






STUDIES IN THE FLORA OF ARABIA: XXXV. NEW RECORDS FROM THE SULTANATE OF OMAN

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Two species are newly reported for the Arabian Peninsula and eight new records for the Sultanate of Oman. Brief comments are provided on the phytogeography and ecology of these species. Most new records have been made from the botanically very poorly known or unexplored mountainous areas of northern Oman, including Musandam and poorly collected areas in Dhofar. These additional records raise the total number of known taxa in the national flora of Oman to 1417.

Keywords. Arabian Peninsula, endemism, Oman, phytogeography.

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Introduction

Located at the southeastern part of the Arabian Peninsula, Oman has diverse topographical features consisting mostly of rugged mountains and gravel and sand deserts. With deserts covering 82% of the total land area, the country is very sparsely vegetated but nonetheless has a unique and varied flora. Oman lies between the tropical and subtropical climate zones (Patzelt, 2015). It has average annual temperatures ranging from 10°C to 30°C, and average annual rainfall ranging between 27 and 400 mm (Charabi, 2013).

In the past 15 years, considerable progress has been made in the investigation and documentation of the flora of Oman, resulting in many new records of plant species for the country (Miller, 1985; Miller & Morris, 1988; Miller & Nyberg, 1991; Miller, 1994; Kilian & Hein, 1999; Patzelt, 2014; Patzelt *et al.*, 2014; Patzelt & Al Hatmi, 2020; Patzelt *et al.*, 2020; Thulin & Patzelt, 2020). These investigations resulted in 65 species being newly recorded for Oman and the Arabian Peninsula. Most of these new records are from the mountains of Musandam and the monsoon-affected mountains in Dhofar, as well as from the Central Desert.

The flora of northern Oman, including Musandam, is classified as part of the Nubian–Sindian local centre of endemism (Ghazanfar, 1992; Kürschner, 1998). Here the flora (especially the Musandam flora) shows strong affinities with the floras of southern Iran and Baluchistan (Feulner, 2011). At a national level, this close phytogeographical relationship is also evident in the higher altitude flora of Musandam and the Eastern Hajar Mountains

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(Patzelt, 2015). In the Musandam range, rainfall is between 160 and 200 mm (Patzelt *et al.*, 2020), and unlike in other parts of northern Oman, subtropical rainfall is very scarce, as the area receives rain mostly in the winter and early spring.

The ancient, rain-fed agricultural terraces and small silty plains distributed across Musandam support the presence of many rare and threatened annual and bulbous species. Many previous new records have been found in or around these habitats. In the present article, two species, *Pistacia khinjuk* Stocks and *Hordeum murinum* L., are recorded from the Musandam mountains and the latter is recorded from these terraces. For millennia, this traditional agricultural system held water and prevented soil erosion from mountain and irrigation run-off, allowing annuals and other small herbs and shrubs to thrive in an otherwise very arid landscape. At present, 94 plant species are restricted in their distribution, in Oman, to the Musandam region (Patzelt, 2015). This high number is indicative of the relative plant richness of the area.

The Dhofar mountains and coastal plains in southern Oman are exposed annually to the *khareef* (summer monsoon). This natural phenomenon usually lasts from mid June to mid September and is influenced by winds that blow from the southwest across the Indian Ocean. Warm and moist air carried by this wind forms thick mists and clouds against the southwest-facing escarpments of Dhofar. Historically, the precipitation from these monsoon mists influenced the development of dense woodlands and unique vegetation types. This annual monsoon is a contributing factor in explaining why the southern mountains contain the highest number of range-restricted species (Miller & Morris, 1988; Patzelt, 2014). The plants of the Dhofar mountains show a close relationship with those of East Africa, and many species are found in both regions.

The Western Hajar Mountains are part of the northern mountain chain, characterised by arid to semi-arid climatic conditions with mean annual precipitation around 400 mm (Patzelt *et al.*, 2020). Floristically, it is considered one of the most species-rich regions in the Arabian Peninsula, with 7.4% of its total flora being range-restricted (Patzelt, 2015). Many new records for this range have been made already. In the present article, an additional four new records are presented. The continuous increase in the number of new records indicates the significant species richness of these mountains.

