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## The flora of Mt Imittos (Sterea Ellas, Greece): checklist, new records, analysis and phytogeographical aspects

### Abstract

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The floristic investigation of the area of Mt Imittos in Sterea Ellas, Greece, resulted in the addition of 95 specific and infraspecific vascular plant taxa. As a result the flora of the mountain now comprises 869 taxa. For each newly recorded taxon local distribution and habitat types are presented. A significant part of the new records concern adventive taxa a fact that reflects the present day dynamics of the flora of human influenced and heavily urbanized areas of Greece. Old records of the Greek endemics *Anthemis tomentosa* subsp. *heracleotica* and *Centaurea orphanidea* are also confirmed. A detailed checklist of the total vascular flora is also presented. The results of floristic analysis and phytogeographical aspects demonstrate the pronounced Mediterranean character of the mountain's flora. Floristic similarities to other mountains of Sterea Ellas and Peloponnisos are discussed.

*Key words:* biodiversity, phytogeography, adventive taxa, Attiki, Mediterranean.

### Introduction

Mt Imittos occupies a significant part of Attiki, a historical region of Greece directly associated with the creation of the Greek civilization. It belongs to the phytogeographical region of Sterea Ellas as defined in the *Flora Hellenica* project (Strid & Tan 1997). More specifically it lies E of the basin of Athens demarcating the eastern boundaries of the Athens urban area.

The mountain has a longitudinal shape. It can be subdivided in two geographical units, which are separated by a pass called Stavros at 454 m. Northern Imittos is bigger and higher with a NNE-SSW orientation. It encompasses the main ridge of the mountain and its higher peak Evzonas (1026 m a.s.l.). The inclination of the ground is often high and a considerable number of impressive cliffs are formed especially in its eastern slopes. These formations host a significant number of interesting plant taxa. Southern Imittos has a N-S orientation, is drier and has in general a lower and gentler relief which ends progressively to the Saronic gulf. Thus the southern part of the mountain is much influenced by the sea. Its main peak is Mavrovouni (774 m a.s.l.).

The main substrates of the mountain are marbles and dolomites followed by schists and limestones. Its peripheral zone is covered mainly by old and new talus cones and scree and terrestrial and fluvial-terrestrial deposits (IGME 2003). The maximum boundaries of the investigated area are defined by the coordinates 37°48'00" to 38°00'40"N and 23°45'18" to 23°51'44"E. However, as a major portion of its lower parts are heavily urbanized, these boundaries are nowadays obscured and often difficult to be distinguished in the field.

Climatic data are available from the nearby meteorological stations of Spata, Elliniko, Tatoi and Anavrita all situated in an altitudinal range of 43-310 m. According to the climatic diagram by Emberger (1955, 1959) and Sauvage (1963), the bioclimate of the area is semi-arid with mild winter. The dry period, according to the ombrothermic diagram by Bagnouls & Gaussen (1957), lasts five (Anavrita) to six and a half (Spata) months. Internal variation also exists, depending on altitude and topography, i.e. the upper altitudinal zone, north-facing slopes and northern Imittos receive considerable higher amounts of precipitation.

Human interferences have been acting since antiquity in the investigated area owing to its proximity to the city of Athens one of the predominant centers of the ancient world. The physiognomy of the western margins has dramatically altered in 1920s with the foundation of settlements for the Greek refugees of Minor Asia and mainly after the 1950s when waves of migrants from rural Greece concentrated in the basin of Athens following changes that occurred in social and economic structure of the country. Its eastern margins remained rural until 1990s when a rapid expansion of the local towns (Glika Nera, Peania, Koropi, Vari) took place in the last decades owing to their proximity to the city of Athens. These towns and villages are now transformed to satellite cities that are economically connected to the Athens urban area. As a result the mountain is nowadays enclosed by urban areas all over its peripheral zone. A significant part of its natural and agricultural ecosystems have been taken over by concrete. A serious human impact was the construction of a huge telecommunication facilities center and military camp that cover a significant part of the extensive ridge of northern Imittos. That caused severe visual pollution and aesthetic degradation of its upper parts visible from a long distance from the inhabitants of the city of Athens. Abandoned marble quarries have a smaller impact in the physiognomy of the mountain especially when compared to the profound impact that this activity has had in the nearby Mt Pendelikon. The quality of the marbles of Imittos is inferior when compared to the ones of Mt Pendelikon. Thus, their exploitation was restricted. Other worth mentioned human interferences comprise deforestation caused by extensive logging that took place mainly in the difficult period of Second World War, wildfires and grazing. The latter is on decline nowadays.

