P. Koutsopoulos & G. Sarlis

Contribution to the study of the flora of Vouraikos gorge (Peloponnnesos, Greece)

Abstract


This study deals with the flora and certain ecological factors of Vouraikos gorge district. Our floristic records in the area reach the number of 275 species and 19 subspecies, a total of 290 taxa, which belong to 214 genera and 58 families. The richest in members families are the Asteraceae with 37 species and 4 subspecies (a total of 41 taxa), the Fabaceae with 34 species and 5 subspecies (a total of 39 taxa), the Lamiaceae with 21 species and the Poaceae with 18 species and 2 subspecies (a total of 20 taxa). Also, Asperula arcadiana, Aurinia moreana, Colchicum peloponnesiacum and Peucedanum achaicum are local endemic taxa of Peloponnnesos. Finally, Silene conglomeratica is a rare species, endemic to the Vouraikos gorge area.

Introduction

Vouraikos river is situated in the northern part of Peloponnnesos (S Greece, Fig. 1). The river springs between mount Chelmos (2338 m) and mount Erymanthos (2221 m) and flows into the Corinthian gulf, near the town of Diakopto. The most interesting part of the river is the one between Kalavryta and Diakopto villages, which is known as the gorge of Vouraikos. The length of the gorge is c. 22 km and its altitude ranges between 0 and 1200 m (Fig. 2).

There are two reasons for which this particular gorge is amongst the most well-known gorges in Greece: on one hand it is deep and narrow at most of its part and on the other hand the presence of the rack railway which crosses the gorge over iron bridges and through tunnels and links Diakopto with Kalavryta. The passing of the gorge on foot over the rail track is safe and consists part of the European path E4 (Fig. 3, 4).

There are also two interesting rivers near Vouraikos, i.e. Kerynitis and Selinountas. The area close to the delta of these three rivers is a coastal plane where orange trees, olive trees and grapes are cultivated. One important city, the ancient Eliki was placed in this area, but was sunk into the sea in 373 A.D. due to an enormous earthquake.

In the gorge, c. 12 km southwards Diakopto and at an altitude of 620 m lies the small
village of Zachlorou. The historic monastery of Mega Spilaion is built above Zachlorou, at an altitude of 924 m, situated in a cavity at the base of a big and precipitous rock.

**Materials and methods**

Our collections of plant specimens were made over the years 1999-2001, during continuous visits, especially during flowering season. Species were identified at the Institute of Systematic Botany of the Agricultural University of Athens.
Fig. 2. Map of Vouraikos gorge in the eastern part of Achaia county.

For the determination of specimens and nomenclature the following works were used: Diapoulis (1939-1949), Greuter & al. (1984-1989), Kavvadas (1956-1964), Polumin (1980), Strid (1986-1991), Strid & Tan (1991) and Tutin & al. (1964-1980).
Fig. 3. The deep and narrow gorge of Vouraikos river.

Fig. 4. The rack railway which crosses the gorge over iron bridges.
Ecological conditions

The geological formations that participate in the structure of the walls of the gorge are generally various sorts of limestone of the Paleocene period as well as Quaternary conglomerates. Limestone occupies the narrowest and most impressive part of the gorge, which extends between the fifth and eleventh kilometer southwards Diakopto. The presence of conglomerates in a continuous zone that covers much of remaining of the gorge and also the areas west of the gorge from Kalavryta to the ends of the Corinthian Gulf indicates that the are was covered by the sea at the end of the Tertiary period.

The climate of Vouraikos gorge, according to the Köppen taxonomy, can be classified in the Csa type or in the “Mediterranean climate type”, which is characterized by its semi-warm climate with an arid period during summer (Sc) and warm summer (a). From a bioclimatic point of view (Emberger, 1967; Mavrommatis, 1980) the Kalavryta district (upper end of the gorge) belongs in the humid Mediterranean Zone (mean annual temperature 13.3 °C, total annual precipitation 996.4 mm), while the Egio district (near the end of the gorge) belongs in the sub-humid Mediterranean Zone (mean annual temperature 18.3 °C, total annual precipitation 665.0 mm) (Fig. 5, 6).

![Climatic diagram of Kalavryta weather station.](image)
Results & discussion

The diversity of the flora of Vouraikos gorge is summarized in Table 1 and the presentation of the flora is made in the Appendix.

