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ARTICLE

First Record of Fourteen Plant Species in the Western Izarene Massif (Prerif, Morocco)

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ABSTRACT

As part of the continuity of our floristic work carried out between June 2021 and July 2024 in the Ouezzane region, we carried out a botanical study in the western part of the Izarene massif, which is part of the Prerif-Moyen Sebou region and corresponds to the Maroc atlantique nord-1 (Man-1) division. Field surveys of the territorial municipalities of Asjen and Brikcha and the Brikcha Site of Biological and Ecological Interest (SBEI) have enabled us to report for the first time the presence of fourteen species belonging to eleven families and fourteen genera, of which *Lilium candidum* is reported for the first time in Moroccan vascular flora. These are *Biscutella pseudolyrata*, *Bolboschoenus glaucus*, *Crepis vesicaria* subsp. *stellata*, *Gagea fibrosa*, *Glinus lotoides*, *Hedera maroccana*, *Juniperus oxycedrus* subsp. *oxycedrus*, *Laurus nobilis*, *Quercus coccifera*, *Senecio glaucus* subsp. *coronopifolius*, *Silene sclerocarpa*, *Scorzonera hispanica* subsp. *hispanica* and

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ARTICLE INFO

Received: 24 August 2024 | Revised: 24 September 2024 | Accepted: 30 September 2024 | Published Online: 14 October 2024
DOI: https://doi.org/10.30564/jees.v6i3.7112

CITATION

Chriqui, A., Benkhnigue, O., Mouniane, Y., et al., 2024. First Record of Fourteen Plant Species in the Western Izarene Massif (Prerif, Morocco). Journal of Environmental & Earth Sciences. 6(3): 273–288. DOI: https://doi.org/10.30564/jees.v6i3.7112

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Thymbra capitata. Among these new species, we counted two endemics, one of which is strictly Moroccan (*Biscutella pseudolyrata*) and one that shares endemism between Morocco and Algeria (*Hedera maroccana*). Two species are rare and two are threatened with extinction. These additions represent an update of data concerning the flora of Man-1. Indeed, a synthesis of all the publications on the update of the vascular flora of Man-1 will be an important contribution to improving scientific knowledge on the distribution of new species in this division.

Keywords: Floristic Diversity; Geographical Distribution; Middle Sebou; Brikcha SBEI Morocco

1. Introduction

From a floristic point of view, Morocco has been divided into 11 main biogeographical divisions and 38 secondary divisions[1], including Man. Man is a natural region characterized by its diversity and wealth of flora. It is renowned for its Maamora, Morocco's largest cork oak forest (Suberaie). The cork groves of Maamora and Larache alone account for 44% of the total area of the national cork grove[2]. According to Fennane and Ibn Tattou[3], North Atlantic Morocco (Man) is home to dozens of Sites of Biological and Ecological Interest (SBEI). Three categories can be distinguished. Continental Sites of Biological and Ecological Interest, wetlands: Aïn de Bou Adel, Idriss 1st Dam, Daya Sidi Bettache, Dayet Arroumi, Dwiyate Fes, Marais du Bas Loukkos (Larache), Merja Bokka, Oued Fouwarate, Body of water Amghass and Sidi Bou Ghaba. Coastal Sites of Biological and Ecological Interest: Bou Regreg, Falaise Sidi Moussa, Merja Bargha, Merja Halloufa, Merja Oulad Skhar, Merja Zerga (Moulay Bousselham Lagoon) and Sansouire du Sebou. Sites of Biological and Ecological Interest in the continental terrestrial zone: Bou Riah Bedouz, Brikcha, Dayas de la Maamora, El Harcha, Jbel Amergou, Ouardane, Jbel Bouhachem, Jbel Haabib, Jbel Lalla Outka, Jbel Zerhoun, Kharrouba, Khatouat, Khemis Es Sahel, Ment, Oued Cherrat, Oued Korifla, Souk El Had and Tsili. Given Man's rich flora, it has attracted the attention of botanists. Several floristic and ethnobotanical studies have been carried out. These include the studies of the following scholars: Hammada et al.[4], Hseini and Kahouadji[5], Orch et al.[6], Bouayyadi et al.[7], Slimani et al.[8], Alaoui and Laaribya[9], Laouzazni et al.[10], Jbilou et al.[11], Boudik et al.[12] and Mouniane et al.[13].

Man is subdivided into four parts of unequal size: Man-1, Man-2, Man-3 and Man-4. Two bioclimatic stages can be distinguished: sub-humid and semi-arid, giving it a special geographical and orographic position. To the west of the Izarene massif, part of Man-1, our study occurred in the territorial municipalities of Asjen and Brikcha and Brikcha SBEI. Our study area represents a very small portion of the Man-1 biogeographical unit, around 1.7% of its total surface area. It lies to the N-N-W of Man-1, and a very small part of its western boundary is in direct contact with Man-2 (Gharb). Historically, the Izarene massif was a region little studied by botanists, and as a result its plant life was poorly known and little explored. The scarcity of bibliographical documents we have managed to gather on floristic studies bears witness to this. Indeed, only one study dealing with taxonomic floristics was found[6]. In most cases, botanists are unable to draw up complete inventories covering the entire floristic potential of the region under study, so an update would be necessary. From June 2021 to the end of July 2024, field missions were carried out at the main sites where spontaneous vegetation persists. The result is an updated floristic inventory whose analysis in terms of the biogeographical distribution of species appears useful.

2. Presentation of the Study Area

Almost entirely shared between the territorial municipalities of Asjen and Brikcha, with a small part attached to the territorial municipality of Ain Beida, the prospected area is located to the north of the town of Ouezzane, in the Moukrissat cercle and is administratively part of the Tangier-Tetouan-Al Hoceima region. It covers an area of 314.51 km^2, including 8.01 km^2 of Brikcha SBEI and a perimeter of 109.78 km, and lies between 5°30′20″ and 5°45′35″ West longitude, between 34°48′37″ and 35°2′2″ North latitude. The climate is sub-humid, characterized by dry, hot summers with temperatures ranging from 26 °C to 44 °C, and cold to mild winters with temperatures ranging from 8 °C to 1 °C. Average annual rainfall varies between 700 mm per year and 900 mm per year with inter-annual irregularity[14]. It

belongs to the thermo-Mediterranean vegetation zone. In relation to the geographical map of Morocco, the study area is located to the north-northwest of Man-1, itself one of the four parts making up Man (**Figure 1**). Altitude varies from 55 m recorded at the edge of Oued Loukkos to 628 m above sea level at the mountain of Moulay Abdeslam Derebetta.

