BOTANICAL CHECKLISTS

Mediterranean Botany
ISSNe 2603-9109

EDICIONES COMPLUTENSE

https://doi.org/10.5209/mbot.72120

Orchids of the Occupied Palestinian Territories (West Bank, Palestine)

Julius Pahl[1,2] & Mazin B. Qumsiyeh[2]

Received: 16 October 2020 / Accepted: 29 December 2020 / Published online: 8 March 2021

Abstract. Literature data and new records of members of the orchid family (Orchidaceae) in the Occupied Palestinian Territories were reviewed and updated with field data. Using data from the Palestine Museum of Natural History (PMNH), data from fellow botanists, and the Biodiversity databases (BioGIS and GBIF), the distribution patterns were analyzed with the QGIS package. Twenty-three taxa of eight genera were found in this preliminary study. For two species, no recent data from the last 20 years were available and in some cases likely declined due to human activity. Most species are from the Mediterranean phytogeographical zone, *Epipactis veratrifolia* Boiss. & Hohen was found in the Sudanian-Ethiopian zone (Dead Sea valley). The majority of the species found prefer semi-open shrublands (garrigue). Nine species had fewer than 20 records overall. Trends observed from the historical data, and current spatial data revealed major threats, including habitat fragmentation, urbanization, intensification of agricultural land use, afforestation and reduced precipitation due to global warming. We noted the proximity to thorny shrubs in many species indicating pressure by grazing animals during field visits. As recent data is scarce, surveys of sites where rare species have been encountered in the past are recommended, and measures to protect vulnerable populations are discussed.

Keywords. Biodiversity; Conservation; Orchidaceae.

How to cite: Pahl, J. & Qumsiyeh, M.B. 2021. Orchids of the Occupied Palestinian Territories (West Bank, Palestine). Mediterr. Bot. 42, e72120. https://doi.org/10.5209/mbot.72120

Introduction

The Mediterranean region is one of the 25 global biodiversity hotspots with many endemic species (Cuttelod *et al*., 2009). Situated at the nexus of continents, the small geographic area of Palestine includes Mediterranean, Irano-Turanian, Saharo-Arabian, Coastal, and Ethiopian Sudanese flora and fauna (Soto-Berelov *et al*., 2015). Many aspects of the Palestinian flora remain unstudied, including updating the status of many families and groups. There are also many areas rarely visited by botanists such as the northern West Bank (see maps in Levin & Shmida, 2007). In recent decades, Palestine has been and still is undergoing drastic change due to urbanisation, intensification or abandonment of agriculture, changes in land use (military zones, firing zones), changes in water management, intensified tourism, and climate change (Qumsiyeh *et al*., 2014; Qumsiyeh & Amr, 2017). Orchidaceae can serve as an environmental indicator locally because of: a) the presence of specific mycorrhiza to germinate; b) need for specialized pollinators; c) narrow climatic and habitat tolerance; and d) sensitivity to human-induced activities such as tourism, collection, and habitat changes (Vereecken *et al*., 2010; Barman & Devadas, 2013; Akhalkatsi *et al*., 2014; Newman *et al*., 2015; Wraith & Pickering, 2017). While some orchids were studied before in Palestine (Dafni *et al*., 1987; Al Sheikh & Mahassneh, 2017), the most comprehensive work on the flora of the region, the "Distribution Atlas of Plants in the Flora Palaestina Area" by Danin (2004) has not included any updates in orchid distribution for the West Bank (Palestinian Occupied territories) since the previous edition from 1985. Shifman just published a book (translated from Hebrew to English in 2019) on Orchids of the region but was mostly reviewing work within the Green Line (little on the West Bank). Due to the paucity of recent data, especially from many key areas, rapid changes due to urbanization, and the importance to gather data for environmental monitoring, this study aims to provide an overview of the current status of orchids in the areas of the West Bank.

Methods

The study area is the Palestinian Occupied Territories of the West Bank specifically focusing on protected and threatened areas from mostly Mediterranean habitats. The area is basically the mountainous regions of Historic Palestine formed geologically by uplift from the friction of the Arabian and African tectonic plates that also formed the Great Rift Valley (lowest point on earth being the Dead Sea). This resulted in varied topography consisting of high mountains that receive more rain on

[1] Science Faculty, Zittau Görlitz University of Applied Sciences. Zittau, Germany
[2] Palestine Institute of Biodiversity and Sustainability, Bethlehem University. Bethlehem, State of Palestine. Email: info@palestinenature.org

their western side (from the Mediterranean Sea) and more arid regions on their eastern side. Thus, rainfall in the West Bank varies by region from 1000 mm to less than 50 mm per year and temperatures can dip below freezing in the mountains and can reach 40ºC in Jericho.

The distribution of Orchidaceae in these areas was studied based on collections from the Palestine Museum of Natural History (PMNH) from twelve locations (Figure 1, Table 1, localities nº 9, 19, 30, 39, 46, 50, 51, 52, 55, 56, 58, 60), the Global Biodiversity Information Facility (GBIF) and the records of Banan Alsheikh who worked as botanist in the area for more than 15 years. Where not otherwise specified, the localities refer to the GBIF (downloaded from GBIF.org on May 14th 2020). Where records exist for the same area from short distances up to 3 km, they are pooled as one locality. To analyze the habitats, the 61 localities were matched with geospatial data covering mean annual rainfall, average temperature, land cover, soil (from the Ministry of local governance platform GeoMolg), phytogeographic zones (from the Applied Research Institute Jerusalem, received May 14th 2020) and elevation data (from the NASA Digital Elevation Model), using an open source Geographic Information System package (QGIS). Data were analyzed in regards to distribution, habitats and conservation needs. To screen for potentially threatened species, two criteria have been checked. The risk of decline for species is discussed for many localities. In contrast, a broader, more general risk assessment, such as dependency on pollinators and current land use trends, is discussed. Taxonomy, especially in the genera *Orchis* and *Ophrys* is debated and subject to changes and even "taxonomic inflation" (Pillon & Chase 2007). To ensure uniformity in this project, the current names from the International Plant Names Index were adopted (IPNI 2020). Flora Palaestina by Danin (2004) and Delforge's third edition (2006) were also used for the description of the taxa.

