

## The morphological and distribution areas characteristics of native *Phlomis* L. (Lamiaceae) taxa in the Lakes district, Turkey

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**Abstract:** The field surveys conducted in the Lakes District of Turkey from 2012 to 2015 revealed that *Phlomis armeniaca* Willd., *P. bourgaei* Boiss., *P. grandiflora* H.S. Thompson var. *grandiflora*, *P. leucophracta* P.H.Davis & Hub.-Mor., *P. lycia* D. Don., *P. nissolii* L., *P. pungens* var. *pungens* Willd., *P. samia* L. taxa were distributed in the region. In this study, in order to measure the morphological features of *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens*, *P. samia* taxa that are distributed in the Lakes District; measurements and observations were performed using digital caliper gauge for the width, height and petiole length of 50 leaf samples from each species; calyx width, height and calyx-teeth length of 50 calyx samples from each sampled species; and also types of inflorescence, number of flowers in state of flowering. Based on the observations and measurements made; the species identification key was prepared for *Phlomis* L. species that were distributed in the Lakes District. Furthermore, observations relating to the characteristics of the distribution areas of *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens*, *P. samia* taxa in the Lakes District are presented.

**Keywords:** *Phlomis*, Morphology, Distribution area, The Lakes District

## Göller yöresi doğal *Phlomis* L. (Lamiaceae) taksonlarının morfolojik ve yayılış alanı özellikleri

**Özet:** 2012-2015 yılları arasında Göller Yöresi'nde gerçekleştirilen arazi çalışmalarında *Phlomis armeniaca* Willd., *P. bourgaei* Boiss., *P. grandiflora* H.S. Thompson var. *grandiflora*, *P. leucophracta* P.H.Davis & Hub.-Mor., *P. lycia* D. Don., *P. nissolii* L., *P. pungens* Willd., *P. samia* L. taksonlarının yayılış yaptığı tespit edilmiştir. Çalışmamızda Göller Yöresi'nde yayılış gösteren *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens*, *P. samia* taksonlarının morfolojik ölçümlerini hesaplamak için dijital çap ölçer ile her bir türe ait 50 şer yaprak örneğinin en boy ölçümleri, yaprak sapı uzunluğu; toplanmış olan örneklerdeki her türe ait 50'şer kaliks örneğinin kaliks eni, boyu ve kaliks dışı boyu; çiçeklerin çiçek durumu tipi, çiçek durumundaki çiçek sayısı gibi özellikler tespit edilmiştir. Yapılan gözlem ve ölçüm lere göre Göller Yöresi'nde yayılış gösteren Çalba (*Phlomis* L.) türlerinin ayırım anahtarları hazırlanmıştır. Ayrıca Göller Yöresi'nde yayılış gösteren *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens*, *P. samia* taksonlarının yayılış alanlarına ait gözlemler hakkında bilgi verilmiştir.

**Anahtar kelimeler:** *Phlomis*, Morfoloji, Yayılış alanı, Göller Yöresi

### 1. Introduction

Flora of Turkey consists of around 11.466 plant taxa while the whole European continent has around 12.000 plant taxa (Güner et al., 2012). Turkey that has high species diversity is a gene center for many genera and also hosts several endemic species in different geographical regions (Tan, 1992).

The plant species in *Lamiaceae* family which is one of the large families in the world have high endemism and can grow in different habitats extending from Africa to America, from Hawaii to Australia, from the Himalayas to the Southeast Asia and at different altitudes (Hedge, 1986). *Lamiaceae* contains sweet-smelling annual or perennial herbaceous plants, rarely shrubs or trees. In Turkey, *Lamiaceae* family is represented by 45 genera and more than 546 species while its members are important for

pharmacology and perfumery industry due to their volatile and aromatic oil content. Etheric oil is extracted from such plants, used as spice and ornamental plants (Seçmen et al., 2011).

The Lakes District of Turkey with the province of Isparta being the center is one of the important locations in Turkey where medical and aromatic plants are cultivated. The interest and use of medical and aromatic plants by people is also growing. One of the medical and aromatic plants used by people is the genus "*Phlomis* L."