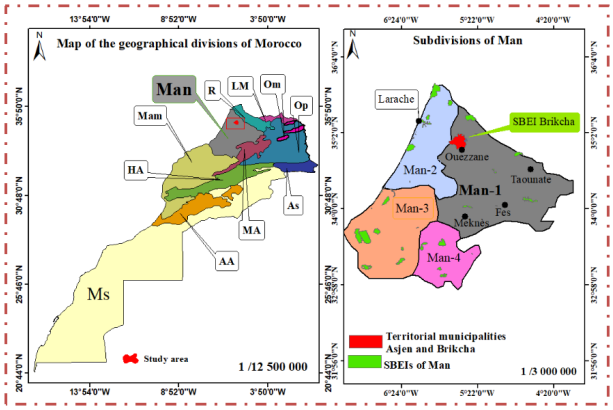


Figure 1. Location of the study area in the map of the geographical division of Morocco. (Fennane and Ibn Tattou, 2017[15]).

Note: As: Saharan Atlas; AA: Anti Atlas; HA: High Atlas; MA: Middle Atlas; Mam: Middle Atlantic Morocco; Man: North Atlantic Morocco; Ms: Morocco Saharan; Op: Eastern Morocco plateaus; Om: Mountains of eastern Morocco; LM: Mediterranean coastline; R: Rif.

3. Materials and Methods

3.1. Materials

To identify new species in the study area, we referred to relevant literature such as the three volumes of the Practical Flora of Morocco[16–18], and the two volumes of the Vascular Flora of Morocco: Inventory and Chorology[19, 20]. In order to categorize species conservation according to the evaluation criteria indicated by the International Union for Conservation of Nature (IUCN), the Red Book of Vascular Flora of Morocco was used to identify threatened and endemic species Fennane[21]. By referring to the Catalog of Rare, Threatened or Endemic Vascular Plants of Morocco[1], rare species were identified.

Taxa not previously cited in the botanical publications of the Rabat Scientific Institute are considered new to the region. The Geographic Information System (GIS) with ArcMap software was used to geolocate the sites in geographic coordinates degrees minutes seconds WGS84 and to establish the map of the geographic division and the map of distribution of the fourteen new species in the study area. For illustration purposes, photos of each species were taken in the field.

3.2. Methodology

Our field study was carried out for three successive years from June 2021 to July 2024. Indeed, via the combination of two sampling methods the floristic inventory of the study area has already been established. The first method is the surface survey. In order to complete the floristic list, the second method of traveling survey was employed. According to this method, the route of different fragments including watercourses and in all directions was carried out to cross the species that were not encountered during the first method. The second step is based on the bibliographic study to identify new species. Thus, the geographical distribution of each species as prescribed in the Practical Flora of Morocco has been carefully studied. Consequently, the consideration of the floristic novelty of the species inventoried in the Man was revealed. The nomenclature has been updated according to the nomenclature of the International Plant Names Index (IPNI) database available online at https://www.ipni.org/.

For each taxon, families are presented in alphabetical order, grouped into gymnosperms, monocotyledonous angiosperms and dicotyledonous angiosperms. The date of first observation, distribution in the study region (The different geographical localities where the species in question have been found are mentioned), distribution in the different biogeographical divisions, endemism, rarity, altitude, geographical coordinates, accompanying species and some additional data are also included. Collected specimens are kept in the National Herbarium at the Rabat Scientific Institute.

4. Results

The floristic study carried out in the study area between June 2021 and July 2024 resulted in the census of 471 species belonging to 301 genera and 84 families Chriqui et al.[22, 23]. The analysis of the geographical distribution of the inventoried species allowed us to report for the first time the presence of fourteen species in Man-1 and by extension in Man (**Figure 2**).

In order to complete the data on the new species, and thanks to observations made in the field over three successive years, we were able to identify the distribution and locations of the said species. It should be noted that *Quercus coc-*

cifera is widely distributed in the north-east of the study area, its places of existence are schematically noted, while the geographic coordinates of thirteen other species are precise.

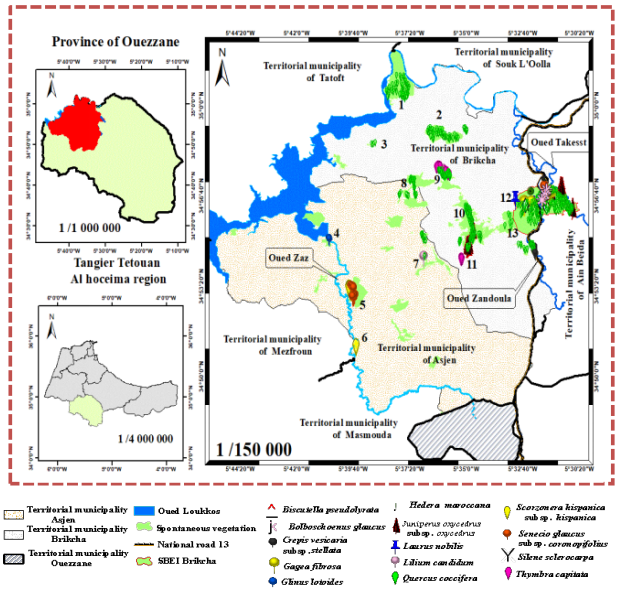


Figure 2. Distribution of the fourteen new species in the study area.
Note: 1: Mountain Righa; 2: Mountain Beni Ahmed; 3: Mountain Ain Hessen; 4: Oued Zaz; 5: Colline Douar Dechiar; 6: Akebaa el kessar; 7: Mountain Sidi Ali Al Jawzi; 8: Mountain Dar Mouden; 9: Mountain Al Adamin; 10: Mountain Moulay Abdeslam Derebetta; 11: Mountain Talla; 12: Ain Bekkar; 13: SBEI Brikcha.

4.1. Gymnosperms

4.1.1. Cupressaceae

Juniperus oxycedrus subsp. *oxycedrus*

It is one of two subspecies of the *Juniperus oxycedrus* species. Its presence was attested for the first time during a floristic inventory campaign in early autumn 2022, more precisely at the end of September 2022. In the Brikcha forest, Canton of Zregfet, five species were found in Bab Daw (5°34′44″ W; 34°54′45″ N) and one on the southern third of the upper eastern slope of the same forest (5°34′44″ W; 34°55′26″ N). Elevations ranged from 364 m to 480 m. In fall 2023, seven other plants were found in Brikcha SBEI on the bed of Oued Takesset in mid-October (**Figure 3**). The first species is located on the eastern boundary at an altitude of 140 m (5°30′37″ W; 34°56′11″ N). About 2 km north of this first plant, the other six plants grow at an altitude of 120 m (5°31′22″ W; 34°56′55″ N). The accompanying species are essentially *Arbutus unedo* L., *Calicotome villosa* (Poiret) Link, *Ceratonia siliqua* L., *Cistus albidus* L., *Cistus monspeliensis* L. *Olea europaea* L., *Phillyrea latifolia* L., *Pistacia lentiscus* L., *Quercus coccifera* L. and *Viburnum tinus* L.



