Abstract

The taxa of the genus *Trifolium* L. are considered valuable genetic plant resources worldwide. The study of their chorological and floristic characteristics is of great importance. This paper aims at evaluating the taxa of the genus found in the flora of Greece in terms of their ecological, chorological and commonness characteristics. A floristic catalogue was produced based on published, but not genus-specific, floristic data collected at various parts of the country and field surveys carried out by the authors in years 2004 and 2005. Information on the localities of the taxa, either found in the field surveys or scattered into floristic reports, was gathered. The present analysis was based on several research results and bibliographic information. It was found that the Greek flora contains 113 taxa (95 species, 17 subspecies, one hybrid) out of a total of approximately 255 species reported worldwide; six of them being Greek endemics. The taxa are distributed into two subgenera of the genus: subgenus *Chromosemium* including 14 species and subgenus *Trifolium* that includes 98 taxa (without counting one hybrid) distributed in five out of eight sections: *Trifolium* (56), *Vesicularia* (18), *Trifolastrum* (15), *Trichocephalum* (7) and *Paramesus* (2). The majority of the taxa are Mediterranean elements (38%), annuals (76%), therophytes (76%), and of scapose growth type (78%). It was also found that the centre of distribution of *Trifolium* is located in Anatolia (Turkey) and Greece, so pointing out this part of east Mediterranean as an important “gene-pool” region. The most common *Trifolium* species in Greece are *T. repens*, *T. campestre*, *T. fragiferum*, *T. physodes* and *T. arvense*.

Introduction

The taxa of the genus *Trifolium* L. (clovers) are important floristic elements almost found in all natural ecosystems of the world. The knowledge of indigenous in each country *Trifolium* taxa is important not only for their rational exploitation in terms of rural economy but also for sustaining ecosystems’ integrity. These taxa are preeminent elements for atmospheric nitrogen fixation, contribute to the improvement of nutritive value of forages for grazing animals, facilitate the root expansion of other species through their fibrous, tap-like roots, increase soil water retention capacity, and protect soils from mineral leaching (Knight & Watson 1977; Taylor 1985; Loi et al. 2000). Consequently, they constitute valuable natural resources, for which ecological, biotic and chorological attributes must be adequately defined prior to any exploitation or restoration effort. Also, many *Trifolium* taxa, especially those from the Mediterranean centre of diversity, are invasive species to other places of the globe, especially in the south hemisphere (e.g. in New Zealand, Gravuer 2004; and in Australia, Emms et al. 2005). The knowledge of their ecology and distribution may help improve their rational exploitation or in conducting studies for invasion prevention of the taxa.
The first historical, taxa-specific description of the genus *Trifolium* on a worldwide basis was carried out by *Zohary & Heller* (1984) in their monumental book “*The Genus Trifolium*”, while *Gillett & Taylor* (2001) report the distributional characteristics of *Trifolium* around the globe. The first, completed identification key, accompanied by European taxa description, was produced by *Tutin et al.* (1968) in *Flora Europaea* (vol. 2). The first catalogue of the floristic elements of the Leguminosae family (*Trifolium*) included for the Mediterranean countries was presented in the Med-Checklist of *Greuter et al.* (1989, vol. 4). According to that catalogue, the flora of Greece contains 102 *Trifolium* taxa. On the other hand, the Mountain Flora of Greece (*Strid* 1986, vol. 1) reports 26 taxa, but in altitudes over 1000 m a.s.l.

The aim of this study is to present chorological and ecological information and to infer about the commonness of the genus *Trifolium* in Greece by pointing out the great diversity of the *Trifolium* taxa. For this purpose, additional data obtained from posterior bibliographic and field work aiming at complementing the existing knowledge on *Trifolium* taxa found in Greece was used. A floristic catalogue is given by reporting the floristic regions where these taxa are present, and their biotic and ecological characteristics. The proximity of Greece to the *Trifolium* distributional centre is additionally discussed. Finally, the ecological adaptation of *Trifolium* is investigated and the most widely adapted taxa are highlighted.

**Method of research**


Information for *Trifolium* taxa were sorted out and a floristic catalogue was build. The catalogue includes taxa allocated to subgenus and sections in alphabetical order according to *Ellison et al.* (2006). Taxa nomenclature followed *Strid* (1986), *Greuter et al.* (1989) and *Hendrych* (1993). The name of the authors of plant names are written according to *Brummitt & Powell* (1992).