The investigated area has a rich history of botanical exploration due to its proximity to the city of Athens. John Sibthorp visited Mt Imittos in June 1787, and collected several species, some of which were subsequently illustrated in *Flora Graeca* (Sibthorp & Smith 1806, 1813, 1824, 1825a, 1825b, 1825c, 1835) among them *Cerastium tomentosum* (now *C. candidissimum*), *Delphinium tenuissimum* (now *Consolida tenuissima*), *Dianthus serratifolius*, *Gypsophila ochroleuca* (now *Petrorhagia ochroleuca*), *Salvia calycina* (now *S. pomifera* subsp. *calycina*), *Silene rigidula* (now *S. corinthiaca*),

*Trigonella foenum-graecum* (now *T. cariensis*), *Valantia muralis* and *Veronica glauca*. Collectors in the period 1830-1860 include Zuccarini, Friedrichsthal, Sartori, Aucher-Éloy, Spruner, Boissier, Mill, Clementi, Guicciardi and, most importantly, Heldreich and Orphanides, the two leading botanists in Athens in the mid-19<sup>th</sup> century. In the late 19<sup>th</sup> century botanical collections were made by Halácsy, Haussknecht, Leonis, Barbey, Pichler, Tuntas and others. Among the most important contributions were the extensive collections made by Haussknecht in the spring and summer of 1885, partly together with Heldreich (Strid, pers. comm.). The first published records concerning its flora are to be found in Heldreich (1877) and Haussknecht (1893-1900). All these old reliable records were summarized in the great work of Halácsy (1900-04, 1908, 1912). Important contributions to the flora of the mountain in the 20<sup>th</sup> century include Maire & Petitmengin (1908), Rikli & Rübel (1923), Rechinger (1929, 1936), Zerlentis (1965), Strid (1986), Strid & Tan (1991), Sarlis (1994). New records are to be found in the phytosociological tables of doctoral thesis concerning the vegetation of the mountain (Gouvas 2001) and the vegetation of Attiki (Hermjakob 1977). Regel (1938) discussed also the forest vegetation of Mt Imittos. Fragmentary floristic information can be found in other publications irrelevant with the flora of the mountain mostly taxonomic revisions of a genus (Dahlstedt 1926; Lowe 1953; Snogerup 1962; Stork 1972; Scholz 1985; Frey 1997; Brullo & al. 1998; Pedersen & Faurholdt 2007; Karamplianis & al. 2013) or dealing with a specific family (Hermjakob 1969; Krämer & Krämer 1983) or with various parts of Greece (Sfikas 2001). Recent florist reports of one or few taxa include Pearce (2006), Jordan (2007), Bazos (2007), Polymenakos & Tan (2012a, 2012b, 2013, 2014a, 2014b, 2015), Alexiou (2014) and Sfikas (2015) while a new taxon has been described recently from the mountain (Zografidis & al. 2014). The present study aims to reveal the floristic diversity of a mountain of a historical region of Greece which has suffered greatly from human interferences and to assess present day dynamics.

