Pak. J. Bot., 40(4): 1497-1520, 2008.

AN OVERVIEW OF THE GEOBOTANICAL STRUCTURE OF TURKISH *PINUS SYLVESTRIS* AND *CARPINUS BETULUS* FORESTS

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Abstract

Pinus L. and *Carpinus* L. are the two widely distributed genera of higher plants being represented by 80 and 170 species respectively. The former has 5 species in Turkey and latter 2 species namely; *P.pinea, P.halepensis, P.brutia, P.sylvestris, P.nigra* ssp.*pallasiana, Carpinus betulus* and *C.orientalis*. In this paper an attempt has been made to present an overview of the geobotanical structure of *Pinus sylvestris* L. and *Carpinus betulus* L. in Turkey. Out of 20.2 million hectares of forests in Turkey yellow pine covers nearly 1.3 million ha and hornbeam species around 10 thousand ha. The forests of *P. sylvestris* are found in North, Northeast Anatolia, on Murat mountains around Kutahya and *C. betulus* mainly in Thrace, Marmara, Black Sea and Inner Anatolia. *P.sylvestris* is represented by 9 associations;*Pinus sylvestris-Vaccinum myrtillus*,*Pinus sylvestris - Daphne glomerata*, *Pinus sylvestis - Astragalus adzharicus, Pinus sylvestris-Lilium ciliatum, Pinus sylvestris-Daphne pontica, Pinus sylvestris-Populus tremula, Populo-Pinetum sylvestris, Pinus sylvestris-Orthilio secundo, Pinus sylvestris* f.*lazica-Epimedium pinnatum* subsp.*colchicum, Triseto-Pinetum sylvestris*, whereas *C.betulus* has only 6 associations *Carpinus betulus-Scaligeria tripartita, Carpinus betulus-Acer campestre, Quercus petraea* ssp. *iberica-Carpinus betulus, Carpinus betulus-Quercus petrae* ssp. *iberica, Fagus orientalis-Carpinus betulus*. *P.sylvestris* associations are floristically rich having 275 taxa as compared to *C.betulus* forests which embody only 121 taxa. The life form spectrum of *P.sylvestris* forests includes 146 chamaephytes, 44 hemicryptophytes, 40 phanerophytes, 28 cryptophytes and 17 therophytes, whereas *C.betulus* forests include 23 phanerophytes, 39 chamephytes, 36 hemicryptophytes,14 cryptophytes and 8 therophytes. Phytogeographically a major part of the taxa in *P.sylvestris* forests are Euro-Siberian elements (24.4 %) followed by the Irano-Turanian (6.4 %) and Mediterranean (1.4 %). In *C.betulus* forests the distribution is as follows; Euro-Siberian-Euxine elements (83 %) followed by Mediterranean (14 %) and Irano-Turanian (3%). These observations stress the fact that geobotanically these forests prefer mainly high altitude moist habitats in the north and northeastern parts of Turkey.

Introduction

Turkey is one of the oldest inhabited regions in the world and embodies a rich biodiversity and plant formations distributed on different landscapes. All through ages it has served as a centre for the production of timber and other forest products for the Mediterranean and near-east civilizations. According to Colak & Rotherham (2006) logs

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have been transported to construct big temples as well as ships for example, thousands of workers have been sent by King Solomon from Israel to the Taurus Mountains of southern Turkey, to cut 30 m tall trees for the construction of his temple in Jerusalem.In addition, after the destruction of *Cedrus libani* forests in Lebanon the timber needs in the eastern Mediterranean countries was provided from the Taurus Mountains (Senitza, 1989). The reports published by Louis (1939); Walter (1956) and Davis (1965-1988) mention that in 2000 BC the forest cover in Turkey was around 70 percent and steppes were spread over an area of 15 percent.Today we find that the area of steppe vegetation has gone upto 24 percent whereas forests have decreased to 25 percent. The reasons for this are strong biotic intrferences starting from the prehistoric times which however have gained an impetus over the last few centuries resulting in severe degradation at several places in the country significantly reducing the plant cover in particular forest vegetation (Malcolm, 1976; Mayer & Aksoy, 1986; Kehl, 1995; Parks *et al.,* 1995; Ozturk 1995, 1999; Turkmen e*t al.* 1996; Ozturk *et al*. 1996, 1997, 1998, 2004a b; Efe 2004, Ahmed *et al*., 2006; Perveen *et al.*, 2007, 2008). Inspite of over-grazing, over-cutting, fires, clearance for agriculture and all other anthropogenic impacts the plant cover in the country still shows a rich composition (Zohary, 1973).

