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REVIEW

Systematic and Biogeographic overview of Lamiaceae in Turkey

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Abstract

Lamiaceae is the third largest family based on the taxon number and fourth largest family based on the species number in Turkey. The family has 48 genera and 782 taxa (603 species, 179 subspecies and varieties), 346 taxa (271 species, 75 subspecies and varieties) of which are endemic (ca. 44%) (data updated 1th February 2017) in the country. There are also 23 hybrid species, 19 of which are endemic (82%). The results proven that Turkey is one of the centers of diversity for Lamiaceae in the Old World. In addition, Turkey has about 10% of all Lamiaceae members in the World. The largest five genera in the country based on the taxon number are *Stachys* (118 taxa), *Salvia* (107 taxa), *Sideritis* (54 taxa), *Phlomis* (53 taxa) and *Teucrium* (49 taxa). According to taxon number, five genera with the highest endemism ratio are *Dorystaechas* (1 taxon, 100%), *Lophantus* (1 taxon, 100%), *Sideritis* (54 taxa, 74%), *Drymosiphon* (9 taxa, 67%), and *Marrubium* (27 taxa, 63%). There are two monotypic genera in Turkey as *Dorystaechas* and *Pentapleura*. Turkey sits on the junction of three phytogeographic regions with highly diverse climate and the other ecologic features. Phytogeographic distribution of Turkish Lamiaceae taxa are 293 taxa in the Mediterranean (37.4%), 267 taxa in the Irano-Turanian (36.7%), 90 taxa in the Euro-Siberian (Circumboreal) phytogeographic region, and 112 taxa in Unknown or Multiregional (14.3%) phytogeographical elements. In the Mediterranean phytogeographic region 61% of the taxa, in the Irano-Turanian phytogeographic region 50% of the taxa, and in the Euro-Siberian (Circumboreal) phytogeographic region 13% of the taxa are endemic. Some endemic taxa are widely distributed in the country, so their phytogeograhic elements are not clearly defined, the endemism ratio of these taxa are 13%. In time, species of Lamiaceae genera are migrated from one phytogeographic region to another one and specialised in specific habitats in the country. *Salvia, Stachys, Sideritis, Phlomis, Teucrium, Thymus, Nepeta, Scutellaria, Origanum* and *Marrubium* are species rich genera in Turkey. Particulary, most of Old Wold species of *Salvia*, *Stachys, Origanum, Marrubium, Ballota, Lamium* and *Drymosiphon* naturally grow in Turkey. These genera have also quite high endemism ratio with *Phlomis, Scutellaria, Thymus, Nepeta* and *Satureja*. Due to high taxon number and endemism ratio, different habitats, climates and soil types, high altitutinal range and diverse pollinators, it is clear that Turkey is a very good example for evolution and speciation of Lamiaceae family in the Old World.

Keywords: Lamiaceae, Systematics, Biogeography, Turkey

Introduction

Turkey has a great variety of biotic and abiotic diversity, i.e. climatic, edaphic, geographic & geologic, and pollinator diversity. These factors leads to Turkey is one of the most important plant biodiversity centers in the world with over 10 000 plant species and ca. 35 % endemism ratio (Güner et al., 2012; Celep et al., unpublished data). In addition, three different phytogeographic regions are come together in the country, as Mediterranean, Irano-Turanian and Euro-Siberian (Circumboreal) phytogeographic regions (Zohary, 1973; Davis, 1975; Thomson, 2005).

Areas surrounding the Mediterranean, Aegean, and Marmara Seas and a little further inside in mainland of Turkey show the characteristics of the Mediterranean phytogeographic region. The large part of Turkey including Central Anatolia, East Anatolia and Southeast Anatolia lies in the Irano-Turanian phytogeographic region. The Black Sea's coastal areas (including norhern part of Black Sea geographic region and northeastern part of Marmara geographic region) lie in the Euro-Siberian (Circumboreal) phytogeographic region (Davis, 1971) (Figure 1). Endemic species are mostly found in the Mediterranean and Irano-Turanian

phytogeographic regions. In regard to Lamiaceae, Turkey sits on one of the seven regions of high Lamiaceae diversity center as "Mediteranean and SW Central Asia" (Harley et al., 2004).

Lamiaceae, the sixth largest Angiosperm family, contains more than 245 genera and 7886 species, and distributed worldwide (The Plant List, 2013, access 1th Feb 2017). It includes many economically and medicinally important species (Harley et al., 2004). In Lamiaceae, Harley et al. (2004) recognized seven subfamilies as Ajugoideae, Lamioideae, Nepetoideae, Prostantheroideae, Scutellarioideae, Symphorematoideae and Viticoideae. Recently, five new additional subfamilies have been described, namely Cymarioideae, Peronematoideae, Premnoideae, Callicarpoideae and Tectonoideae (Li et al., 2016; Li & Olmstead, 2017). In Turkey, there are five subfamilies as Ajugoideae, Lamioideae, Nepetoideae, Scutellarioideae and Viticoideae (Harley et al., 2004; Li et al., 2016; Li & Olmstead, 2017).

In the family, the largest genera are *Salvia* L. (945 species), *Scutellaria* L. (360 species), *Stachys* L. (300 species), *Plectranthus* L'Hér. (300 species), *Hyptis* Jacq. (280 species), *Teucrium* L. (250 species), *Vitex* L. (250 species), *Thymus* L. (220 species) and *Nepeta* L. (200 species) (Harley et al., 2004; Will et al., 2015).