Data analysis included the determination of the major a) ecological and b) chorological characteristics of the *Trifolium* taxa, while in addition c) commonness of each taxon was determined. Specifically, ecological analysis included the classification of the taxa according to their (i) life duration, (ii) life form, (iii) growth type growth type according to *Raunkiaer’s* (1910) system as modified by *Ellenberg* (1956). Classification was based on *Garcke* (1972), *Pignatti* (1982), *Davis* (1969), *Strid* (1986) and *Oberdorfer* (1990). Moreover, taxa were classified according to their (iv) altitudinal expansion range and (v) type of habitat. Altitudinal expansion range was determined as the difference between the lower and the highest altitude of taxon’s reference. For example, an altitudinal expansion range of 300 m for a given taxon may be resulted from a difference of 1500 m (highest altitude) minus 1200 m (lower altitude), while the same range for another taxon may derive from other altitudinal differences (e.g. 1000 m minus 700 m). Taxa were allocated into eight types of habitats according to their dominant appearance (grasslands, shrublands, open woodlands, forests, cultivated fields, roadides, urban areas, and coasts). Chorological analysis was performed by means of the chorological spectrum.
following Oberdorfer’s system of geographical partition of Europe into major floristic units (OBERDORFER 1990) in order to locate the distribution centre of each taxon and to define its level of endemism. Information for species distribution was drawn from GARCKE (1972), PIGNATTI (1982), DAVIS (1969), GREUTER et al. (1989), GREUTER & RAUS (1995, 2001a, b, 2002, 2005), STRID (1986) and OBERDORFER (1990). Moreover, chorological analysis included the allocation of taxa into the phyto-geographical areas of Greece as described by STRID & TAN (1997). Finally, results on the commonness of the Trifolium taxa were produced by graphically combining the relative location of each taxon into the two dimensional space of its altitudinal expansion rate with the number of phytogeographical areas of Greece where each taxon is found. Wide-spread Trifolium taxa were those that occur frequently in high numbers of phytogeographical areas and have wide altitudinal expansion rates. On the opposite side, narrow-spread taxa were those extending over a narrow area in terms of number of phyto geographical areas and altitudinal expansion rate. The rest of the taxa were classified as having intermediate commonness.

Results and discussion

Genus Trifolium is one of the large genera in the legumes’ family with ca. 255 species (ZOHARY & HELLER 1984; GILLET & TAYLOR 2001; ELLISON et al. 2006). Of these species, 95 are naturally found in Greece and, according to existing records, there are almost 113 Trifolium taxa, including one hybrid (T. hybridum subsp. anatolicum × elegans). In the past, taxa nomenclature varied considerably; there were taxa with over 25 synonyms (e.g. T. arvense, T. pratense), while at least eight genera were used to describe Trifolium species (Amarenus, Amoria, Calymorphomorph, Chrysaspis, Falcatula, Micranthemum, Mistyllus, Paramesus) (ZOHARY & HELLER 1984). A recent study allocated two subgenera to the genus Trifolium (ELLISON et al. 2006); the subgenus Chronosemium comprising approximately 20 Mediterranean species, 14 of them present in Greece, and the subgenus Trifolium comprising the remaining species, with 81 of them present in Greece. According to the same study, 81 species are distributed into five out of a total of eight sections, namely Paramesus (2 species), Trichocephalum (4 species), Trifoliastrotrum (9 species), Trifolium (51 species) and Vesicaria (15 species). The other three sections, the Central-European section of Glycyrrhizum, the Euro-Siberian section of Lupinaster, and the American section of Involucratum are not present in Greece.

Ecological characteristics

The life duration spectrum revealed that the majority of the taxa are annuals, followed by perennials, while one (T. velenovskyi) is biennial (Fig. 1). Therophytes dominate over hemicryptophytes and geophytes. The majority of the taxa is of the scapose growth type followed by caespitose, reptans, and rhizomatous. All reptans taxa are perennials, and all rhizomatous taxa are geophytes.

The majority of species are found in areas of low altitude (below 1000 m), while the number of species reduces with increasing altitude; only four species are recorded in altitudes over 2500 m (T. pratense, T. repens, T. parnassi, T. pallescens) (Fig. 2).
31 species out of 95 are found in closed or open forest communities (Fig. 3), of which only five (T. ochroleucon, T. heldreichianum, T. pseudomedium, T. diffusum, T. pignantii) are distributed in a wide altitudinal range [(s.l.–)300–1800(–2300) m]. Phytosociological studies have shown that six perennial taxa (T. pseudomedium, T. patulum, T. alpestre, T. ochroleucon, T. physodes, T. medium subsp. medium) are typical elements of Mediterranean forests (and shrublands) (MUČINA 1997; TSIRIPIDIS 2001; FOTIADIS & ATHANASIADES 2008). Many typical forest taxa are perennials (e.g. T. ochroleucon, T. pannonicum, T. heldreichianum, T. patulum, T. pignantii, T. pseudomedium, T. hybridum subsp. elegans) in contrast to the dominant annual life duration pattern of the whole genus. Consequently, these species have the potential to be introduced into forests or silvopastoral systems for improving their forage quality potential. The majority of taxa (48) are found in open places; 16 of them in an altitude of 0–1000 m. Ten species are commonly found in a variety of habitats (more than six habitats).