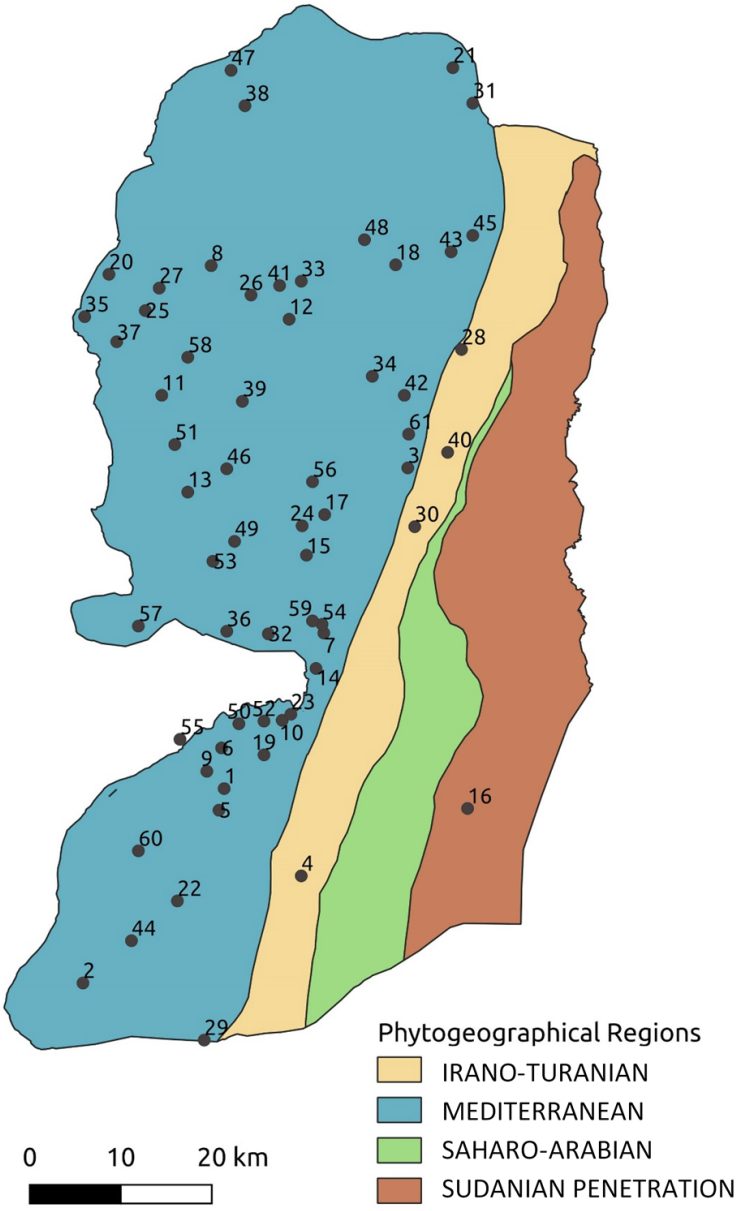

Figure 1. Map of localities in the West Bank. See Table 1.

Table 1. List of localities by ID number also referred to in Figure 1. Datum WGS84.

ID	Locality	Longitude (N)	Latitude (E)	N. records
1	Abu Soda (Khallet Afana)	31°38’42”	35°7’58.8”	12
2	Ad-Dhahiriya	31°25’12”	34°58’12”	1
3	Al-Mughayer	32°0’57.6”	35°20’42”	2
4	Al-Kanoub	31°32’38.4”	35°13’19.2”	1
5	Al-Qarn	31°37’12”	35°7’37.2”	9
6	Banyas (hill near Nahalin)	31°41’31.2”	35°7’48”	2
7	Beit Hanina	31°49’30”	35°14’52.8”	24
8	Beit Lid	32°15’0”	35°7’4.8”	4
9	Beit Skarya	31°39’54”	35°6’46.8”	9
10	Bethlehem	31°43’26.4”	35°12’0”	2
11	Bidia	32°6’0”	35°3’39.6”	1
12	Bir Yan’bu (Tell)	32°11’16.8”	35°12’28.8”	5
13	Deir Abu Masha Deir Ammar/Zarqa	31°59’16.8”	35°5’27.6”	16
14	East Jerusalem (incl. Abu Dis)	31°47’2.4”	35°14’20.4”	10
15	East of Albireh	31°54’54”	35°13’40.8”	7
16	Ein Gedi - Dead sear area (NR)	31°37’19.2”	35°24’50.4”	8
17	Ein Siniyaa	31°57’43.2”	35°14’56.4”	2
18	El Jabel Elkabeiir (Al-Badhan)	32°15’3.6”	35°19’51.6”	9
19	Ertas	31°41’2.4”	35°10’44.4”	3
20	Falamiyeh	32°14’24”	35°00’00.0”	2
21	Faqqua’	32°28’44.4”	35°23’49.2”	9
22	Hebron	31°30’54”	35°4’44.4”	2
23	Jabel Abu Ghneim	31°43’51.6”	35°12’36”	12
24	Jalazone RC	31°56’56.4”	35°13’22.8”	5
25	Jayyous	32°11’52.8”	35°2’31.2”	1
26	Jit	32°12’57.6”	35°9’50.4”	6
27	Kafr Zibad	32°13’26.4”	35°3’28.8”	2
28	Khirbet Tana	32°9’10.8”	35°24’25.2”	2
29	Khirbit Ein Nabi (Har Amasa)	31°21’14.4”	35°6’36”	1
30	Kufer Malik	31°56’52.8”	35°21’10.8”	10
31	Mt. Afner (Al Mughayer)	32°26’16.8”	35°25’12”	5
32	Nabi Samuel	31°49’26.4”	35°11’2.4”	15
33	Nablus	32°13’55.2”	35°13’19.2”	5
34	Osarin	32°7’19.2”	35°18’14.4”	10
35	Qalqilya	32°11’27.6”	34°58’19.2”	1
36	Biddu (Radar Mt.)	31°49’37.2”	35°8’9.6”	11
37	Ras Tira	32°9’43.2”	35°0’32.4”	13
38	Sahl Arraba	32°26’6”	35°9’25.2”	1
39	Salfit - Harris	32°5’34.8”	35°9’14.4”	15
40	Sartava	32°2’2.4”	35°23’27.6”	3
41	Sebastia	32°13’37.2”	35°11’49.2”	2
42	Tal al Khashabe	32°6’0”	35°20’27.6”	3
43	Tammoun (Jebel)	32°15’57.6”	35°23’42”	1
44	Tarama	31°28’8.4”	35°1’33.6”	1
45	Tayasir	32°17’6”	35°25’12”	7
46	Um Safa	32°0’54”	35°8’9.6”	123
47	Umm ar Rihan	32°28’33.6”	35°8’27.6”	20
48	Wadi al Far’a	32°16’48”	35°17’42”	1
49	Wadi Al-Dileb (Ein Qinia)	31°55’51.6”	35°8’42”	19
50	Wadi Al-Makhrour	32°49’48”	35°9’0”	12