## Material and methods

The study is based on collections and field observations made mainly from 2015 to 2017. Collections were conducted in various localities and habitats of the mountain in all the seasons of the year in order to obtain a precise idea of the character of its flora. All specimens are temporarily kept in my personal herbarium and will be deposited in the Herbarium of the Agricultural University of Athens (ACA). Species identification and/or nomenclature were based mostly on Davis (1965-1985), Tutin & al. (1968, 1972, 1976, 1980, 1993), Greuter & al. (1984, 1986, 1989), Strid & Tan (1997, 2002), Greuter & Raab-Straube (2008) and Dimopoulos & al. (2013). The life-form and chorological categories used in the relevant classifications follow Dimopoulos & al. (2013). The complete plant list including spontaneous and subspontaneous taxa reports the new findings and literature records, most of which have been confirmed by the author and is included in the Electronic Supplementary File 1. Families, genera, species and subspecies are listed within the major taxonomic groups in alphabetical order. Transliteration of localities is in accordance with “*Flora Hellenica*” (Strid & Tan 1997, 2002).

**Localities (Fig. 1)**

1. Summit Evzonas, 1026 m a.s.l. 37°56'47"N 23°48'51"E
2. N of the summit Evzonas, 850-980 m a.s.l., 27.2.2016, 13.4.2015. 37°57'18"N 23°49'15"E
3. c. 0.5 Km N of Peanias cave, 400-700 m a.s.l., 13.4.2015, 22.4.2015. 37°57'27"N 23°49'39"E
4. Southeastern slopes of Korakovouni summit, 500-550 m a.s.l., 30.4.2015. 37°58'19"N 23°49'26"E
5. Municipality of Glika Nera, 200-270 m a.s.l., 22.9.2015, 27.10.2015, 1.9.2017. 37°59'19"N 23°50'44"E
6. Between Glika Nera and Peania, 200-300 m a.s.l., 1.9.2017. 37°58'23"N 23°50'33"E
7. Prosilio, 280-400 m a.s.l., 30.4.2015. 37°58'14"N 23°49'50"E
8. Municipality of Peania, 160-210 m a.s.l., 13.4.2015, 22.4.2015, 2.6.2015, 1.9.2017. 37°57'13"N 23°51'02"E
9. Between Peania and Peanias cave, 210-300 m a.s.l., 13.4.2015, 22.4.2015, 12.5.2015, 2.6.2015. 37°56'56"N 23°50'10"E
10. Peanias cave, 520 m a.s.l., 22.4.2015. 37°56'46"N 23°49'43"E
11. Agios Nikolaos and Chalidou, 160-240 m a.s.l., 12.5.2015, 1.9.2017. 37°56'11"N 23°50'06"E
12. Doukas stream, 320 m a.s.l., 8.4.2016. 37°54'28"N 23°48'30"E
13. Locality Kalivia, 170-200 m a.s.l., 8.4.2016. 37°52'17"N 23°49'29"E
14. Galini settlement, 100-130 m a.s.l., 8.4.2016. 37°51'18"N 23°49'05"E
15. c. 1.5 Km W of Galini settlement, 160-180 m a.s.l., 11.3.2016. 37°51'18"N 23°47'58"E
16. Municipality of Vari, between the locality Cheroma and the military training camp, 40-50 m a.s.l., 11.3.2016, 24.3.2017. 37°50'27"N 23°48'08"E
17. Terpsithea athletic facilities, 170-190 m a.s.l., 16.5.2015. 37°54'01"N 23°46'34"E
18. Stavros pass, 454 m a.s.l., 16.5.2015. 37°54'42"N 23°48'10"E
19. Between Terpsithea athletic facilities and Stavros pass, 200-450 m a.s.l., 16.5.2015. 37°54'44"N 23°47'26"E
20. Profitis Ilias chapel, 500-520 m a.s.l., 16.5.2015. 37°54'58"N 23°48'52"E
21. Between Stavros pass and Profitis Ilias chapel, 450-500 m a.s.l., 16.5.2015. 37°54'42"N 23°48'37"E
22. Monastery of Kesarianis, 350-370 m a.s.l., 27.2.2016. 37°57'38"N 23°47'52"E

**Habitats**

- a. *Quercus coccifera* scrub, marbles.
- b. Open *Pinus halepensis* wood, marbles.
- c. Open scrub with *Olea europaea* subsp. *europaea* and *Juniperus phoenicea*, schists.
- d. Disturbed places (street margins, crevices and edges of pavements, disturbed ground).
- f. Fallow and abandoned fields.
- g. *Genista acanthoclada* subsp. *acanthoclada*-*Thymbra capitata* dominated phrygana, dolomites.

