:

	MAM	(MRO)	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12
				?							

Systematic remarks:

Dactylorhiza romana with both subsp. *georgica* and *romana* have been highlighted by their occurrence in Turkey territories (Renz & Taubenheim, 1984) while only subsp. *georgica* had been reported for Iranian territories (see Renz, 1978): subsp. *romana* is a real Mediterranean element (from Italy to W-Turkey throughout Balkan Region) and mostly characterized by its rather large flowers with red to yellow colour; while subsp. *georgica* is an Irano-Anatolian and Transcaucasian element and characterized by its rather small flowers mainly or only yellow and with a shorter spur (Renz, 1978; Renz & Taubenheim, 1984; Delforge 2005). None has ever been reported in Kurdistan Region and Iraqi territories (Renz, 1978; Renz & Taubenheim, 1984; Wood, 1985; Kreutz, 1998; Delforge, 2005; Govaerts et al., 2017), until our discovering for the first time in Hariké locality (Gara Mountain), under the subsp. *georgica* characterized by its rather small flowers mainly or only yellow colour, and its shorter spur around 1.5 longer than the lip (Renz & Taubenheim, 1984; Delforge, 2005). Thus, it is a new record for the Flora of Iraq (Youssef et al., 2017b).



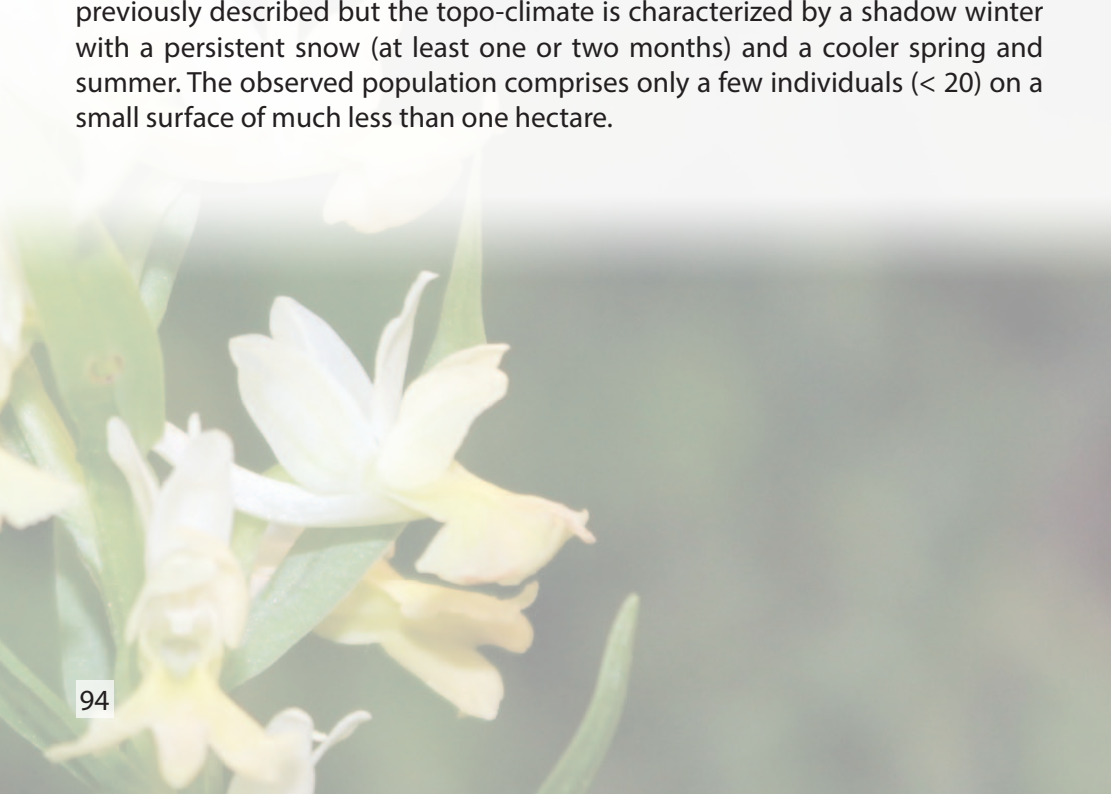
Dactylorhiza romana subsp. *georgica*

Description and characteristic features:

It is a robust tuberous plant (15-40 cm high). Basal leaves lanceolate or narrowly obovate, up to 18 cm long. Inflorescence cylindrical, densely flowered; bracts clear bright green, lanceolate, exceeding the flowers. **Flowers mainly or only yellow colour**, rather small; **sepals not connivent**, labellum usually longer than broad, to 8 mm broad, shortly 3-lobed towards the apex. Spur narrowly cylindrical, **horizontal or slightly turned upwards**, slightly ascending, usually equalling the ovary, **around 1.5 longer than the lip**.

Ecological niche in Kurdistan Region areas:

This species has been found in open habitat at more or less 969 m asl dominated by herbaceous vegetation community marked frequently by the occurrence of diverse dwarf shrub (e.g. *Daphne acuminata*, *Lonicera arborea*, *Astragalus* sp.). It is just situated on the margin of Lebanon Oak (*Quercus libani*) forest zone on a secondary crest with northern exposure. It grows on relatively deep soil with a sufficient water supply in spring. The local climate is globally the same than previously described but the topo-climate is characterized by a shadow winter with a persistent snow (at least one or two months) and a cooler spring and summer. The observed population comprises only a few individuals (< 20) on a small surface of much less than one hectare.



Dactylorhiza umbrosa

Nomenclature, synonyms, etymology*:

Dactylorhiza umbrosa (Kar.& Kir.) Nevski, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh.Rast.4: 332 (1937).

≡ *Orchis umbrosa* Kar.&Kir., Bull. Soc. Imp. Naturalistes Moscou 15: 504 (1842).

***Dark Dactylorhiza** (refers to the dark colours of its flowers).

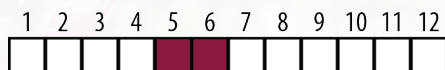
Biogeographical distribution:

Irano-Turanian

Distribution in KRAs:

	MAM	MRO	MSU	

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) reported two varieties: var. *umbrosa* floral bracts not noticeably elongated, the lowermost rarely reaching 9 cm and var. *longibracteata* floral bracts much elongated, exceeding the flowers, the lowermost often up to 9 cm. Whoever, we treated in this study, the species in sensu lato due the insufficient morphological materials collected in order to identify this two varieties.