**Chorological characteristics and endemism**

Chorological spectrum revealed the dominance of Mediterranean elements, followed from sub-Mediterranean, and Balkanic/sub-Balkanic (Fig. 4). There are six endemic taxa [T. praetermissum, T. aurantiacum (uncertain status), T. dolopium, T. parnassi, T. barbeyi, T. ottonis], mostly found on limestone, on islands and sub-alpine grasslands. The number of Eurasianic elements is small (seven), with one
(T. spadiceum) northern, and three (T. badium, T. pallescens, T. noricum subsp. praetutianum) alpine. The presence of T. glomeratum is impressive, since apart from the Mediterranean basin it is also found in South Africa and Chile (ZOHARY & HELLER 1984). Chorologically, the east Mediterranean taxa (omed/osmed) (20 in number) dominate over west Mediterranean/Atlantic (wmed/atl/subatl) ones (five in number) (Fig. 5). This is in accordance with ZOHARY & HELLER (1984) who argued that Anatolia (Asia Minor) is the preponderant centre of distribution for Trifolium. There is strong evidence that Anatolia holds the greater number of endemic Trifolium species (eight in number) followed by Greece (six) and Syria (three) (DAVIS 1969; JORDANOV et al. 1976; PIGNATTI 1982; ZOHARY & HELLER 1984; GREUTER et al. 1989; GREUTER & RAUS 1995, 2001a, b, 2002, 2005). It seems that a great number of endemic species is accumulated between the Balkans and Anatolia, since the endemics of a) the east Mediterranean (Anatolia, Cyprus, Syria, Israel), b) the Balkans and Anatolia, and c) the Italian peninsula and the Balkans are proportionally distributed according to the rate 29:33:27. In addition, the maximum number of Trifolium species is found in the Balkans and Anatolia area, since the species proportion of West Mediterranean Europe (Italy included): Balkans:Asian Mediterranean:African Mediterranean is 77:116:119:59, while the species proportion of Balkans:Anatolia:Asian Mediterranean is 116:105:73. These numbers and proportions clearly indicate that the distribution centre of Trifolium is in Anatolia, but slightly shifted to the Balkans, and more specifically to Greece. This is further confirmed by examining the chorological distribution of Trifolium in the Greek territory (Map 1); north-east Greece (NE) hosts the highest number of species, while the region of the east Aegean islands (EAe) is found in the fourth position.

Commonness
Most of the species are present in only one phytogeographical region of Greece (Fig. 6), while five species (T. campestre, T. repens, T. arvense, T. fragiferum, T. physodes) are present almost in the whole country. Most of the species appear in an altitudinal expansion range of 1000 m, while those recorded in a range over 2000 m are 15 (T. tomentosum, T. physodes, T. fragiferum, T. pratense, T. pignantii, T. heldreichianum, T. ochroleucon, T. arvense, T. alpestre, T. repens, T. hybridum,
By combining (with graphical means) the relative location of each *Trifolium* species into the two dimensional space of altitudinal expansion rate with the number of phytogeographical areas of Greece where each species is found, three distinct groups of *Trifolium* species are produced according to their commonness (Fig. 6; groups separated by gray line). The first group includes the narrow-spread *Trifolium* species, i.e. those extending over a narrow area in terms of number of phytogeographical areas and altitudinal expansion rates. There are 29 narrow-spread species; four of them...
Fig. 6

Number of phytogeographical areas (1–13) and altitudinal expansion range (1–27 viz. from 100 to 2700 m) where *Trifolium* species are distributed.
(T. cinctum, T. obscurum, T. pilzii, T. scutatum) appear in a single phytogeographical region and up to 100 m of altitudinal expansion range, while the rest are found up to three phytogeographical regions and up to 1200 m of altitudinal expansion range. Four out of six Greek endemic species (T. praetermissum, T. dolopium, T. barbeyi, T. ottonis) are included in this group. On the contrary, 15 species are found in more than seven phytogeographical regions and in altitudinal expansion range over 1400 m, thus belonging to the wide-spread group. Some characteristic wide-spread taxa are T. arvense, T. physodes, T. fragiferum, T. campestre and T. repens found in at least 12 phytogeographical regions and in altitudinal expansion ranges of over 2000 m. The wide commonness of the perennial T. repens and other species justify and support their cultivation in many areas of the globe (BAKER & WILLIAMS 1987; TAYLOR & QUESENBERRY 1996), while in other areas of the world they are the most important in terms of invasion, like in New Zealand (GRAVUER 2004). The rest of the species were classified as having intermediate commonness.

Conclusions

The present research maintains that the current number of Trifolium taxa found in Greece is 113. They are distributed into two subgenera of the genus; subgenus Chronosemium includes 14 species and subgenus Trifolium includes 98 taxa (without counting one hybrid); the latter are further distributed in five out of eight sections: Trifolium (56), Vescaria (18), Trifolias-trum (15), Trichocephalum (7) and Paramesus (2). The majority of the taxa are Mediterranean elements (38%), annuals (76%), therophytes (76%), and of scapose growth type (78%). Six species are Greek endemics [T. praetermissum, T. aurantiacum (uncertain status), T. dolopium, T. parnassi, T. barbeyi, T. ottonis]. The greatest number of taxa is found in north-east Greece (NE) and the endemic elements found in Greece indicate that the distribution centre of Trifolium is in Anatolia, but slightly shifted to the Balkans, and more specifically to Greece. The most common Trifolium species in Greece are T. repens, T. campestre, T. fragiferum, T. phy-sodes and T. arvense. Trifolium species are further classified as those having wide commonness (29 species), narrow commonness (15 species), and intermediate commonness (the remaining 51 species).

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Annex

Floristic catalogue

Subgenus Chronosemium

**Trifolium aurantiacum** BOISS. & SPRUNER: A/ Tscap/ hell (?)/ 200–1900 m/ Pe, StE, NPi, NC, WAe, EAe/ shrublands, forests and rocky places. – Even though ELLISON et al. (2006) did not include the species in the subgenus Chronosemium, according to ZOHARY & HELLER (1984) the species belongs to section Chronosemium which became a subgenus. According to the Med-Checklist (GREUTER et al. 1999), it is a Greek endemic and it is not detectable in the East Aegean islands. Probably, it is misidentified or confused with other *Trifolium* taxa (*T. boissieri, T. grandiflorum* or even *T. campestre*). According to LASSEN (GREUTER & RAUS 1999), the single record from the Cretan area (KK) is in fact, a misidentified specimen of *T. campestre*.