Figure 3. *Juniperus oxycedrus* subsp. *oxycedrus* in its habitat near Oued Takesst.
Note: Photo taken by Chriqui in June 2024.

4.2. Monocotyledon Angiosperms

4.2.1. Cyperaceae

Bolboschoenus glaucus (Lam.) S. G. Sm.

During the spring season, in May 2023 and during a field mission, this species was observed on the left bed of Oued Zandoula at an altitude of 118 m (5°31′42″ W; 34°56′53″ N). In fact, other small populations have been observed scattered across this same Oued. Certainly, it is very likely that dozens of species are scattered elsewhere. It is a heliophytic species that forms part of the plant community on the river bed. It occurs in small populations some 456 m from the confluence of the Oued with Oued Takesst (**Figures 4** and **5**).



Figure 4. Helophytic species covered with water on the Oued Zandoula bed.
Note: Photo taken by Chriqui in April 2024.

The only mention of this species in the national flora

was in Mam (Oued Massa). We therefore confirm its second existence in the Man geographical division. It should be noted according to Fennane[21], that this species is classified in the data deficient (DD) category.

Its fasciculate spikelets make it easy to observe in its natural habitat. The main accompanying species are: *Arundo donax* L., *Lythrum junceum* Banks & Solander and *Nerium oleander* L.



Figure 5. *Bolboschoenus glaucus*: (**a**) Appearance and habit of the plant in its habitat, (**b**) Creeping rhizome with swollen underground stolons, (**c**) Fasciculate spikelets, **(d)** Brown akene (Magnification 40).

Note: These photos were taken by Chriqui in May 2024.

4.2.2. Liliaceae

Gagea fibrosa (Desf.) Schult. & Schult. f.

This species has been recorded in six geographical divisions (As, AA, Mam (Sidi Mohammed Semba; Messjoun au North of Azib du Caid Layadi), Op, Om (Bni Snassène), and LM) to date. This is the seventh record to extend the distribution of the species to northwest Morocco. During the rainy season, January 2024, during our brief surveys (Two outings), we observed a few flowering and non-flowering individuals of *Gagea fibrosa* in two localities on either side of Oued Zandoula. It is confined to hilltops. To the west, at an altitude of 440 m (5°32′36″ W; 34°56′20″ N), the pretty yellow flowers of this species fascinate the summit. To the east, on the western slope of the summit of a hill at an altitude of 215 m (5°31′29″ W; 34°56′45″ N), dozens of species can be seen scattered about. Because our field trips were carried out at the beginning of the flowering of this species, its distribution in the SIBE is not limited to the two localities mentioned. Its observation should motivate interested parties (Amateurs and professionals) to continue their research in the other hills and mountains of the region. It may be found mainly to the east of the SBEI. Given the strong floristic affinity between the Man and the Rif, it may also be present in the Rif. Among others, *Pulicaria odora* (L.) Rchb, *Rumex bucephalophorus* L. and *Saxifraga granulata* L. have been observed near *Gagea fibrosa* (**Figure 6**).

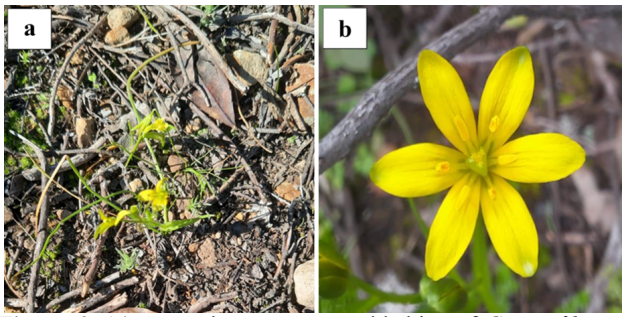


Figure 6. (**a**) General appearance and habitat of *Gagea fibrosa*, (**b**) Flower.

Note: These photos were taken by Chriqui in February 2024.

Lilium candidum L.

This species does not appear among the species of the Liliaceae family in inventory work on the Practical Flora of Morocco[18]. Consequently, this taxon is new to the Man and also to the national flora. The *Lilium* genus joins the three existing genera (*Fritillaria* L., *Gagea* Salisb. and *Tulipa* L.). In the second month of spring in 2022, following our surveys on the south-facing slope of mountain Sidi Ali Al Jawzi (497 m; 5°36′44″ W; 34°54′20″ N), we identified the presence of just three species of *Lilium candidum*, previously unknown in Morocco. This locality is close to the remains of a historic douar (Al Baajin El Khalia) whose inhabitants emigrated there at the end of the 19th century. Man's human activities have always transformed the plant landscape, causing species to disappear or regress in their place of existence. In this context, unfortunately, despite careful surveys of the region's vegetation, no other species has been found to date. This is undoubtedly due to the clearing of habitats in the vicinity of the douar, of which only a few graves remain. This observation leads us to believe that this is a species that has been introduced to the region from elsewhere, even though it is not native to it.

It is a perennial herb with a bulb of thick, fleshy scales unprotected by tunics. The leaves are in a basal, lanceolate

rosette ranging from 7 cm to 20 cm in length. The flowering stem emerges from the center of the rosette and reaches a length of around 50 cm. The leaves are smaller than those of the basal rosette, narrow and spirally arranged. It blooms in spring, in clusters of 3 to 6, with a strong, white bell-shaped fragrance. The tepals are sparsely scurred, 10 cm to 15 cm wide (**Figure 7**). Accompanying species include: *Anagallis arvensis* L., *Cleonia lusitanica* L., *Origanum compactum* Benth, *Pallenis spinosa* L., *Staehelina dubia* L. and *Teucrium barbarum* Jahand. & Maire.

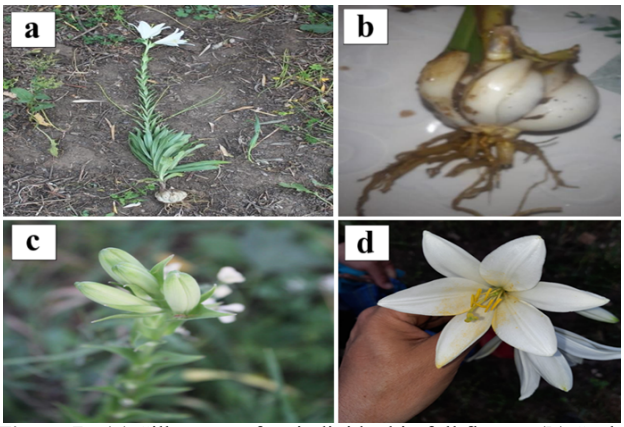


Figure 7. (**a**) Silhouette of an individual in full flower, (**b**) Scaly bulb, (**c**) Young inflorescence emitted, (**d**) Blooming flower.