Oman has a rich and unique flora; its special phytogeography is characterised by many rare and endemic species, especially in mountain habitats. However, in the past 30 years there have been increasing threats to Oman's flora and its habitats, due to the growth of urban areas, an increase in the number of livestock, and numerous infrastructure development projects. Climate change is also a serious threat to Oman's fragile vegetation, particularly at higher elevations (Patzelt, 2015). The decline of juniper woodlands in the Western Hajar Mountains has been attributed to the impact of climate change on such fragile systems (MacLaren, 2016). Over the past two to three decades, there has been a significant increase in warming across the Arabian Peninsula, especially in eastern

and southeastern regions (AlSarmi & Washington, 2011). Additionally, land degradation and habitat loss have increased the pressure on fragile and endangered plant species, particularly in the mountainous areas of the country, and this has led to population decline for many species.

The rise in invasive species is a significant threat to Oman's natural habitats, particularly in the southern mountains, due to the favourable humid conditions brought on by the summer monsoon (Patzelt & Lupton, 2021). These include *Parthenium hysterophorus* L., *Nicandra physalodes* (L.) Gaertn. and *Lantana camara* L. and exert remarkable pressure on the natural habitat's capacity to regenerate.

According to Patzelt (2014), 9.2% of the total flora is categorised as Threatened; 4.8%, Near Threatened; 5.2%, Least Concern; and 2.6%, Data Deficient. These percentages highlight the direct impact of all the factors listed above on the native flora and their fragile habitats.

Materials and methods

Field explorations were undertaken by the Oman Botanic Garden team throughout 2021 to different areas of Oman, including Dhofar, Musandam, and the Western Hajar Mountains. The identification of new species records took place partially in the field and subsequently through research at Oman Botanic Garden. Multiple herbarium specimens for all new records were collected, and photographic records made. All herbarium collections are deposited at the Oman Botanic Garden herbarium (OBG) (herbarium codes follow Thiers, continuously updated).

Several online resources were consulted to identify and determine the correct nomenclature for the collections made during field excursions. These included APG III (Angiosperm Phylogeny Group, 2009), APG IV (Angiosperm Phylogeny Group *et al.*, 2016), the International Plant Names Index (IPNI, 2023), Plants of the World Online (POWO, 2023), and the online Herbarium Catalogue of the Royal Botanic Garden Edinburgh. Additionally, a range of floristic treatments were used to help in the identification of specimens, including Miller & Morris (1988), Miller & Cope (1996), Wood (1997), Collenette (1999), Ghazanfar (2003), Miller & Morris (2004), Cope (2007), Ghazanfar (2007), Struwig & Siebert (2013), and Ghazanfar (2015, 2018).

Results

There were new records of 10 species (Figure 1), all belonging to the angiosperms. Two of these are new records for the Arabian Peninsula and are restricted to the Dhofar region: *Clerodendrum phlomidis* L.f. and *Verbascum virgatum* Stokes. The remaining eight are new to Oman but are found in neighbouring countries of the Peninsula. These new records increase the total number of species newly recorded in Oman in the past 15 years to 75, and raise the total number of taxa in the national flora to 1417.