**Trifolium aureum** POllICH: A(β)/ T(Η)scap/ gemabkont(-smed)/ s.l.–2000 m/ Pe, StE, SPi, NC, Kik/ fields, grasslands, shrublands, forests and rocky places.

**Trifolium badium** SCHREBER: P/ Hscap/ alp/ 700–2100 m/ NPi, NC/ grasslands, open woodlands, forests, coasts, roadsides, wet places and rocky places.

**Trifolium aureum** POLlich: A(B)/ T(H)scap/ gemabkont(-smed)/ s.l.–2000 m/ Pe, StE, SPi, EC, NC, NE, Kik/ fields, grasslands, shrublands, open woodlands, forests, coasts, roadsides, wet places and rocky places.
olive fields, shrublands (mainly maquis and phrygana), forests and rocky places.

**Trifolium campestre** Schreber: A/ Tscap/ smed-subatl/ s.l.–2200 m/ KK, Pe, StE, SPI, NPi, EC, NC, NE, IoI, WAE, NAE, EAE, Kik/ almost everywhere, but mostly in grasslands.

**Trifolium dolopium** Gibelli & Belli: A/ Tscap/ hell/ ~300 m/ NE/ slopes. Stenotopic endemic restricted in an area of the Athos peninsula. – Even though Ellison et al. (2006) did not include the species in the subgenus Chronosemium, according to Zohary & Heller (1984) the species belongs to section Chronosemium which became a subgenus.

**Trifolium dubium** Sibth.: A/ Tscap/ med-atl(-smed)/ s.l.–1400 m/ EC, NC, NE/ grasslands, urban areas, roadsides and sandy places.

**Trifolium filiforme** L.: A/ Tscap/ med-atl/ s.l.–1800 m/ KK, SPI, EC, NC, NE, EAE, Kik/ fields, Fagus forests, wet, damp places and sandy places. – Even though Ellison et al. (2006) did not include the species in the subgenus Chronosemium, according to Zohary & Heller (1984) the species belongs to section Chronosemium which became a subgenus.

**Trifolium grandiflorum** Schreber: A/ Tscap/ omed/ s.l.–1600 m/ KK, Pe, StE, SPI, NPi, EC, NC, NE, EAE, Kik/ shrublands, forests, urban areas and rocky places.

**Trifolium patens** Sibth.: A/ Trept/ smed/ s.l.–2200 m/ KK, Pe, StE, SPI, EC, NC, NE, IoI, WAE, EAE/ fields, grasslands, shrublands, open woodlands, forests, roadsides, wet and rocky places but mostly in nutrient-rich grasslands.

**Trifolium praetermissum** Greuter et al.: P(A)/ H(T)scap/ hell/ 100–1000 m/ KK, Pe, StE, SPI, NPi, EC, NC, NE, IoI, WAE, EAE/ fields, grasslands, shrublands, open woodlands, forests, roadsides, wet and rocky places but mostly in nutrient-rich grasslands.

**Trifolium praetermissum** Greuter et al.: P(A)/ H(T)scap/ hell/ 100–1000 m/ KK, Pe, StE, SPI, NPi, EC, NC, NE, IoI, WAE, EAE/ fields, grasslands, shrublands, open woodlands, forests, roadsides, wet and rocky places but mostly in nutrient-rich grasslands.

**Trifolium sebastianii** Savgi: A/ Tscap/ osmed/ 300–1300 m/ NPi, NE/ open woodlands. – Even though Ellison et al. (2006) did not include the species in the subgenus Chronosemium, according to Zohary & Heller (1984) the species belongs to section Chronosemium which became a subgenus.

**Trifolium spadiceum** L.: A(P)/ T(H)scap/ nokont-pralp/ 1300–1600 m/ NC, NE/ open woodlands and forests.

**Trifolium velenovskyi** Vandans: B/ Hscap/ balc (Al-Ju-Bu)/ 900–1900 m/ StE, NC, NE/ grasslands, shrublands, open woodlands and forests. – Even though Ellison et al. (2006) did not include the species in the subgenus Chronosemium, according to Zohary & Heller (1984) the species belongs to section Chronosemium which became a subgenus. The species has also been recorded on the island of Zakynthos (IoI), but its occurrence needs confirmation.

**Subgenus Trifolium**

**Section Paraneus**

**Trifolium glanduliferum** Boiss.: A/ Tscap/ omed/ 600–1000 m/ EAE/ fields, grasslands, shrublands (mainly maquis) and Pinus forests.

**Trifolium strictum** L.: A/ Tscap/ smed/ s.l.–1550 m/ StE, SPI, EC, NC/ grasslands, open woodlands.

**Section Trichocephalum**

**Trifolium globosum** L.: A/ Tscap(rept)/ omed/ grasslands, amongst shrubs and sandy places/ s.l.–900 m. StE, NE, WAe, EAe, Kik.