Description and characteristic features:

Rootstock not stoloniferous, with robust erect, densely leafy, stem (10-80 cm). Leaves 4-6(-9), lanceolate, narrowly elliptic, broadest near the middle, **always unspotted**, often grouped at the base. Inflorescence cylindrical dense elongate (5-25 cm) bearing many purple-lilac flowers. Dorsal sepal and petals connivent, **forming a loose helmet**. **Labellum with dark purple spots entire**, subentire; mid-lobe (when present) small, triangular, lateral lobes (when present) semi-ovate, rounded. **Spur cylindrical (8-13 mm), equalling or slightly exceeding ovary**, directed downwards.

Ecological niche in Kurdistan Region areas:

It occurs occasionally in wet habitat on a calcareous substrate such as marshy places flooded by streams, and/or near springs. It is found sometimes in damp fresh patches under trees, in upper mountain near the summit of the Halgurd-Sakran mountain (alpine region and thorn cushion zones, about 1600 to 3000 m).



Epipactis helleborine "sensu lato"

Nomenclature, synonyms, etymology*:

Epipactis helleborine (L.) Crantz, Stirp. Austr. Fasc., ed. 2, 2: 467 (1769).

≡ *Serapias helleborine* L., Sp. Pl.: 949 (1753), nom. cons.

≡ *Epipactis latifolia* subsp. *helleborine* (L.) Rivas Goday & Borja, Anales Inst. Bot.

Cavanilles 19: 537

(1961), nom. illeg.

***Broad-leaved Helleborine** (indicating to curdle milk which was used by the Greeks).

Biogeographical distribution:

Paleotemperate

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

There is no infraspecific variation reported for Kurdistan Region in Flora of Iraq (Wood, 1985) nor in Flora Iranica (Renz, 1978) and Flora of Turkey (Renz & Taubenheim, 1984). Bauman et al. (2007), for the Euro-Mediterranean area, recognized a series of 9 subspecies but they never cited any of these subspecies for Kurdistan Region. During our botanical surveys, we observed this species in Helgurd-Sakran mountainous areas between 1300 and 1400 m asl. Nevertheless, the poor morphological vegetative data in our possession do not let us identify the intraspecific variation. Therefore, we preferred treated this species in *sensu lato* waiting for a deeper examination when flowering

Description and characteristic features:

Rootstock rhizomatous plant with isolate or grouped (1-6) erect stem (35-90 cm high); It has brownish-green sheaths towards the base and often minutely pubescent above. There are about 4 to 9 cauline lanceolate leaves, lowermost rather short and broad, evenly **distributed in a spiral along the stem (in close succession)**.



Epipactis helleborine "sensu lato"

Inflorescence elongate (1/4 to 1/3 the stem), lax to dense, bearing many small spreading flowers. Sepals and petals connivent at the base, forming an open campanulate perianth. Sepals green, sometimes with brownish nerves while petals are pale green sometime purple-violet, ovate or oblong. **Labellum relatively small (9-11 mm),** hypochile brownish green and epichile greenish-white, pink or violet.

Ecological niche in Kurdistan Region areas:

Found occasionally in mi-shaded to shaded fresh places with deep substrate rich in litter in the lower and middle (900-1400 m) forest zone of Iraq among oak and pine woods.



Epipactis veratrifolia subsp. *veratrifolia*

Nomenclature, synonyms, etymology*:

Epipactis veratrifolia Boiss.& Hohen.in P.E.Boissier, Diagn. Pl. Orient. 13: 11 (1854).

***Eastern Marsh Helleborine** (refers to the leaves of the white veratrum (*Veratrum album*)).

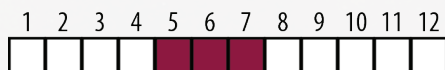
Biogeographical distribution:

Irano-Anatolian

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	
	FNI			

Flowering period:




Systematic remarks:

There is no infraspecific variation reported for Kurdistan Region in Flora of Iraq (Wood, 1985) nor in Flora Iranica (Renz (1978), Flora of Turkey (Renz & Taubenheim, 1984). According to Shifman (2014), the septentrional plants under Mediterranean climate with aestival flowering correspond to subsp. *veratrifolia*, while the meridional ones under Saharian climate with correspond to subsp. *oaseana*, not considered in the Zagros area.

Description and characteristic features:

Rootstock rhizomatous plant, with ascendant grouped (1-6) straight or flexuose erect stem (20-120 cm high). The stem is densely leafy throughout, glabrous below, minutely pubescent to tomentose above. There are about 3 to 10 cauline ovate-lanceolate large leaves. Inflorescence lax to dense, bearing many **relatively large flowers (20-40 mm diam.)**, becoming pendulous with age. The labellum is relatively large; **hypochile narrowly boat shaped** white (up to 10 mm. long) while **epichile ovate-lanceolate reddish-brown** with a purple band and a white apex.

 Picture taken in Turkey



Epipactis veratrifolia subsp. *veratrifolia*

Ecological niche in Kurdistan Region areas:

It is quite common in open habitats, on the calcareous substrate, in the lower (500-1050 m) forest zone of Kurdistan Region; It prefers fresh places near streams, sometimes under oak trees shade or in a damp rock cleft by a waterfall. Despite this species has been reported as quite common in the forest zone of Iraq (Wood, 1985), we missed it in our botanical field explorations!



i Picture taken in Turkey



i Picture taken in Turkey



i Picture taken in Cyprus

Himantoglossum caprinum "sensu lato"

Nomenclature, synonyms, etymology*:

Himantoglossum caprinum (M.Bieb.) Spreng., Syst. Veg. 3: 694 (1826)

subsp. *caprinum*

= *Himantoglossum affine* (Boiss.) Schltr., Repert. Spec. Nov. Regni Veg. 15: 287 (1918).

≡ *Himantoglossum hircinum* subsp. *affine* (Boiss.) H. Sund., Europ. Medit. Orchid., ed. 3: 40 (1980).

***Goat-Like Himantoglossum** (refers to its specific smell scent).

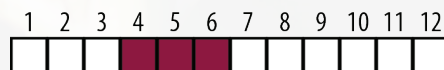
Biogeographical distribution:

NE-Medit.-Caucasian

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	

Flowering period:



Systematic remarks:

The first problem was nomenclatural and was solved recently. Sramkó et al. (2012) shown that the plants of the typical form *H. caprinum* (M.Bieb.) Spreng. subsp. *caprinum* from the Crimean peninsula were similar to the long-time called *H. affine* and then the first name has priority over the latter one. Consequently, the old name *H. caprinum* used in Turkish or Balkans' floras has been misused for another taxon, now described as under the new name *H. jankae* Somlyay, Kreutz & Óvári (Molnar et al., 2012).