More than 450 species of trees and shrubs are distributed naturally in the forests of Turkey (Colak & Rotherham, 2006). Although several exotics have been introduced in to degraded forest areas to overcome the timber shortage (Urgenc, 2004), present forest cover of Turkey has a global relevance in the light of global climate change. The country can serve as a reservoir for species transfer to othetr countries in the regionb. This has been fully stressed in the Helsinki Resolution (Ministerial Conference on the Protection of Forest in Europe, 1993 (Geburek, 1998). These forests need a priority under the Global Plan of Action (FAO, 1996; Schachl, 1998) in order to select and protect key gene-pool reserves.

This paper thus presents an overview of the *Pinus sylvestris* and *Carpinus betulus* forest in Turkey. There are 475219 ha of degraded and 262973 ha of well protected Scots Pine forests in Turkey.The biggest areas occur in Amasya (222430 ha) and Erzurum (155172 hektare) followed by Trabzon (76304 ha). Best Scots Pine forests occur especially around Kastamonu-Elekdagi, Bolu-Aladagi, Eskisehir-Catacık-Oltu-Gole, Sarikamis, Dumanlı and Köse mountains. Their altitudinal distribution area generally ranges between 1000-2500 m, but with the exceptions in Surmene and Of where the altitude falls down to 10 -15 m. In Sarıkamış they are found at 2700 m asl. The distribution generally begins from 1000 m. on the northern slopes and from1400-1500 m. on the southern slopes in Central Anatolia. Temperature and soil depth are the main factors limiting vertical and horizontal distribution of Scots Pine (Tosun, 1999; 2003; Tosun *et al*., 2003). The area of *Carpinus betulus* and *C.orientalis* forest lies around 545400 ha. These forests exist from the sea level upto 1300 m. C.betulus prefers North facing slopes or river beds and is distributed in Thrace, Marmara, Black Sea and Inner West Anatolian regions of Turkey (Gunal, 1997).

Materials and Methods

The study is based on the field work undertaken during the years covering 2002-2005. In addition to this following phytosociological studies; Akman (1974, 1976, 1995); Adiguzel & Vural (1995), Canakcioglu (1983), Davis (1982), Duzenli (1979), Ekim &

Akman (1990), Gezer *et al.* (2000, 2002), Gunal (1997), Kilinc & Karaer (1995), Ozen & Kilinc (1995), Quezel *et al*. (1980), Tatli (1987), Yurdakulol *et al*. (1998) and Zohary (1973) were evaluated. The nomenclature, taxonomy and chorology of the taxa was taken from Davis *et al*. (1965-1988) and Zohary (1973). The life forms were determined according to Raunkier (1934) and Ellenberg & Mueller-Dombois (1967). The vegetation analysis in this study and the studies evaluated, were performed according to traditional Braun-Blanquet approach (Braun-Blanquet, 1964). The cover abundance scale of Barkman *et al*. (1964) was used. The names and classifications of all earlier and here described syntaxa were checked and necessary corrections made in accordance with the "International Code of Phytosociological Nomenclature" (ICPN) (Quézel *et al*., 1992; Weber *et al*., 2000). The characteristic and differential species belonging to the associations were rearranged and re-defined in the situations that were thought to be necessary. For the exotic species nomenclature from Elicin (1980) and CABI (2005) was used.