Note: Photos taken by Chriqui in May 2022.

4.3. Dicotyledonous Angiosperms

4.3.1. Araliaceae

Hedera maroccana McAll.

It is an endemic species between Morocco and Algeria, reported in AA, HA, MA, Mam, LM and R [17], so this is the first record for Man. At the end of the second month of spring 2023, on the right bed of a temporary stream north of the SBEI, close to the first bridge of the peri-urban forest, a population was identified clinging to a limestone cliff (**Figure 8**). This is a shady, damp spot. The altitude is around 185 m, with geographic coordinates 5°32′20″ W; 34°56′50″ N. The observation of this species is important for the floristic heritage of the SBEI and confirms the particular character of its biodiversity. Although this species has been identified in a single location with very difficult access (On a rocky cliff, damp and under trees) where it forms a population, the presence of numerous small damp rocks with difficult access leads us to assume that other populations of *Hedera maroccana.* may exist in the SBEI. The pool of associated species to *Hedera maroccana* are *Asplenium adiantum-nigrum* L., *Ruscus aculeatus* L. and *Trachelium caeruleum* L.



Figure 8. General appearance of *Hedera maroccana* McAll. hanging on a steep rock.

Note: Photos taken by Chriqui in April 2023.

4.3.2. Asteraceae

Crepis vesicaria L. subsp. *stellata*

It is a taxon that has been reported according to Fennane et al. [18] in the following geographical divisions: AA (Kest), HA, Mam, Om (Taforhalt) and R (Tangier). So, by its observation in Man-1, this one is added to the said divisions. During the beautiful spring season, we observed it in small populations in April 2022 in a few points near private land in the territorial municipality of Brikcha at an altitude of 270 m (5°32′10″ W; 34°54′31″ N). It is therefore potentially threatened by agriculture and trampling. It would be very useful to look for this species elsewhere in the region, particularly in the Brikcha SBEI. In the latter, it may have escaped our investigations and the presence of *Crepis vesicaria* L. subsp. *taraxacifolia* fully supports this suggestion (**Figure 9**).

Bellis annua L., *Cichorium intybus* L. and *Raphanus raphanistrum* L. are the main species living with this species.



Figure 9. (**a**) *Crepis vesicaria* subsp. *stellata* in its environment, (**b**) Flower head.

Note: Photos taken by Chriqui in March 2024.

Scorzonera hispanica L. subsp. *hispanica*

In a small, relict patch of spontaneous vegetation (5°39′33″ W; 34°51′4″ N) 203 m before and to the right of the Akebaa El Kessar spawning site and confined in a few places to the west of douar Dchiare in the territorial municipality of Asjen, the species was seen in flower in April 2022. A few plants were scattered among *Campanula rapunculus* L., *Chamaerops humilis* L., *Daphne gnidium* L., *Eryngium tricuspidatum* L., *Fritillaria oranensis* Pomel, *Gladiolus italicus* Mill., *Magydaris panacifolia* (Lam.) Paol., *Moraea sisyrinchium* (L.) Ker Gawl. and *Scorpiurus vermiculatus* L. After being identified in the Rif geographical division (Mountain of Tissouka; Bni Zedjel; Issaguen; Targuist to Bab Izougar), this is its second geographical division. This observation confirms the biogeographical floristic affinities of these two divisions. In an interview, local residents confirmed its presence in other very small localities (**Figure 10**).



Figure 10. *Scorzonera hispanica* subsp. *hispanica*: (**a**) Vegetative apparatus, (**b**) Specimen collected, (**c**) Appearance and habit of the plant in its environment, (**d**) Flower head.

Note: Photos taken by Chriqui in April 2024.

Senecio glaucus subsp. *coronopifolius* (Maire) C. Alexander

According to Fennane et al.[18], this species has not been seen outside Ms, As, AA, HA, Mam and Op until our study. This species has been observed in two separate localities. On the one hand, in the full flowering period in April 2022, in the west of douar Dchiare at an altitude of 185 m (5°60′47″ W; 34°26′65″ N) the taxon found favorable conditions in several sites to form a population of around ten plants. At the beginning of May 2023, on the edge of the northern entrance to the SBEI Brikcha peri-urban forest, several populations were observed at an altitude of 164 m (5°31′48″ W; 34°56′59″ N). Among the main accompanying species were: *Convolvulus tricolor* L., *Hedypnois rhagadioloides* (L.) FWS Schmidt, *Leontodon saxatilis* Lam., *Malva hispanica* L. and *Euphorbia falcata* L. (**Figure 11**).



Figure 11. *Senecio glaucus* subsp. *coronopifolius* in full bloom.

Note: Photos taken by Chriqui in February 2024.

4.3.3. Brassicaceae

Biscutella pseudolyrata A. Vicente, M. Á. Alonso & M. B. Crespo

This is a species described from the Atlantic coastal areas of northwest Morocco by Vicente et al.[24]. On the basis of plastid phylogenetic trees and nuclear DNA sequence data, it was considered a new species endemic to Morocco instead of being related to the Spanish endemic *Biscutella lyrata* and the central Mediterranean *Biscutella maritima*. Boudik et al.[12] have already reported the presence of this species in the Moulay Driss Zerhoun region, which is part of the same division (Man-1). South of SBEI, *Biscutella pseudolyrata* is scattered across the two slopes separated by Oued Zandoula. In May 2023, when the spring season is in full bloom, we easily identified the genus *Biscutella* in the field by its appearance and flowers, but the determination of the species was confirmed in the Rabat Scientific Institute. The species was encountered again in June, scattered over several hills in the western part of the SBEI. The observation of this new station in Man-1 gives it a heritage value that it currently shares at the national level only with the northwestern Atlantic coastal zones. This is particularly important for species that are endemic or have a restricted range. Given the multiple means of seed dissemination that would certainly extend its range, this species deserves regular monitoring of its population outside our study area. *Anagallis arvensis*

L., *Euphorbia falcata* L., *Geranium molle* L., *Leontodon saxatilis* Lam., *Malva hispanica* L., *Sherardia arvensis* L. and *Tolpis barbata* (L.) Gaertn. are the main species living in the same biotope with *Biscutella pseudolyrata* (**Figure 12**).



Figure 12. (**a**) Appearance and wearing of *Biscutella pseudolyrata*, (**b**) Silicules.

Note: Photos taken by Chriqui in March 2024.