The second problem is taxonomic. In Flora of Iraq, Wood (1985) treated this species under the name *Himantoglossum hircinum* (L.) Spreng. subsp. *affine* (Boiss.) Sunderm. with two varieties: var. *affine* (Boiss.) J. Wood (occur occasionally in the central sector of the middle forest zone of Iraq (MAM, MRO, MSU) and var. *pseudocaprinum* J. Wood (endemic and very rare found only in MRO district Kurdistan Region). Nevertheless, the detailed description of his variety *pseudocaprinum* found in the same locality of the typical *affine* encourages us to consider as individual variation and part of the normal intra-population variation. Furthermore, the precise identity of the Kurdish *H. comperianum* sensu lato is still unclear, whereas in Lebanon and in Israel/Palestine have been described new taxa, respectively *H. a.* subsp. *levantinum* (B. Baumann & H. Baumann) Kreutz and *H. galilaeum* Shifman.



Himantoglossum caprinum "sensu lato"

Description and characteristic features:

Rootstock tuberous with an erect, robust, leafy stem (40-70 cm), with 1 or 2 membranous sheaths at the base. Leaves dull bluish-green, the lowermost 7-10 grouped at the base while the uppermost (2-3 cauline) bract-like, often reaching the base of the inflorescence. Inflorescence elongate and lax (10-35) bearing (15-40) flowers, greyish-green and brown. Sepals green, often bordered dull purple or brownish-violet, the veins on the inner surface usually deep purple, connivent to form an obtuse helmet. Petals pale green, linear-lanceolate. Labellum deeply 3-lobed with a **middle lobe brownish green, more or less spirally twisted**, more or less **divided at apex into 2 segments (2-15 mm)**; lateral lobes falcately lanceolate, with undulate margin.

Ecological niche in Kurdistan Region areas:

It is found occasionally in open dry grassy, mi-shaded places, on the calcareous substrate, among trees and shrubs (e.g. *Quercus*, *Juniperus* sect. *Juniperus*, *Crataegus*, *Prunus* sect. *Prunus*, *Prunus* sect. *Amygdalus*) in the central sector of the middle (900-1500 m asl) forest zone of Iraq.



Himantoglossum comperianum

Nomenclature, synonyms, etymology*:

Himantoglossum comperianum (Steven) P.Delforge, Naturalistes Belges 80: 401 (1999).

≡ *Orchis comperiana* Steven, Nouv.Mém. Soc. Imp. Naturalistes Moscou 1: 259 (1829).

≡ *Comperia comperiana* (Steven) Asch.&Graebn., Syn. Mitteleur. Fl. 3: 620 (1907).

***Compère's Himantoglossum** (refers to the name of the plant French discoverer "Compère").

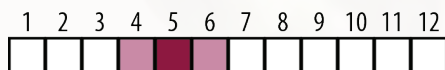
Biogeographical distribution:

NE-Medit.-Caucasian

Distribution in KRAs:

	MAM	MRO	MSU	

Flowering period:



Systematic remarks:

Classically treated in floras under the genera *Orchis* or *Comperia*, it has been recently proposed to be considered in the close genus *Himantoglossum* thanks to morphological, biological and phylogenetical data (Pridgeon et al., 1997; Delforge, 1999). There are no infraspecific variations for this monotypic species.

Description and characteristic features:

Rootstock tuberous plant, having an erect, robust brownish-green stem (25-65 cm high). Leaves 3-4, spreading oblong-lanceolate, with decreasing size, uppermost narrowly elliptic. Inflorescence broadly cylindrical, lax, elongate (up to 25 cm), with large flowers. **Sepals olive-green or more or less brownish-purple, connivent to form an obtuse helmet**; dorsal sepal 3-veined; lateral sepals ovate-ligulate, slightly curved, often reflexed at the apex. Petals pale green, margins slightly sinuate with 1 or 2 fine teeth about the middle of both sides. **Labellum 3-lobed**, pale pink or whitish, convex at the base, **becoming expanded into 4 narrowly linear, pendulous, apical segments** thanks to middle lobe divided into 2 segments, all up to 8(-10) cm. Spur cylindrical, ± obtuse, 12-15 mm., gently curved.



Himantoglossum comperianum

Ecological niche in Kurdistan Region areas:

Wood (1985) reported this species as a rare in Iraq because he only found it in two localities: (i) in Handren mountain in the middle (1200-1300 m) forest zone of Rowendez' mountains (Erbil governorate) (ii) above Penjwin mountain in the forest zone of Sulaymaniyah governorate. During our botanical surveys, we found it in Mateen and Barwarya mountains (MAM), situated in most north-western mountains of Kurdistan Region. We also found it in Halgurd-Sakran mountainous areas around 1100 m asl (MRO) It often grows in damp places with deep soil in open habitat characterized by grassy clearings on dry calcareous substrate among Oak trees and other shrubs.



Picture taken in Lebanon



Picture taken in Lebanon

Limodorum abortivum var. *abortivum*

Nomenclature, synonyms, etymology*:

Limodorum abortivum (L.) Sw., Nova Acta Regiae Soc. Sci. Upsal. 6: 80 (1799)

var. *abortivum*

≡ *Orchis abortiva* L., Sp. Pl. ed. 1: 943 (1753).

***Violet Limodore** (alluding to the ancient Greek name haemodoron reported by Theophrastus).

Biogeographical distribution:

Paleotemperate

Distribution in KRAs:

(MJS)	MAM	MRO	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

Wood (1985) described the species without any precision of infraspecific variations. Furthermore, there isn't any intraspecific variation reported for Kurdistan Region in Flora of Iranica (Renz, 1984) and Flora of Turkey (Renz & Taubenheim, 1984). Nevertheless, Kreutz (1998) reported var. *rubrum* in western Turkey (e.g. Adana, Antalya...) where labellum has more purple-reddish colour. Our findings concern only the typical variety (var. *abortivum*) with a long spur and an open flower with complete labellum with more less violet colour.

Description and characteristic features:

It is a rootstock rhizomatous with violet erect robust stem (up to 80 cm high), bearing numerous violet scale-like sheaths. It is the most **mycoheterotrophic orchids in Kurdistan Region**, with very little or no chlorophyll whit **vestigial leaves** almost absent. It has an elongated (up to 35 cm) inflorescence bringing (4-25) lax open **violet to violet-purple large flowers**. Sepals pale to dark violet while petals are pale violet towards the tip.