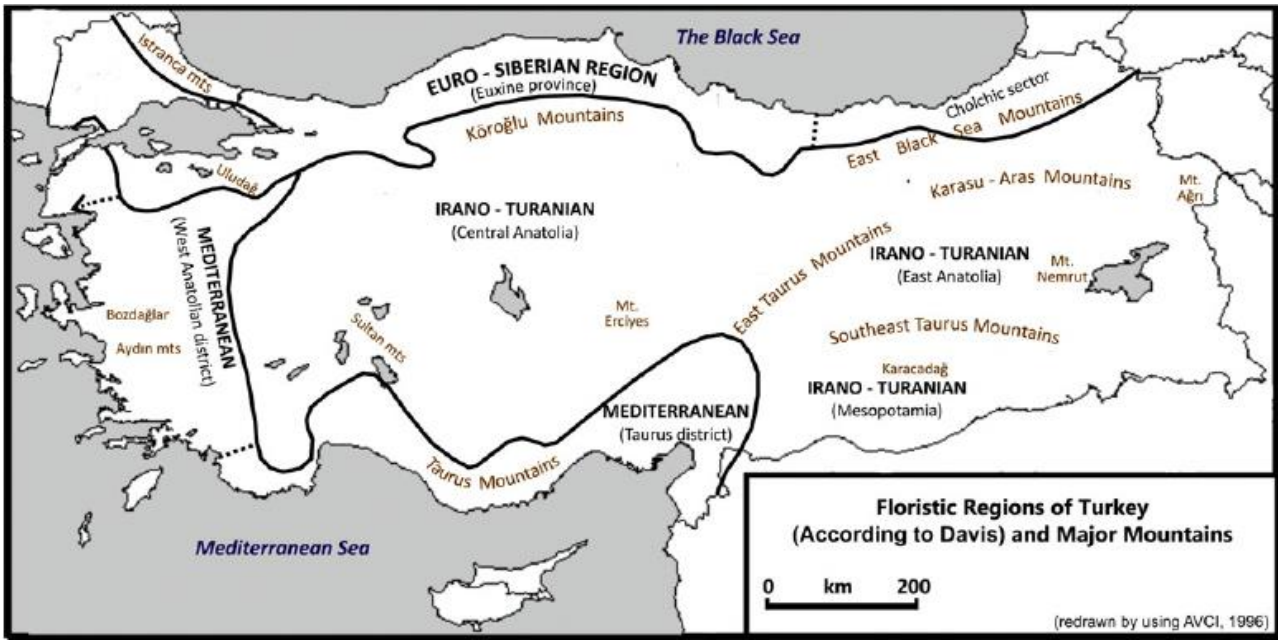
After the publication of Flora of Turkey and the East Aegean Islands volume 7 (Davis, 1982), volume 10 (Davis et al., 1988) and volume 11 (Güner et al., 2000), which include Lamiaceae members, many new taxa have been published from Turkey (Güner et al., 2012; IPNI-The International Plant Name Index, access 1th February 2017). In addition, some taxonomic and nomenclatural changes have been done by classical and molecular taxonomists for last three decades (The Plant List, access 30 Sep. 2017). In this review, we have updated the latest taxonomic status of genera and species in the family for Turkish Lamiaceae members. In addition, we have provided some geographic and biogeographic/phytogeographic data based on species/taxon distribution pattern. Finally, we have suggested some hypothesis about origins of Turkish Lamiaceae members.

Materials and Methods

This is a review study on Turkish Lamiaceae members. It was presented in International Symposium on Advances in Lamiaceae Science, April 26-29 2017, Antalya, Turkey, therefore the data used in this paper was prepared at 1th of February 2017. After presentation of data, two new endemic Lamiaceae species have been published from Turkey as *Micromeria aybalae* (Duman & Dirmenci, 2017) and *Lamium bilgilii* (Celep, 2017). When preparing the data set, we reviewed the current literature and related web sites (Davis, 1982; Güner et al., 2012; The Plant List, 2017; IPNI-The International Plant Name Index, access 1th February 2017). Based on the updated data set, we produced relevant informations and statistics for Turkish genera and species. In this data set, taxon or species which were only known from in the East Aegean Islands (Greece Islands) are exluded. Only taxa or species are known from Turkey mainland (Anatolia/Asian part of Turkey & Thrace region/European part of Turkey) are included.

Phytogeographic regions of Lamiaceae taxa were mostly obtained from related literatures (Davis, 1982; Güner et al., 2012). If the phytogeographic element of an endemic taxon is not known, we determined it based on its biogeographic distribution pattern and habitat in this study. To preventing wrong placement of the phytogeographic region, we only determined new phytogeographic region for Turkish endemic taxa. Phytogeographic regions of Turkey is shown in Figure 1.

Figure 1. Phytogeographic regions of Turkey (Davis, 1965; modified by Avcı, 1996).