4.3.4. Caryophyllaceae

Silene sclerocarpa Dufour

This species has been recorded in four geographical divisions (Mam, Om, LM and R). In our study area, during a spring floristic inventory campaign in the SBEI of Brikcha, this species was observed in flower in May 2023 in two distant localities. The first is at an altitude of 155 m (5°31′50″ W; 34°57′9″ N), while the second is a rocky outcrop on a hill at 459 m (5°32′37″ W; 34°56′20″ N). However, as the botanical exploration of the SBEI has not yet been fully completed, it is highly probable that other localities of *Silene sclerocarpa* Dufour exist here and there, particularly in the part of the area covered by the territorial municipality of Ain Beida. This latest encounter adds to the *Silene* genus in the region's flora, bringing the number of species to five. Among the companion species inventoried are: *Cerastium glomeratum* Thuill., *Geranium purpureum* Vill., *Rumex bucephalophorus* L. and *Trifolium stellatum* L. (**Figure 13**).

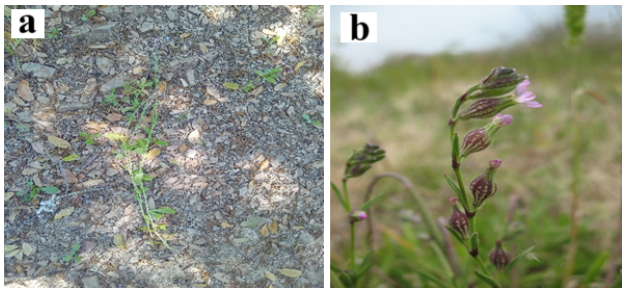


Figure 13. (**a**) Silhouette of an individual in the SIBE Brikcha, (**b**) Inflorescence.

Note: Photo (**a**) taken by Chriqui in March 2024) and Photo (**b**) taken from PlantNet.

4.3.5. Fagaceae

Quercus coccifera L.

According to Fennane et al.[16], this species has been localized in three geographical divisions Om, LM and R. It is common in the northeastern mountains of the study area. In September, October and November, which correspond respectively to the autumn and winter seasons, during surveys of the north-western slopes of mountain Sidi Ali El Jawszi, the northern slopes of mountain Seloum, the western slopes of mountain Dar Mouden-Meghoussa, the Zergfet forest, the Beni Ahmed Forest, mountain Ain Hessen and mountain Righa, we found this shrub to be widespread. However, no plants were found to the west or south of the study area. *Quercus coccifera* was identified during fieldwork in Brikcha SBEI between March and July 2023. With the exception of the south-east, it is found almost everywhere in the Brikcha SBEI. Its altitudinal range is between 130 m and 615 m. It lives in association with *Arbutus unedo* L., *Pistacia lentiscus* L., *Olea europaea* L., *Phillyrea latifolia* L. and *Viburnum tinus* L. Among the three other *Quercus* species coexisting in the SBEI (*Quercus faginea* Lam., *Quercus rotundifolia* Lam. and *Quercus suber* L.), *Quercus coccifera* is easily recognized in its plant procession, its small, leathery evergreen leaves, shiny green on both sides, making it detectable at first glance. Its observation in Man-1 represents a new addition to the flora of this division (**Figure 14**).



Figure 14. *Quercus coccifera* in its habitat.

Note: Photo taken by Chriqui in December 2023.

4.3.6. Lamiaceae

Thymbra capitata (L.) Cav.

It is the only species of the genus *Thymbra*. *Thymbra capitata* locally known as Thyme, is very localized in Morocco; it is only known in the geographical division of the western Rif and the north of mountain of Adouz (around Khenifra). The latter is part of the extreme south of North Atlantic Morocco (Man) and is hundreds of kilometers away from our study area, so this is not really its first sign. In summer, during a field survey carried out in July 2023 in the hills of the western Izarene massif around the north-western side of mountain Moulay Abdeslam Derebetta, we came across it in full bloom in a dry, warm-sloping scrubland on the southern slope of mountain Al Adamin (**Figure 15**). It is found at an altitude of between 270 m and 370 m, with geographical coordinates of 5°36′12″ West longitude and 34°57′39″ North latitude. Its purple-pink flowers are melliferous and grouped in an oblong, capitate inflorescence. In its environment, its shape in compact clumps of rounded cushions, its size which does not exceed 80 cm, the presence of pollinators and its strongly aromatic scent make it easy to find in the field. It was also found in a second locality, an east-facing garrigue at 340 m (5°35′13″ W; 34°54′21″ N). It would be useful to look for it in other mountains in the region in the hope of finding it, especially as it is classified as an endangered species (EN), i.e., threatened with extinction. It lives in association with *Ampelodesmos mauritanicus* (Poir.), *Calicotome infesta* (C. Presl) Guss., *Ceratonia siliqua* L., *Chamaerops humilis* L., *Olea europaea* L., *Origanum compactum* Benth., *Pistacia lentiscus* L., *Teucrium barbarum* Jahand. & Maire, *Teucrium polium* L., and *Staehelina dubia* L.

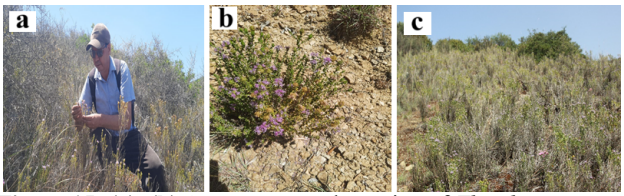


Figure 15. (**a**), (**b**) Appearance and wearing of *Thymbra capitata* in its environment, (**c**) Garrigue.

Note: Photos taken by Chriqui in July 2023.

4.3.7. Lauraceae

Laurus nobilis L.

It is one of two representatives of the Lauraceae family. On a national scale, it has so far been known from two geographical divisions: MA (El Ksiba) and the Rif[16]. *Laurus nobilis* thus represents a new record for Man-1 and, by extension, Man. This addition extends its range and makes a significant contribution to the regional flora. It was found in three different locations, two of them in the Brikcha part of the commune. Indeed, during our fall field trip carried out in October 2023 in the extreme west of the SBEI, a single foot was located in a shady, damp confined area near a temporary stream called Ain Bekar. It lies at 340 m with the following geographical coordinates: 5°32′59″ W; 34°56′32″ N. A second locality was found where two species of *Laurus nobilis* found refuge. This is a steep north-facing site at an altitude of 240 m (5°32′14″ W; 34°56′18″ N). In November 2023, during a botanical survey in the territorial municipality of Ain Beida, a local resident informed us of the presence of a few plants in a locality 0.74 km east of SBEI (**Figure 16**). The individuals were spotted and photographed north of douar Ferzimane at an altitude of 230 m (5°30′32″ W; 34°55′38″ N) on the bed of a permanent stream. *Aristolochia baetica* L., *Phragmites australis* (Cav.) Steud. and *Smilax aspera* L. are the main species observed in the vicinity of *Laurus nobilis*.