**Trifolium pauciflorum** Dum.-Urville: A/ Tscap/ omed/ s.l.–1200 m/ EAe/ grasslands and stony calcareous places.

**Trifolium pilulare** Boiss.: A/ Tscap/ omed/ s.l.–800 m/ EAE/ grasslands.

**Trifolium subterraneum** L.: A/ Trept/ smed/ s.l.–1250 m/ KK, Pe, StE, SPI, EC, NC, IoI, WAE, NAE, EAE/ fields, grasslands, shrublands, open woodlands, urban areas and wet places. Three subspecies recognized in Greece: a. the Mediterranean subsp. oxaloides Nyman, b. the submediterranean subsp. subterraneum, and c. the balkan endemic subsp. yanninicum Katzin. & F. Morley. Greuter et al. (1989) do not mention the existence of the subspecies subterraneum in the Mediterranean region, even though, according to Zohary & Heller (1984), the subspecies is native only in Greece.

**Section Trifoliastrum**

**Trifolium retusum** L.: A/ Tscap/ euras/ 100–1100 m/ NC, NE/ grasslands, shrublands, forests, coasts and roadsides but mostly in inland salt-marches, salt-pans and salt-steppes. – The
species not mentioned for Greece by G. Reuter et al. (1989), although Zohary & Hellier (1984) mentions the existence of the species in Greece and Raus et al. (G. Reuter et al. 2002) give the information above cited.

**Trifolium suffocatum** L.: A/ Tscap/ med/ s.l.–1500 m/ KK, StE, EC, NE, Wae, EaE, KiK/ grasslands and waste places but mostly in short-lived, trampled ruderal plant communities.

**Trifolium nigrescens** VIV.: A/ Tscap/ med-/ smed/ s.l.–1800 m/ KK, Pe, StE, SPi, EC, NC, Wae, NaE, EaE, KiK/ fields, grasslands, shrublands, roadsides, wet and waste places, sandy places and rocky places but mostly in annual, herb-rich ruderal plant communities. Two subspecies recognized in Greece: subsp. nigrescens and subsp. petrisavii (G. C. Clementi) Holmboe.

**Trifolium pilczii** AdAMOV: Ψ/ Hcaesp/ balc (Al-Ju)/ 2100–2200 m/ NP/ calcareous grasslands.

**Trifolium uniflorum** L.: Ψ/ Hcaesp/ med/- s.l.–2400 m/ KK, Pe, StE, SPi, EC, Ne, WaE, NaE, EaE, KiK/ fields, grasslands, shrublands, amongst maquis and phrygana, coasts, urban areas, roadsides and rocky places.

**Trifolium repens** L.: P/ H(Ch)rept/ euras-/ subozean-smed/ s.l.–2700 m/ KK, Pe, StE, SPi, NPi, EC, NC, Ne, IoI, WaE, NaE, EaE/ almost everywhere but mostly in nutrient-rich and wet grasslands. Four subspecies recognized in Greece: a. the continental subsp. orbelicum (Velen.) Pawl., b. the mediterranean subsp. orphanideum (Boiss.) D.E.Coombe, c. the submediterranean subsp. prostratum Nyman, and d. the eurasian subsp. repens. – Greuter et al. (1989) do not mention the existence of the subspecies repens in the Mediterranean region, even though, according to Zohary & Hellier (1984), the subspecies is native in the Mediterranean countries.

**Trifolium pallescens** Schreber: Ψ/ Hcaesp/ alp-pralp/ 1600–2800 m/ NC, Ne/ grasslands and dry places. – According to Strid & Papanicolaou (1981), the occurrence of the species in Vermio and Voras (NC) needs confirmation, but according to Strid (1986) the material from Tzena (NC) looks like the material from Olympus (NC) of *T. pallescens* and that of Voras resembles that from the Alps of *T. pallescens*.

**Trifolium glomeratum** L.: A/ Tscap/ smed (also in S. Africa and Chile)/ s.l.–1500 m/ KK, Pe, StE, SpI, EC, Ne, Wae, EaE, KiK/ fallow fields, grasslands, shrublands, forests, urban areas, roadsides, riverbanks and rocky places but mostly in annual herb-rich ruderal communities.

**Trifolium parnassi** BOISS. & SPRUNER: Ψ/ Hcaesp/ hell/ 1500–2700 m/ Pe, StE, SpI, NPi, NC/ grasslands and rocky places but mostly in siliceous alpine and boreal grasslands.

### Section Trifolium

**Trifolium affine** C.Presl: A/ Tscap/ balc (buktu)-an/ s.l.–300 m/ Ne, NaE, EaE/ grasslands and dry places.

**Trifolium alpestre** L.: Ψ/ Hscap/ ge-mabkont-smed/ 200–2300 m/ Pe, StE, SPi, NPi, EC, NC, Ne, NaE/ grasslands, shrublands, open woodlands, forests and roadside but mostly in herb-rich heliophilous and (sub-)thermophilous fringe plant communities of temperate forests.

**Trifolium angustifolium** L.: A/ Tscap/ subatl- smed/ s.l.–1100 m/ KK, Pe, StE, SpI, NPi, EC, NC, Ne, IoI, WaE, NaE, EaE/ fields, grasslands, amongst scrubs and roadsides, open woodlands, urban areas, roadsides and rocky places.