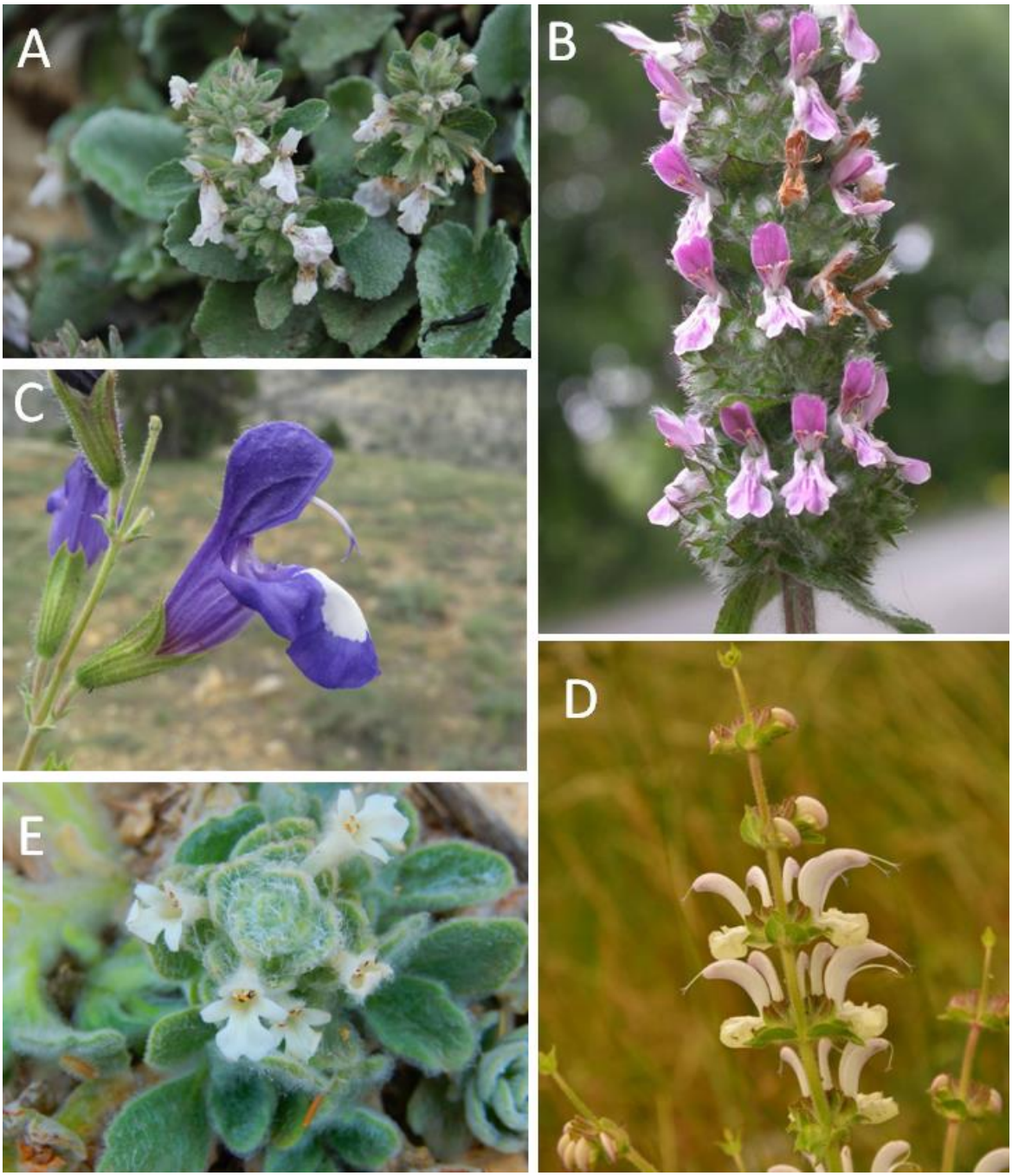


Results and Discussion

According to our data set, there are 48 genera in Lamiaceae in Turkey with diverse habit, flower morphology, size and color (Figure 2 & 3). Recently, Drew et al. (2017) included some genera (*Dorystaechas*, *Meriandra*, *Perovskia*, *Rosmarinus*, and *Zhumeria*) in *Salvia* based on comprehensive molecular studies. On the other hand, Will and Classen-Bockhoff (2017) suggested to split *Salvia s.l.* into six genera with other closely related genera i.e. *Dorystaechas* and *Rosmarinus*. Although both studies (Drew et al., 2017, Will and Classen-Bockhoff, 2017) have similar data and results, Drew et al. (2017) and Will & Classen-Bockhoff (2017) reached different conclusions based on their point of view and interpretation. Due to ongoing molecular and taxonomic studies on generic status of *Dorystaechas* and *Rosmarinus*, we accepted them as still valid genera in this study as given in the Flora of Turkey.

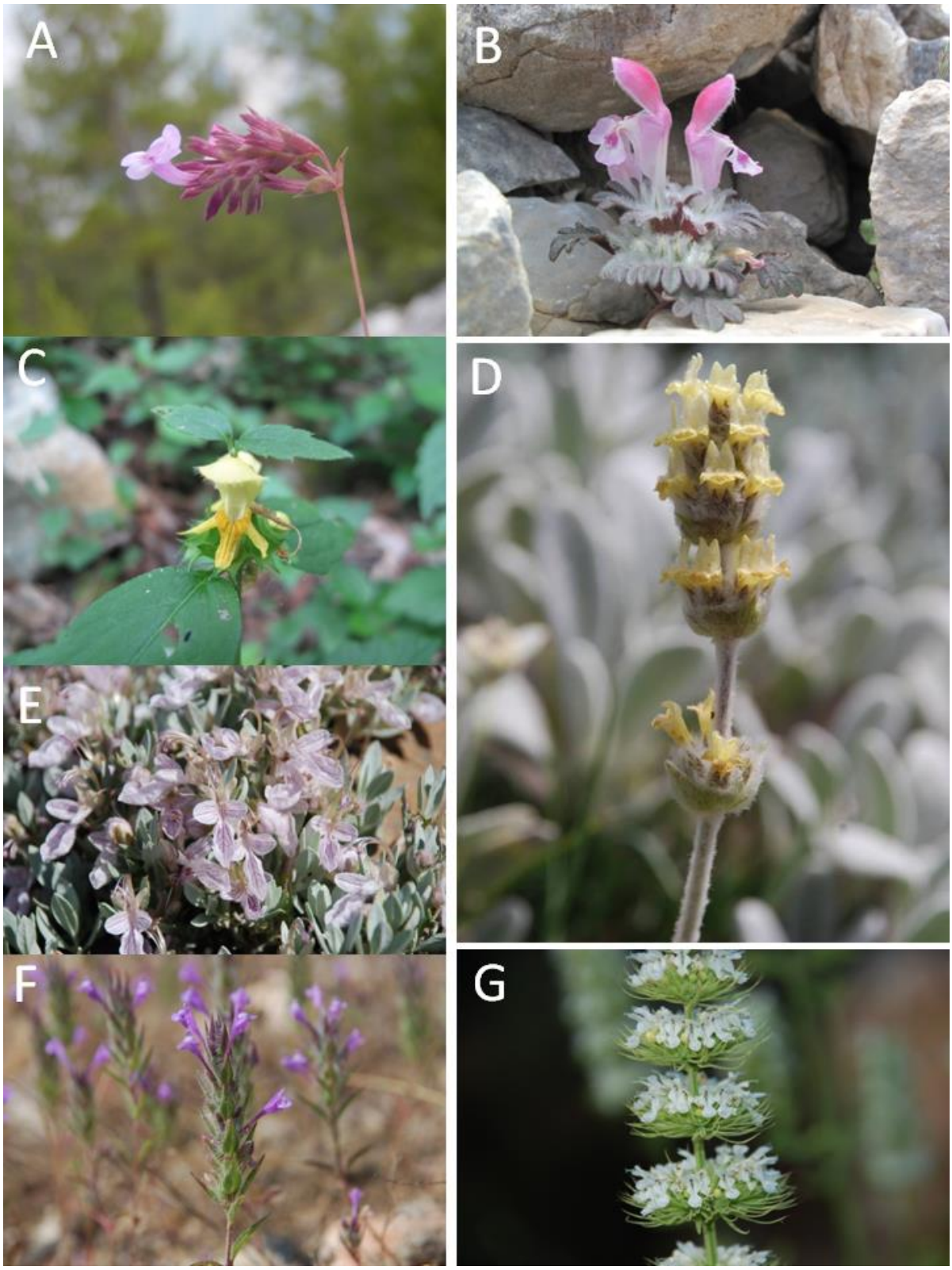
The genus *Lophanthus* Adans. has 23 species and mostly distributed in China, Mongolia, Afghanistan and Central Asia (Harley et al., 2004). Dirmenci et al. (2010) described *Lophanthus turcicus* Dirmenci, Yildiz & Hedge from eastern Anatolia. The genus represented only this endemic species in Turkey. Recently, Serpooshan et al. (2017) did a molecular phylogenetic study on *Hymenocrater*, *Nepeta*, *Lophanthus* and the other closely related genera. In this study, Serpooshan et al. (2017) made some taxonomic changes among studied genera, for example they transfered *Lophantus turcicus* into *Nepeta* as *Nepeta turcica* (Dirmenci, Yildiz & Hedge) Jamzad & Serpooshan. According to Serpooshan et al. (2017), a complete DNA sequencing of *Lophanthus* species with *Nepeta* and *Hymenocrater* may provide more resolved phylogenetic tree and more accurate interpretation on taxonomy of the genera. Until we will have more data about *Lophanthus turcicus*, we accepted it as a valid species in this study.