 Picture taken in Lebanon

Limodorum abortivum var. *abortivum*

The **labellum** is entire and violet, distinctly **constricted** between the **hypochile** (pale violet) and **epichile** has dark violet longitudinally arranged lines and slightly undulated margins. Spur is hanging down, slender-cylindric relatively long with pale violet colour.

Ecological niche in Kurdistan Region areas:

It found occasional in a wide altitudinal ecological range (900 to 2100 m asl) from lower to upper forest zone in Iraq. It grows mostly in shaded and/or mi-shaded places with deep soil and litter, calcareous substrate, in dry Oak and Pine forest. It occurs often in small populations mostly under *Pinus brutia* and *Quercus aegilops* trees.



Neotinea tridentata subsp. *tridentata*

Nomenclature, synonyms, etymology*:

Neotinea tridentata (Scop.) R.M.Bateman, Pridgeon & M.W.Chase, Lindleyana 12: 122 (1997) **subsp. tridentata**.

≡ *Orchis tridentata* Scop., Fl. Cam. ed. 2, 2: 190 (1772).

***Three-toothed orchid** (refers to its 3-lobed or 3-toothed labellum).

Biogeographical distribution:

S-Europ.-Caucasian

Distribution in KRAs:

(MJS)	MAM	(MRO)		

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

Infraspecific variations only based on morphological data is not clear. Wood (1985) gives for Iraq var. *tridentata* and var. *commutata*. While, Govaerts et al. (2017), following the new genus taxonomy (i.e. *Neotinea tridentata*) give only subsp. *tridentata* for Iraq, because including *N. t.* var. *commutata* (Tod.) Kretz in synonymy. But *Orchis commutata* Tod., the basionym, was described from Sicily as species. What we know is that in Sicily it is a tetraploid element, sometimes considered as a variety (Kretzschmar et al., 2007) probably endemic, other times considered as species and possibly widespread at least in the central-eastern Mediterranean (Delforge, 2005). In another hand, Kretzschmar et al. (2007), recognized two subsp. *tridentata* and *conica*, interpreted as sisters. While *N. t.* subsp. *conica* is a western Mediterranean element, the Mediterranean distribution area of subsp. *tridentata* is fragmented on the northern and eastern Mediterranean sides. In this circumstance, we follow this scheme of the distribution, considering the presence only of the subsp. *tridentata* for the Kurdistan Region of Iraq.



Neotinea tridentata subsp. *tridentata*

Description and characteristic features:

Rootstock tuberous plant reaches heights of 15 to 40 cm with an erect leafy stem with a few highly clasping sheaths above from the centre of the rosette built of 3 to 8 basic leaves, unspotted, silvery grey-green. Floral bracts are lanceolate, acuminate, sometimes rose-tinged, more or less equalling the ovary. **Inflorescence short (10 cm max), dense, weakly conical, bearing many pale rose flowers. Sepals and petals coherent or connivent, forming a loose helmet with sepals divergent at the top.** Labellum (7 to 10 mm long) deeply 3-lobed that are devoid of hair white, pale rose or pale reddish-violet, spotted purple, mid-lobe cuneate, bilobed, often with a small tooth in the sinus, exceeding the lateral lobes. The basic colour of **the labellum is white to pale pink with numerous purple dots** that stretch right to the edges.

Ecological niche in Kurdistan Region areas:

It is a rare species found occasionally on the middle (800-1200 m asl) steppic forest zone of Duhok province. It prefers calcareous substrate, on mi-shaded meadows and dry grasslands on rocky mountain slopes often under oak and Pine trees.



Ophrys bornmuelleri subsp. *carduchorum*

Nomenclature, synonyms, etymology*:

Ophrys bornmuelleri subsp. *carduchorum* Renz & Taubenheim, Orchidee (Hamburg) 31: 242 (1980).

≡ *Ophrys carduchorum* (Renz & Taubenheim) P.Delforge, Naturalistes Belges 71: 127 (1990).

— *Ophrys bornmuelleri* M.Schulze, Mitth. Thüring. Bot. Vereins, n.f., 13-14: 127 (1899), sensu Fl. Iran., Fl. Iraq.

***Carduchians Ophrys** (in honour of the name of the Carduchian antic people).

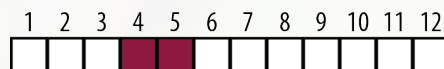
Biogeographical distribution:

Zagrosian endemic
(the species Levantine-Zagrosian)

Distribution in KRAs:

(MJS)	MAM	MRO	(MSU)	

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) just given *O. bornmuelleri* without the precision of any infraspecific variations while Govaerts et al. (2017) name it *O. fuciflora* subsp. *bornmuelleri* (M.Schulze) B.Willing & E.Willing following a very lumper perspective including in synonymy a lot of neighbouring taxa (cf. Pedersen & Faurholdt, 2007; Faurholdt & Pedersen, 2009). Baumann et al. (2006) are the only one to give a subspecific precision for Iraq, considering it as *O. bornmuelleri* subsp. *bornmuelleri*, excluding also *O. bornmuelleri* subsp. *carduchorum* Renz & Taubenheim (endemic to SE-Turkey?) and *O. levantina* Gözl & H.R.Reinhard limited to Cyprus (and the Levant?). Curiously, the Baumann's point of view does not consider that *O. b.* subsp. *carduchorum* was described from Siirt, i.e. the same biogeographic area than the Iraqi southern Zagros, while the typical subsp. *bornmuelleri* was described from the Mediterranean Levantine area. Thus, the consideration of subsp. *bornmuelleri* by Baumann et al. (2006) for Iraq or that subsp. *carduchorum* is a SE-Turkish endemic by Kreutz (1998) were only motivated by a lack of knowledge in the Iraqi area.

Since our first publication (Véla et al., 2013), we have discovered a lot of new localities and our data allow now us to revise our taxonomic position initially kept uncertain ("sensu lato"). The relative size of the labellum is characterised by a short but large shape, making the labellum slightly shorter but slightly larger than the length of sepals. Furthermore, the relative small appendix (not as big as for subsp. *bornmuelleri* and subsp. *ziyaretiana* (Kreutz & Ruedi Peter) Kreutz), and the relative elongated triangular petals (not as short as for subsp. *bornmuelleri*



Ophrys bornmuelleri subsp. *carduchorum*

and *O. levantina* Gözl & H.R.Reinhard) confirm the identity of our plants with *O. b.* subsp. *carduchorum*. Logically, this subspecies shows a continuous distribution area from Lice (N of Diyarbakir, Turkey) to Choman (NE of Erbil, Iraqi Kurdistan).