Results and Discussion

Turkey has the richest number of flowering plants in Southwets Asia (Ozturk *et al*., 1995a, b), with avery high number of endemics (Ekim *et al*., 2000). Several endemics show transitional characteristics Due to its being a meeting place of Irano-Turanian, Mediterranean and Euro-Siberian phytogeographical regions. The country is at the same time one of the major centres of plant diversity.

Forest vegetation: The latest reports published by the Turkish Ministry of Environment and Forests (www.ogm.gov.tr) reveal that the area of forests in Turkey lies around 21million ha. Out of this more than 10 million ha are healthy and the rest is degraded type. A major part of the healthy forests (around 4 million ha) are distributed at high altitudes (1500-2500 m). The coniferous forests constitute more than 40 percent (Sag, 2002). The percentage distribution of different species according to Mayer & Aksoy (1986) is given in Fig.1.

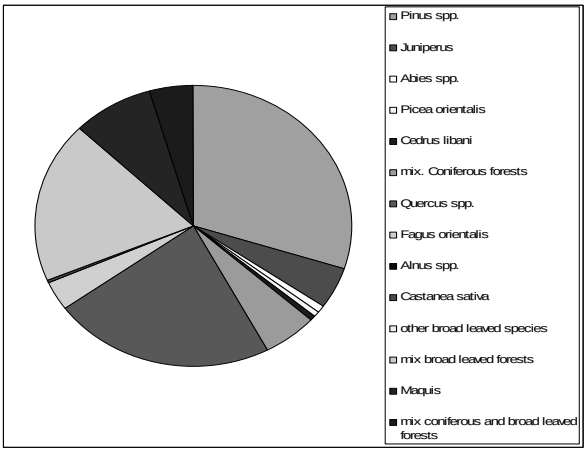

Fig. 1: The percentage distribution of major trees species and other formations in the forests of Turkey

The forests have been classified as near-natural, semi-natural and partly altered or as oligohemerobic, mesohemerobic and partly euhemerobic (Colak *et al*., 2003; Colak & Rotherham, 2006). According to Colak & Rotherham (2006) there are three main forest regions of Turkey. The first one is North Anatolian Euxin-Subeuxin Forest Region flourishing under cool winters, humid to sub-humid summers, hich includes mainly the North-west Euxin-Subeuxin, Middle Euxin-Subeuxin and East Euxin-Subeuxin forests. The second one is Steppe Forest Region mainly found in the areas with cold winters and dry summers. It includes the East Thrace Lowland Steppe, Central Anatolia Sub-Mediterranean Steppe between Lowland and Highland, East Anatolia Highland Steppe, Southeast Anatolia Mountain Steppe and Mesopotamia Steppe Forests. The third one is the South and East Anatolia Mediterranean / Sub-Mediterranean Forest Region distributed in the areas with very hot summers and mild winters, and includes South Anatolia Mediterranean, the Mediterranean West Aegean and Sub-Mediterranean East Aegean Forest Regions.The plant taxa mainly found in the Euxin-Subeuxin Forest Regions of North Anatolia are; *Abies bornmulleriana, A.nordmanniana, Acer trautvetteri, Alnus glutinosa* ssp. *barbata, Betula pendula, Buxus sempervirens, Carpinus betulus, Castanea sativa, Corylus avellana, Crataegus orientalis, Fagus orientalis, Fraxinus angustifolia* ssp. *oxycarpa, F.excelsior, Ilex colchica, Juglans regia, Juniperus comminus* ssp. *nana, J. communis* ssp. *communis, J. excelsa, J. foetidissima, J. oxycedrus, Laurocerasus officinalis, Laurus nobilis, Myrtus communis, Olea europaea, Ostrya carpinifolia, Phillyrea latifolia, Picea orientalis, Pinus brutia, P. nigra, P. pinea, P. sylvestris, Pistacia terebinthus, Platanus orientalis, Prunus spinosa, Pterocarya fraxinifolia, Punica granatum, Quercus cerris , Q.coccifera, Q. hartwissiana, Q. iberica, Q. macranthera* ssp. *syspirensis, Q. petraea* ssp. *iberica, Q. petraea* ssp. *petraea, Q. robur* ssp. *robur, Q. pubescens, Q. syspirensis, Rhododendron ponticum, Sophora jaubertii , Sorbus aucuparia , S. torminalis, Taxus baccata, Tilia platyphyllos, T. argentea, Ulmus glabra, U. minor,* and *Zelkova carpinifolia.* In the Steppe Forest Region we generally come across *Betula pendula, Juniperus excelsa, J. foetidissima, J. oxycedrus, Paliuris spina-christi, Pinus nigra, P. sylvestris, Populus tremula, Quercus branti, Q. cerris, Q. coccifera, Q. frainetto, Q. libani, Q petraea* ssp. *pinnatiloba, Q. pubescens, Q. robur* ssp. *pedunculiflora, Q. robur* ssp. *robur,* and *Q. vulcanica.* A perusal of the species list from the South and East Anatolia Mediterranean/Submediterranean Forest Regions shows that following species flourish in this region; *Abies cilicica, Acer hyrcanum, A. sempervirens, Alnus orientalis, Arbutus andrachne, Arceutos drupacea, Carpinus betulus, C. orientalis, Castanea sativa, Cedrus libani, Celtis australis, Cercis siliquastrum, Ceratonia siliqua, Cupressus sempervirens, Fraxinus ornus, Juniperus excelsa, J. foetidissima, J. oxycedrus* ssp. *oxycedrus, J. phoenicea, J. Sabina, Laurus nobilis, Liquidambar orientalis, Olea europaea, Ostrya carpinifolia, Phillyrea latifolia, Pinus brutia, P. halepensis, P. nigra, P. pinea, Pistacia terebinthus* ssp. *palaestina, Platanus orientalis, Populus tremula,Prunus divaricata, Quercus aucheri, Q. calliprinos,Q. cerris,Q. coccifera,Q. frainetto,Q. ilex, Q. ithaburensis* ssp. *macrolepis,Q. infectoria ssp infectoria,Q. pubescens,Q. trojana,Sorbus umbellata,Styrax officinalis*, and *Tamarix smyrnensis* (Colak & Rotherham, 2006).