**Trifolium apertum** Bordov: A/ Tscap/ osmed/ s.l.–1000 m/ IoI/ shrublands, meadows and clay hills.

**Trifolium arvense** L.: A/ Tscap/ euras-/ subozean-smed/ s.l.–2000 m/ KK, Pe, StE, SpI, NPi, EC, NC, Ne, IoI, WaE, NaE, EaE, KiK/ fields, grasslands, amongst scrubs, open woodlands, urban areas and rocky places but mostly in terrestial plant communities dominated by annual low-growing herbs and grasses.

**Trifolium apertum** BORDOV: A/ Tscap/ osmed/ s.l.–1000 m/ IoI/ shrublands, meadows and clay hills.

**Trifolium arvense** L.: A/ Tscap/ euras-/ subozean-smed/ s.l.–2000 m/ KK, Pe, StE, SpI, NPi, EC, NC, Ne, IoI, WaE, NaE, EaE, KiK/ fields, grasslands, amongst scrubs and roadsides, open woodlands, urban areas, roadsides and rocky places but mostly in grasslands and related short-lived, herb-rich plant communities of sandy and skeletal, predominantly nutrient-poor and drought-stressed soils.

**Trifolium barbeyi** Gibelli & Belli: A/ Tscap/ hell/ s.l.–500 m/ KK/ dry grasslands.

**Trifolium bocconei** Savvi: A/ Tscap/ med/ s.l.–800 m/ KK, Pe, NC, Ne, EaE, KiK/ grasslands, amongst scrubs and roadsides.

**Trifolium caudatum** BOISS.: Ψ/ Hcaesp/ hell- an/-400m/ EaE/ pastures. – Even though Ellisson et al. (2006) did not include the species in the section *Trifolium*, according to Zohary &
HELLER (1984) the species belongs to section Trifolium.

*Trifolium cherleri* L.: A/ Tscap/ smed/ s.l.–1800 m/ KK, Pe, StE, EC, NC, NE, WAe, E Ae. Kik/ grasslands, shrublands, urban areas and rocky places but mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses.

*Trifolium cinctum* DC.: A/ Tscap/ balc (AI-Ju)/ ~90 m/ IoI/ wet grasslands. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium elypeatum* L.: A/ Tscap/ omed/ s.l.–700 m/ KK, Pe, EaE, Kik/ fields and roadsides.

*Trifolium congestum* GUSS.: A/ Tscap/ med/ s.l.–600 m/ E Ae/ dump open places. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium constantinopolitanum* SER.: A/ Tscap/ omed/ s.l.–700 m/ NE/ fields, river banks and damp places.

*Trifolium dalmaticum* VIS.: A/ Tscap/ balc (AI-Ju-Bu)/ 100–1600 m/ Pe, StE, SpI, NPi, EC, NC, NE, IoI/ grasslands, shrublands, open woodlands, forests and disturbed places but mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses.

*Trifolium dasyurum* C.PRESL: A/ Tscap/ omed/ s.l.–1300 m/ KK, Pe, StE, IoI, EaE, Kik/ fields, grasslands, stony and calcareous soils.

*Trifolium desvauxii* BOISS. & BLANCHE: A/ Tscap/ omed/ s.l.–100 m/ E Ae. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium diffusum* EHRH.: A/ Tscap/ smed/ 200–1800 m/ StE, SpI, NC, NE/ shrublands (mainly maquis), open woodlands and forests.

*Trifolium echinatum* M.BIEB.: A/ Tscap/ osmed/ 100–750 m/ NPi, EC, NC, NE, WAe, E Ae/ open woodlands, urban areas and sandy places.

*Trifolium heldreichianum* (GIBELLI & BELLi) HAUSKRN.: P/ Hcaesp/ balc (AI-Ju-Bu)/ An/ 100–2100 m/ StE, SpI, NPi, NC, NE/ grasslands, shrublands, open woodlands and forests.

*Trifolium hirtum* ALL.: A(B)/ Tscap/ smed/ s.l.–1400 m/ KK, Pe, StE, SpI, NPi, EC, NC, NE, WAe, N Ae, E Ae, Kik/ grasslands, shrublands, open woodlands, forests, roadsides and rocky places. Two subspecies recognized in Greece: a. subsp. *incarnatum* – GREUTER et al. (1989) do not mention the existence of this subspecies in the Mediterranean region, even though, according to ZOHARY & HELLER (1984), the subspecies (as var. *incarnatum*) is widely cultivated and naturalized in the Mediterranean region – and b. subsp. *molinerii* (HORNEM.) SYME – According to GREUTER et al. (1989), the occurrence of the subspecies in Greece needs confirmation. According to LASSEN (GREUTER & RAUS 1999), the only record of the subspecies from the EAe (island of Rhodos) is based on mixed material of *T. infamia-ponertii* and *T. stellatum*.

*Trifolium infamia-ponertii* GREUTER: A/ Tscap/ med-omed/ s.l.–1150 m/ KK, Pe, StE, WAe, E Ae, Kik/ grasslands and mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium lappaceum* L.: A/ Tscap/ smed-med/ s.l.–1100 m/ KK, Pe, StE, EC, NC, NE, IoI, WAe, EAe, Kik/ fields, grasslands, amongst scrub, roadsides, rocky and wet places.

*Trifolium latium* SEBASTIANI: A/ Tscap/ balc (Bu)–It-an/ 100–600 m/ Pe, StE, SpI, E Ae/ shrublands (mainly maquis) and forests.