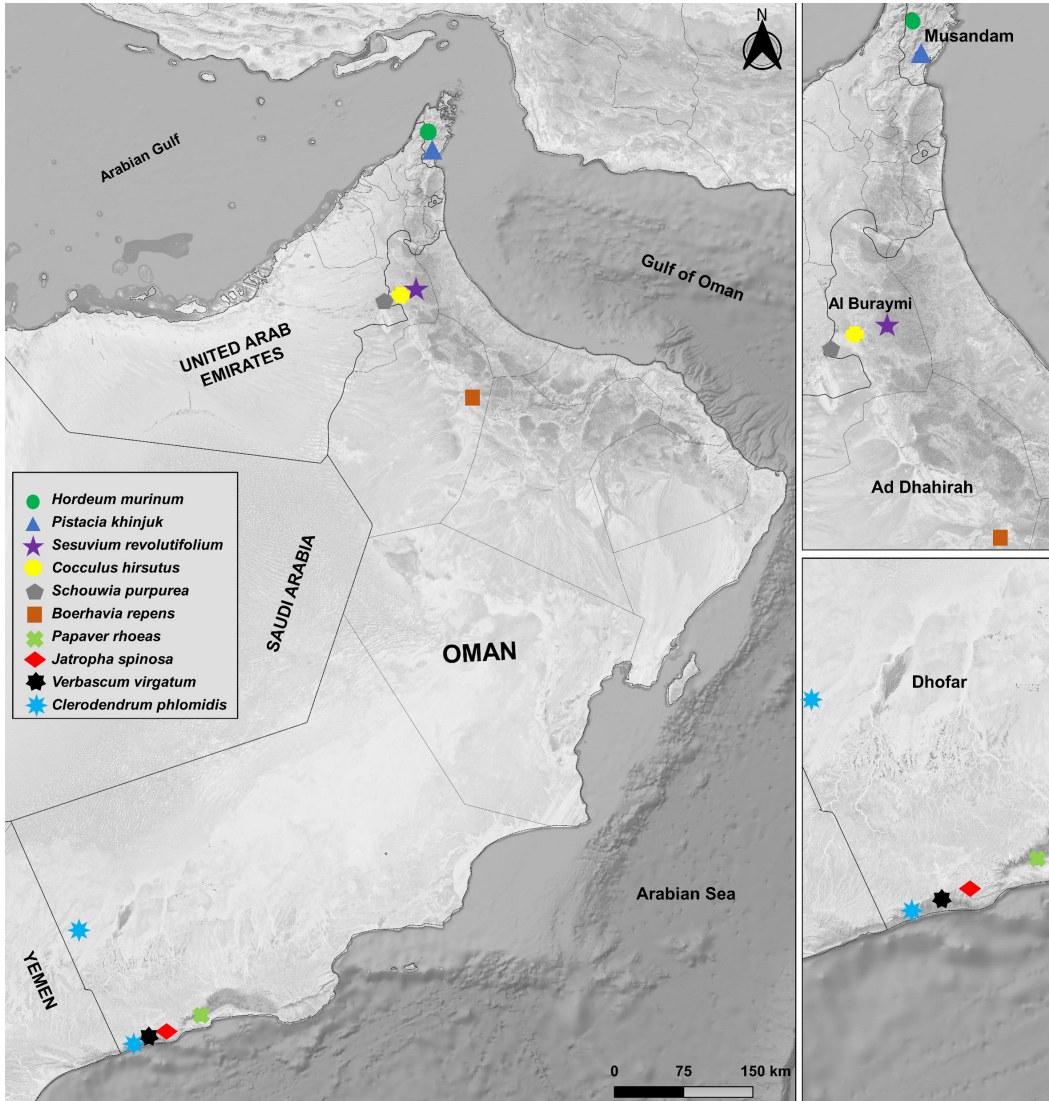


Figure 1. Locations of the 10 new records of angiosperm species described in this article.

New records for the Arabian Peninsula

Lamiaceae

Clerodendrum phlomidis L.f.

Distributed in tropical regions of Southeast Asia, specifically the Indian subcontinent and Myanmar, this species has not previously been recorded for the Arabian Peninsula. This new record for Arabia represents the westernmost natural distribution of the species. In Oman, it

was found at two different locations, in a dry wadi with abundant mature trees and shrubs, 10 km north of Dalkut, as well as in shrubland with *Rhazya stricta* Decne. in Willayat Al Mazyounah (Figure 2A–C). Both locations are in the most western part of Dhofar and about 140 km away from each other, adjacent to the border with Yemen.

Specimens. OMAN. Southern Oman: Dalkut, dry wadi with abundant mature trees and shrubs, 16°44'52.9"N, 53°13'17"E, 451 m, D. Lupton, S. Al Hatmi, A. Al Hinai DLHH 149 (OBG); Willayat Al Mazyounah, shrubland with *Rhazya stricta*, 17°53'43.6"N, 52°40'17.4"E, 483 m, L. Al Harthy, S. Al Hatmi, A. Al Hinai LAS 37 (OBG), 16°44'55.6"N, 53°13'26"E, 447 m, A. Patzelt, S. Al Hatmi, A. Al Hinai AP 4854, SHP 282 (OBG).