The Scots pine (*Pinus sylvestris* L.; family Pinaceae) is a species of pine native to Europe and Asia, ranging from Great Britain and Spain to eastern Siberia, to the Caucasus Mountains in the south, and spreads as far north as Lapland. It is one of the valuable basic tree species of Turkey represented by various forms, subspecies and

varieties (Tosun, 1999). Despite its origin from Asia and Europe, the best forests occur around Eskisehir (Catacik) in Turkey (Yucel, 1995). Its synonyms are *P. frieseana* Wich., *P. lapponica* (Fr. ex Hartm.) Mayr, *P. sylvestris* L. ssp. *lapponica* (Fr. ex Hartm.) Sylvén (var. *lapponica*); *P. sylvestris* L. ssp. *septentrionalis* (Schott) Sylvén, *P. sylvestris* L. var. *borussica* Ant. Schott, *P. sylvestris* L. var. *rigensis P. sylvestris* L. var. *septentrionalis* Schott (var. *sylvestris*), *Pinus rubra* (Mill.), *P. nigra* f. *pygmaea*[G] *P. silvestris*[E,H] P. *sylvestris* var. *mongolica*[G], *Pinus densiflora* f. *sylvestriformis* taken. (basionym), *Pinus rubra* Mill., non Michx., *Pinus mughus* Jacq., non Mill., *Pinus montana* Hoffm., non Mill., *Pinus resinosa* Savi , non Aiton, *Pinus tartarica* Mill., *Pinus fominii* Kondratjuk. Scots Pine could reach to 30-40 m with slender cylindirical stems and sharp pointed top. Young stems and the uppermost branches of old trees are fox yellow in colour. Buds are grey-brown, 6-12 mm, ovate-conical in shape, generally not resinous but in very dry areas covered with resin. Twisted needle like leaves are blue-green in colour, with spiny tips and toothed margins. Cones are stalked, hanging like anchors, 2.5-7 cm, and non symmetrical at the base. These forests prefer light, sandy loose soils. City centres and polluted areas are not suitable for growing Scots Pine (Yucel, 1995).