Figure 16. First observation of the general appearance of *Laurus nobilis* in Brikcha SBEI.

Note: Photo taken by Chriqui in December 2023.

Our study area and the geographical division of the Rif are only 25 km apart as the crow flies, so the observation of *Laurus nobilis* already known in the Rif reinforces their biogeographical affinity. This proves the extent to which our study area has retained its floristic originality.

Laurus nobilis is classified as vulnerable (VU), i.e., threatened, and according to the degree of rarity adopted by Fennane and Ibn Tattou [1], it belongs to the category of rare species (R). As it is a rare and threatened species, it has a high conservation value, for heritage, ecological and extinction risk reasons. Locally, it is subject to overexploitation, notably leaf harvesting, limiting its natural regeneration and accelerating the ageing of the few existing vines. Hence the need to rapidly implement measures to protect the three current sites of the species in Man-1 and to regenerate it naturally or by cuttings.

4.3.8. Molluginaceae

Glinus lotoides L.

Among the four genera of the Molluginaceae family, the *Glinus* genus is represented by a single species, *Glinus lotoides* L. The latter's range extends to Man-1, after being mentioned in Ms (Oued Chebeika near Abattih), Man (Oued Fouarate, Maâmora and Ain Sferjla). In April 2022, during the spring month, at the mouth of Oued Zaz on river Lokkous, this species was found scattered on both beds. Its altitude varies from 60 m to 80 m (5°40′42″ W; 34°55′3″ N). It is therefore necessary to survey the mouths of the other wadis on the right bed of river Lokkous in greater depth, in order to determine the distribution and extent of this species. On the one hand, it is classified as near-threatened (NT) on the red list, and therefore at risk of collapse, and on the other, it belongs to the rare category (R). *Heliotropium supinum* L., *Saxifraga granulata* L. and *Verbena supina* L. are the main species observed in association with *Glinus lotoides* (**Figure 17**).



Figure 17. Glinus lotoides in the Oued Zaz bed.

Note: Photos taken by Chriqui in April 2022.

To better illustrate the new species recorded in the study area, **Table 1** groups them together.

Table 1. Information for each species.

Scientific Name	Family	Name of Place of Existence	Altitude (m)	Associated Species	Assessment Criteria
GYMNOSPERMS					
Juniperus oxycedrus subsp. *oxycedrus*	Cupressaceae	Brikcha forest SBEI Brikcha	364, 480 140	*Arbutus unedo, Calicotome villosa, Ceratonia siliqua, Cistus albidus, Cistus monspeliensis, Olea europaea, Phillyrea latifolia, Pistacia lentiscus, Quercus coccifera* and *Viburnum tinus*	LC
MONOCOTYLEDONOUS ANGIOSPERMS					
Bolboschoenus glaucus	Cyperaceae	Oued Zendoula	118	*Arundo donax, Lythrum junceum* and *Nerium oleander*	DD
Gagea fibrosa	Liliaceae	On either side of Oued Zandoula	215, 440	*Pulicaria odora, Rumex bucephalophorus* and *Saxifraga granulata*	LC
Lilium candidum		Mountain of Sidi Ali Al jawzi	497	*Anagallis arvensis, Cleonia lusitanica, Origanum compactum, Pallenis spinosa, Staehelina dubia* and *Teucrium barbarum*	LC
DICOTYLEDONOUS ANGIOSPERMS					
Hedera maroccana	Araliaceae	SBEI Brikcha	185	*Asplenium adiantum-nigrum, Ruscus aculeatus* and *Trachelium caeruleum*	LC

Table 1. *Cont.*

Scientific Name	Family	Name of Place of Existence	Altitude (m)	Associated Species	Assessment Criteria
Crepis vesicaria subsp. *stellata*	Asteraceae	Asjen territorial municipality	270	*Bellis annua, Cichorium intybus* and *Raphanus raphanistrum*	LC
Scorzonera hispanica subsp. *hispanica*		West of douar Dchiare	203	*Campanula rapunculus, Chamaerops humilis, Daphne gnidium, Eryngium tricuspidatum, Fritillaria oranensis, Gladiolus italicus, Magydaris panacifolia, Moraea sisyrinchium* and *Scorpiurus vermiculatus*	LC
Senecio glaucus subsp. *coronopifolius*		West of douar Dchiare Akebaa El kessar	185 203	*Convolvulus tricolor, Hedypnois rhagadioloides, Leontodon saxatilis, Malva hispanica* and *Euphorbia falcata*	LC
Biscutella pseudolyrata	Brassicaceae	SBEI Brikcha	210–454	*Anagallis arvensis* subsp. *arvensis, Euphorbia falcata, Geranium molle, Leontodon saxatilis, Malva hispanica, Sherardia arvensis* and *Tolpis barbata*	LC
Silene sclerocarpa	Caryophyllaceae	SBEI Brikcha	459	*Cerastium glomeratum, Geranium purpureum, Rumex bucephalophorus* and *Trifolium stellatum*	LC
Quercus coccifera	Fagaceae	Asjen territorial municipality SBEI Brikcha	207–620	*Arbutus unedo, Pistacia lentiscus, Olea europaea, Phillyrea latifolia* and *Viburnum tinus*	LC
Thymbra capitata	Lamiaceae	Mountain of Al Adamin Mountain of Talla	270 370	*Ampelodesmos mauritanicus, Calicotome infesta, Ceratonia siliqua, Chamaerops humilis, Olea europaea, Origanum compactum, Pistacia lentiscus, Teucrium barbarum, Teucrium polium* and *Staehelina dubia*	EN
Laurus nobilis	Lauraceae	SBEI Brikcha	240, 340	*Aristolochia baetica, Phragmites australis* and *Smilax aspera*	VU
Glinus lotoides	Molluginaceae	Oued Zaz	60–80	*Heliotropium supinum, Saxifraga granulata* and *Verbena supina*	NT

Note: DD: Data Deficient; EN: Endangered; LC: Least concern (Low risk of extinction); NT: Near Threatened, VU: Vulnerable.