Figure 2. Some Lamiaceae taxa from Turkey



A. *Stachys ketenoglui* B. *Stachys thracica* C. *Salvia albimaculata* D. *Salvia argentea* E. *Ajuga vestita* (Photos A, B, D, & E by T. Dirmenci, C by F. Celep).

Figure 3. Some Lamiaceae taxa from Turkey



A. *Origanum husnucan-baseri* B. *Lamium eriocephalum* C. *Lamium galeobdolon* D. *Sideritis trojana* E. *Teucruim alyssifolium* F. *Ziziphora taurica* G. *Nepeta cadmea* (Photos A, D, E, F & G by T. Dirmenci, B by F. Celep).

Lamiaceae in Turkey

According to our data set which updated at 1th of February 2017, there are 782 Lamiaceae taxa in Turkey, 346 of which are endemic (44.2 % endemism ratio). According to species number, there are 603 Lamiaceae species in Turkey, 271 of which are endemic (44.9 % endemisim ratio). There are 23 hybrid species, 19 of which are endemic (82 % endemism ratio). The largest 15 genera based on taxon number in Turkey are given in Table 1.

Table 1. The largest 15 genera based on the taxon number in Turkish Lamiaceae

	Genera	Taxon number	Species number	Endemic taxa number and endemism ratio (%)	Endemic species number and endemism ratio
1	*Stachys*	118	90	53 (45%)	43 (48%)
2	*Salvia*	107	100	58 (54%)	53 (53%)
3	*Sideritis*	54	45	40 (74%)	36 (80 %)
4	*Phlomis*	53	33	30 (57%)	16 (48%)
5	*Teucrium*	49	36	17 (35%)	15 (42%)
6	*Thymus*	47	42	20 (43%)	20 (48%)
7	*Nepeta*	46	39	20 (43%)	17 (44%)
8	*Scutellaria*	39	17	17 (44%)	6 (35%)
9	*Origanum*	31	27	18 (58%)	18 (67%)
10	*Marrubium*	27	21	17 (63%)	11 (52%)
11	*Lamium*	26	15	5 (19%)	4 (27%)
12	*Clinopodium*	25	16	7 (24%)	3 (19%)
13	*Ajuga*	23	13	7 (30%)	6 (46%)
14	*Ballota*	18	12	11 (61%)	8 (67%)
15	*Satureja*	17	16	6 (35%)	5 (31%)

Sideritis, Drymosiphon, Marrubium, Ballota, Origanum, Phlomis, Salvia have a large number endemic taxa and species. Their endemism ratio is over 54 % in Turkey. There are two monotypic genera in Turkey as *Dorystaechas* (endemic) and *Pentapleura* (non-endemic). Though *Lophanthus* has also only one species in Turkey, it is not a monotypic genus. Fifteen genera with the highest endemism ratio are given in Table 2.

Table 2. Fifteen genera with the highest endemism ratio in Lamiaceae in Turkey

	Genera	Endemism ratio based on taxa number (%)	Endemism ratio based on species number (%)
1	*Dorystaechas*	100	100
2	*Lophantus*	100	100
3	*Sideritis*	74	80
4	*Drymosiphon*	67	75
5	*Marrubium*	63	52
6	*Ballota*	61	67
7	*Origanum*	58	67
8	*Phlomis*	57	48
9	*Salvia*	54	53
10	*Stachys*	45	48
11	*Scutellaria*	44	35
12	*Thymus*	43	48
13	*Nepeta*	43	44
14	*Teucrium*	35	42
15	*Satureja*	35	31

List of Turkish Lamiaceae Genera based on their Subfamilial Classification

In Turkey, there are five subfamilies as Viticoideae, Ajugoideae, Scutellarioideae, Lamioideae, and Nepetoideae. We prepared subfamilial classification of Turkish Lamiaceae genera according to Harley et al., 2004; Li et al., 2016; Li & Olmstead, 2017.