The particular geomorphologic conditions, the soil, the climate and grazing pressures have affected the flora and vegetation of the gorge.

In general, the vegetation of the gorge is sparse. This is due to the fact that the largest part of the whole area is stony and rocky on one hand, but also to the intensive grazing at that parts of the gorge that border Diakopto, Zachlorou and Kalavryta villages. This resulted in the degradation of the bushy vegetation.

The largest proportion of the species in the flora of Vouraikos gorge are therophyta and low-shrubby xerophytes (phrygana). This is mostly due to the stony soil which keeps low amounts of humidity and also to the dry and warm climate, which prevails for a long period each year.

The vegetation of the northern part of the gorge, which extends up to the eighth kilometer south of Diakopto, belongs to the inferior zone of the Mediterranean conifers and the sclerophyllous broad-leaved shrubs and is characterized by the presence of *Pinus*...
Table 1. Systematic units and taxa of the flora of Vouraikos gorge.

<table>
<thead>
<tr>
<th>Systematic Units</th>
<th>Families</th>
<th>Genera</th>
<th>Species</th>
<th>Subspecies</th>
<th>Taxa</th>
<th>Percentage</th>
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<td>4</td>
<td>4</td>
<td>-</td>
<td>4</td>
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<tr>
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<td>3</td>
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<td>-</td>
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<td>170</td>
<td>224</td>
<td>18</td>
<td>242</td>
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<tr>
<td>Monocotyledones</td>
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<td>37</td>
<td>40</td>
<td>1</td>
<td>41</td>
<td>14.1</td>
</tr>
<tr>
<td>Total</td>
<td>58</td>
<td>214</td>
<td>271</td>
<td>19</td>
<td>290</td>
<td>100.00</td>
</tr>
</tbody>
</table>

halepensis in association with Arbutus andrachne, Cercis siliquastrum, Phillyrea latifolia, Pistacia lentiscus and P. terebinthus. Various phrygana have penetrated this vegetation type, mainly Ballota acetabulosa, Cistus creticus, Hypericum empetrifolium, Micromeria juliana, Phlomis fruticosa, Salvia fruticosa, Teucrium flavum and Coridothymus capitatus.

Southwards this above-mentioned vegetation type a forest of Quercus ilex has been formed. Next to that and from Zachlorou to Kalavryta at the eastern part of the gorge a forest of Abies cephalonica can be observed. At the western part we meet a few individuals of Abies together with sparse bushes, mainly of Quercus coccifera and Juniperus oxycedrus.

The banks of the river are dominated by Platanus orientalis, especially in humid, cool and shadowy places. At the southern part of the gorge there are extensive and thick clusters of Platanus orientalis under which various herbaceous species grow, such as Arum italicum, Ranunculus neapolitanus, R. repens, Symphytum bulbosum and Urtica dioica. Moreover, the presence of Nerium oleander is prominent along the river near Diakopto.

Some of the endemic to Peloponnnesos plant species are also met in the gorge of Vouraikos. These are Asperula arcadiensis, Aurinia moreana, Colchicum peloponnesiacum, Peucedanum achaticum and Silene congesta subsp. moreana. Achillea umbellata subsp. monocephala, once considered a local endemic taxon of Vouraikos gorge, has now been assigned to the variation of the polymorphic A. umbellata without any special taxonomic status (Tzanoudakis & Iatrou 1981; Dimopoulos & Georgiadis 1992; Iatrou 1992).

Finally, a number of species that are met mainly or exclusively on the rocks of the gorge are worth mentioning:


References


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Appendix 1. List of species found in the Vouraikos gorge district.

PTERIDOPHYTA

Adiantaceae

Adiantum capillus-veneris L.

Aspleniaceae

Ceterach officinarum DC.

Hypolepidaceae

Pteridium aquilinum (L.) Kuhn

Polypodiaceae

Polypodium cambricum L.

SPERMATOPHYTA

GYMNOSPERMAE

Cupressaceae

Juniperus oxycedrus L.

Pinaceae

Abies cephalonica Loudon

Pinus halepensis Miller
ANGIOSPERMAE
DICOTYLEDONES

Acanthaceae
*Acanthus spinosus* L.