ID	Locality	Longitude (N)	Latitude (E)	N. records
51	Wadi Al-Zarqa	32°2’34.8”	35°4’33.6”	82
52	Wadi Cremisan, Bethlehem	31°43’22.8”	35°10’44.4”	10
53	Wadi Ein-Arik	31°54’28.8”	35°7’12”	12
54	Wadi El-Khafi (between Hizma & Beit Hanina)	31°50’6”	35°14’45.6”	1
55	Wadi Fukeen	31°42’3.6”	35°4’55.2”	4
56	Wadi Haramiya	32°00’0”	35°14’6”	36
57	Wadi Musrara	31°49’58.8”	35°2’2.4”	5
58	Wadi Qana	32°8’38.4”	35°5’27.6”	19
59	Wadi Qelt	31°50’20.4”	35°14’6”	3
60	Wadi Quff	31°34’22.8”	35°2’2.4”	9
61	Western hill of Duma	32°3’18”	35°20’45.6”	5

Results

Twenty species and three subspecies belonging to eight genera were listed in Flora Palaestinae as occurring in historic Palestine (Danin, 2004). The initial search on GBIF yielded 622 entries, of which 16 were not identified at the species level and have been discarded. Besides historical reports, for example, from the American Colony Jerusalem, they include data from the Israel National Parks Authority, the global citizen science platform iNaturalist, and the Israel Biodiversity Information System (BioGIS). Additional data stem from thirteen field trips of PMNH staff members. Furthermore, botanist Banan Al-Shaikh contributed to the data. After the exclusion of doubles, the dataset contained 642 records from 61 localities (Table 1). For all species, the geo-data was assigned to 61 locations documented (Table 1, Figure 1).

The vast majority of records are located in the Mediterranean phyto-geographical zone; only four species are found in other areas. *Epipactis veratrifolia* is found at spring sites near the Dead Sea, in the Sudanese-Ethiopian Penetration zone. *Anacamptis papilionacea* subsp. *palaestina* has the widest distribution, covering the Mediterranean zone and into the Iranio-Turanian. The Mediterranean zone covers the semi-coastal plain (50–300 mm annual rainfall) in the North-East, the Western slopes (300–600 mm), and the mountain plateau (600–1000 mm). The Mediterranean influence subsides with the diminishing precipitation on the eastern slopes of the Samaria and Jerusalem and Hebron mountains.

Species Accounts

The numbers listed are localities corresponding to Table 1 and Figure 1.

Anacamptis collina (Banks & Sol. ex Russell) R.M. Bateman, Pridgeon & M.W.Chase
Fan lipped Orchid
Localities: 3, 14, 18, 21, 34, 37, 39, 41, 43, 47, 57, 61.

Oldest record from 1975 from the settlement of Elon Moreh, East of Nablus and Kida E of Turmus Ayya. Widespread throughout the North, one recent record was found in 2020 from a new locality in East Jerusalem. Prefers open grassland or batha on terra rossa soil (Danin, 2004). On Jebel Tammoun, for example, lives in south-facing of savannah-like slopes.

Anacamptis papilionacea subsp. ***palaestina*** (B. Baumann & R.Lorenz) H.Kretzschmar, Eccarius & H.Dietr.
Pink butterfly Orchid
Localities: 1, 4, 5, 7–9, 12, 13–15, 17, 18–21, 23, 24, 26–28, 30, 31–34, 36–41, 45–47, 49–53, 55, 56, 57.

Most common species in garrigue and maquis habitats. Noted in Lebanon to hybridize with *A. morio* subsp. *syriaca* (E.G.Camus) H.Kretzschmar, Eccarius & H.Dietr. (Vela & Viglione, 2015).

Anacamptis pyramidalis (L.) Rich.
Pyramid Orchid
Localities: 7, 13, 14, 23, 25, 30, 33, 34, 36, 37, 39, 42, 46, 47, 49, 50, 51, 53, 56, 58, 60, 61.

Common in the Mediterranean region preferring more open habitats compared to *A. papilionacea* subsp. *palaestina* (Figure 2).

Anacamptis sancta (L.) R.M.Bateman, Pridgeon & M.W.Chase
Holy Orchid
Localities: 42, 46, 56, 58.