1. Subfamily Viticoideae: *Vitex*.
2. Subfamily Ajugoideae: *Ajuga, Teucrium, Clerodendrum*.
3. Subfamily Scutellarioideae: *Scutellaria*.
4. Subfamily Lamioideae: *Marrubium, Sideritis, Ballota, Eremostachys, Phlomis, Phlomoides, Stachys, Betonica, Prasium, Leonurus, Chaiturus, Galeopsis, Molucella, Lamium, Melittis*.
5. Subfamily Nepetoideae:

Tribe Elsholtzieae: *Perilla, Elsholtzia*

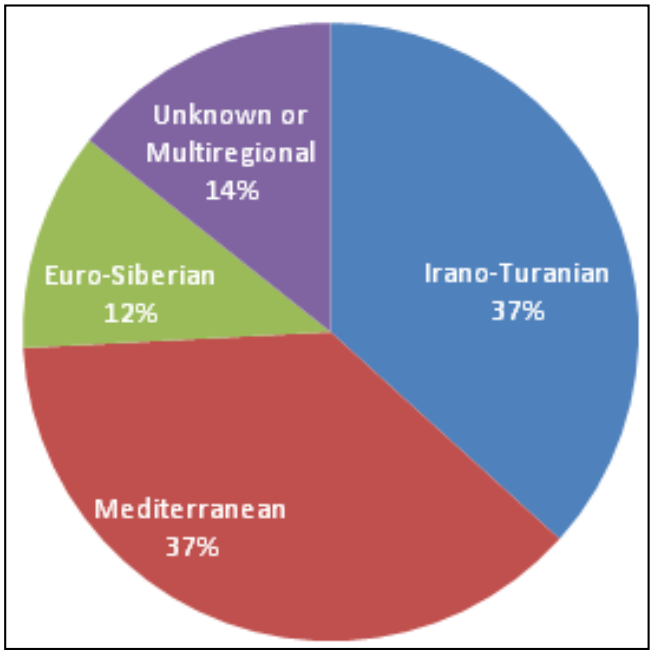
Tribe Mentheae: *Nepeta, Lycopus, Dorystaechas, Rosmarinus, Ziziphora, Salvia, Clinopodium, Drymosiphon, Hymenocrater, Lallemantia, Dracocephalum, Glechoma, Lophanthus, Prunella, Micromeria, Cyclotrichium, Melissa, Origanum, Mentha, Thymbra, Thymus, Hyssopus, Satureja, Pentapleura.*

Tribe Ocimeae: *Lavandula, Ocimum*.

Phytogeographic distribution of Lamiaceae taxa in Turkey (total 782 taxa)

According to our updated data, 287 taxa (36.7 %) are in the Irano-Turanian phytogeographic region, 293 taxa (37.4 %) are in the Mediterranean phytogeographic region, 90 taxa (11.5%) are in the Euro-Siberian (Circumboreal) phytogeographic region, and 112 taxa (14.3 %) are Unknown or multiregional element in Turkey. Though Irano-Turanian phytogeographic region covers larger area than the Mediterranean phytogeographic region in Turkey, both phytogeographic regions have about the same number taxa. The least number taxa are found in the Euro-Siberian phytogeographic region (Figure 4).

Figure 4. Phytogeographic distribution of Lamiaceae taxa in Turkey



Phytogeographic distribution of Lamiaceae species in Turkey (total 603 species)

Irano-Turanian element: 229 species, 37.9 % in total.

Mediterranean element: 220 species, 36.4 % in total.

Euro-Siberian (Circumboreal) element: 72 species, 11.9 % in total.

Unknown or multiregional element: 82 species, 13.6 % in total.

Phytogeographic distribution based on the hybrid species in Turkey (total 23 species)

Irano-Turanian element: 8 species, 34.7 % in total.

Mediterranean element: 10 species, 43.5 % in total.

Euro-Siberian (Circumboreal) element: 2 species, 8.7 % in total.

Unknown or multiregional element: 3 species, 13 % in total.

Endemism in the Phytogeographic regions

In the Irano-Turanian phytogeographic region: Total 287 taxa, 144 of which are endemic (50%).
Total 229 species, 115 of which are endemic (50%).

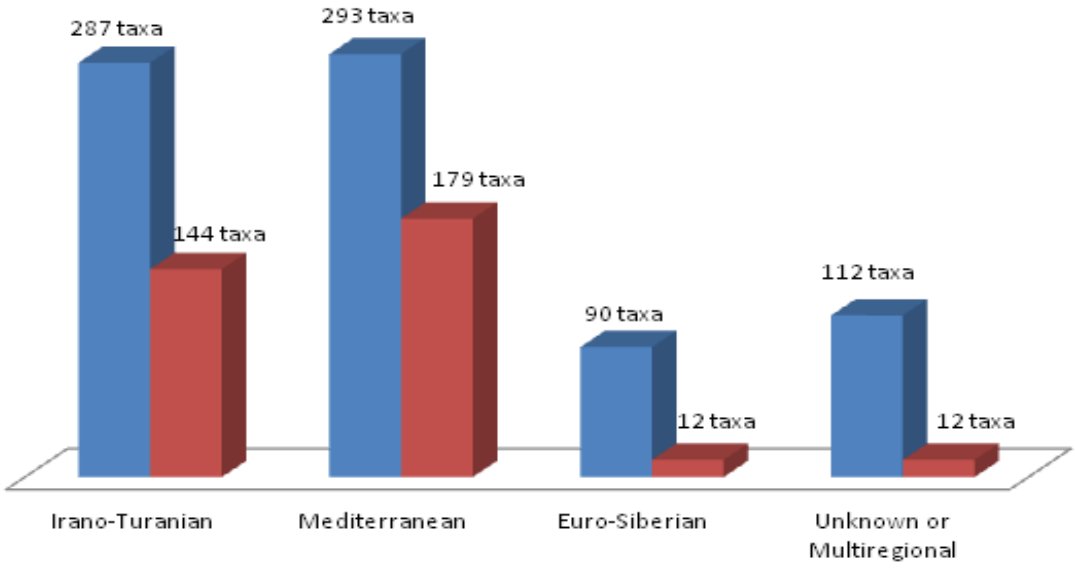
In the Mediterranean phytogeographic region: Total 293 taxa, 179 of which are endemic (61%).
Total 217 species, 139 of which are endemic (64%).