5. Discussion

5.1. Floristic Analysis

The present note describes 14 new species in 11 families and 14 genera. Dicotyledonous angiosperms are the best represented systematic group, with 10 taxa in 8 families and 10 genera. Monocotyledonous angiosperms are represented by 3 taxa in 2 families and 3 genera, while gymnosperms have just one species. The distribution of species between families is not homogeneous. The best represented family is the Asteraceae (3 species), followed by the Liliaceae (2 species). The remaining 9 families are each represented by a single species. The observation of the new species in Man-1 confirms that historically this region has not been fully prospected. Thus, these species (With the exception of *Biscutella pseudolyrata*) had never been reported there before. These additions once again confirm the biogeographical interest of the Man-1 flora. Apart from *Crepis vesicaria* subsp. *stellata*, *Glinus lotoides*, *Lilium candidum*, *Scorzonera hispanica* subsp. *Hispanica*, and *Thymbra capitata*, the other nine species were found in the SBEI, three of them exclusively there (*Biscutella pseudolyrata*, *Hedera maroccana*, and *Laurus nobilis*). These results justify SBEI's classification as a priority 2 protected area [3] and its link to the Mediterranean Intercontinental Biosphere Reserve (MIBR). Sheltered from anthropogenic pressures and disturbances, the SBEI plays the primary role in maintaining regional biodiversity in terms of protection. It also reinforces the interest and need for its protection as a nature reserve of high biodiversity value. Despite the small size of the study area in relation to the Man, it is a refuge for many plant species with very limited ranges, such as *Biscutella pseudolyrata*, *Laurus nobilis* and *Juniperus oxycedrus* subsp. *oxycedrus*. Some of the new species we encountered in the region remain rare overall, and one has only been found in three plants (*Lilium*

candidum).

5.2. Protection of New Species

Based on our field observations from 2021 to 2024, our knowledge collected from the local population and the Red List of National Vascular Flora and according to our estimates, the fourteen new species could be classified into two categories. This classification is defined according to the size of the population, the risk factors detected and the geographical distribution area. The first category is composed of *Biscutella pseudolyrata, Bolboschoenus glaucus, Crepis vesicaria* subsp. *stellate, Gagea fibrosa, Quercus coccifera* and *Senecio glaucus* subsp. *coronopifolius*. These six species are abundant, stable and widespread in the study area therefore their concern is minor. Some of them, via the means of dissemination, have a distribution area that is continuously expanding. It is important to emphasize that although some are not listed among the threatened species in the national references, locally they may need conservation measures. This is the case for *Bolboschoenus glaucus*. The second category of restricted distribution with limited numbers is composed of *Glinus lotoides, Hedera maroccana, Juniperus oxycedrus* subsp. *oxycedrus, Laurus nobilis, Lilium candidum, Scorzonera hispanica* subsp. *hispanica, Silene sclerocarpa* and *Thymbra capitata*. Given a reduced spatial distribution, a restricted extent and a population that can sometimes be counted on the fingertips and is in decline, these eight species are assessed as threatened. The pressures exerted by anthropogenic activities combined with climatic hazards severely threaten their existence. This current situation requires urgent awareness and the protection and conservation of these species are more necessary than ever. As a relict representative of the floristic past, particularly *Juniperus oxycedrus* subsp. *oxycedrus* and *Laurus nobilis* must benefit from rigorous protection to preserve the floristic history of the region. The situation of *Thymbra capitata* is not much better, even if their overall population numbers in the hundreds of individuals. A sad observation made last July noted that the loss of its habitat in favor of agricultural land.

5.3. Presumed Origin of the *Lilium Candidum* in the Study Area

Lilium candidum is a plant native to the Middle East, used in traditional pharmacopoeia for its various medicinal virtues: treating burns [25]; its benefits for heart health [26]. It also has excellent potential as an ornamental crop. We conclude that there is a strong probability that it was brought here by the ancestors of the inhabitants of the Al Baajin El Khalia douar who lived at the foot of mountain Sidi Ali El Jawzi (**Figure 18**). Two strong pieces of evidence support this proposition. Firstly, the region was a meeting place for different ethnic groups, including Berbers, Andalusites, Saharans and Arabs from the east [27].

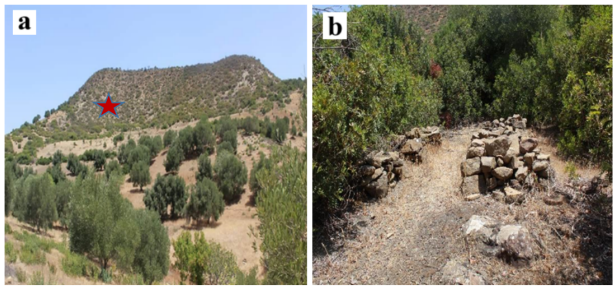


Figure 18. a: Mountain of Sidi Ali El Jawzi, **b**: Remains of old cemetery.

★: Observation location *Lilium candidum*.

The second piece of evidence is the presence of *Dracunculus* sp. (**Figure 19**) in a family from the El Ghara douar. Passing through douar Necharine, this is approximately 6.5 km from douar Al Baajin El Khalia. A member of the family who owns *Dracunculus* sp. declares that it is a sacred and blessed medicinal species inherited from one generation to the next within the same family. In the past, for his warm welcome, a blessed man left the bulb of the species to be cultivated for use of its aerial part. The dry leaves, mainly associated with milk, are used in cases of intoxication (Snake and scorpion toxins). This information indicates the extent to which medicinal plants are a source of medical care and an integral part of the local population's culture. Indeed, our study area is part of a region that has a long traditional medical tradition based on plants with therapeutic properties. For centuries, people have used various plants found in their environment to heal themselves and fight disease. Traditional indigenous know-how has been accumulated and transmitted from one generation to the next. So much so that this region was very renowned for its traditional practitioners like the

famous late woman Fatima Tehami from douar Necharine known under the nickname Tallia. Whether they are the foliage, the whole plant, the seeds, the flowers, the stem, the fruit, the bark or the underground apparatus, the practitioners of traditional medicine know how to prepare them by decoction, infusion, powder preparation, fumigation, poultice, maceration, raw, or cooking the effective remedy. These remedies are used to treat diseases of the digestive system, dermatological, genitourinary, respiratory, neurological, and visual diseases. In this sense, Orch et al.[28, 29] conducted two ethnobotanical studies in our study area. For the first study, ethnobotanical surveys carried out among the local population of the Izarene forest made it possible to list and identify 57 species of plants belonging to 30 families and divided into 52 genera. Forty (40) of these plants are used against diabetes, thirty (30) against high blood pressure, and 13 plants are used to treat both high blood pressure and diabetes. The results of the second study showed the use of 62 plants in dermato-cosmetology. Other ethnobotanical studies based on interviews could reveal other phytotherapeutic secrets.



Figure 19. *Dracunculus* sp. in its habitat (El Kouissi, 2023).

With its many medicinal properties and therapeutic virtues, it is essential to use plant biotechnology to obtain large numbers of *Lilium candidum*. Its conservation is of great floristic value.