Fig. 2a: The distribution of *Pinus sylvestris* associations in Turkey

Fig. 2b: The distribution of *Carpinus betulus* associations in Turkey

Güner, Ş.T., " Türkmen Dağı Sarıçam (*Pinus sylvestris* ssp. *hamata*) Ormanlarının yükseltiye Bağlı Büyüme Beslenme İlişkilerinin Belirlenmesi". Anadolu Üniversitesi, Fen Bilimleri Enstitüsü, 12/07/2006. *Pinus sylvestris* is represented by the following associations in Turkey: (Fig. 2a)

1. Pinus sylvestris - Vaccinum myrtillus (Quezel, Barbero, Akman, 1980): Grows in Giresun area and around Trabzon from 1700-2100 m altiudes on siliceous bedrock.

2. Pinus sylvestris - Daphne glomerata (Quezel, Barbero, Akman, 1980: Locaized on the northern slopes of Karadeniz region from 1700-2100 m and associate with *Picea orientalis.*

3. Pinus sylvestis - Astragalus adzharicus (Düzenli, 1979): This association had been studied by Duzenli around Melo vicinity on Tiryal mountain. Its distribution is around 120 m in Borcka and 800 m in Goktas. Scots pine grows on bedrock composed of dasit and tuff.Soil is acidic and loamy.

4. Pinus sylvestris - Lilium ciliatum (Quezel, Barbero, Akman, 1980): Grows on the southern slopes of high mountain mass from 1500-1700 m, around Zigana region Hydromorphic conditions in the soils are seen seldom.

5. Pinus sylvestris - Daphne pontica (Akman, Demirors, 1984): This association grows on hard metamorphic and calcerous rocks around Karabuk and on deep forest soils with humus between 700-1500 m around Keltepe-Buyukduz, Kumluca-Dibektas and Citdere-Karabuk.

6. *Pinus sylvestris -Populus tremula* (Adıgüzel, Vural, 1994) (Populo - Pinetum sylvestris): Populo- Pinetum sylvestris association grows between 1400-2000 m on shallow, dull pink or brown sandy-loam, acidic and rich in organic matter (18-42 %),soils on andezit bedrocks.The association forms pure or mixed forests with *Abies nordmanniana* subsp. *bornmuellariana* around Tolubelen, Incegelis and Cakmakli regions.

7. Pinus sylvestris-Orthilio secundo (Akman; 1974, 1976; Akman, Barbero, Quezel, 1978): This association is especially found in Karasar, Egriova, Benli (Beypazarı) regions and Gerede-Aktas, Isık mountains (Akman, 1974-1976) over 1600 m, on the southweast and north of Sakarya from 1300-1650 m on dazit, andezit, volcanic tuf bedrock.

8. Pinus sylvestris-f.lazica-Epimedium pinnatum subsp.colchicum (Quezel, Barbero, Akman, 1980): This association forms *Pinus sylvestris* f.*lazica* forests in Of. It grows over 1500-1600 m or on the southern slopes of Blacksea region mountain parts.

9. Triseto-Pinetum sylvestris (Tatlı, 1986): This association was discovered on the Allahuekber mountains which is found in Sarıkamıs- Selim-Kars-Gole-Aksar and Senkaya (Tatlı, 1986). This altitude lies between 2305-3120 m.

Table 1a: The species composition of Scots Pine associations.