Anacardiaceae
*Pistacia lentiscus* L.
*P. terebinthus* L. subsp. *terebinthus*
*Rhus coriaria* L.

Apiaceae
*Aptum nodiflorum* (L.) Lag.
*Bupleurum fruticosum* L.
*Daucus carota* Sm. subsp. *guttatus*
*Ferula communis* L.
*Ferulago nodosa* (L.) Boiss.
*Malabathricum aureum* (Sm.) Boiss.
*Myrrhoides nodosa* (L.) Camou
*Opopanax hispidus* (Friv.) Griseb.
*Orlaya grandiflora* (L.) Hoffm.
*O. daucoides* (L.) Greuter
*Peucedanum achaicum* Halácsy
*P. aegopodioides* (Boiss.) Vandas
*Pimpinella peregrina* L.
*Scaligeria napiformis* (Sprengel) Grande
*Tordylium opulum* L.
*T. officinale* L.
*Tordis arvensis* subsp. *purpurea* (Ten.) Hayek

Apocynaceae
*Nerium oleander* L.

Araliaceae
*Hedera helix* L. s.l.

Aristolochiaceae
*Aristolochia sempervirens* L.

Asteraceae
*Achillea millefolium* L.
*Andryala integrifolia* L.
*Anthemis chia* L.
*Atractylis gummifera* L.
*Bellis perennis* L.
*B. sylvatica* Cyr.
*Carduus pycnocephalus* L. s.l.
*Carlina acaulis* Heldr. & Sart.
*Carthamus dentatus* Vahl subsp. *ruber* (Link) Hanelt
Centanrea cyanus L.
C. raphana Sm. subsp. mixta (DC.) Runemark
Cirsium creticum (Lam.) D’Urv. subsp. creticum
Crepis discors L.
C. neglecta L.
C. fraasii Schultz Bip.
Crepis crupinastrum (Moris) Vis.
Ditrichia viscosa (L.) W. Greuter
Doronicum orientale Hoffm.
Hypochoeris achyrophora L.
Hula verbascifolia (Willd.) Hausskn. s.l.
Leontodon tuberosus L.
L. crispus Vill.
Mycelis muralis (L.) Dumort.
Patentia spinosa (L.) Cass. s.l.
Phagnalon graecum Boiss. & Heldr.
Pienion mon acara (L.) Cass.
Picris echinodes L.
Pilostemon chamaepoecus (L.) Less.
P. stellatus (L.) W. Greuter
Pulicaria dysenterica (L.) Bernh.
Reichardia picroides (L.) Roth
Rhodoselena stellata (L.) Gaertner
Scolymus hispanicus L.
Scorzonera crocifolia Sm.
S. laciniata L.
Sisymbrium iranthum (L.) Gaertner
Sonchus asper (L.) Hill s.l.
Tanacetum perrihenium (L.) Schultz
Tussilago farfara L.
Tyrrhenum leucophyllum (L.) Cass.
Urosperum picroides (L.) Scop.

Boraginaceae
Alkanna tinctoria Hausskn.
Anchusa cretica Miller
A. officinalis L.
Cerinthe retorta Sm.
Cynoglossum officinale L.
Echium italicum L.
E. planaginum L.
Myosotis conestea R.J. Shuttlew
Neatostema apulum I.M. Johnston
Onosma frutescens Lam.
O. montana Sm.
Symphytum bulbosum C. Schimper

Brassicaceae
Alliaria petiolata (Bieb.) Cavara & Grande
Alyssum sectatum Jordan
Arabis verna (L.) R. Br.
Aubrieta deltoidea (L.) DC.
Aurinia novea Sm. Tzanoudakis & Iatrou
A. saxatilis (L.) Desv. subsp. orientalis (Ard.) Dudley
Biscutella didyma L.
Brussaugera erucago L.
Cardamine graeca L.
Fibigia eriocarpa (DC.) Boiss.
Lunaria anina L.
Malcolmia graeca subsp. bicolor (Boiss. & Heldr.) A.L. Stork
Thlaspi praecox Wulfen

Campanulaceae
Campanula ramosissima Sm.
C. rapistris Sm.
C. spatulata Sm. s.l.
C. versicolor Andrews

Caryophyllaceae
Petrorhagia obcordata (Margot & Reuter) Greuter
P. saxifraga (L.) Link
P. dubia (Raffn) G. López & Romo
Silene behen L.
S. congesta Sm.
S. corinthiaca Boiss. & Heldr.
S. graeca Boiss. & Spruner
S. italicca (L.) Pers.
S. nutans L.
S. vulgaris (Moench) Garcke
Siegeia cuspiata (Jordan & Fourr.) Béguinot
Velezia rigida L.