The taxonomic classification of the genus *Phlomis* is as follows (Seçmen et al., 2011)

Regnum: Plantae  
Phylum: Magnoliophyta  
Class: Magnoliopsida (Dicotyledon)  
Order: Asterales  
Family: Lamiaceae

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### Genus: *Phlomis*

One of the genera in the Lamiaceae family that has the highest number of species is the genus *Phlomis* with around 100 species in the worldwide. The taxa of this genus are distributed across Asia, Southern and Northern Europe (Matthiesen et al., 2011). The members of *Phlomis* represented by 50 taxa consisting of 40 species and subspecies, 20 hybrids as described in the book of Davis (1982) titled Flora of Turkey were reclassified into 58 taxa comprised of 39 species and subspecies, 19 hybrids according to the revision study of Dadandı (2002) on *Phlomis* in Turkey. It is represented by 52 taxa consisting of 39 taxa and 13 hybrids in the List of Plants in Turkey (Güner et al., 2012). According to the Flora of Turkey, all regions except those located in A10 and B10 grid squares are the natural distribution areas of *Phlomis* (Huber-Morath, 1982).

Description of the *Phlomis*: Perennial herbaceous or small shrub with pilose or tomentose, glandular or eglandular hairs. Leaf lamina entire or crenate. Stem leaves covered with pilose or tomentose hairs, sometimes with glandular hairs. Verticillasters few to many flowered, crowded or distant in axil of floral leaves; bracteoles absent, few or numerous, subulate to ovate. Calyx tubular or narrow bell shape with 5–10 veins and 5 teeth; teeth equal or unequal. Corolla 2 lipped, purple, pink or yellow, as long as calyx tube; inner corolla with ring and glabrous, upper lip hooked at apex, lower lip attached to the surface vertically with 3 lobes; stamens as long as or longer than corollas with double anthers, half of anther is different, branches unequal. Fruit nut-like with 3 edges, glabrous or hairy (Davis, 1982).

*Phlomis* species are locally known as “Ballık Otu”, “Calba”, “Çalba” and “Şalba” in Turkey. (Baytop, 1997; Demirci et al., 2003). Their leaves and flowers are used as appetitive, anti-allergic, diuretic, anti-diarrheal, carminative, stomach soothing, analgesic, anti-diabetic herbal tea and tonic. On the other hand, they are known to be used by people against respiratory diseases and haemorrhoids (Harput et al., 2006).

In this study, the morphological features of *Phlomis* taxa distributed in the Lakes District of Turkey and the characteristics of their distribution areas were identified. Moreover, the species identification key was prepared for *Phlomis* species distributed in the Lakes District in the light of the observations and measurements.

## 2. Material and Method

In order to identify the distribution areas of the native *Phlomis* L. taxa that are distributed in the Lakes District of Turkey; field schedule was prepared, according to areas where the study was performed. The coordinates of the points where the identified *Phlomis* species were located were taken through the expeditions to the research sites, and the sample plots within these sites were identified. The sample plots were selected in line with the criteria that the species must be dominant in the site; individuals in the species must be at a certain maturity level and be healthy, must represent different habitats and must be free from human impact as much as possible. After that, sample plots of 20 × 20 m were identified and plant samples were collected to be stored in the herbarium. While collecting the samples; such tools and instruments as field bag, loop, steel

shovel, compass, topographic and contour map, stand map, pruning shears, field book, altimeter, press, blotting paper, camera, steel measuring tape were used. The collected samples were delivered to Süleyman Demirel University, Faculty of Forestry, Forest Botany laboratory. The region, location, aspect, altitude, collection date of the samples taken for the herbarium and the name and surname of the collector were written on the field book. The plant species recorded and collected were dried according to the techniques under half-shadow light condition and stored in Herbarium of Süleyman Demirel University. Photo albums were created for the collected samples and identification was performed.

The research material consisted of *Phlomis* samples collected from Antalya, Burdur, Isparta and Konya provinces located in the Lakes District of Turkey (C2, C3, C4 grid squares) from 2012 to 2015. Samples of *Phlomis* species were collected from a total of 33 sampling plots located across the Lakes District (Figure 1).

Leaf, flower and calyx samples were collected with a view to identifying the morphological features of the relevant taxa taken from the sample plots that had been previously identified on the field. In order to find out the morphological features of *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens* and *P. samia* taxa that are distributed in the Lakes District; measurements were performed using digital calibre gauge for the width, height and petiole length of 50 leaf samples from each species; calyx width, height and calyx-teeth length, bracteole length and corolla length of 50 calyx samples from each species sample that was collected.