Scrophulariaceae

Verbascum virgatum Stokes

This is the first record of this species from the Arabian Peninsula. In Oman, the genus *Verbascum* is represented by three species: *V. sinaiticum* Benth. in DC., *V. akhdarensis* (Murb.) Hub.-Mor. and *V. omanense* Hub.-Mor., the last two of which are endemic to northern Oman. The record of this species is the first occurrence of this genus in southern Oman. It has



Figure 2. *Clerodendrum phlomidis*: A, habitat; B, leafy twig; C, close-up of leafy twig, showing flowers. *Hordeum murinum*: D, inflorescence. Photographs: Saif Al Hatmi.

been found in a few locations in the mountains of Dhofar; all are near disturbed areas or ruderal areas.

The original distribution of *Verbascum virgatum* was limited to western Europe, but it has since been introduced to many regions of the world, particularly in parts of the Americas and Australia (POWO, 2023). The species is considered invasive in many parts of the world; it can compete with native flora and forms dense monocultures. Although it is not yet clear how widespread this species is in Dhofar's mountains, it is important to monitor its spread and take steps to control it.

Specimens. OMAN. **Southern Oman:** Dhofar, Jabal Qamar, Kezat amqat, 16°48'59.1"N, 53°23'20.9"E, 965 m, L. Al Harthy, A. Al Hinai LAH 186 (OBG).

New records for Oman

Aizoaceae

Sesuvium revolutifolium Ortega

This largely herbaceous species is native to the Americas, from Mexico to western and central USA (POWO, 2023). With the exception of Yemen and Oman, it has been recorded throughout the rest of the Arabian Peninsula. This new record extends its distribution further east in the Arabian Peninsula. In Oman, it has been recorded from a farm in Mahdah in western Oman, growing among cultivated crops, and it appears that this is how it has been introduced.

Specimens. OMAN. **Northern Oman:** Western Hajar Mountains, Mahdah, Maslah village, 24°22'31.2"N, 56°04'53.4"E, 474 m, A. Al Hinai, S. Al Hatmi SHAH 1093 (OBG).

Anacardiaceae

Pistacia khinjuk Stocks

Feulner (2011) recorded this species but without providing any precise distribution details to indicate if this record was from Oman or the United Arab Emirates. We hereby prove the existence of this species in Oman.

The distribution of *Pistacia khinjuk* on the Arabian Peninsula was previously confined to Saudi Arabia and the United Arab Emirates. To date, the genus *Pistacia* has been represented by only one species in Oman, *P. falcata* Becc. ex Martelli, which is restricted to the southern mountains of Dhofar. Our recent fieldwork revealed trees of *Pistacia khinjuk* in a single location in the mountains of Musandam, in a wadi north of Daba, where it was found growing with trees of *Ficus salicifolia* Vahl and *Moringa peregrina* (Forssk.) Fiori (Figure 3A). This represents the second record of this genus in Oman.

Specimens. OMAN. **Northern Oman:** Musandam, Wadi Maqi, north of Daba after wadi Khabb A Shamsi, 25°46'11.4"N, 56°14'57.3"E, 586 m, S. Al Hatmi SAHATM 558 (OBG).



Figure 3. *Pistacia khinjuk*: A, leafy twig with fruit. *Boerhavia repens*: B, abaxial and adaxial leaf surfaces (left and right leaf, respectively). *Jatropha spinosa*: C, habit; D, leafy twig; E, fruit. Photographs: Saif Al Hatmi.

Brassicaceae

Schouwia purpurea (Forssk.) Schweinf.

The native range of this annual species is from North Africa to India, including most countries of the Arabian Peninsula (Miller & Cope, 1996). In Oman, it is now recorded from a single location, where it was found on open sedimentary plains in *Vachellia tortilis* (Forssk.) Galasso & Banfi woodland. Its distribution is confined to the westernmost range of the Western Hajar Mountains. This new record extends its distribution further east in the Arabian Peninsula.

Specimens. OMAN. **Northern Oman:** Western Hajar Mountains, Al Burami, Al Khadrah village, 24°16'08.6"N, 55°47'49.1"E, 300 m, L. Al Harthy, A. Al Hinai, S. Al Hatmi LAS 132 (OBG).