Cistaceae
Cistus creticus L. s.l.
C. salviolius L.
Helianthemum hymettium Boiss. & Heldr.
H. nummularium (L.) Miller

Convolvulaceae
Calystegia silvatica (Kit.) Grisch
Convolvulus elegantissimus Miller
Cuscuta palustrina Boiss.

Crassulaceae
Sedum album L.
S. cepaea L.
S. laconicum Boiss. & Heldr.
S. ochroleucum Chaix
S. rubens L.
Umbilicus horizontalis (Guss.) DC.
Dipsacaceae
Cephalaria ambrosioides (Sm.) Roemer & Schultes
Knautia integifolia (L.) Bertol.
Pterocephalus perennis Coulter subsp. perennis
P. plumosus (L.) Coulter
Trematostema palaestinum (L.) Jansen

Ericaceae
Arbutus andrachne L.

Euphorbiaceae
Euphorbia characias L. subsp. walfenii (Hoppe) A.R. Sm.

Fabaceae
Athyllis hermanniae L.
A. vulneraria subsp. rubriflora (DC.) Arcangeli
Astragalus hamosus L.
A. monspessulanus L.
Calicotome villosa (Poiret) Link
Cercis siliquastrum L.
Cohueta arborescens L.
Coronilla scorpionides (L.) Koch
Dorycnium hirsutum (L.) Ser.
D. pentaphyllum Scop. s.l.
Hippocrepis emerus (L.) Lassen subsp. emeroides (Boiss. & Spruner) Lassen
H. unisiliquosa L.
Lathyrus setifolius L.
Lotus cytisoides L.
L. ornithopodioides L.
Medicago sesiflora DC.
M. minima (L.) Bartal
M. orbicularia (L.) Bartal
M. praecox DC.
M. rugosa Desr.
Melilotus neapolitanus Ten.
Onobrychis aequidentata (Sm.) D’Urv.
O. ebenoides Boiss. & Spruner
O. caput-galli (L.) Lam.
O. ebenoides Boiss. & Spruner
Ononis pubescens L.
O. viscosa L. subsp. breviflora (DC.) Nyman
Psoralea bituminosa L.
Scorpiurus muricatus L.
Securigera securidaca (L.) Degen
Sparium junceum L.
Trifolium angustifolium L.
T. campestre Schreber
T. nigrescens Viv.
T. physodes Steven
T. speciosum Willd.
T. stellatum L.
Vicia sativa L. subsp. nigra (L.) Ehrh.
V. villosa Roth subsp. eriocarpa (Hausskn.) P.W. Ball

**Fagaceae**
*Quercus cocciifera* L.
*Q. ilex* L.

**Gentianaceae**
*Blackstonia perfoliata* (L.) Hudson
*Centaurium erythraea* Rafn. s.l.
*C. tenellum* (Hoffmanns & Link) Fritsch

**Geraniaceae**
*Geranium lucidum* L.
*G. purpureum* Vill.

**Hypericaceae**
*Hypericum empetrifolium* Willd. subsp. empetrifolium
*H. vesiculsum* Griseb.

**Juglandaceae**
*Juglans regia* L.

**Lamiaceae**
*Balloa acetabulosa* (L.) Bentham
*Calamintha nepeta* (L.) Savi s.l.
*Coridothymus capitatus* (L.) Reichenb. fil.
*Lamium garganicum* L. s.l.
*Lycopus europaeus* L.
*Menica longifolia* (L.) Hudson
*Micromeria juliana* (L.) Bentham
*Phlomis fruticosa* L.
*Salvia fruticosa* Miller
*S. ruggens* Sm.
*S. verbascnaca* L.
*S. viridis* L.
*Teucrium capitatum* L.
*T. chamaedrys* L. subsp. chamaedrys
*T. divaricatum* Sieber s.l.
*T. flavum* L. s.l.
*Thymus articus* ?elak.
*Sideritis curvidens* Stapf
*Stachys cretica* L. s.l.
*S. graeca* Boiss. & Heldr.
*S. parolint* Vis.