In the Euro-Siberian phytogeographic region: Total 90 taxa, 12 of which are endemic (13%).
Total 72 species, 9 of which are endemic (12.5%).

Unknown or multiregional element: Total 112 taxa, 12 of which are endemic (11%).
Total 82 species, 9 of which are endemic (11%).

According to the results, the highest number of taxa (293 taxa) and endemism ratio (64 %) are seen in the Mediterranean phytogeographic region. The second highest number of taxa (287 taxa) and endemism ratio (50 %) are seen in the Irano-Turanian phytogeographic region. The least number of taxa (90 taxa) and endemism (13 %) are seen in the Euro-Siberian (Circumboreal) phytogeographic region (Figure 5).

Figure 5. Total taxa in the each phytogeographic region (blue column), and endemic taxa number in each phytogeographic region (red column).



Phytogeographic properties of the largest 15 genera in Lamiaceae in Turkey are given in Table 3. Most taxa in *Salvia*, *Nepeta*, *Thymus*, *Scutellaria* and *Marrubium* are distributed in the Irano-Turanian phytogeographic region. Except for *Nepeta* (29 %), endemism ratio of these genera are over 52% in the Irano-Turanian

phytogeographic region (Table 3). On the other hand, though *Salvia*, *Nepeta* and *Marrubium* has lower number taxa in the Mediterranean region, they have higher endemism ratio in the Mediterranean phytogeographic region than Irano-Turanian phytogeographic region (Table 3) in the country. Most taxa of *Sideritis*, *Teucrium, Ballota* and *Origanum* are distributed in the Mediterranean phytogeographic region with a high endemism ratio. Though *Sideritis, Ballota* and *Origanum* has lower number taxa in the Irano-Turanian phytogeographic region than Mediterranean phytogeographic region, they have over 75 % endemism ratio in the Irano-Turanian phytogeographic region (Table 3) in the country.

Both *Stachys* and *Phlomis* have more or less equal number taxa in the Irano-Turanian and Mediterranean phytogeographic regions. While most *Stachys* endemic taxa (63%) are distributed in the Mediterranean phytogeographic region, most *Phlomis* endemic taxa (70%) are distributed in the Irano-Turanian phytogeographic region (Table 3).

Table 3. Phytogeographic distribution of the genera based on the taxon number

	Genera (Total taxon number)	**Number of Irano-Tur. Element/ Endemic taxa (%) in the region**	**Number of Medit. Element/ Endemic taxa (%) in the region**	**Number of Euro-Sib. (Circumboreal) Element/ Endemic taxa (%) in the region**	**Number of Unknown or Multiregional/ Endemic taxa (%) in the region**	**Total endemic taxa number and endemism ratio (%) in the genus**
1	*Stachys* (118)	41/19 (46%)	46/29 (63%)	16/3 (%19)	15/3 (20%)	53 (45%)
2	*Salvia* (107)	65/35 (54%)	30/20 (67%)	7/1(%14)	5/2 (40%)	58 (54%)
3	*Sideritis* (54)	10/8 (80%)	38/29 (76%)	4/2 (50%)	2/1 (50)	40 (74%)
4	*Phlomis* (53)	23/16 (70%)	22/12 (55%)	1/1 (100%)	7/1 (14%)	30 (57%)
5	*Teucrium* (49)	13/4 (31%)	24/13 (54%)	5/0 (0%)	7/0 (0%)	17 (35%)
6	*Thymus* (47)	20/13 (65%)	12/5 (42%)	7/2 (29%)	8/0 (0%)	20 (43%)
7	*Nepeta* (46)	24/7 (29%)	17/13 (76%)	2/0 (0%)	3/0 (0%)	20 (43%)
8	*Scutellaria* (39)	21/11 (52%)	9/4 (44%)	4/0 (0%)	5/2 (40%)	17 (44%)
9	*Origanum* (31)	4/3 (75%)	20/15 (75%)	2/0 (0%)	5/0 (0%)	18 (58%)
10	*Marrubium* (27)	14/10 (71%)	8/7 (88%)	-	5/1 (20%)	17 (63%)
11	*Lamium* (26)	6/1 (17%)	5/2 (40%)	8/2 (25%)	7/0 (0%)	5 (19%)
12	*Clinopodium* (25)	3/1 (33%)	5/2 (40%)	8/1 (13%)	6/0 (0%)	7 (24%)
13	*Ajuga* (23)	8/4 (50%)	7/3 (43%)	3/0 (0%)	5/0 (0%)	7 (30%)
14	*Ballota* (18)	5/4 (80%)	10/7 (70%)	2/0 (0%)	1/0 (0%)	11 (61%)
15	*Satureja* (17)	4/1 (25/)	6/3 (50%)	2/0 (0%)	-	6 (35%)