Endemic to the Levant region. Reported from four distinct locations only with one more recent record by Banan Al-Shaikh. At least one record is from an extinct population west of Route 505, an area that is now used as agricultural field. Besides *Epipactis veratrifolia* Boiss. & Hohen., this is the only other orchid from the West Bank that offers nectar as a pollination reward. However, pollination strategy is not fully understood and might explain its rarity (Cozzolino *et al*., 2001). The closest genetic proximity is with *A. coriophora* (L.) R.M. Bateman, Pridgeon & M.W. Chase, the bug orchid, which is also very rare in its range across Southern Europe and only reported very few times from the Galilee and Lebanon. Both hybridize in Lebanon (Vela & Viglione, 2015).

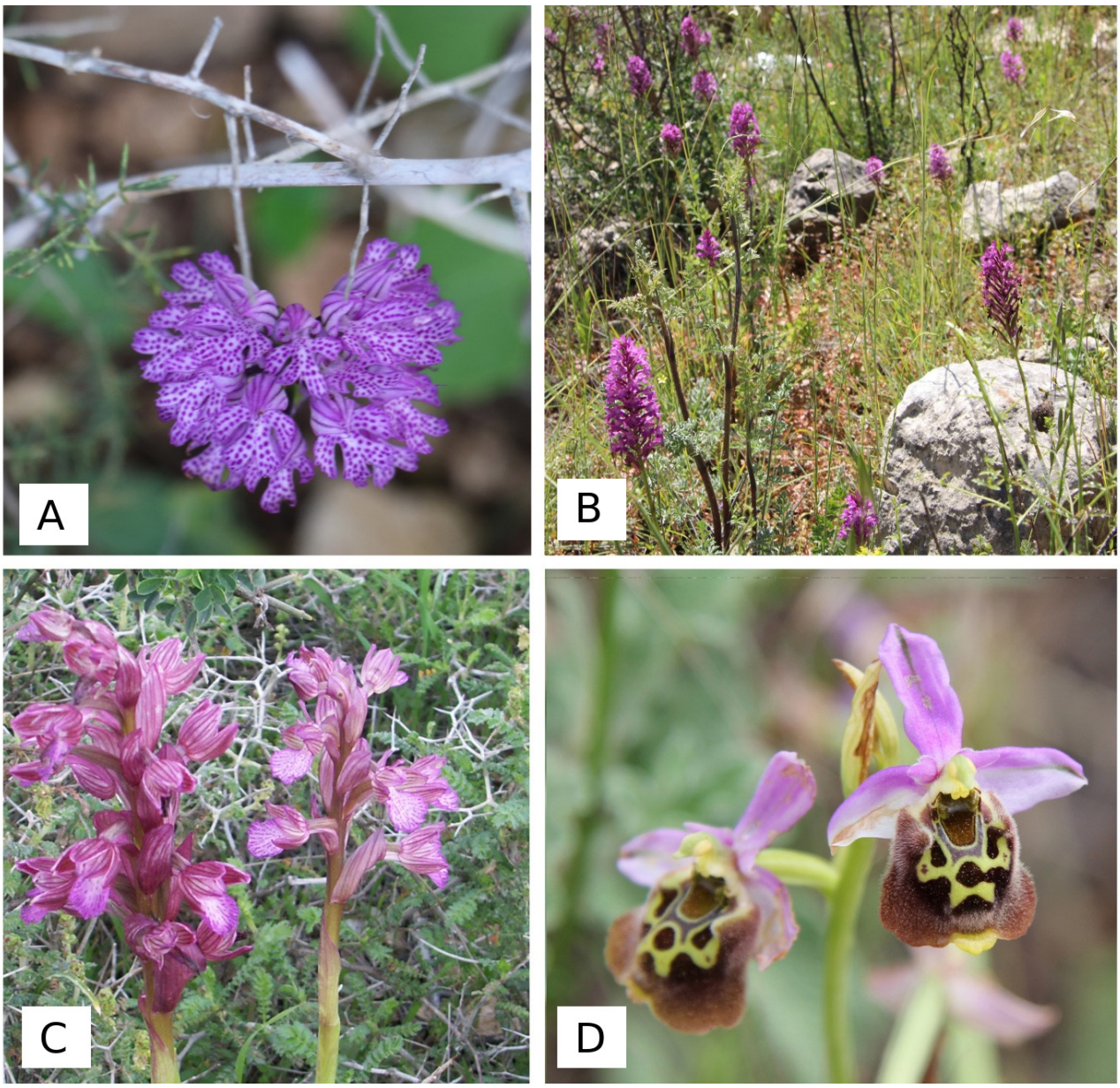

Figure 2. A, *Neotinea tridentata*; B, Field of *Anacamptis pyramidalis* in Wadi Al-Makhrour (World Heritage Site area); C, *Anacamptis papilionacea* subsp. *palaestina* growing in a thorny setting of *Sarcopoterium spinosum*; D, *Ophrys* cf. *libanotica*.

Cephalanthera longifolia (L.) Fritsch
Narrow-leaved Helleborine
Locality: 47.

Status similar to the *Limodorum abortivum* (L.) Sw. Latest data from 1988, all six records are from the Umm ar Rihan forest area, part of this forest is a Natural Reserve. Located in the very north-west of the Westbank, they mark the south-eastern edge of the species' range. A *C. longifolia* plant has been reported near an Israeli colony in the hills of Western Jerusalem (GBIF.org, observation 30037971 on iNaturalist.org). *Halictus marginatus* is the only pollinator reported for this species. This bee is deceived through floral mimicry where the common *Cistus salvifolius* is present (Dafni & Ivri, 1981; Burns-Balogh *et al*., 1987). Habitats are maquis and pine forests on terra rossa, where a certain amount of moisture is kept in the soil and midshade occurs (Danin, 2004).

Epipactis veratrifolia Boiss. & Hohen.
Eastern Marsh Helleborine
Localities: 16, 51.