- h.** Stony slopes with *Olea europaea* subsp. *europaea*, *Pistacia lentiscus* and *phrygana*, dolomites.
- o.** Olive groves.
- r.** Road margins.
- s.** Forest roadsides.
- v.** Vineyards.

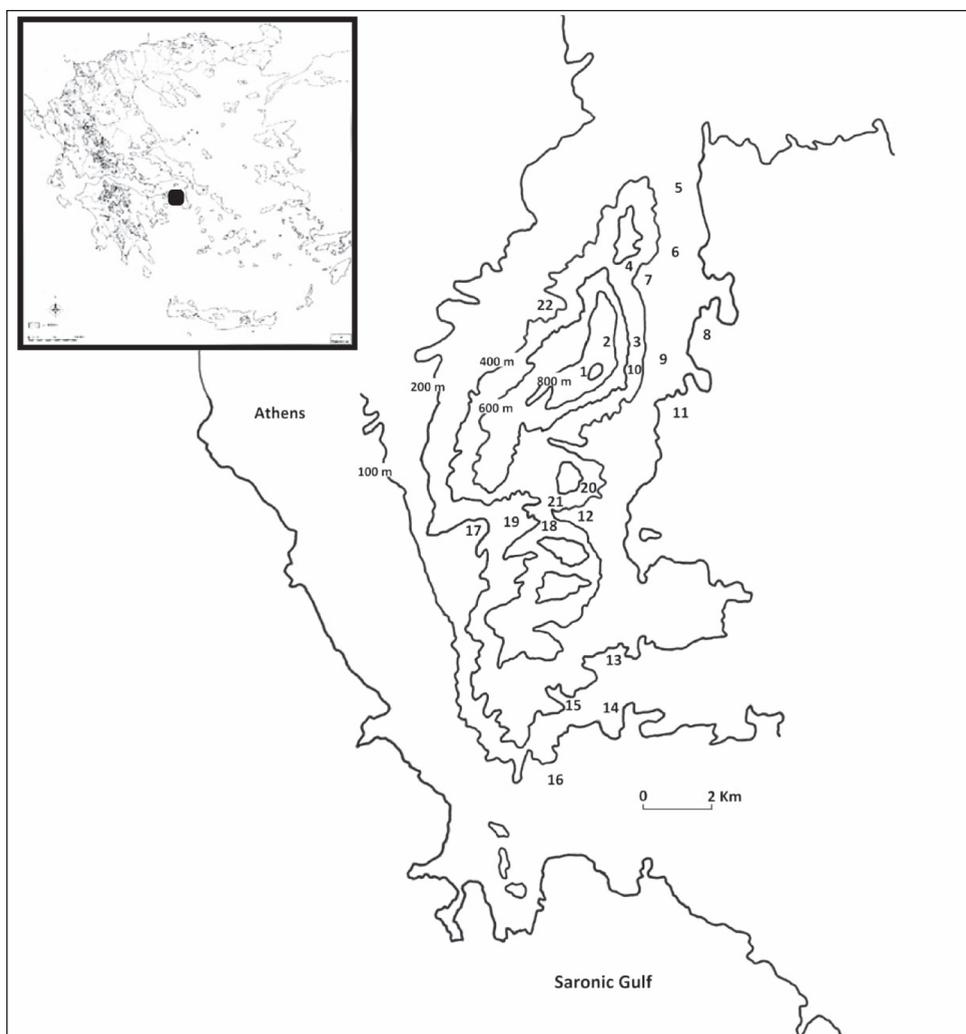


Fig. 1. Geographical position of Mt Imittos in Greece and a map of the investigated area.