Geographic distribution of Turkish Lamiaceae taxa

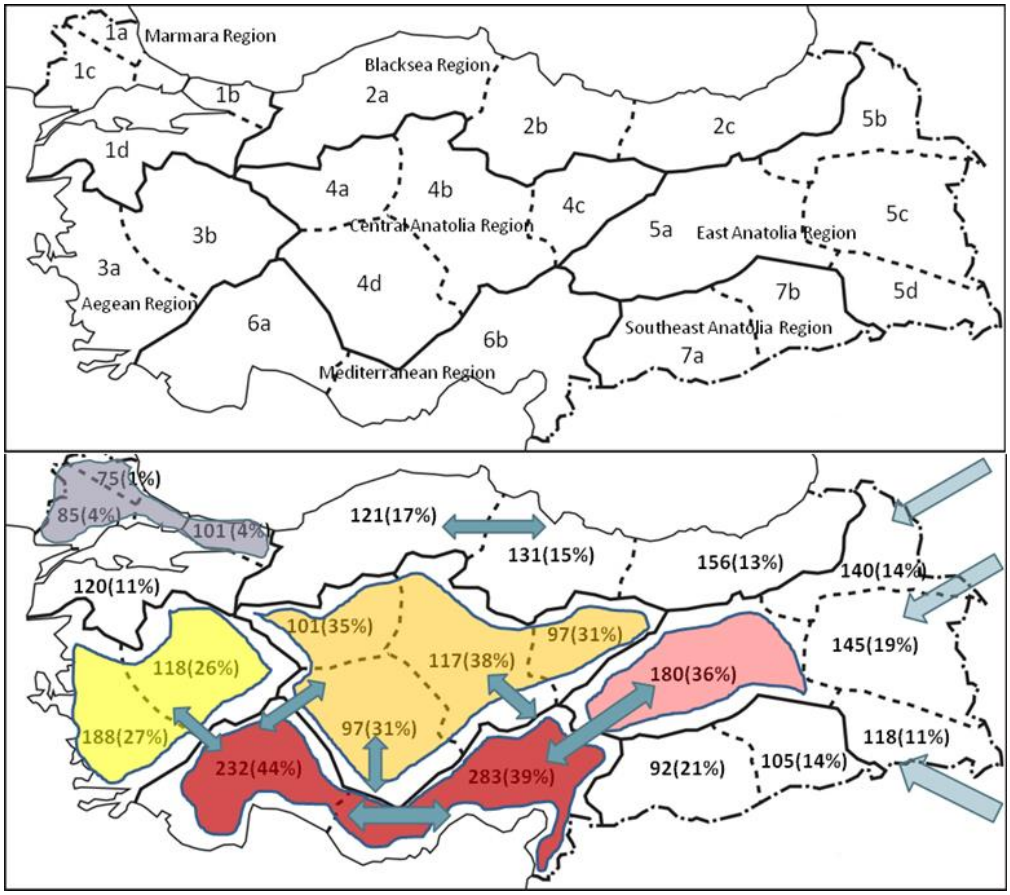
Turkey has seven geographic regions and their subregions (Table 4, Figure 6). Results shown that most of Turkish Lamiaceae taxa are distributed in the Mediterranean geographic region, particularly in the eastern part of the Mediterranean geographic region with 283 taxa. The highest endemism ratio is found in the western part of the Mediterranean geographic region (43.5%). The other high taxon rich areas are western Aegean and western part of East Anatolia regions with 188 and 180 taxa, respectively.

While Central Anatolian geographic region has lower taxa than the Black Sea geographic region, it has higher endemism ratio than the Black Sea geographic region (Table 4, Figure 6). Both the least number taxa and endemism ratio are seen in the Marmara geographic region, particularly in the European part of Turkey (Thrace region). Southeast Anatolia and southern part of East Anatolia have moderate number of taxa and endemism (Table 4, Figure 6).

Table 4. Geographic distribution of Lamiaceae taxa in Turkey (see Figure 6 for Geographic regions and divisions).

Geographic regions	Geographic division	Taxon number	Endemic taxon number	Endemism ratio (%)
Marmara	1a	75	1	1.3
	1b	101	4	4.0
	1c	85	3	4.0
	1d	120	13	10.8
Black Sea	2a	121	20	16.5
	2b	131	20	15.2
	2c	156	21	13.4
Aegean	3a	188	51	27.1
	3b	118	31	26.2
Central Anatolia	4a	101	35	34.6
	4b	117	45	38.4
	4c	97	39	40.2
	4d	97	30	30.9
East Anatolia	5a	180	65	36.1
	5b	140	20	14.2
	5c	145	27	18.6
	5d	118	13	11
Mediterranean Region	6a	232	101	43.5
	6b	283	109	38.5
Souteast Anatolia	7a	92	20	21.7
	7b	105	15	14.2

Figure 6. Geographic regions and Taxon Distribution of Lamiaceae taxa in Turkey. (Arrows below show supposed taxon movement or migration routes, endemism ratio for each subgeographic region are given in the paranthesis).



Supposed hypothesis on origins of Turkish Lamiaceae taxa

After reviewing all available data on Turkish Lamiaceae taxa, we have proposed three hypotheses about origins of Turkish Lamiaceae members:

1. Manafzadeh et al. (2014) reported that the Irano-Turanian phytogeographic region represents one of the hotspots of evolutionary and biological diversity in the Old World, and serves as a source of xerophytic taxa. For this reason, we may assume that some Lamiaceae genera (i.e. *Salvia*, *Nepeta*, *Thymus*, *Scutellaria* and *Marrubium*) originated in the Irano-Turanian phytogeographic region and then they spread into mountainous Mediterrenean Phytogeographic region of Turkey, particularly in the northern face of Taurus Mountains. Anatolian Diagonal may played crucial role for migration of taxa for both directions from Irano-Turanian to the Mediterranean phytogeographic region.

Although *Salvia*, *Nepeta* and *Marrubium* has lower number taxa in the Mediterranean phytogeographic region than the Irano-Turanian phytogeographic region in Turkey, their endemism ratio is higher in the Mediterranean phytogeographic region. Most of endemic or non-endemic taxa of these genera are locally distributed in the Mediterranean phytogeographic region at modetare (800-1500 m) or high altitute (1500-3000 m). Taxa of these genera may penetrated into the Mediterranean phytogeographic region during Glacial times and then adapted to Mediterranean environment. When comparing species habitat of these genera in the Mediterranen phytogeographic region in Turkey, they grow relatively similar climate both in the Irano-Turanian and in the Mediterranean phytogeographic regions (Table 5).

Table 5. The genera which mostly distributed in the Irano-Turanian phytogeographic region.