Nine records from two localities are reported here. One locality from the Sudanese-Ethiopian penetration zone with poor soil and very limited rainfall (less than 100 mm/year) located near the springs Ein Gedi and Ain AlFashkha (now renamed Enot Tsukim). This is a protected area under Israeli control. The second locality was in Wadi Zarqa in typical moist Mediterranean habitats. Such contrast in habitats is a peculiar finding and requires further research. This species is endangered due to the small number and vulnerability of potential habitats available. The species has a unique pollination pattern with deception of Syrphidae through aphid alarm pheromone secretion (Stökl *et al.,* 2011).

Limodorum abortivum (L.) Sw.
Violet Limodore
Localities: 46, 51.

Fourteen records from two localities (Wadi Al-Zarqa Al-Ulwi and Um-Safa) are reported but the latest record is from 1988. At least three of the specific localities are now urbanized or degraded. The population in Wadi Al-Zarqa most likely became locally extirpated because a recent survey of the area didn't encounter this species (PMNH, 2018). Two leading botanists of the region reported to the authors to have never encountered this species in any of their field surveys. There may be a thriving population in the pine forest near Um-Safa, but it needs verification in the next spring season as the flowering period is in April. The range of potential habitats is quite limited naturally to mid-shady areas in montane pine forest (Delforge, 2006). Parts of the forest near Um-Safa is protected as a Natural Reserve, but possible repopulation of adjacent areas is restricted to the few densely forested areas. A number of pollinators are associated with *L. abortivum* including *Anthidium, Bombus, Anthophora* and *Halictus marginatus* (Claessens & Kleynen, 2014).

Neotinea maculata (Desf.) Stearn
Dense-Spiked Orchid
Localities: 17, 28, 50, 52, 54.

Only five localities were confirmed of this light loving species with an area of occupancy (AOO) of 16000 km^2. The most northern record is from the edge of the Irano-Turanian zone with semiarid conditions while others are from the Mediterranean zone and located around areas with >700 mm annual rainfall. As it grows in bathas and prefers light rendzina (Danin, 2004) it is endangered due to habitat destruction. One record is from an area in Wadi Al-Khafi that is now built up by the Pisgat Ze'ev colony (31°50'5.117"N, 35°14'43.312"E).

Neotinea tridentata Scop.
Toothed Orchid (Figure 2)
Localities: 1, 2, 5, 7–10, 12–14, 24, 30, 32, 34, 36, 37, 39, 46, 47, 49, 50–53, 56, 58.

Very common in Mediterranean habitats. This was the species we found in most localities in our study.

Ophrys adonidis A.Camus & Gomb.
Localities: 13, 21, 23, 33, 34, 36, 37, 39, 46, 49, 51, 56.

Common. Belonging to the large *O. mammosa*-complex and formerly known as *O. transhyrcana* Czerniak, also described as *O. mouterdeana* (B. Baumann & H. Baumann) P. Delforge. The status of this taxon has been clarified by Paulus & Hirth (2017), who identified the bee *Andrena fuscosa* as major pollinator for this group.

Ophrys apifera Huds.
Bee Orchid
Localities: 39, 46, 49, 51, 58.

Ten records have been found. All of them are in a close range from each other with an AOO of 32000 km^2. Nine of the records are older than 30 years. It has been recently confirmed only near Salfit.

Ophrys bornmuelleri subsp. ***bornmuelleri*** M.Schulze
Bornmueller's Ophrys
Localities: 3, 7, 8, 13, 21, 23, 37, 46, 51, 56, 58.

Fairly common. Sepals can be greenish, pink or whitish. Slightly bigger than the other subspecies of the *O. bornmuelleri*-complex, rare in the region: *O. bornmuelleri* subsp. *ziyaretiana* blooms two weeks before *O. bornmuelleri* subsp. *bornmuelleri* (Kreutz, 2006). Kreutz reported larger populations of the mentioned subspecies in Lebanon and Syria.

Ophrys iricolor Desf.
Iris Coloured Bee Orchid
Localities: 39, 50, 52, 56.

This species was only recorded four times from fragmented areas. Its limited occurrence might be attributed to its specific interaction with *Andrena morio* for pollination (Paulus & Gack, 1990; Stökl *et al*., 2011). This bee is more common in the Western Mediterranean and data about its Eastern distribution is scarce.

Ophrys israelitica H.Baumann & Künkele
Tawny Bee-Orchid
Localities: 6, 11, 14, 26, 27, 33, 36, 46, 50, 51, 55, 56.

Part of the closely related *O. omegaifera*-complex. Pollinated by the relatively common bee *Andrena flavipes* (Delforge 2005, p. 430).

Ophrys cf. ***libanotica*** P.Delforge
Lebanese Orchid
Localities: 9, 14, 33, 36, 39, 46, 50, 51, 56.

Formerly grouped to the *O. holoserica/fuciflora*-complex, Delforge (2000) classified the Eastern variant as a distinct species: *Ophrys aramaeorum* P.Delforge. In his catalogue of European orchids, Kreutz (2004) described it as subspecies of *O. holoserica* (Burm. f.) Greuter while Véla & Viglione (2015) proposed *O. episcopalis* subsp. *libanotica* (B.Baumann & H.Baumann) Véla & Viglione for this taxon. In the same year it was combined with *O. libanotica* (B. Baumann & H. Baumann) P. Delforge. More changes to this classification appear likely in the future and we are told that a new species is being described from historic Palestine by CAJ Kreutz (pers. comm, 2020). This species was recorded ten times from the West Bank area with a wider distribution in the wetter parts of the Mediterranean zone (mean annual rainfall >500mm). It prefers open maquis and batha habitats (Danin, 2004). The records between Um-Safa, Wadi Elblat and Salfit indicate a stable metapopulation with the potential to repopulate open habitats. However, these habitats are endangered through expanding urbanisation not only

in these three localities but also near the Gush Etzion settlement complex in the Bethlehem district (Darr, 2014).