### Floristic analysis - Discussion

The present study raises the total number of vascular plant taxa that have been reported from Mt Imittos to 869. This number does not include dubious records, mainly for phyto-geographical reasons, not substantiated by herbarium specimens. The 869 taxa belong to 97 families and 414 genera (Table 1). The 5 richest in number of taxa families are *Fabaceae* (100), *Asteraceae* (95), *Poaceae* (74), *Brassicaceae* (47), *Orchidaceae* (47).

The diversity of the flora of Imittos can be attributed to the diversity the mountain exhibits in geology, topography and climate and to the range of the human impacts. Consequently to the diversity of its habitats many of which are of anthropogenic origin. Many of the new records presented in this paper concern taxa characteristic of the latter habitat category. This fact reflects the contemporary dynamics of the flora of heavily urbanized areas of Greece and particularly in Attiki (Baliouis & Yannitsaros 2011).

The life-form spectrum shows that therophytes dominate (48.9 %) followed by hemicryptophytes (21.3 %) while the other life forms are represented by smaller percentages (Table 2). The high proportion of therophytes can be attributed to the xerothermic bioclimatic conditions that prevail in this part of Attiki, to the intensity of human influences and to the low altitude of Mt Imittos.

The analysis of the chorological spectrum (Table 3) shows that Mediterranean floristic elements are dominant (62.2 %). Greek endemics comprise 60 taxa (6.9 % of the total flora) a proportion that is expected for a mountain of Attiki (Constantinidis 1997; Baliouis 2011). Balkan endemics (19 taxa, 2.2 %) are weakly represented in the flora of Mt Imittos. Its phyto-geographical position (eastern Sterea Ellas) and its lower altitude compare to higher massifs of the Pindhos mountain range explains the relatively small number of this chorological group which is more prominent in the Greek mountain flora (19.9 %). The latter includes mainly taxa found above an altitude of 1500-1800 m (Strid 1993). The flora of Mt Imittos has been enriched significantly with adventive taxa (38) mainly of American origin. The same phenomenon has been observed in the nearby Mt Pendelikon (Baliouis

Table 1. Distribution of vascular plant taxa (species and subspecies) of the flora of Mt Imittos in the major systematic units.

<b>Systematic unit</b>	<b>Families</b>	<b>Genera</b>	<b>Taxa</b>	<b>%</b>
<b>Pteridophyta</b>	4	5	5	0.6
<b>Gymnospermae</b>	3	3	5	0.6
<b>Angiospermae</b>	71	321	666	76.6
<b>Dicotyledones</b>				
<b>Angiospermae</b>	19	85	193	22.2
<b>Monocotyledones</b>				
<b>Total</b>	97	414	869	100

Table 2. Life-form spectrum of the vascular flora of Mt Imittos.

<b>Life-forms</b>	<b>Number of taxa</b>	<b>%</b>	<b>Vascular flora of Greece (%) (Dimopoulos &amp; al. 2013)</b>
<b>Therophytes (T)</b>	425	48.9	25
<b>Hemicryptophytes (H)</b>	185	21.3	44
<b>Geophytes (G)</b>	130	15	13
<b>Chamaephytes (C)</b>	67	7.7	10
<b>Phanerophytes (P)</b>	61	7	6
<b>Aquatics (A)</b>	1	0.1	2
<b>Total</b>	869	100	100

& Yannitsaros 2011; Baliouis 2011). Many of them are reported here for the first time. Newly recorded alien species such as *Euphorbia prostrata*, *Euphorbia maculata*, *Chenopodium giganteum*, *Symphytotrichum squamatum* and *Solanum elaeagnifolium* expand rapidly their distribution range in the investigated area and generally in Attiki, especially in anthropogenic habitats.