Forest layer ***Plant***	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Abies nordmanniana (Mattf.) Coode& Cullen subsp. *bornmuellariana* (Stev.) Spach	*Pinaceae*	Euxine	+	Ph
Acer campestre L.subsp.leiocarpum (Opia)Pax	*Aceraceae*			Ph
Acer cappadosicum Gleditsch var. *Cappadosicum*	*Aceraceae*	Hyrcano-Euxine		Ph
Berberis integerrima Bunge	*Berberidaceae*			Ph
Carpinus betulus L.	*Corylaceae*	Euro.-Sib.		Ph
Carpinus orientalis Miller subsp. *Orientalis*	*Corylaceae*			Ph
Cerasus mahaleb (L.)Mill.var.mahaleb	*Rosaceae*	Euxine	+	Ph
Cerasus microcarpa (C.A.Mey)Boiss.	*Rosaceae*			Ph
Cistus creticus L.	*Cistaceae*	Medit.		Ph
Cistus laurifolius L.	*Cistaceae*			Ph
Crataegus curvisephala Lindman	*Rosaceae*			Ph
Crataegus microphylla C.Koch	*Rosaceae*	Hyrcano-Euxine		Ph
Crataegus monogyna Jacq.	*Rosaceae*			Ph
Crataegus tanecetifolia (Lam.)Pers.	*Rosaceae*			Ph
Daphne glomerata Lam.	*Thymelaeaceae*	Euxine		Ph
Daphne pontica L.	*Thymelaeaceae*	Euxine		Ph
Ilex colchica Poj.	*Aquifoliaceae*	Euxine		Ph
Juniperus communis L. subsp. *nana* Syme	*Cupressaceae*			Ph
Juniperus oxycedrus L. subsp. *oxycedrus*	*Cupressaceae*			Ph
Lonicera caucasica Pallas subsp. *Caucasica*	*Caprifoliaceae*			Ph
Lonicera caucasica Pallas subsp. *orientalis* (Lam.)Cham.& Long.	*Caprifoliaceae*		+	Ph
Melapyrum arvense L. subsp. *arvense*	*Scrophulariaceae*	Euro-Sib		Ph
Pinus nigra Arn. ssp. *pallasiana* (Lamb.)Holmboe	*Pinaceae*			Ph
Pinus sylvestris L.	*Pinaceae*	Euro.-Sib.		Ph
Picea orientalis (L.)Link	*Pinaceae*			Ph
Populus tremula L	*Salicaceae*	Euro.-Sib.		Ph
Populus tremula L.	*Salicaceae*	Euro-Sib.		Ph
Primula vulgaris Huds. subsp. *vulgaris*	*Primulaceae*	Euro-Sib.		Ph
Quercus cerris L.	*Fagaceae*			Ph
Quercus macranthera Fisch.& Mey.ex Hohen ssp. *syspirensis* (C.Koch) Menitsky.	*Fagaceae*		+	Ph
Quercus petraea (Mattuschka)Liebl. subsp. *iberica* (Steven ex Bieb.)Krassiln	*Fagaceae*			Ph
Quercus pubescens Wild.	*Fagaceae*			Ph
Rhododendron luteum Sweet	*Ericaceae*	Euxine		Ph
Rhododendron ponticum L. subsp. *Ponticum*	*Ericaceae*	Euxine		Ph
Rosa canina L.	*Rosaceae*			Ph
Rosa foetida J.Herrm.	*Rosaceae*	İr.-Tur.		Ph
Rubus canescens DC. subsp. *glabratus* (Gordon) Davis & Meikle	*Rosaceae*			Ph
Salix caprea L.	*Salicacea*			Ph
Salix cinerea L.	*Salicacea*			Ph
Vaccinium myrtillus L.	*Ericaceae*	Euro-Sib.		Ph
Viburnum lantana L.	*Caprifoliaceae*	Euro-Sib.		Ph