Ophrys lutea var. ***galilaea*** (H.Fleischm. & Bornm.) Soó
Small Yellow Bee Orchid
Localities: 1, 5, 7, 9, 12−15, 18, 21, 23, 24, 26, 31, 32, 34, 36, 37, 39, 46, 49, 51, 52, 56, 57, 61.

This is a common in Mediterranean garrigue habitats. Hennecke (2016) classified from old records and descriptions that both very similar species *O. lutea* var. *galilaea* and *O. sicula* (Tineo) exist in the Eastern Mediterranean with a chance of hybridisation. As suggested by Delforge (2006) and later assessed and confirmed by Hennecke (2017), the decisive feature between the two species is the angle between longitudinal axis and side lobes. In *O. lutea,* this angle is around 80°, while in *O. sicula* only 48° on average (Hennecke, 2017).

Ophrys sicula Tineo
Lesser Yellow Bee Orchid
Locality: 9.

Hennecke (2016, p. 139) reported numerous populations in forested areas of the southern part of the Westbank in 1997. This species was confirmed blooming near the village Beit Skarya by S. Shaheen, a staff member of the PMNH, on March 29th, 2020. Hennecke suggested that some of the many *O. lutea* var. *galilaea* (above) records were misidentified, then *O. sicula* is shown underrepresented in the current paper.

Ophrys umbilicata Desf.
(= *Ophrys carmeli* H.Fleischm. & Bornm.)
Carmel Bee Orchid
Localities: 1, 7, 8, 14, 15, 18, 20, 21, 23, 29−32, 34, 36, 39, 40, 46, 49, 51, 53, 56, 57, 59.

Very common in Mediterranean habitats.

Orchis anatolica Boiss.
Anatolian Orchid
Localities: 1, 5, 6, 7, 9, 10, 13, 14, 15, 19, 22, 26, 32, 36, 37, 39, 44−47, 49, 50, 51, 52, 53, 55, 56, 58.

Common in Mediterranean habitats.

Orchis galilaea (Bornm. & M.Schulze) Schltr.
Galilee Orchid
Localities: 9, 13, 21, 23, 24, 36, 42, 45−47, 49, 50, 51, 53, 56, 60.

Common in Mediterranean batha and garrigue habitats. Habitat studies using GIS have successfully been conducted in Lebanon before to predict the distribution of this species (Machaka-Houri *et al*., 2018).

Serapias vomeracea Burm.f. subsp. ***levantina*** H.Baumann & Künkele
Long-lipped Serapias
Localities: 13, 31, 35, 39, 46, 51, 56, 58.

Noted with a wide distribution in the Mediterranean region and Western Europe. For nomenclature, see Vela & Viglione (2015).

Due to the lack of recent findings, the status of two species is unclear:

Orchis italica Poir.

On the GBIF database recorded as *O. longicruris* Link *sin localidad* from 1913 and observed in 1988 in the Irano-Turanian zone, east of Tammoun village. That land has turned into agricultural fields since. The third record is from the year 2000 in Jabbel Al-Qarn, a hill that has been reforested in the past twenty years. This north-western slope is now densely covered with Palestine Oak (*Quercus calliprinos*) and *Pistacia palaestina.* On the south-eastern aspect, the gaps between trees and shrubs are closing at a slower pace. However, the habitat is disturbed by visitors who come to the area to rest and often barbeque. The population of *O. italica* has not been re-encountered since then. A planned survey of Al-Qarn will shed some light on the status of the population there.

Orchis israelitica Baumann & Dafni
(= *Anacamptis israelitica* R.M.Bateman, Pridgeon & M.W.Chase)

It is known from the Galilee area only (Bauman & Dafni, 1979; Delforge, 2005). It was reported from one locality in the Hebron district by Ighbareyeh *et al.* (2017); after correspondence with the author in May 2020, this record was dismissed as unconfirmed or misidentified.

Discussion

Most orchid species are well adapted to habitats in temperate and tropical regions (rarely in arid regions). In our region, most of their distribution is attributed to the three types of natural vegetation cover in the Eastern Mediterranean (maquis, garrigue, and batha). They prefer sunny to mild-shady locations, in open woodlands, forest edges, garrigues and grasslands. The majority tolerates or even prefers less moist soil, with only two species preferring more moist conditions: *Cephalanthera longifolia* and *Epipactis veratrifolia.* The dominant soils in the Mediterranean zone are directly derived from the bedrock. Terra Rossa is found on hard limestone and dolomite, while pale rendzina can be encountered on chalk or marl. Where Nari crust or hard chalk is present, brown (forest) rendzina can be found. These create organically rich and somewhat alkaline soils, generally ideal conditions for orchids. They range throughout these soil areas where precipitation is sufficient (Figure 1). Only a small percentage of the West bank is forested (Ghattas *et al.*, 2002), leaving plenty of open shrubs and grasslands as (potential) habitats for the Mediterranean

orchids. However, they suffer from expanding urban areas, increasing land use, overgrazing, fires, changing climatic conditions and decrease precipitation (Nofal & Barakat, 2001; Mizyed, 2009). Intensifying agriculture, climate change and expansion of human infrastructure are also main contributors to the global insect decline (Sánchez-Bayo & Wyckhuys, 2019). Reduced availability of pollinators would threaten the orchid populations in addition to direct habitat loss. Declining figures of insect biomass and diversity in the area are yet to be confirmed; however, they can be well anticipated for the area. The Israeli emphasis on filling every hill with settlements, especially around Jerusalem (Chiodelli, 2013) had a particularly negative impact by destroying many populations and disconnecting other populations. A number of old records point to formerly natural areas that are now covered with colonies or agricultural land. For example *Ophrys lutea* was reported by the Israeli Nature Park Authority (INPA) in 1997 where the settlement Beit Aryeh-Ofarim has now proliferated. Another example discussed above is the decline of *Limodorum abortivum.* In the latter case, the decline is due to Palestinian development. There was rapid increase in population in historic Palestine from about 1.5 million before 1948 to currently 12.5 million (this number also excludes the Palestinian refugees of 1948 and their descendants who now live in places like Jordan, Lebanon and Syria). The increase is both due to large family size and to immigration of many Jews from around the world to this area. This creates stresses on the land and the natural areas.