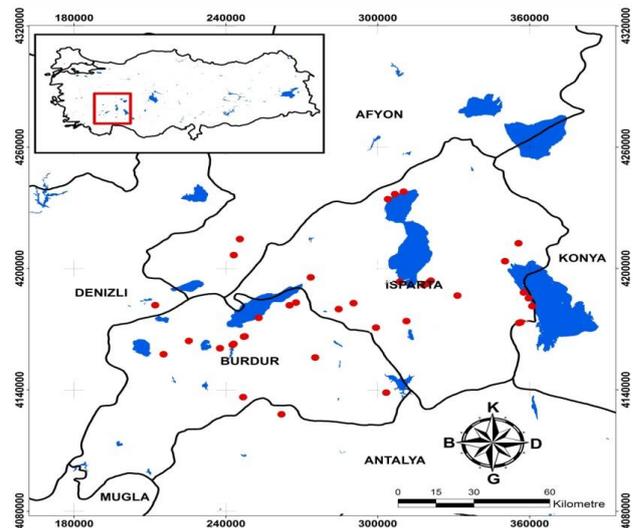


Figure 1. Sampling plots of *Phlomis* taxa in the Lakes District

### 3. Results

#### 3.1. Morphological measurements of *Phlomis* Taxa

In this study, in order to identify the morphological features of *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora*, *P. leucophracta*, *P. lycia*, *P. nissolii*, *P. pungens* var. *pungens* and *P. samia* taxa that are distributed

in the Lakes District; measurements were performed using digital calibre gauge for the width, height and petiole length of 50 leaf samples from each species; calyx width, height and calyx-teeth length, bracteole length and corolla length of 50 calyx samples from each species sample that was collected, and then the mean values were calculated (Table 1).

Table 1. Measurements for leaf and calyx of *Phlomis* taxa

Species	<i>Phlomis armeniaca</i> (Figure 2 A)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,5	2	0,8
Leaf Length	2	6	2,7
Petiole	0,4	5	1,4
Calyx	8	12	11
Calyx teeth	2	6	4
Bracteole	5	12	9
Corolla	11	25	17

Species	<i>Phlomis bourgaei</i> (Figure 2 B)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	1	6,5	2,9
Leaf Length	2,2	10	4,7
Petiole	0,5	5,5	2
Calyx	13	20	16
Calyx teeth	4	10	7
Bracteole	12	19	16
Corolla	10	28	15

Variety	<i>Phlomis grandiflora</i> var. <i>grandiflora</i> (Figure 2 C)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,8	4,6	2,1
Leaf Length	1,5	9	4,8
Petiole	0,2	3,5	2,2
Calyx	10	16	13
Calyx teeth	1	5	3
Bracteole	10	18	14
Corolla	20	40	22

Species	<i>Phlomis leucophracta</i> (Figure 2 D)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	1	5	2,9
Leaf Length	3	8	5,6
Petiole	2	4,6	3,2
Calyx	15	25	19
Calyx teeth	5	12	8
Bracteole	15	24	19
Corolla	20	34	28

Species	<i>Phlomis lycia</i> (Figure 3 A)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,7	2,5	2,0
Leaf Length	2,0	4,6	3,2
Petiole	0,5	2,2	1,3
Calyx	8	13	10
Calyx teeth	1	1	1
Bracteole	8	12	9
Corolla	15	25	18

Species	<i>Phlomis nissolii</i> (Figure 3 B)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,4	2,1	0,9
Leaf Length	1,2	6	2,7
Petiole	0,3	4,3	1,2
Calyx	8	13	10
Calyx teeth	1	4	3
Bracteole	2	10	4
Corolla	8	23	11

Variety	<i>Phlomis pungens</i> var. <i>pungens</i> (Figure 3 C)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,4	4,2	1,9
Leaf Length	2,2	11,5	7,2
Petiole	0,2	7,7	2,1
Calyx	6	12	8
Calyx teeth	2	7	5
Bracteole	8	20	13
Corolla	5	15	8

Species	<i>Phlomis samia</i> (Figure 3 D)		
Measurements	Minimum (cm)	Maximum (cm)	Mean (cm)
Leaf Width	0,8	8,5	3,7
Leaf Length	2,0	14	6,1
Petiole	0,4	6	1,8
Calyx	10	20	14
Calyx teeth	4	8	6
Bracteole	10	23	18
Corolla	10	26	15



Figure 2. Leaves and flowers of *Phlomis* taxa, A- *Phlomis armeniaca*, B- *Phlomis bourgaei*, C- *Phlomis grandiflora* var. *grandiflora*, D- *Phlomis leucophracta*