5.4. Status of Species Potentially of High Conservation Interest

Of the fourteen plant species, *Laurus nobilis* found in the SBEI belongs to the vulnerable category, and is therefore on the list of threatened species. Illegal cutting and excessive leaf-picking have been observed at all three stations where this species grows. As such, it should occupy a place of prime importance in any conservation program for the region's flora. Urgent measures need to be taken both in situ to conserve the few remaining plants, and ex situ (Seeds and cuttings) in laboratories and botanical gardens to preserve this therapeutically valuable species. Locally, this does not mean that the rest of the species is not in real danger of extinction.

Glinus lotoides is only found in a few populations. Especially as its natural habitat is subject to various threats, such as human activities linked to the cultivation of the Oued Zaz beds, its survival is threatened. It is therefore desirable that localities hosting this taxon should be subject to protection measures in order to safeguard the few populations of this species.

In a context of growing interest and strong demand for aromatic and medicinal plants, *Thymbra capitata* has become increasingly sought-after by the local population and on the local market. It is used in food (flavoring) and traditional medicine. Several studies have proven its medicinal virtues[30–33]. Indeed, from June onwards, when it starts to bloom, it is intensively harvested. Harvesters cut the flowering, leafy twigs in order to market them or keep them for domestic use. As a result of this intensive, uncontrolled overharvesting and the clearing of its natural habitat for farmland, the area and numbers of *Thymbra capitata* have declined. This anthropic pressure, combined with climatic hazards, is endangering the species and threatening its preservation. As an endangered species, it risks disappearing from the region if no protective measures are taken by the relevant authorities. In order to counter the threats weighing heavily on the future and survival of *Thymbra capitata*, there is an urgent need to adopt a sustainable management approach that reconciles the imperatives of conserving this natural capital with its rational use.

The presence of *Laurus nobilis* and *Thymbra capitata*, although new, is not surprising, particularly in view of the proximity of our study area to the geographical division of the Rif, where both species have been found. This observation once again confirms the biogeographical link between the two divisions and is also of as yet little-known biogeographical interest.

Indeed, given the ecological and historical importance of the now relict population of *Juniperus oxycedrus* subsp. *oxycedrus*, as well as its rarity and reduced numbers, we propose that this species should be given special attention. We propose that it be listed as critically endangered in the region. Given that the mountains to the north-east of the SBEI are covered with a dense, spontaneous plant community, our field observations lead us to believe that this species may be found in other localities, such as mountain Sidi Ali. In addition, this taxon would benefit from a genetic, phylogenetic and ecological study to provide it with further details and information on a national scale. In addition, precise mapping of the species would be very useful for monitoring purposes.

During the flowering period, *Scorzonera hispanica* subsp. *hispanica* is much sought-after by the local population. They harvest it for consumption and for traditional practices. Thus, far from being rational, the severe exploitation regime to which it has been exposed in recent decades has led to its rarefaction and/or disappearance in most of the territory studied. Given this alarming situation, conservation efforts for this species must be a priority. It should be pointed out that this species is difficult to see in the field without the help of local connoisseurs.

Although these new species represent only 2.96% of the total flora of the study area, they are important for its floristic heritage and confirm the interest of this area. This percentage could be increased if more extensive surveys were carried out. Our results corroborate those found by [13] in the Moulay Driss Zerhoun region. Indeed, the authors were able to report for the first time the existence of 16 new species belonging to 10 families. As a result, the number of new species added to the vascular flora of Man-1 rose to 29 (*Biscutella pseudolyrata* was found in both regions). Our study area and that of Moulay Driss Zerhoun represent only a small fraction of the Man division, but continued prospecting in this division could add further unknown taxa. This is confirmed by Jbilou et al. [11] with the observation of *Cotula australis*. Encountered in the cork oak forest of Maamora, this new species is added to the Moroccan vascular flora and to North Africa. These additions align with the opinion of Fennane and Ibn Tattou [34]. Thus, these authors postulate that for many species, the ranges are little or poorly known and there are no solutions without research and field surveys. It seems clear to us that the level of survey of certain parts of Man-1 remains incomplete to date, in this case the Izarene massif. The latter is home to an original flora of heritage interest, so considerable effort would be needed to establish an up-to-date floristic inventory that is as exhaustive as possible.

6. Conclusions

The study area is home to a rich and diversified vascular flora, some species of which were not mentioned in the Man study. Thus, the present study is a contribution to updating the range of fourteen species, nine of which grow in the Brikcha SBEI and have never been reported beyond their known geographical divisions. In addition, a taxon never before seen in Morocco has been recorded in this small portion of Man-1. These observations confirm not only the need for more detailed exploration of the Man's geographical divisions, but also the need for a taxonomic revision of its flora. Indeed, as botanical exploration has not yet been completed in Man-1, further investigations on a larger scale would probably add other new taxa. In the future, it would be desirable to map the spatial distribution of each of the fourteen new species. This map would provide information on the locations of each species. If need be, researchers, teachers and managers will be able to find the geographical coordinates of their natural habitats. All in all, it is time for local authorities to commit themselves fully to a policy of sustainable natural resource management. At the very least, special-status species should be a priority.

With a view to identifying more new species beyond our region and enriching the regional flora, it would be interesting to continue this type of study. Indeed, the evidence of the insufficiency of botanical surveys is confirmed with the publication of these new data. Thus, regular field missions must be organized in the different parts of the west of the Izarene massif before this massif is too degraded by the combination of anthropogenic activities and climatic conditions.

Author Contributions

Ahmed Chriqui carried out the fieldwork, edited and corrected the manuscript imperfections; Ouafae Benkhnigue established the methodology, participated in the field part, the determination and confirmation of the scientific names of the species, the writing and revision of the manuscript;

Yassine Mouniane contributed to the data analysis, revision of the manuscript and took care of the submission stages; Issam El-Khadir contributed by reviewing the literature and revising the manuscript; Lahcen Zidane confirmed the scientific names of certain species and analyzed the results; Noureddine Chaachouay provided his expertise in the interpretation of the results and refinement of the manuscript; Driss Hmouni contributed with study design, supervision, interpretation of results and final revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

Funding

This work received no external funding.

Institutional Review Board Statement

Not applicable, as this study did not involve human or animal participants.

Informed Consent Statement

Not applicable, as this study did not involve humans or animals.

Data Availability Statement

No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments

We would like to thank the following organizations and individuals, without whom this work would not have been possible: the Natural Resources and Sustainable Development Laboratory in Kenitra, the Rabat Scientific Institute, the local authorities, the National Agency for Water and Forests in Rabat, the Provincial Directorate of Water and Forests in Ouezzane, and especially El Ghalia Zahira for her advice, as well as my field companions El Benani Mohamed and Mohamed Elloussi for providing us with valuable information about the *Laurus nobilis* locality.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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