**Linaceae**
*Linum pubescens* Banks & Solander
*L. strictum* L.
Lythraceae
Lythrum salicaria L.

Malvaceae
Alcea pallida (Willd.) Waldst. & Kit.
Althaea hirsuta L.
Lavatera thomasii E. Miller

Moraceae
Ficus carica L.

Oleaceae
Fraxinus ornus L.
Phillyrea latifolia L.

Orobanchaceae
Orobanche pubescens D’Urv.

Papaveraceae
Fumaria parviflora Lam.
Papaver apulum Ten.
P. rhoecas L.

Plantaginaceae
Plantago afra L.

Platanaceae
Platanus orientalis L.

Primulaceae
Anagallis arvensis L.
Cyclamen hederifolium Aiton

Ranunculaceae
Anemone blanda Schott. & Kotschy
A. pavonina Lam.
Clematis vitalba L.
Consolida ajacis (L.) Schur
Nigella damascena L.
Ranunculus ficaria L. Bory & Chaub.
R. neapolitanus Ten.
R. paludosus Poiret
R. repens L.
R. sprunerianus Boiss.

Rosaceae
Rosa canina L.
Sorbus aucuparia L. Scop. s.l.
Sarcopoterium spinosum L.
Rubiaceae
Asperula arcadiaea Sims
Rubia peregrina L.

Salicaceae
Salix alba L.
S. elaeagnos Scop.
S. fragilis L.

Saxifragaceae
Saxifraga rotundifolia L. subsp. chrysosplenifolia (Boiss.) D.A. Webb

Scrophulariaceae
Odontites linkii Heldr. & Sart. subsp. linkii
Parentucellia latifolia (L.) Caruel
Scrophularia heterophylla Willd.
Verbascum maruarum Ten.
V. sinuatum L.

Solanaceae
Solanum dulcamara L.

Urticaceae
Urtica dioica L.

Valerianaceae
Centranthus calcitraceae (L.) Dufresne
C. ruber (L.) DC. subsp. sibthorpii (Heldr. & Sart. ex Boiss.) Hayek
Valeriana italica Lam.
Valerianella discoidea (L.) Loisel.

Verbenaceae
Vitex agnus-castus L.

Violaceae
Viola odorata L.

Vitaceae
Vitis vinifera L.

MONOCOTYLEDONES

Amaryllidaceae
Sternbergia lutea (L.) Ker-Gawler

Araeae
Arisarum vulgare Targ.-Tozz.
Arun italicum Miller
Iridaceae
*Crocus boryi* Gay

Liliaceae
*Amaryllis atheyi* Tausch
*A. subhirsuta* L.
*Asparagus asperifolius* L.
*Asphodeline liburnica* (Scop.) Reichenb.
*Colchicum petoponesiaeum* Rech. fil. & P.H. Davis
*Gagea arvensis* (Pers.) Dumort.
*Ornithogalum escaupum* Ten.
*Muscari commutatum* Guss.
*M. comosum* (L.) Miller
*M. pulchellum* Heldr. & Sart.
*Ruscus aculeatus* L.
*Smilax aspera* L.
*Urginea maritima* (L.) Baker

Orchidaceae
*Anacamptis pyramidalis* (L.) L.C.M. Richard
*Barlia robertiana* (Loisel.) W. Greuter
*Orchis italica* Poiret
*O. quadriradiata* Cyr.

Poaceae
*Aegilops geniculata* Roth
*Aira elegantissima* Schur
*Alopecurus utriculatus* Solander
*Anthoxanthum odoratum* L.
*Avena sterilis* L.
*Briza minor* L.
*Bromus madritensis* L. s.l.
*Cynodon dactylon* (L.) Pers.
*Cynosurus echinatus* L.
*Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman
*Desmazeria rigida* (L.) Tatin
*Hordeum murinum* L. subsp. *leporinum* (Link) Archangeli
*Lolium ovatus* L.
*Lolium perenne* L.
*Melica ciliata* L.
*Phalaris arundinacea* L.
*Piptatherum miliaeacum* (L.) Cossan
*Poa annua* L.
*Setaria viridis* (L.) Beauv.
*Stipa lagascae* Roemer & Schultes