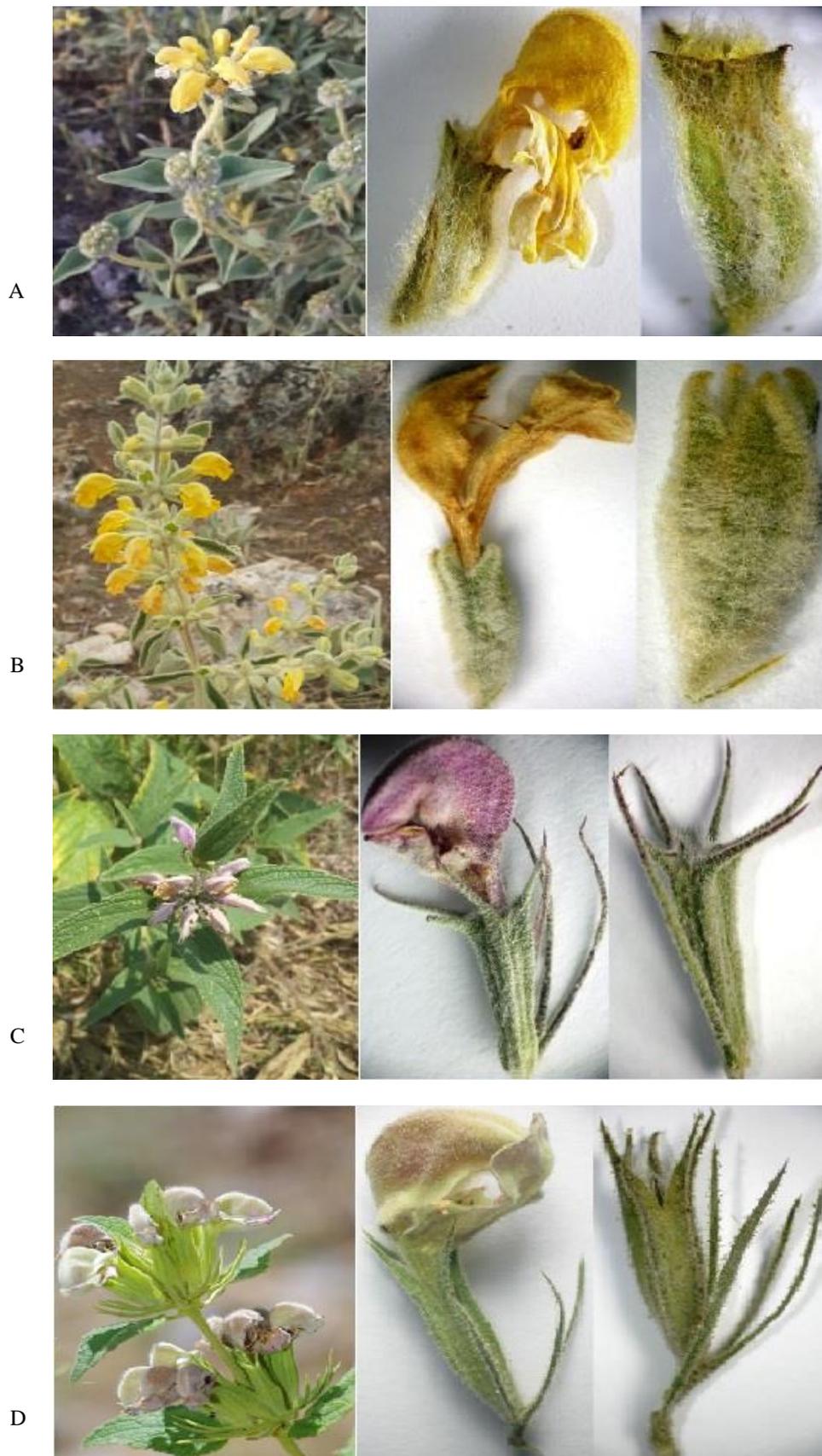


Figure 3. Leaves and flowers of *Phlomis* taxa, A- *Phlomis lycia*, B- *Phlomis nissolii*, C- *Phlomis pungens* var. *pungens*, D- *Phlomis samia*

### 3.2. Observations for the characteristics of the sampling areas

*Phlomis armeniaca* samples were collected within the Lakes District was found to be in Afyon province-Çay district with 830 m as the lowest altitude, while the highest was found in Isparta province-Yenişarbademli district with 1762 m. *P. armeniaca* was observed to be distributed on stony and slightly stony lands, at a slope of 5–20%, in glades, at north-west, north-east, south-west and south-east aspects. Tree species such as *Pinus nigra* Arnold, *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus brutia* Ten., *Cedrus libani* A. Rich., *Quercus vulcanica* Boiss. & Heldr. ex Kotschy, *Quercus cerris* L. var. *cerris*, shrub species such as *Cistus creticus* L., *Astragalus microcephalus* Willd., *Daphne sericea* Vahl., herbaceous plant species such as *Artemisia campestris* L., *Marrubium globosum* Montbret & Aucher ex Bentham, *Omphalodes luciliae* Boiss. were identified in the sample plots.