Description and characteristic features:

The plant has an erect slender stem (10-40 cm.) with two tubers often one sessile and other stipulate. Leaves 3-4 narrowly elliptic-obovate grouped near the base. Inflorescence elongate usually lax with 2-12- flowers. **Sepals pale-green or whitish with a dark green mid-nerve**, the lateral reflexed or spreading while the dorsal arched forward. **Petals small, elongated triangular** (at least 1.5 more long than large), yellowish-greenish to pale-rose-greenish, the edges somewhat villous. Labellum purplish-brown convex or rather rounded, entire, subquadrate or trapeziform-flabellate, the apical **appendage is subquadrate glabrous**, moderate big, yellowish-green, and two small conical bosses with a small marking between, **resembling a short-branched letter H**.

Ecological niche in Kurdistan Region areas:

Wood (1985) had reported that *O. bornmuelleri* was only found once in the mountains of Erbil Province more than 80 years ago near Seri Hassan Beg (MRO). While, we found it, during our botanical surveys, several times in the mountains of Duhok governorate (MAM) and twice in Halgurd-Sakran mountainous areas (MRO). It grows mostly in mi-shaded places, on the calcareous substrate, under Oak trees and Juniper shrubs on the lower and middle (500-1100 m asl) forest zone. It occurs sometimes in open fresh grassland habitats on the north-western exposition above the valleys.



Ophrys cilicica

Nomenclature, synonyms, etymology*:

Ophrys cilicica Schltr., Repert. Spec. Nov. Regni Veg. 19: 45 (1923).

= *Ophrys kurdica* D.Rückbr. & U.Rückbr., Orchidee (Hamburg) 26: 164 (1975)

***Cilician Ophrys** (referring to its geographical distribution on Cilician region).

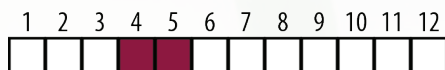
Biogeographical distribution:

Cilician-Zagrosian

Distribution in KRAs:

	MAM	(MRO)	(MSU)	

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) doesn't mention its presence in Iraqi territories. Indeed, Baumann et al. (2006) cited it as "S-, SE-Turkey, N-Syria, Iran (Kurdistan)"; and Govaerts et al. (2017) confirmed its occurrence only for "S- & SE-Turkey to N-Syria and Iran". But Wood (1985) give for Iraq the relative neighbour rare taxa *O. reinholdii* subsp. *strausii* as "only found once" and curiously the drawing is based on Turkish material. (sic)! Thus, was *O. cilicica* really new for Iraqi Kurdistan and *O. reinholdii* subsp. *strausii* not seen for a long time? Consequently, we formulated the hypothesis that it was possible that *O. cilicica* was confused with *O. reinholdii* subsp. *strausii*. However, during our continuous botanical surveys (2 years later, in 2015), we re-discovered *O. r.* subsp. *strausii* in different locations (e.g. Hariké and Beduhé) on mountains of Duhok governorate; and therefore, we confirmed officially the real presence of the two taxa in Kurdistan Region of Iraq.



Ophrys cilicica

Description and characteristic features:

Plants have an erect slender stem (15-40 cm), with 1-5 leaves, crowded near the base. Inflorescence, lax to dense with 3-12 flowers. Sepals greenish, or more or less suffused with rose, laterals always opened while dorsal sometimes curved forwards. **Petals linear**, minutely hairy, greenish or suffused brownish-rose. **Labellum** deeply **3-lobed, narrowed towards the base**, spiculate at apex, without distinct appendix; middle lobe with reflexed margins, **thus appearing narrow**, tapering towards apex into a point, **brown to purplish-brown** velvety; **speculum whitish** or very pale yellowish-green, **complex and variably drawn**.

Ecological niche in Kurdistan Region areas:

We reported officially for the first time its presence as a new record in Kurdistan Region of Iraq. During our botanical field surveys, we found two localities in a small area (Atrush and Bakrman) at southern-western of Duhok Province between Akre and Duhok city. It occurs mostly in open habitats on the lower (800-900 m asl) Oak forest of Gara mountains. It grows relatively in dry grassland places, sometime in mi-shaded places under Oak trees and Juniper shrubs.



Ophrys mammosa subsp. *mouterdeana*

Nomenclature, synonyms, etymology*:

Ophrys mammosa subsp. *mouterdeana* B.Baumann & H.Baumann, J. Eur. Orch. 37: 263 (2005).

—*Ophrys sintenisii* H.Fleischm.&Bornm., Ann. Naturhist. Mus. Wien 36: 10 (1923), sensu Nouv. Fl. Lib. Syr.

—*Ophrys transhyrcana* Czerniak., Bot. Mater. Gerb.Glavn. Bot. Sada R.S.F.S.R. 4: 1 (1923) subsp. *transhyrcana* sensu Fl. Turk.

—*Ophrys sphegodes* subsp. *transhyrcana* (Czerniak.) Soó, Acta Bot. Acad. Sci. Hung. 5: 444 (1959), sensu Fl. Iraq, Fl. Iran.

***Mouterde's Spider orchid** (alluding to the name of famous French botanist Mouterde).

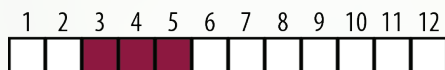
Biogeographical distribution:

Levantine-Zagrosian

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	
	FNI	FAR		

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) reported *O. sphegodes* subsp. *transhyrcana* while Govaerts et al. (2017) name it *O. sphegodes* subsp. *mammosa* following an extreme lumpers perspective including the whole complex in synonymy (Perdersen & Faurholdt, 2007; Faurholdt & Pedersen, 2009). On another hand, Baumann et al. (2006) distinguished seven subspecies and they don't cite explicitly for Iraq any species or subspecies from this aggregate. They are giving *O. mammosa* subsp. *mammosa* from Albania to Cyprus, but are writing "eastern border unclear". They are limiting *O. mammosa* subsp. *cyclocheila* (Aver.) B. Baumann, H. Baumann, R. Lorenz & Ru. Peter to NW-Iran and *O. transhyrcana* Czerniak. (treated as separate species) to N- and NE-Iran and Turkmenistan. Finally, another taxon named *O. mammosa* subsp. *mouterdeana* B. Baumann & H. Baumann is proposed replacing subsp. *mammosa* in Mediterranean coasts from S-Turkey to Israel/Palestine. In Turkey, Kreutz (1998) was considering *O. Mammosa* s.s. limited to Mediterranean coasts and *O. transhyrcana*, considered in a broad sense, present in S- and SE-Turkey. But in the second edition (Kreutz & Çolak, 2009) he recognises the new taxa under the name *O. transhyrcana* subsp. *mouterdeana* (B.Baumann & H.Baumann) Kreutz. In our plants, the petals are not very long nor undulate, excluding *O. Transhyrcana* sensu stricto. The blunt protuberances on the labellum are excluding the true *O. mammosa* s.s.. Finally, only *O. mammosa* subsp. *cyclocheila* and subsp. *mouterdeana* are possible candidates for naming to our plants. The first is described from Azerbaijan in 1994, the second from Lebanon



Ophrys mammosa subsp. *mouterdeana*

in 2005. At this step, we are led to consider it as subsp. *mouterdeana*, illustrating an extension of the Mediterranean influences into the southern Zagros area.