The orchids' relation to grazing mammals needs more work, but some interesting observations were made. In some garrigue habitats, the orchids were noted growing only in the thorny dwarf shrub *Sarcopoterium spinosum* Spach's confines. In early spring, these shrubs don't have as many leaves, still letting enough light come through, but their bristles/thorns protect the orchids from being eaten by grazing goats and sheep. Goats are more damaging than sheep because they yank the orchids while sheep break the leafy parts off, leaving the roots, which may get a second chance. Goats, sheep and gazelles may, on the other hand, have a positive effect as they keep the garrigues open by preventing the growth of trees and larger bushes (Perevolotzky & Seligman, 1998). In our experience, the damage is far more prevalent.

Conclusion

The few studies available in the occupied Palestinian Territories (West Bank) suggested the need for this and similar studies from a nascent Palestine Museum of Natural History. The study of orchids here provided interesting new observations, including the disappearance of some species due to human influences like building settlements and the fact that some orchids seem to survive in heavily grazed areas by growing in the middle of thorny plants like *Sarcopoterium spinosum.* We propose a need for a more thorough survey of orchids in our region. In Lebanon, a recent study showed 51 species and subspecies and there is every reason to expect our list to grow with further research. Such research is especially needed in the most vulnerable areas of human urban encroachment (including settlement expansion areas) and at the edges of the remaining few protected natural habitats. We also propose the creation of a system to designate and protect certain areas (hotspots) for orchid conservation. Initial candidate locations are Um-Safa and Wadi Al-Makhrour. In particular, the latter is a very interesting area designated a UNESCO World Heritage Site with many species of orchids, including areas with a good population of orchids like *Anacamptis pyramidalis* and *Ophrys* cf. *libanotica* (Figure 2).

Acknowledgements

The work on orchids at our institute was partially supported by the Critical Ecosystem Partnership Fund (project title "Green Oasis in Bethlehem for Plant and Ecosystem Conservation'), Botanic Gardens Conservation International, and by the EU Peace Initiative fund (for project titled "Unity and Diversity in Nature and Society" ENI/2019/412-148). Funders are not responsible for the content of this paper. We thank Mr. Banan Al-Shaikh for sharing his records with us. We are grateful to Dr. Karel Kreutz, Dr. Zuzana Ferencova, and an anonymous reviewer for helping with editing.

References

Akhalkatsi, M., Arabuli, G. & Lorenz, R. 2014. Orchids as indicator species of forest disturbances on limestone quarry in Georgia (South Caucasus). J. Eur. Orch. 46(1): 123–160.

Al Sheikh, B. & Mahassneh, M. 2017. Flora of Wadi Al-Quff Protected Area, Hebron Governorate, Palestine. Jordan J. Nat. Hist. 6: 47–57.

Barman, D. & Devadas, R. 2013. Climate change on orchid population and conservation strategies: a review. J. Crop Weed. 9(2): 1–12.

Baumann, H. & Dafni, A. 1979. Orchis israelitica spec. nov.—eine neue endemische Art aus Israel. Mitteilungsbl. Arbeitskr. Heim. Orchid. Baden-Württ 11: 249–282.

Burns-Balogh, P., Szlachetko, D.L. & Dafni, A. 1987. Evolution, pollination, and systematics of the tribe Neottieae (Orchidaceae). Plant Syst. Evol. 156(1-2): 91–115.

Chiodelli, F. 2013. Re-shaping Jerusalem: The transformation of Jerusalem's metropolitan area by the Israeli barrier. Cities 31: 417–424.

Claessens, J. & Kleynen, J. 2014. The pollination of European Orchids Part 3: Limodorum and Epipactis. J. Hardy Orchid Soc. 11(2): 64–71.

Cozzolino, S., Aceto, S., Caputo, P., Widmer, A. & Dafni, A. 2001. Speciation processes in Eastern Mediterranean Orchis s.l. species: molecular evidence and the role of pollination biology. Isr. J. Plant Sci. 49(2): 91–103.

Cuttelod, A., García, N., Malak, D.A., Temple, H.J. & Katariya, V. 2009. The Mediterranean: a biodiversity hotspot under threat. Wildlife in a Changing World - an analysis of the 2008 IUCN Red List of Threatened Species, 89.

Dafni, A. & Ivri, Y. 1981. The flower biology of Cephalanthera longifolia (Orchidaceae) - pollen imitation and facultative floral mimicry. Plant Syst. Evol. 137(4): 229–240.

Dafni, A., Talmon, Y. & Gertmann, Y. 1987. Updated list of the orchids of Israel. Isr. J. Plant Sci. 36(3): 145–157.

Danin, A. 2004. Distribution atlas of plants in the Flora Palaestina area. Israel Academy of Sciences and Humanities.

Darr, S. 2014. The Expansion of Israeli Settlements in the West Bank and their Impact on Displacement. Journal of Palestinian Refugee Studies 316: 1–7.

Delforge, P. 2000. Ophrys aramaeorum sp. nova, une espèce orientale du groupe d'Ophrys tetraloniae. Natural Belges 81: 225–231.

Delforge, P. 2005. Guide des Orchidées d´Europe d´Afrique du Nord et du Proche Orient. Delachaux & Niestlé, Laussane.

Delforge, P. 2006. Orchids of Europe, North Africa and the Middle East. 3rd ed. London, UK: A&C Black Publishers Ltd.

Delforge, P. 2015. Nouvelles contributions taxonomiques et nomenclaturales aux Orchidées d'Europe. Natural Belges 96 (Orchid. 28): 14–21.