The lowest altitude across the sample plots where flower and leaf samples were collected from *Phlomis bourgaei* was found to be in Sığla Forest Nature Conservation Site with 379 m, while the highest altitude was in Isparta urban Forest with 1312 m. In the sample plots identified in the Lakes District; *P. bourgaei* was observed to be distributed in glades, at the sides of forest roads, on macquis shrublands, on steep rocks, cliffs and stony lands, at a slope of 10–45%, at north-west, north-east, south and south-east aspects. Tree and small tree species such as *Arbutus andrachne* L., *Quercus cerris* L. var. *cerris*, *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Olea europaea* L., *Pinus brutia* Ten., *Platanus orientalis* L., *Prunus spinosa* L., *Cedrus libani* A. Rich., *Abies cilicica* (Ant. & Kotschy) Carr., *Cerris siliquastrum* L., *Quercus coccifera* L., *Pistacia terebinthus* L., *Crataegus monogyna* L.; shrub species such as *Phillyrea latifolia* L., *Phlomis leucophracta* P. H. Davis & Hub.-Mor., *Cistus creticus* L., *Paliurus spina-christi* Mill., *Daphne sericea* Vahl., *Myrtus communis* L., *Fontanesia phillyreoides* Labill., *Nerium oleander* L., *Vitex agnus castus* L., *Styrax officinalis* L., *Smilax aspera* L., *Spartium junceum* L., *Rubus sanctus* Schreber., *Berberis crataegina* DC.; herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Anthemis cretica* L., *Trifolium arvense* L., *Origanum onites* L., *Coronilla varia* L., *Gladiolus anatolicus* Boiss., *Senecio vulgaris* L., *Astragalus onobrychis* L., *Asparagus acutifolius* L., *Salvia tomentosa* Mill., *Lathyrus annuus* L., *Arum dioscoridis* L. were identified within the sample plots.

*Phlomis grandiflora* var. *grandiflora* was found to be in Antalya-Burdur Highway Dağbeli Location with 855 m as the lowest, while the highest altitude was in Isparta-Sütçüler, Tota Mountain Böğülüuyut with 1580 m. Within the sample plots identified in the Lakes District; *P. grandiflora* var. *grandiflora* was observed to be distributed on steep rocks, rocky and stony lands, at a slope of 5–45%, at north, north-west, south, south-east and south-west aspects. Tree and small tree species such as *Pinus nigra* Arnold., *Quercus cerris* L. var. *cerris*, *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus brutia* Ten., *Prunus spinosa* L., *Quercus coccifera* L., *Pistacia terebinthus* L., *Crataegus monogyna* L.; shrub species such as *Phlomis lycia* D. Don, *Paliurus*

*spina-christi* Mill., *Daphne sericea* Vahl., *Styrax officinalis* L., *Smilax aspera* L., *Spartium junceum* L., *Genista anatolica* Boiss., herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Trifolium arvense* L., *Origanum onites* L., *Coronilla varia* L., *Senecio vulgaris* L., *Astragalus onobrychis* L., *Asparagus acutifolius* L., *Salvia tomentosa* Mill., *Lathyrus annuus* L., *Arum dioscoridis* L., *Sedum album* L., *Colutea cilicica* Boiss., *Inula anatolica* Boiss., *Micromeria mytifolia* Boiss. et Hohn., *Verbascum adenocarpum* L. were identified in the sample plots.

*Phlomis leucophracta* was found to be in Burdur-Bucak, Kargı Taşdıbi province with the lowest on 176 m, while the highest altitude was in Burdur province, Ağlasun district, Çamlidere village with 690 m. In the sample spots identified in the Lakes District; *P. leucophracta* was observed to be distributed in glades, at the sides of forest roads, in macquis shrublands, on rocky and stony lands, at a slope of 10–20%, at south aspects. Tree and small tree species such as *Quercus cerris* L., *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Olea europaea* L., *Pinus brutia* Ten., *Platanus orientalis* L., *Cerris siliquastrum* L., *Quercus coccifera* L., *Pistacia terebinthus* L., *Crataegus monogyna* L.; shrub species such as *Phillyrea latifolia* L., *Phlomis bourgaei* Boiss., *Cistus creticus* L., *Paliurus spina-christi* Mill., *Daphne sericea* Vahl., *Myrtus communis* L., *Fontanesia phillyreoides* Labill., *Nerium oleander* L., *Vitex agnus castus* L., *Styrax officinalis* L., *Rubus sanctus* Schreber., *Berberis crataegina* DC., and herbaceous plant species such as *Anthemis cretica* L., *Trifolium arvense* L., *Coronilla varia* L., *Senecio vulgaris* L. were identified in the sample spots.