*Trifolium leucanthum* M.BIEB.: A/ Tscap/ smed/ 200–1600 m/ KK, StE, NC, NE, EAe/ grasslands, shrublands (mainly phrygana), open woodlands and mountain slopes.

*Trifolium ligusticum* LOISEL.: A/ Tscap/ wmed/ s.l.–800 m/ KK, Pe, WAe/ fields and rocky places.

*Trifolium lucanicum* GUSS.: A/ Tscap/ med-smed/ 50–1600 m/ KK, Pe, StE, NE/ dry...
and rocky places, but mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses of Thero-Brachypodietea.

*Trifolium medium* L. subsp. medium: P/Grhiz/ eurossubozone (-smed)/ 600–1500 m/ NPi, NC, NE/ forests and shrublands, but mostly in herb-rich heliophilous and (sub)-thermophilous fringe communities of temperate woodlands. – Despite the several records of the subspecies, GREUTER et al. (1989) do not mention its existence in the Mediterranean region. Additionally, according to ZOHARY & HELLER (1984), the subspecies is native in the Mediterranean countries but they do not mention Greece.

*Trifolium noricum* subsp. praetutianum (Savi) Arcang.: P/Hcaesp/ oalp/ 1400–2400 m/ Pe, StE, SPi, NPi, NC, NE/ rocky places but mostly in subalpine calcareous grasslands.

*Trifolium obscurum* Savi: A/Tscap/wmed/ ~40 m/ EAe/ sandy soils damp in winter.

*Trifolium ochroleucon* Hud.: P/Hcaesp/ smed-subatl/ 50–2100 m/ Pe, StE, EC, SPi, NPi, NC, NE, WAE/ grasslands, shrublands, open woodlands, forests and roadides but mostly in steppes, rocky steppes and continental sandy grasslands of Festuco-Brometea.

*Trifolium othonis* Boiss.: P/Hscap/ hell/ 2050–2350 m/ Pe, StE/ grasslands. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium pallidum* Waldst. & Kit.: A-B/ T(H)scap/ med-smed/ s.l.–900 m/ KK, Pe, StE, EC, NC, NE, WAE/ grasslands, shrublands, mainly phrygana, forests, roadides and rocky places.

*Trifolium pamphilicum* Boiss. & Heldr.: A/ Tscap/ omed/ s.l.–100 m/ KK/ grasslands and amongst scrubs. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

*Trifolium pannonicum* Jacq. subsp. pannonicum: P/Hcaesp/ osmed/ 1000–2000 m/ StE, NC/ open woodlands and wet places.

*Trifolium patulum* Tausch: P/Hcaesp/ balc (Ai-Ju-It) 450–1500 m/ Pe, StE, SPi, NPi, NC, NE, WAE/ shrublands and forests.

*Trifolium phleoides* Willd.: A/ Tscap/ smed/ 200–1600 m/ StE, SPi, NC, NE/ fields, grasslands, open woodlands and rivulets.

*Trifolium pignatii* Fauché & Chaub.: P/Grhiz/ balc (Ai-Ju-Bu) 50–2300 m/ Pe, StE, SPi, NPi, EC, NC, NE, WAE/ grasslands and mostly forests.

*Trifolium pratense* L.: P/Hscap/ eurasubozone(-smed)/ s.l.–2500 m/ Pe, StE, SPi, EC, NC, NE, Iol, NAe, WAE/ almost everywhere but mostly in nutrient-rich and wet grasslands.

*Trifolium pseudomedium* Hausskn.: P/Grhiz/ balc (Ju-Bu) 100–1800 m/ StE, SPi, NPi, EC, NC, NE/ grasslands, shrublands, open woodlands and mostly forests.

*Trifolium purpureum* Loisel.: A/ Tscap/ omed/ s.l.–500 m/ Pe, StE, EC, NC, NE, WAe, EAe, Kik/ fields, grasslands, urban areas, roadides and limestones slopes.

*Trifolium scabrum* L.: A/Trept-scap/ med-smed (-subatl)/ s.l.–1600 m/ KK, Pe, StE, EC, NC, NE, WAE, EAe, Kik/ fields, grasslands, shrublands (mainly phrygana and maquis), coasts, urban areas, roadides, rocky, calcareous, sandy places but mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses and in grasslands and related short-lived, herb-rich plant communities of sandy and skeletal, predominantly nutrient-poor and drought-stressed soils.

*Trifolium scutatum* Boiss.: A/Tscap/ omed/ s.l.–500 m/ EAe/ grasslands and shrublands.

*Trifolium squamosum* L.: A/Tscap/ ge-mabkont-smed/ s.l.–1000 m/ KK, IoI, Pe, EC, NC, NE, WAE, EAe, Kik/ fields, grasslands, shrublands (mainly phrygana), forests, roadides and rocky places.

*Trifolium squarrosum* L.: A/Tscap/ smed/ s.l.–600 m/ NE, IoI/ fields, grasslands and urban areas.

*Trifolium stellatum* L.: A/ Tscap/ med-smed/ s.l.–1500 m/ KK, Pe, StE, EC, NC, NE, Iol, WAE, EAe, Kik/ fields, grasslands, shrublands, open woodlands, urban areas, roadides and rocky places but mostly in terrestrial plant communities dominated by annual low-growing herbs and grasses.