Description and characteristic features:

The plant has an erect slender stem (15-40 cm), with 2-5 leaves, crowded near the base. Inflorescence, lax to dense with 3-12 flowers. Dorsal **sepal greenish**, **lateral ones half green up, half purplish down**. **Petals ribbon-like, glabrous** or subglabrous, greenish, suffused brownish-rose. **Labellum** slightly 3-lobed, narrowed towards the base, **spiculate at apex**, without strong appendix; **partially convex, brown** to purplish-brown velvety; **speculum** greyish-bluish sometimes iridescent, **H shaped**.

Ecological niche in Kurdistan Region areas:

It is quite common in the lower and middle (500 to 1400 m) forest zones of Iraq. It occurs in relatively open dry grassland habitats on the calcareous substrate. It occurs sometime in mi-shaded fresh places among Oak trees and prickly Juniper shrubs on a rocky limestone ledge above gorge a near a stream.



Ophrys reinholdii subsp. *straussii*

Nomenclature, synonyms, etymology*:

Ophrys reinholdii subsp. *straussii* (H.Fleischm.) E.Nelson, Gestaltw.Arthb.

Orchid. Eur. Mittelmeer 1: 149 (1962).

≡ *Ophrys straussii* H.Fleischm., Beih. Bot. Centralbl. 33(2): 204 (1915).

= *Ophrys kurdistanica* Renz, Fl. Iranica 126: 83 (1978).

= *Ophrys reinholdii* subsp. *leucotaenia* Renz & Taubenheim, Orchidee (Hamburg) 31: 238 (1980).

≡ *Ophrys straussii* var. *leucotaenia* (Renz & Taubenheim) R.Peter, Mitt. Arbeitskreis Heimische Orchid. Baden-Württemberg 24: 575 (1992).

***Reinhold's Ophrys** (in honour to the Greek Doctor "Reinhold").

Biogeographical distribution:

Cilician-Zagrosian

Distribution in KRAs:

	MAM	MRO	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

Wood (1985) gave two subspecies for *Ophrys reinholdii*: (i) subsp. *reinholdii* ("occurs throughout the western range of the species on NE Mediterranean and has not been found in Iraq") (ii) subsp. *straussii* well distributed in Irano-Turanian region and present in Iraqi territories. Renz (1978) confirmed also the presence of the *O. r.* subsp. *straussii* for the Kurdistan Region of Iraq. Baumann et al. (2007) have distinguished another subsp. *antiochiana* (H.Baumann & Künkele) H.Baumann & R.Lorenz, which occurs in Antakya S of Turkey not far from NW Syrian border. In Kurdistan territories, Youssef et al. (2015) confirmed only the presence of subsp. *straussii*.

Description and characteristic features:

It is a tuberous plant, with an erect leafy (30-60 cm) stem, with 1-2 sheaths above, naked below the inflorescence. It has 3-6 lanceolate, rosulate leaves. Inflorescence elongate, with 3-10 lax flowers. **Sepals often rose**, sometimes whitish or greenish-rose with a dark green midnerve, spreading to reflexed, **petals ligulate**, pink brownish to dark violet-rose. **Labellum is deeply 3-lobed**, 12-15 mm long, slightly convex downward with a broad greenish border; mid-lobe **dark brown**, **speculum snowy-white**, consisting of **two spots** or parallel lines sometimes joined at base (like the Greek letter "Pi": Π); **lateral lobes purple-brown with smoothed gibbosities**, often whitish outside ("var. *leucotaenia*") or otherwise entirely brownish. **Apical appendage small** often reduced to a triangular mucro.



Ophrys reinholdii subsp. *straussii*

Ecological niche in Kurdistan Region areas:

Generally, it is found in hills and mountains of Duhok district from 700 to 1700 m asl. It prefers shady and relatively humid places under Pine trees of Zawita forest and Oak trees. According to Flora of Iraq, it is considered as very rare species because it was seen only once in the central mountains of Erbil governorate (Wood, 1985); Recently, it has been seen several times during our botanical survey in different locations and is now known in other mountainous localities e.g. Hariké, Beduhé (MAM) and Halgurd-Sakran mountainous areas around 1000-1700 m asl (MRO).



Ophrys schulzei "sensu lato"

Nomenclature, synonyms, etymology*:

Ophrys schulzei Bornm.&Fleischm., Mitth. Thüring. Bot. Vereins, n.f., 28: 60 (1911).

Ophrys schulzei subsp. *kurdica* H.Fleischm., Beih. Bot. Centralbl. 33(2): 204 (1915)

Ophrys luristanica Renz, Orchidee (Hamburg) 24: 47 (1973)

***Schulze Ophrys** (in dedication to the German botanist "Schulze"(1841-1915)).

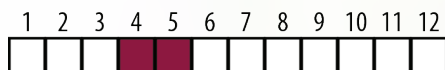
Biogeographical distribution:

Levantine-Zagrosian

Distribution in KRAs:

	MAM	MRO	MSU	

Flowering period:



Systematic remarks:

No infraspecific variations were reported by Wood (1985), Renz & Taubenheim (1984) or Renz (1978) for Iraqi territories. Nevertheless the subspecies *kurdica* considered as a synonym should be reinvestigated, particularly seeing the variability of ours samples.