	Genera (Total taxon number)	**Ir.-Tur. Element-Endemic taxa (%) in the region**	**Medit. Element-Endemic taxa (%) in the region**	**Euro-Sib. (Circumboreal) Element-Endemic taxa (%) in the region**	**Unknown or Multiregional-Endemic taxa (%) in the region**	**Total endemic taxa number and endemism ratio (%)**
1	*Salvia* (107)	65/35 (54%)	30/20 (67%)	7/1(%14)	5/2 (40%)	58 (54%)
2	*Nepeta* (46)	24/7 (29%)	17/13 (76%)	2/0 (0%)	3/0 (0%)	20 (43%)
3	*Thymus* (47)	20/13 (65%)	12/5 (42%)	7/2 (29%)	8/0 (0%)	20 (43%)
4	*Scutellaria* (39)	21/11 (52%)	9/4 (44%)	4/0 (0%)	5/2 (40%)	17 (44%)
5	*Marrubium* (27)	14/10 (71%)	8/7 (88%)	-	5/1 (20%)	17 (63%)

2. Some genera (*Sideritis, Origanum, Teucrium*) are mostly distributed and originated in the Mediterranean Phytogeographic region (Iestwaart, 1980; Greuter et al., 1986; Barber et al., 2007). It is also true for Turkey (Table 6). According to data, though *Sideritis* and *Origanum* have lower number taxa in the Irano-Turanian phytogeographic region than the Mediterranean phytogeographic region, they are mostly endemic and locally distributed in the Irano-Turanian phtogeographic region. Therefore, we may assume that these species could be migrated from the Mediterranean phytogeographic region to Irano-Turanian phytogeographic region and then specialized in there.

Table 6. The genera which mostly distributed in the Mediterranean phytogeographic region.

	Genera (Total taxon number)	Ir.-Tur. Element/Endemic taxa (%) in the region	Medit. Element/Endemic taxa (%) in the region	Euro-Sib. (Circumboreal) Element/Endemic taxa (%) in the region	Unknown or Multiregional/ Endemic taxa (%) in the region	Total endemic taxa number and endemism ratio (%)
1	*Sideritis* (54)	10/8 (80%)	38/29 (76%)	4/2 (50%)	2/1 (50)	40 (74%)
2	*Teucrium* (49)	13/4 (31%)	24/13 (54%)	5/0 (0%)	7/0 (0%)	17 (35%)
3	*Origanum* (31)	4/3 (75%)	20/15 (75%)	2/0 (0%)	5/0 (0%)	18 (58%)

3. Some cosmopolitan Lamiaceae genera are also distributed in Turkey. Some of their members are specialized in the specific habitats in Turkey in time. *Stachys* (Harley et al., 2004) and *Phlomis* (Mathiesen et al., 2011) have a fairly large number of taxa in Turkey. While *Stachys* and *Phlomis* taxa are distributed in all parts of the country, most of endemic and non-endemic taxa are localized in the Irano-Turanian and Mediterranean phytogeographic regions of Turkey (Table 7).

Table 7. Example for cosmopolitan Lamiaceae genera in Turkey.

	Genera (Total taxon number)	Ir.-Tur. Element-Endemic taxa (%) in the region	Meditterrenean Element-Endemic taxa (%) in the region	Euro-Siberian (Circumboreal) Element-Endemic taxa (%) in the region	Unknown or Multiregional-Endemic taxa (%) in the region	Total endemic taxa number and endemism ratio (%)
1	*Stachys* (118)	41/19 (46%)	46/29 (63%)	16/3 (%19)	15/3 (20%)	53 (45%)
2	*Phlomis* (53)	23/16 (70%)	22/12 (55%)	1/1 (100%)	7/1 (14%)	30 (57%)

In the Euro-Siberian phytogeographic region (northern Turkey), cosmopolitan and non-endemic Lamiaceae taxa are mostly distributed. European part of Turkey (western Euro-Siberian phytogeographic region in Turkey) is similar to European Lamiaceae flora. On the other hand, northeastern Turkey (eastern Euro-Siberian phytogeographic region in Turkey) is similar to Caucasian Lamiaceae flora.

To sum up, the results pointed out that Turkey is one of the species biodiversity centers in Lamiaceae in the Old World. *Salvia, Stachys, Sideritis, Phlomis, Teucrium, Thymus, Nepeta, Scutellaria, Origanum* and *Marrubium* are species rich genera in Turkey. Particulary, most of Old Wold species of *Salvia*, *Stachys, Origanum, Marrubium, Ballota, Lamium* and *Drymosiphon* naturally grow in Turkey. These genera have also quite high endemism ratio with *Phlomis, Scutellaria, Thymus, Nepeta* and *Satureja*.

Taxonomic position of *Dorystaechas hastata*, *Rosmarinus officinalis* and *Lophanthus turcicus* are still under discussions. Their final taxonomic positions will be clarified with additional molecular and systematic studies.

Most of the endemic and non-endemic Turkish Lamiaceae taxa are distributed in the Mediterranean (total 293 taxa, 179 taxa of which are endemic) and Irano-Turanian (total 287 taxa, 144 taxa of which are endemic) phytogeographic regions. Less and mostly non-endemic Lamiaceae taxa are distributed in the Euro-Siberian (Circumboreal) (total 90 taxa, 12 taxa of which are endemic) phytogeographic region.

Mediterranean geographic region of Turkey has the most number endemic and non endemic taxa in Turkey (Figure 6). The other geographic regions where high endemism ratio are Central Anatolia, Aegean region and western part of Eastern Anatolia. The lowest number endemic and non-endemic taxa are found in the European part of Turkey (Figure 6).

Due to its abiotic and biotic diversity (geology, climate, geography, phytogeography, edaphic, Anatolian Diagonal, pollinators), 782 Lamiaceae taxa (603 species), 346 taxa of which are endemic, are naturally grow in Turkey. We hypothesize that some Lamiaceae genera originated in the Mediterranean phytogeographic region (i.e. *Sideritis*, *Origanum*) and some others originated in the Irano-Turanian phytogeographic (i.e. *Nepeta*, *Thymus*) regions. In time, species of these genera migrated from one phytogeographic region to another one, and localised in specific habitats. Euro-Siberian Lamiaceae flora in Turkey is similar to European and Caucasus Lamiaceae flora. Interestingly, we have not seen a genus of Lamiaceae, which is mostly distributed with a high endemism ratio in the Euro-Siberian (Circumboreal) phytogeographic region of Turkey. In addition, ca. 112 taxa, which are unknown or present in multiregional phytogeographic regions in Turkey, are widely distributed in the country. In conclusion, Turkey is a very good example for evolution and speciation of the Lamiaceae family. Our hypotheses to explain origins of Lamiaceae in Turkey need to be further studies based on molecular phylogenetic, molecular dating and biogeographic studies with geological data.

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