The lowest altitude across the sample spots where flower and leaf samples were collected from *Phlomis lycia* was found to be in Burdur-Bucak, Boğazköy with 783 m, while the highest altitude was found in Burdur-Bucak Çubuk Beli with 908 m. *P. lycia* was observed to be distributed on steppe rocks, at road sides, rocky and stony lands, at a slope of 5–30%, at south-west aspects. Tree and small tree species *Quercus cerris* L. var. *cerris*, *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus nigra* Arnold., *Pinus brutia* Ten., *Quercus coccifera* L.; shrub species such as *Phillyrea latifolia* L., *Phlomis grandiflora* H. S. Thompson var. *grandiflora*, *Daphne sericea* Vahl., *Styrax officinalis* L., *Genista anatolica* Boiss. and herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Trifolium arvense* L., *Coronilla varia* L., *Senecio vulgaris* L., *Astragalus onobrychis* L., *Asparagus acutifolius* L., *Lathyrus annuus* L., *Sedum album* L., *Colutea cilicica* Boiss., *Micromeria mytifolia* Boiss. et Hohn., *Verbascum adenocarpum* L. were identified in the sample plots.

*Phlomis nissolii* was found to be in Afyon province, Çay district with 830 m as the lowest altitude, while the highest altitude was in Isparta Urban Forest with 1316 m. *P. nissolii* was observed to be distributed in glades, on roadsides, macquis shrublands, rocky and stony lands, at a slope of 10–45%, at north, south, southeast and south-west aspects. Tree and small tree species such as *Quercus cerris* L. var. *cerris*, *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus brutia* Ten., *Quercus coccifera* L., *Cedrus libani* A. Rich., *Abies*

*cilicica* (Ant. & Kotschy) Carr., *Platanus orientalis* L., *Pistacia terebinthus* L., *Prunus spinosa* L., *Crataegus monogyna* L.; shrub species such as *Styrax officinalis* L., *Celtis glabrata* Steven ex Planch., *Cistus creticus* L., and herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Senecio vulgaris* L., *Astragalus onobrychis* L., *Asparagus acutifolius* L., *Micromeria mytifolia* Boiss. et Hohn., *Origanum onites* L., *Anthemis cretica* L., *Salvia sclarea* L., *Verbascum adenocarpum* L. were identified in the sample plots.

The lowest altitude across the sample plots where flower and leaf samples were collected from *Phlomis pungens* var. *pungens* was found to be in Burdur-Göhlisar with 1455 m, while the highest altitude was in Isparta-Aksu Sorgun Highland with 1488 m. Within the sample plots identified in the Lakes District, *P. pungens* var. *pungens* was observed to be distributed in glades, macquis shrublands and stony lands, at a slope of 15-20%, at north-east aspects. Tree and small tree species such as *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus brutia* Ten., *Quercus coccifera* L., *Platanus orientalis* L., *Crataegus monogyna* L.; shrub species such as *Paliurus spina-christi* Mill., and herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Senecio vulgaris* L., *Astragalus onobrychis* L., *Anthemis cretica* L. were identified in the sample plots.

*Phlomis samia* was found to be distributed was in Isparta Kovada Lake National Park with 942 m in the lowest, while the highest altitude was found in Isparta province, Yenişarbademli District, Pınargözü location with 1529 m. *Phlomis samia* was observed to be distributed in glades, by roadside, on macquis shrublands, rocky and stony lands, at a slope of 5-20%, at south aspects. Tree and small tree species such as *Quercus cerris* L., *Quercus infectoria* Oliv., *Juniperus oxycedrus* L. subsp. *oxycedrus* var. *oxycedrus*, *Pinus brutia* Ten., *Platanus orientalis* L., *Prunus spinosa* L., *Cedrus libani* A. Rich., *Abies cilicica* (Ant. & Kotschy) Carr., *Cercis siliquastrum* L., *Quercus coccifera* L., *Pistacia terebinthus* L., *Crataegus monogyna* L.; shrub species such as *Paliurus spina-christi* Mill., *Daphne sericea* Vahl., *Myrtus communis* L., *Fontanesia phillyreoides* Labill., *Nerium oleander* L., *Vitex agnus castus* L., *Styrax officinalis* L., *Smilax aspera* L., *Spartium junceum* L., *Rubus sanctus* Schreber., *Berberis crataegina* DC., and herbaceous plant species such as *Euphorbia arvalis* Boiss. subsp. *arvalis*, *Anthemis cretica* L., *Trifolium arvense* L., *Origanum onites* L., *Coronilla varia* L., *Gladiolus anatolicus* Boiss., *Senecio vulgaris* L., *Astragalus onobrychis* L., *Asparagus acutifolius* L., *Salvia tomentosa* Mill., *Lathyrus annuus* L., *Arum dioscoridis* L. were identified in the sample plots.