Description and characteristic features:

It is a tuberous plant, with slender, erect leafy stem (25-65 cm). Leaves 4-5, narrowly elliptic to lanceolate. Inflorescence lax elongate (reaches to 20-30 cm.), bearing **many spreading lax small flowers**; **Sepals reflexed, pink** or violet-rose with a green mid-vein, while **petals are minutes, elongated triangular, rose-violet**, velvety near the base, papillose towards the apex. **Labellum distinctly 3-1 lobed, strongly convex; lateral lobes large, forming obtuse cones hairy outside**; while mid-lobe dark brown, strongly convex, **margin and apex revolute**; speculum reddish-brown, irregular, extending from the base to almost the apex of the mid-lobe and diverging in varying ways towards the sides, enclosing a central dark brown; **apical appendage greenish-yellow, large, entire or slightly tridentate, recurved downside**.

Ecological niche in Kurdistan Region areas:

It occurs occasionally, locally frequent, in the lower to the middle (600-1400 m) of forest zone of Iraq. It prefers open damp grassland places, sometimes under amidst Oak trees on the calcareous substrate.



Ophrys umbilicata subsp. *khuzestanica*

Nomenclature, synonyms, etymology*:

Ophrys umbilicata subsp. *khuzestanica* Renz & Taubenheim, Notes Roy. Bot. Gard. Edinburgh 41: 273 (1983).

≡ *Ophrys khuzestanica* (Renz & Taubenheim) P.Delforge, Naturalistes Belges 71: 127 (1990).

—*Ophrys carmeli* H.Fleischm. & Bornm., Ann. Naturhist. Mus. Wien 36: 7 (1923), sensu Fl. Iran.

—*Ophrys attica* (Boiss. & Orph.) Soó, Notizbl. Bot. Gart. Berlin-Dahlem 9: 909 (1926), sensu Nouv. Fl. Lib. Syr.

—*Ophrys umbilicata* subsp. *carmeli* (H.Fleischm. & Bornm.) J.J.Wood, Kew Bull. 38: 136 (1983), sensu Fl. Iraq.

***Khuzistan Ophrys** (referring its discovery from Khuzistan, Iran).

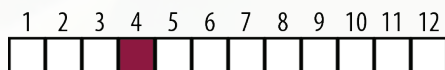
Biogeographical distribution:

Zagrosian endemic
(the species Levantine-Zagrosian)

Distribution in KRAs:

(MJS)	MAM	MRO	MSU	
	(FNI)			

Flowering period:



Systematic remarks:

In Flora of Iraq, Wood (1985) reported *Ophrys umbilicata* subsp. *carmeli* for Iraq while Govaerts et al. (2017) name it *O. umbilicata* subsp. *umbilicata* following the same lumpers perspective including inter alia subsp. *carmeli* and subsp. *khuzestanica* in synonymy. Whoever, Baumann et al. (2006) indicated subsp. *khuzestanica* for Iraq, as a related taxa described from W-Iran and endemic from Kurdistan area (E Turkey, N Iraq, W & S Iran), and are considering subsp. *carmeli* as synonymous with *O. umbilicata* subsp. *umbilicata*. The same position is proposed by Kreutz (1998), but treated as species rank: in Turkey, *O. umbilicata* s.s. is limited to Mediterranean coast while *O. khuzestanica* (Renz & Taubenheim) P. Delforge is limited to Kurdish mountains in SE Anatolia. Indeed, in our plants, the high number of flowers (8 to 13) with small labellum and green sepals exclude subsp. *umbilicata* and confirm their identity as subsp. *khuzestanica*.

Description and characteristic features:

Tuberous plant with erect leafy stem (20-45 cm). Leaves (4-6) acute, minutely apiculate, rosulate near the base. **Inflorescence elongate**, dense, **with 8-14 small flowers**. Bracts narrowly elliptic, lower sometimes equalling or exceeding flowers. **Sepals greenish** or green, **the dorsal one folded back on the gynostema**, **petals olive-green** coloured. **Labellum deeply 3-lobed** with a distinctly excised sinus between the mid and lateral lobes; **lateral lobes protuberances with short horns**; **middle lobe convex**, oblong, fan-shaped



Ophrys umbilicata subsp. *khuzestanica*

when spread out, brownish to brownish-purple velvety, with yellowish **appendix erected forward** ; speculum complex and large, reddish-brown with a creamy-white border usually encircling only 3 patches; basal field dark brown with a pale violet border.

Ecological niche in Kurdistan Region areas:

It occurs occasionally in the lower and middle (500-1200 m) forest mountains zone. It is found mostly in damp places on the calcareous substrate, in mi-shaded under Oak trees and Juniper shrubs, on a rocky slope between vineyards.



Orchis punctulata

Nomenclature, synonyms, etymology*:

Orchis punctulata Steven ex Lindl., Gen. Sp. Orchid. Pl.: 273 (1835).

***Punctate orchid** (indicating to the dark coloured spots on the labellum).

Biogeographical distribution:

NE-Medit.-Caucasian

Distribution in KRAs:

	(MAM)	(MRO)	MSU	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

There are no infraspecific variations for Iraqi territories (Renz 1978; Renz & Taubenheim 1984; Wood, 1985) despite its discontinuity and dispatched geographic distribution according to Kretzschmar (2007). Both *Orchis sepulchralis* Boiss. ex Soó and *Orchis schelkownikowii* Woronos are currently classified as synonyms of *Orchis punctulata* after examination of the type material.

Description and characteristic features:

Punctate orchid actually is the unique *Orchis* taxa occurring in Kurdistan Region that have yellow flowers. It has **yellowish-green sepals outside** (with brownish dotted lines along the veins inside) **and petals** incline with them to **form a helmet**. It is a quite large robust plant having a stout erect stem (25 to 80 cm). The inflorescence is quite tall (15 to 40 cm), subcylindrical, may consist of about 100 flowers. It has a 3-8 unspotted shiny lanceolate green leaves, mostly rosulate. **The labellum** is distinctly three-lobed; both **tongue-shaped side lobes** bend inwards at the tip. The tips of the central and side lobes are often **coloured reddish-brown**. Spur green or yellowish-green, broadly cylindrical, about half as long as the ovary.