*Trifolium striatum* L.: A(A)/ T(H)scap/ subatl-smed/ 400–1600 m/ Pe, StE, SPi, NC, NE/ grasslands, shrublands, forests, roadides and disturbed places but mostly in annual,
herb-rich ruderal communities of Stellarietea mediae.

**Trifolium sylvaticum** GÉRARD: A/ Tscap/ med/ 200–1600 m/ KK, StE, NE, EAe/ hillsides and montane valleys.

**Trifolium tenuifolium** TEN.: A/ Tscap/ balc (Al-Ju-Bu-Tu)-It-An/ s.l.–1100 m/ KK, Pe, StE, EC, NC, NE, WAe, Kik/ grasslands, shrublands, forests, dry, rocky places, valleys and hillsides. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

**Trifolium trichopterum** PANČIĆ: A/ Tscap/ balc (Al-Ju-Bu-Tu)/ 1100–1400 m/ StE, NC, NE/ forests, dry and stony hillsides.

**Trifolium xanthinum** FREYN: A/ Tscap/ hell-an/ 1000–1500 m/ Pe, StE/ ?. – Even though ELLISON et al. (2006) did not include the species in the section *Trifolium*, according to ZOHARY & HELLER (1984) the species belongs to section *Trifolium*.

**Section Vesicastrum**

**Trifolium argutum** BANKS & SOL.: A/ Tscap/ omed/ 200–500 m/ EAe, Kik/ fields, shrublands and roadsides.

**Trifolium balansae** BOISS.: A/ Tscap/ balc(Ju-Bu-Tu)-An/ ?/ StE, EAe, Kik/ fields.

**Trifolium michelianum** SAVI: A/ Tscap/ wmed/ s.l.–1800 m/ KK, Pe, StE, EC, NC, NE, WAe, NAe, EAe, Kik/ grasslands, shrublands, forests, dry and stony hillsides. – According to LASSEN (GREUTER & RAUS 1999), the occurrence of species in Crete (KK) needs confirmation.

**Trifolium mutabile** PORT.: A/ Tscap/ med/ s.l.–600 m/ Pe, StE, NE/ field and grasslands.

**Trifolium ornithopodioides** L.: A/ Tscap/ smed-smed(-sub)/ s.l.–600 m/ KK/ slopes.

**Trifolium setiferum** BOISS.: A/ Tscap/ balc (Al-Ju-Bu-Tu)-It-An/ 100–600 m/ NE/ amongst scrubs.

**Trifolium spumosum** L.: A/ Tscap/ med/ s.l.–1000 m/ KK, Pe, StE, NE, WAe, EAe, Kik/ fields, grasslands, roadsides and damp places.

**Trifolium vesiculosum** SAVI: A/ Tscap/ med/ s.l.–700 m/ KK, Pe, StE, SPi, EC, NE, IoI/ grasslands, shrublands and open woodlands.

**Trifolium clusii** GORDON & GREN.: A/ Tscap/ med/ ?/ EAe, Kik/ mostly in annual, herb-rich ruderal communities.

**Trifolium fragiferum** L.: P/ Hrept/ med-smed(-gemabkont)/ s.l.–2200 m/ KK, Pe, StE, EC, SPi, NPi, NC, NE, IoI, WAe, NAe, EAe, Kik/ grasslands, open woodlands, urban areas, damp open and sandy places.

**Trifolium hybridum** L.: P/ Hcaesp/ gemabkont(-osmed)/ s.l.–2400 m/ KK, Pe, StE, SPi, NPi, EC, NC, NE/ road sides, grasslands, open woodlands, urban areas, roadsides and wet places but mostly in nutrient-rich grasslands. Three subspecies recognized in Greece: a. the balkan endemic subs. *anatolicum* (BOISS.) HOSSAIN, b. the Mediterranean subs. *elegans* (SAVI) ASCH. & GRAEBN., and c. the Mediterranean subs. *hybridum* – GREUTER et al. (1989) do not mention the existence of the subspecies in the Mediterranean region, even though, according to ZOHARY & HELLER (1984), the subspecies is native only in the Mediterranean countries. Additionally, STRID (1986) found in SPi and NPi a hybrid of subs. *anatolicum* x subs. *elegans*.

**Trifolium physodes** M.BIEB.: P/ Hscap/ omed/ s.l.–2100 m/ KK, Pe, StE, SPi, NPi, EC, NC, NE, IoI, WAe, NAe, EAe, Kik/ grasslands, shrublands, open woodlands, forests, coasts and wet meadows but mostly in annual, herb-rich ruderal plant communities.

**Trifolium resupinatum** L.: A(B)/ T(H)rept/ med-smed/ s.l.–1500 m/ KK, Pe, StE, SPi, EC, NC, NE, IoI, WAe, EAe, Kik/ fields, grasslands, open woodlands, roadsides, wet and disturbed places but mostly in nutrient-rich and wet grasslands.

**Trifolium tomentosum** L.: A/ Trept/ smed/ s.l.–1300 (2200) m/ KK, Pe, StE, EC, NE, IoI, WAe, EAe, Kik/ fields, grasslands, shrublands, urban areas and roadsides but mostly in annual, herb-rich ruderal plant communities.

**Trifolium bullatum** BOISS. & HAUSSKN.: A/ Tscap/ omed/ s.l.– 200 m/ EAe/ in a small rocky island.