#### 4. Discussion and conclusion

In our study, the leaf size of *Phlomis armeniaca* was found to be 2-6 × 0,5-2 cm, petiole length to be maximum 5 cm, bracteol length to be 5-12 mm, calyx length to be 8-12 mm, calyx-teeth length to be 2-6 mm, corolla length to be 11-25 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. armeniaca* was reported to be 2-10 × 0,8-2 cm, petiole length to be maximum 7 cm, bracteol length to be 3-10 mm, calyx length to be 13-17 mm, calyx-teeth length to be 4-6 mm, corolla length to be 25-35 mm. In the study of Dadandı (2002), the leaf size of *P. armeniaca* was reported

to be 2-12 × 0,6-3,5 cm, petiole length to be maximum 6 cm, bracteol length to be 0,5-15 mm, calyx length to be 10-16 mm, corolla length to be 19-34 mm. These values were different from the leaf sizes, petiole, bracteole, calyx and corolla lengths found in our study.

In this study, the leaf size of *Phlomis bourgaei* was found to be 2,2-10 × 1-6,5 cm, petiole length to be maximum 5,5 cm, bracteol length to be 12-19 mm, calyx length to be 13-20 mm, calyx-teeth length to be 4-10 mm, corolla length to be 10-28 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. bourgaei* was reported to be 3-16 × 1,5-6 cm, petiole length to be maximum 5 cm, bracteol length to be 12-17 mm, calyx length to be 17-20 mm, calyx-teeth length to be 3-7 mm, corolla length to be 20-30 mm. Dadandı's (2002) study, however, found that the leaf size of *P. bourgaei* was 2,5-11 × 1-4,5 cm, petiole length was maximum 6 cm, bracteol length was 10-24 mm, calyx length was 13-20 mm, calyx-teeth length were 3-9 mm, corolla length was 25-34 mm. The calyx length we found was similar to that found in study of Dadandı (2002).

It was found that the leaf size of *Phlomis grandiflora* var. *grandiflora* was 1,5-9 × 0,8-4,6 cm, petiole length was maximum 3,5 cm, bracteol length was 0,9-18 mm, calyx length was 10-16 mm, calyx-teeth length were 1-5 mm, corolla length was 20-40 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. grandiflora* var. *grandiflora* was reported to be 3-8 × 2-4 cm, petiole length to be maximum 3 cm, bracteol length to be 12-18 mm, calyx to be 13-17 mm, calyx-teeth length to be 2-3 mm, corolla length to be 30-40 mm. Dadandı (2002), however, reported that the leaf size of *P. grandiflora* var. *grandiflora* was 1,2-12 × 0,5-6 cm, petiole length was maximum 8 cm, bracteol length was 10-20 mm, calyx length was 12-20 mm, calyx-teeth length were 1-5 mm, corolla was 33-40 mm. The calyx teeth size found in our study was similar to that found by Dadandı (2002).

The leaf size of *Phlomis leucophracta* was measured to be 3-8 × 1-5 cm, petiole length to be up to 4 cm, bracteol length to be 15-24 mm, calyx length to be 15-25 mm, calyx-teeth length to be 5-12 mm, corolla length to be 20-34 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. leucophracta* was reported to be 5-12 × 2-5 cm, petiole length to be up to 4 cm, bracteol length to be 15-22 mm, calyx length to be 20-27 mm, calyx-teeth length to be 5-12 mm, corolla to be 30-35 mm. In the study of Dadandı (2002), the leaf size of *P. leucophracta* was reported to be 1,6-8,5 × 0,6-4,7 cm, petiole length to be up to 5 cm, bracteol length length to be 10-26 mm, calyx length to be 15-30 mm, calyx-teeth length to be 5-14 mm, corolla length to be 31-38 mm. Our petiole length and calyx teeth length values were similar to those found by Davis (1982).

In our study, the leaf size of *Phlomis lycia* was measured to be 2-4,6 × 0,7-2,5 cm, petiole length to be up to 2,2 cm, bracteol length to be 8-12 mm, calyx length to be 8-13 mm, calyx teeth length to be 1 mm, and corolla length to be 15-25 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. lycia* was reported to be 2-5 × 0,7-2 cm, petiole length to be short, bracteol length to be 8-11 mm, calyx length to be 10-12 mm, calyx teeth length to be 1 mm, and corolla length to be 25-30 mm. Dadandı (2002) reported in his study that the leaf size of *P. lycia* was 1,4-5,5 × 0,4-2,3 cm, petiole length was up to 2 cm, bracteol length 8-14 mm, calyx length was 9-14 mm, calyx-teeth length were 0,5-1,5

mm and corolla length was 22–30 mm. Calyx teeth length found in our study was similar to the value reported by Davis (1982).