Floristic affinities were examined with mountains of the closely related phytogeographical regions of Sterea Ellas and Peloponnisos. Comparisons were made with other medium sized mountains with altitude below 1500 m and more specifically with the well studied mountains of Attiki such as Gerania, Pateras, Kitheron (Constantinidis 1997), Pendelikon (Baliouis 2011) and the mountains of Peloponnisos, Likeo (Baliouis 2013) and Aphrodisio (Baliouis 2016) (Table 4). The floristic affinities to these mountains were estimated using the Sørensen similarity coefficient or index (Sørensen 1948). As it was expected Imittos has the strongest floristic similarity with the nearby Mt Pendelikon followed by the mountains of western Attiki Pateras and Gerania. The floristic similarity index is lower with the mountains Aphrodisio and Likeo. These two mountains of Peloponnisos comprise habitats such as *Quercus frainetto* Ten. forests which have been shaped by a combination of ecological factors that does not exist in Mt Imittos, i.e. more humid bioclimatic conditions and flysch as geological substrate. On the contrary floristic affinities are enhanced by floristic elements found in man-made habitats. It seems that human interference tends to homogenize the flora of the examined mountains although this factor does not affect these areas to the same degree. The examined mountains of Peoponnisos are sparsely populated nowadays. On the contrary the physiognomy of Mt Imittos has changed dramatically in recent decades and especially its lower parts have been transformed to an urban environment. As a result its flora has a more dynamic character, e.g. it comprises more adventive taxa. It is

Table 3. Chorological spectrum of the flora of Mt Imittos.

<b>Chorological group</b>	<b>Number of taxa</b>	<b>%</b>	<b>% of all taxa in Greece (Dimopoulos &amp; al. 2013)</b>
<b><i>1. Widespread taxa</i></b>	<b><i>185</i></b>	<b><i>21.3</i></b>	<b><i>24.5</i></b>
European (Eu)	3	0.3	4.3
European-SW Asian (EA)	95	11	9.9
Euro-Siberian (ES)	8	0.9	3.5
Paleotemperate (Pt)	34	3.9	2.0
Circumtemperate (Ct)	7	0.8	1.0
Irano-Turanian (IT)	1	0.1	0.2
Saharo-Sindian (SS)	0	0	0.2
Subtropical-Tropical (ST)	7	0.8	0.6
(Circum-)Boreal (Bo)	0	0	0.8
Arctic-Alpine (AA)	0	0	0.4
Cosmopolitan (Co)	30	3.5	1.5
<b><i>2. Mediterranean taxa</i></b>	<b><i>541</i></b>	<b><i>62.2</i></b>	<b><i>33.1</i></b>
E Mediterranean (EM)	87	10.0	9.2
Mediterranean (Me)	310	35.7	14.3
Mediterranean-Atlantic (MA)	9	1.0	1.0
Mediterranean-European (ME)	60	6.9	5.1
Mediterranean-SW Asian (MS)	75	8.6	3.5
<b><i>3. Balkan taxa</i></b>	<b><i>45</i></b>	<b><i>5.2</i></b>	<b><i>16.4</i></b>
Balkan (Bk)	19	2.2	9.8
Balkan-Italian (BI)	6	0.7	1.8
Balkan-C European (BC)	0	0	1.3
Balkan-Anatolian (BA)	20	2.3	3.5
<b><i>4. Endemic taxa</i></b>	<b><i>60</i></b>	<b><i>6.9</i></b>	<b><i>22.2</i></b>
<b><i>5. Alien taxa</i></b>	<b><i>38</i></b>	<b><i>4.4</i></b>	<b><i>3.8</i></b>

Table 4. Floristic affinities of Mt Imittos to other mountains.

Mountain	Total taxa	Shared taxa	Sørensen index
Pendelikon	1090	757	77.3
Pateras	791	555	66.9
Gerania	945	590	65.0
Kitheron	835	391	45.9
Aphrodisio	650	361	47.5
Likeo	701	375	47.8

evident that the factors shaping the floristic similarity index with these two mountains of Peloponnisos are related to phytogeography and ecology.

An important issue studying the flora of Mt Imittos is to assess the status of the indigenous taxa. It seems from the results of this investigation, that though the mountain has suffered from numerous human interferences, its main mass still acts as a refugee for the diverse and spectacular flora of Attiki which includes many rare and/or endangered taxa. Monitoring of their populations in the years to come will continue thus enabling us to make definite conclusions.

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