Euphorbiaceae

Jatropha spinosa Vahl

Jatropha spinosa is distributed from Djibouti to Somalia and the southwestern Arabian Peninsula (POWO, 2023). In the Arabian Peninsula, it was previously known from Yemen

(Wood, 1997) and Saudi Arabia (Collenette, 1999). In Oman, it was found in a single location, in Jabal Al Qamar, growing on a rocky, steep, north-facing slope within the range of monsoon, with *Euphorbia cactus* Ehrenb. ex Boiss. and *Commiphora gileadensis* (L.) C.Chr. (Figure 3C–E).

Specimens. OMAN. **Southern Oman:** Jabal Al Qamar, Rakhyout, west of Shatt, 16°52'19.7"N, 53°32'30"E, 793 m, L. Al Harthy, A. Al Hinai, S. Al Hatmi LAS 22 (OBG).

Menispermaceae

Cocculus hirsutus (L.) W.Theob.

This species was found in one location at Jabal Al Qatar, an isolated small mountain south of Mahdah. It was found hanging off rocky limestone cliffs with the shrubs *Capparis cartilaginea* Decne. and *Cocculus pendulus* (J.R.Forst. & G.Forst.) Diels. The population of this species is restricted to just a few individuals, which are in poor condition because of prolonged drought. This species is found in all other countries of the Arabian Peninsula. Its record from Oman extends its distribution to include the whole of the Arabian Peninsula.

Specimens. OMAN. **Northern Oman:** Mahdah, Jabal Al Qatar, 24°19'27.1"N, 55°54'18.5"E, 503 m, S. Al Hatmi SAHATM 671 (OBG).

Nyctaginaceae

Boerhavia repens L.

This species is distributed from Africa across southern Asia to Australasia. Previously, it was known from the whole of the Arabian Peninsula except Oman. This new record from Oman extends its distribution to the entire Peninsula. In Oman, it was found in Al Dreez village (Ibri), where it was growing as a weed in a private cultivated garden (Figure 3B).

Specimens. OMAN. **Northern Oman:** Ibri, Al Dreez (in private garden), 23°17'30.3"N, 56°38'05.5"E, 400 m, S. Al Hatmi SAHATM 669 (OBG).

Papaveraceae

Papaver rhoeas L.

This is a cosmopolitan annual weed. The native range of this species is North Africa, Europe and Western Asia, and it is introduced and naturalised in the Americas and temperate regions of southern Africa and Australia (POWO, 2023). In the Arabian Peninsula, the corn poppy has so far been recorded from only Saudi Arabia and Kuwait (Miller & Cope, 1996). This is the first record of this species from southern Oman; the other two species in this genus, *Papaver laevigatum* M.Bieb. and *P. decaisnei* Hochst. & Steud. ex Elkan, are both recorded from Musandam, northern Oman.

The new record of *Papaver rhoeas* for Oman was collected from Dhofar, Jabal Al Qamar, close to the Taitam road intersection in shrubland with *Olea europaea* subsp. *cuspidata*

(Wall. & G.Don) Cif., in the montane drought-deciduous sclerophyllous *Olea europaea*–*Gymnosporia dhofarensis* (Sebsebe) Jordaan woodland community. Despite an intensive search of the whole area, only one red poppy plant was found, surrounded by large communities of the invasive *Parthenium hysterophorus*.

Specimens. OMAN. Southern Oman: Dhofar, Taitam road intersection (21 km west of Salalah), 17°01'37.6"N, 53°54'27.3"E, 388 m, I. Al Rashdi, L. Al Harthy, A. Al Hinai, S. Al Hatmi RHHH 26 (OBG).

Poaceae

Hordeum murinum L.

This new record extends this species' area of distribution to include Oman with the rest of the Arabian Peninsula, except for Yemen (Cope, 2007). In Oman, it is recorded from the Musandam mountains at higher altitudes, where it was found growing in abandoned agricultural terraces (Figure 2D).

Specimens. OMAN. Northern Oman: Musandam, Jabal Harim, Sahaseh Plateau, 25°57'51"N, 56°12'21.3"E, 1450 m, L. Al Harthy & A. Al Hinai LAH 36 (OBG).

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