The leaf size of *Phlomis nissolii* was found to be 1,2–6 × 0,4–2,1 cm, petiole length to be up to 4,3 cm, bracteol length to be 2–10 mm, calyx length to be 8–13 mm, calyx teeth length to be 1–4 mm, and corolla length to be 8–23 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. nissolii* was reported to be 6–14 × 3–6 cm, petiole length to be 12 cm, bracteol length to be 5–10 mm, calyx length to be 10–15 mm, calyx teeth length to be 2–4 mm, and corolla length to be 20–25 mm. Dadandı (2002) reported in his study that the leaf size of *P. nissolii* was 5–20 × 2,5–9 cm, petiole length was up to 5,5 cm, bracteol length was 2–10 mm, calyx length was 10–15 mm, calyx teeth length was 1,5–5 mm, and corolla length was 19–31 mm. The bracteole length we found in our study was similar to the value reported by Dadandı (2002). The other values found in our study were different.

In our study, the leaf size of *P. pungens* var. *pungens* was found to be 2,2–11,5 × 0,4–4,2 cm, petiole length to be 7,7 cm, bracteol length to be 8–20 mm, calyx length to be 6–12 mm, calyx teeth length to be 2–7 mm, corolla length to be 5–15 mm. Davis (1982) reported in his flora study that the leaf size of *P. pungens* var. *pungens* was 5–13 × 1–6 cm, petiole length was up to 10 cm, bracteol length was 11–17 mm, calyx length was 8–15 mm, calyx teeth length was 2–7

mm, and corolla length was 15–25 mm. In Dadandı's (2002) study, however, the leaf size of *P. pungens* var. *pungens* was reported to be 3,5–20 × 0,6–8 cm, petiole length to be up to 11 cm, bracteol length to be 5–20 mm, calyx length to be 8–18 mm, calyx teeth length to be 2–11 mm, and corolla length to be 16–26 mm. The calyx teeth length found in our study was similar to that reported by Davis (1982).

The leaf size of *Phlomis samia* was found to be 2–14 × 0,8–8,5 cm, petiole length to be up to 6 cm, bracteol length to be 10–23 mm, calyx length to be 18–25 mm, calyx teeth length to be 4–8 mm, and corolla length to be 10–26 mm. In the Flora of Turkey (Davis, 1982), the leaf size of *P. samia* was reported to be 8–23 × 5–15 cm, petiole length to be up to 18 cm, bracteol length to be 20–26 mm, calyx length to be 18–25 mm, calyx teeth length to be 6–12 mm, and corolla length to be 26–35 mm. Dadandı (2002) reported in his study that the leaf size of *Phlomis samia* was 7–25 × 4,5–16 cm, petiole length was up to 23 cm, bracteol length was 18–24 mm, calyx length was 18–23 mm, calyx teeth length was 18–24 mm, and corolla length was 30–34 mm. The calyx length found in our study was similar to that reported by Davis (1982).

In conclusion, the species identification key developed according to the observations and measurements conducted for *Phlomis* distributed in the Lakes District of Turkey is presented below.

#### 1. Herbaceous plant

##### 2. Corolla purple or pink

3. Stem and bracteol covered with glandular hairs
3. Stem and bracteol covered with soft or hard eglandular hairs

##### 2. Corolla yellow

3. Calyx and bracteol covered with stellate tomentose hairs, corolla 11–25 mm long
3. Calyx and bracteol covered with white pannose hairs, corolla 8–23 mm long

#### 1. Woody plant

##### 4. Upper lip of corolla brownish, lower lip yellow

##### 4. Corolla completely yellow

5. Calyx covered with hard, sticky hairs; bracteol subulate
5. Calyx and bracteole not like the ones above
6. Verticillasters 1-flowered and multiple flowers; calyx 10–16 mm long
6. Verticillasters 1-2-flowered and with 6–12 flowers; calyx 8–13 mm long

8. samia

7. pungens var. pungens

1. armeniaca

6. nissolii

4. leucophracta

2. bourgaei

3. grandiflora var. grandiflora

5. lycia

It is thought that this identification key will be helpful for identification of *Phlomis* taxa in further studies which will be conducted in the Lakes District.

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