Orchis punctulata

Ecological niche in Kurdistan Region areas:

Punctate orchid occurs mostly in meadows and marshy places in mountain valleys among Oak and Pine forest. According to Wood (1985), it is considered as an extremely rare species in Kurdistan Region because it had been only found once (a single plant) about 80 years ago in the lower forest zone, at 600 m asl, on Sulaymaniyah district (MSU).



i Picture taken in Lebanon



i Picture taken in Cyprus



i Picture taken in Lebanon



i Picture taken in Cyprus

Orchis simia subsp. *simia*

Nomenclature, synonyms, etymology*:

Orchis simia Lam., Fl. Franç. 3: 507(1779), subsp. *simia*

***Monkey orchid** (refers to the monkey shape of its flowers).

Biogeographical distribution:

Paleotemperate

Distribution in KRAs:

	MAM	MRO	(MSU)	

Flowering period:

1	2	3	4	5	6	7	8	9	10	11	12

Systematic remarks:

In Flora of Iraq, Wood (1985) had not reported any infraspecific precision; Since the description of *Orchis taubertiana* B. Baumann & H. Baumann endemic of Cyrenaica in 2001 and its reclassification as a subspecies of *O. simia* (Kreutz, 2004), the subsp. *simia* is the name of the dominant taxa occurring in the general area including Kurdistan Region of Iraq and the whole Middle East. Especially since the Transcaucasian *Orchis stevenii* Rchb.f. is now considered as a subspecies of *O. militaris* L. but no longer of *O. simia*.

Description and characteristic features:

Monkey orchid has two elongated ovoid or ellipsoid tubercles. It has a green erect stem about 20 to 45 cm high with 3 to 6 shiny green, unspotted, oblong-elliptic or oblong-ovate basic leaves in a rosette. It has a **broad short dense inflorescence** (about 3-9 cm high) carrying many **flowers which open from the top downwards**; Floral bracts are triangular-ovate to elliptic and shorter than the ovary. Sepals and petals are coherent or connivent in a loose helmet, **sepals are whitish to pale greyish-pink outside** but purple spotted inside, like petals.



Orchis simia subsp. *simia*

The **labellum** is **deeply four-lobed evocating arms and legs of a monkey**; two basal linear pink lobes; the central main lobe white and purple spotted being distinctly divided into 2 other narrowly linear pink lobules with a small additional tooth between them.

Ecological niche in Kurdistan Region areas:

It is found occasionally in open Oak forest at the bottom and middle (750 to 1300 m) of the southern side of Mateen and Gara, and the Halgurd-Sakran mountainous areas. It occurs in relatively deep soil pockets under Oak trees and perhaps under the shrubs of prickly Juniper. Even though in Atrush district, it found under Pine trees. Its presence in western mountains of Duhok Province had well been reported by Wood (1985); while we added new localities at the eastern border from MRO (Erbil Province).



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7. Authorship and biographies

Sami Youssef and Errol Vêla wrote the scientific chapters. Sami Youssef, Ahmed Mahmood, and Honar Mahdi conducted field prospections in Duhok governorate. Ali Galalae conducted field prospections in the Erbil and Sulaymaniyah governorates.

Photographs were taken by Sami Youssef except for the following orchid species: *Anacamptis laxiflora* subsp. *dielsiana* by Karel Kreutz (1st, 2nd, 3rd pictures) and Ali Galalae (4th picture) ; *Dactylorhiza umbrosa* by Ali Galalae ; *Dactylorhiza iberica*, *Himantoglossum caprinum* “sensu lato” (3rd, 4th pictures), *Himantoglossum comperianum* (3rd, 4th pictures) and *Limodorum abortivum* var. *abortivum* (1st picture) by Julien Viglione ; *Epipactis helleborine* “sensu lato” by Ali Galalae (3rd, 5th pictures), Julien Viglione (1st, 4th pictures) and Zerevan Merguê (2nd picture), *Epipactis veratrifolia* subsp. *veratrifolia* by Julien Viglione (1st, 2nd, 3rd pictures) and Michel Geniez (4th picture), *Orchis punctulata* by Julien Viglione (1st, 2nd, 4th pictures) and Michel Geniez (3th, 5th pictures).

Illustration p.55, book design and page layout by Ugo Schumpp ; completed on the 25th of February 2019.

This document should be cited as following (e.g. in APA style):

Youssef, S., Galalae, A., Mahmood, A., Mahdi, H., & Vela, E. (2019). *Wild orchids of the Kurdistan Region areas: a scientific window on the unexpected nature of the North-Western Zagros*. La Motte-d'Aigues (FR): Société Méditerranéenne d'Orchidologie, 164 p. ISBN: 978-2-900082-08-9.



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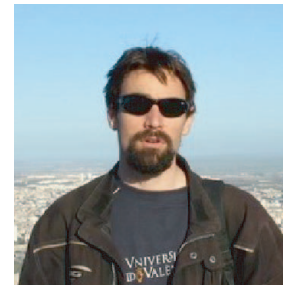
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Scientific abstract:

This illustrated electronic book is about the natural history of the Kurdish autonomous region of Iraq and its surroundings. It focuses on the Orchidaceae botanical family as a windows on the biodiversity of the North-Western Zagros, part of the Irano-Anatolian biodiversity hotspot.

A general introduction presents the main aspects of orchids as their biology, their classification, their traditional use (salep), their ecological significance and their presence in the Kurdistan Region areas (KRAs).

A biogeographical analysis presents the main factors influencing the biodiversity of the KRAs: the landscape, the climate, the geology, the natural vegetation, the nature protection and the human activities.

This fruitful collaborative project aims to fill a gap about the biodiversity knowledge in the hope of setting an example and a basis for future works on orchids or other taxa, by the same team or other ones in the KRAs. The studied territory is divided in accordance with the Flora of Iraq traditional classification. The genera and species nomenclature follows an up-to-date and argued point-of-view. Each species is described according to its morphological characteristics, its field ecology, its global biogeography, its regional chorology (both from classical literature and from current field data) and its phenology (flowering period).

A monographic chapter presents the 26 species historically found in Iraq, all of them at least in the Kurdistan Region areas if not exclusive. Three of these species were not recently found on the field, but also insufficiently sought (*Dactylorhiza iberica*, *Epipactis veratrifolia* subsp. *veratrifolia*, *Orchis punctulata*). Inversely, four of these species were recently discovered as new for Iraq according to the team's published works. None of them are strictly endemic to the studied territory but two are Zagrosian endemic (*Ophrys bornmuelleri* subsp. *carduchorum* and *Ophrys umbilicata* subsp. *khuzestanica*) and six are Cilician-Zagrosian or Levantine-Zagrosian subendemic species or subspecies. Most of them are present and generally widely distributed in the northernmost areas (mountain forests zone). Only four are also historically known in the foothill zones (*Anacamptis collina*, *Anacamptis coriophora* subsp. *fragrans*, *Epipactis veratrifolia* subsp. *veratrifolia*, *Ophrys mammosa* subsp. *mouterdeana*), where they were not recently seen but also not sought either.



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ISBN: 978-2-900082-08-9