Ghattas, R., Hrimat, N. & Isaac, J. 2002. Forests in Palestine. Applied Research Institute, Jerusalem.

Hennecke, M. 2016. Once again on Ophrys lutea: galilaea or sicula or minor? GIROS Orch. Spont. Eur. 59(1): 132–149.

Hennecke, M. 2017. What is Ophrys phryganae. GIROS Orch. Spont. Eur, 60(2), 261–275.

Ighbareyeh, J.M., Cano-Ortiz, A., Carmona, E.C., Suliemieh, A.A. & Ighbareyeh, M.M. 2017. Flora endemic rare and bioclimate of Palestine. Open Access Library J. 4(11): 1–14.

Kreutz, C.A.J. 2004. Catalogue of European orchids. Kreutz Publishers, Landgraaf.

Kreutz, C.A.J. 2006. Bemerkungen zu den Orchideen von Libanon, Syrien, Israel, Zypern und der Türkei. J. Eur. Orch. 38(1): 105–160.

Levin, N. & Shmida, A. 2007. Determining conservation hotspots across biogeographic regions using rainfall belts: Israel as a case study. Isr. J. Ecol. Evol. 53(1): 33–58.

Machaka-Houri, N., Houri, A., Westbury, D. & Ibrahim, M. 2018. Predicting Potential Distribution of Orchis galilaea in Lebanon Using GIS. Proceedings of the 18th International Multidisciplinary Scientific Geoconference 18(1.5): 749–756.

Mizyed, N. 2009. Impacts of climate change on water resources availability and agricultural water demand in the West Bank. Water Resour. Manag. 23(10): 2015–2029.

Newman, B., Ladd, P., Batty, A. & Dixon, K. 2015. Ecology of orchids in urban bushland reserves–can orchids be used as indicators of vegetation condition? Lankesteriana 7(1–2): 313–315.

Nofal, I. & Barakat, T. 2001. Desertification in the West Bank and Gaza Strip. In: Pasternak D., Schlissel, A. (Eds.). Combating Desertification with Plants. 1st ed. Pp. 369–374. Springer, Boston.

Paulus, H.F. & Gack, C. 1990. Pollination of Ophrys (Orchidaceae) in Cyprus. Plant Syst. Evol. 169(3–4): 177–207.

Paulus, H.F. & Hirth, M. 2017. Bestäubungsbiologie und Systematik des Ophrys mammosa-Komplexes im östlichen Mittelmeerraum mit Neu-beschreibungen von Ophrys prespaensis und O. willingii vom griechischen Festland. J. Eur. Orch. 49(2): 219.

Perevolotsky, A. & Seligman, N.A.G. 1998. Role of grazing in Mediterranean rangeland ecosystems. Bioscience 48(12): 1007–1017.

Pillon, Y. & Chase, M.W. 2007. Taxonomic exaggeration and its effects on orchid conservation. Conserv. Biol. 21(1): 263–265.

Qumsiyeh, M. & Amr, Z. 2017. Environmental conservation and protected areas in Palestine: Challenges and Opportunities. Rep. Hanns Seidel Found. http://www.mahmiyat.ps/uploads/171013%20HSF_Bethlehem_Printed%20Version_NC.pdf

Qumsiyeh, M.B., Zavala, S.S. & Amr, Z.S. 2014. Decline in Vertebrate Biodiversity in Bethlehem, Palestine. Jordan J. Biol. Sci. 7(2): 101–107.

Sánchez-Bayo, F. & Wyckhuys, K.A. 2019. Worldwide decline of the entomofauna: A review of its drivers. Biol. Conserv. 232: 8–27.

Shifman, A. 2019. The Wild Orchids of Israel: The Complete Guide. Privately published by author.

Soto-Berelov, M., Fall, L., Falconer, E. & Ridder, E. 2015. Modeling vegetation dynamics in the Southern Levant through the Bronze Age. J. Archaeol. Sci. 53: 94–109.

Stökl, J., Brodmann, J., Dafni, A., Ayasse, M. & Hansson, B.S. 2011. Smells like aphids: orchid flowers mimic aphid alarm pheromones to attract hoverflies for pollination. P. R. Soc. B 278(1709): 1216–1222.

Vela, E. & Viglione, J. 2015. Recent inputs to the Lebanese orchid flora and proposal of a national checklist for Orchidaceae family. Acta. Bot. Gallica. 162(4): 271–285.

Vereecken, N.J., Dafni, A. & Cozzolino, S. 2010. Pollination syndromes in Mediterranean orchids -implications for speciation, taxonomy and conservation. Bot. Rev. 76(2): 220–240.

Wraith, J. & Pickering, C. 2017. Tourism and recreation a global threat to orchids. Biodivers. Conserv. 26(14): 3407–3420.

Websites

BioGIS. 2020. Israel Biodiversity Information System. http://www.biogis.huji.ac.il

GBIF 2020. GBIF Home Page. Available from: https://www.gbif.org [Accessed on May 14th 2020].

GBIF.org May 14th 2020. GBIF Occurrence Download https://doi.org/10.15468/dl.8qyjpe [Download available at http://api.gbif.org/v1/occurrence/download/request/0063088-200221144449610.zip]

GeoMOLG. Ministry of Local Governance. Available online: geomolg.ps [Accessed on May 5th 2020].

iNaturalist. Available from https://www.inaturalist.org.

IPNI 2020. International Plant Names Index. Published on the Internet http://www.ipni.org, The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Botanic Gardens. [Retrieved November 14th 2020].

Palestine Museum of Natural History (PMNH). 2018. Actions for Environmental Sustainability in Wadi Al-Zarqa Al-Ulwi. Palestine Museum of Natural History, Bethlehem https://www.palestinenature.org/conservation/WadiZarqaTechnical.pdf

QGIS.org 2020. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.org

The Applied Research Institute Jerusalem ARIJ. Available online: http://www.arij.org