Table 1a continued

Shrub layer

Plant	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Allaria petiolata(Bieb.) Cavara & Granda	Brassicaceae			Ch
Alyssum condensatum Boiss.et Hausskn.subsp. *flexibrile* (Nyar.)Dudley.	Brassicaceae			Ch
Anchusa arvensis (L.) Bieb.subsp. orientalis(L.)Nordh.	Boraginaceae			Ch
Anchusa leptophylla Roemer et Schultes subsp.*incana* (Ledep.) Chamb.	Boraginaceae	İr.-Tur.	+	Ch
Anemone blanda (Scott & Kotschy.) Hayek	Ranunculaceae			Ch
Anthemis melanoloma Trautu	Asteraceae			Ch
Anthriscus nemorosa (Bieb.) Sperengel	Apiaceae			Ch
Anthyllis vulneria L. subsp. boisieri (Seg.)Bornm.	Fabaceae			Ch
Aquilegia olympica Boiss.	Ranunculaceae			Ch
Arabis causica Willd.subsp.causica	Brassicaceae			Ch
Arabis nova Vill.	Brassicaceae			Ch
Arabis sagittata (Bert.)DC.	Brassicaceae			Ch
Arenaria serpillifolia L.	Caryophyllaceae			Ch
Argyrolobium biebersteinii Ball.	Fabaceae			Ch
Asperula cymulosa (Post) Post.	Rubiaceae	E.Medit	+	Ch
Asperula involucrata Wahlenb.	Rubiaceae	Euxine		Ch
Astragalus adzharicus Popov.	Fabaceae			Ch
Astragalus brachypetalus Fischer	Fabaceae	İr.-Tur.		Ch
Astragalus cadmicus Boiss.	Fabaceae		+	Ch
Astragalus campylosema Boiss. subsp. *Campylosema*	Fabaceae	İr.-Tur.	+	Ch
Astragalus fragans Willd.	Fabaceae	İr.-Tur.		Ch
Astragalus glycyphyllos L. subsp. *glycyphylloides* (DC.) Matthews	Fabaceae	Euro-Sib.		Ch
Astragalus karputans Boiss. et Noe	Fabaceae	İr.-Tur.	+	Ch
Astragalus lineatus Lam.var. *lineatus*	Fabaceae			Ch
Astragalus macroscepus Boiss.	Fabaceae	İr.-Tur.	+	Ch
Astragalus melanophrurius Boiss.	Fabaceae	İr.-Tur.	+	Ch
Astragalus odoratus Lam.	Fabaceae			Ch
Astragalus pinetorum Boiss., End.	Fabaceae	İr.-Tur.	+	Ch
Astragalus podperae Sirj., End.	Fabaceae	İr.-Tur.		Ch
Astragalus ponticus Pall.	Fabaceae			Ch
Astragalus pycnocephalus Fischer var.*pycnocephalus*	Fabaceae	İr.-Tur.		Ch
Astragalus spruneri Boiss.	Fabaceae			Ch
Astragalus squalidus Boiss.& Noe	Fabaceae		+	Ch
Astrantia maxima Pallas subsp. *maxima*	Apiaceae	Euxine		Ch
Asyneuma amplexicaula (Willd.)Hand-Mazz.subsp. *amplexicaula* var. *amplexicaula*	Campanulaceae			Ch
Asyneuma rigidum (Willd.)Grossh. subsp. Rigidum	Campanulaceae	İr.-Tur.		Ch

Table 1a continued

Bungea trifida (Vahl.) C.A.Mey	Scrophulariaceae		Ch
Bunium microcarpum (Boiss.)Freyn.subsp.*bourgaei* (Boiss.) Hedge et Lamond	Apiaceae		Ch
Calamintha grandiflora (L.)Moench .	Lamiaceae	Euro-Sib.	Ch
Calamintha graveolens L.	Lamiaceae		Ch
Campanula involucrata Aucher et DC.	Campanulaceae		Ch
Campanula rapunculoides L.subsp. *rapunculoides*	Campanulaceae		Ch
Campanula stevenii Bieb.subsp. *stevenii*	Campanulaceae	Hyrcano	Ch
Cardamine bulbifera (L.) Crantz	Brassicaceae	Euro-Sib.	Ch
Carex ornithopoda Willd.	Cyperaceae		Ch
Catabrosa aquatica (L.) P. Beauv.	Poaceae		Ch
Cephalanthera damasonium (Mill.)Druce.	Orchidaceae		Ch
Cephalanthera rubra (L.) L.C.M.Richard	Orchidaceae		Ch
Cephalaria sparsipilosa Matthews.	Dipsacaceae		Ch
Cerastium fragillimum Boiss.	Caryophyllaceae		Ch
Cicerbita racemosa (Willd.)Beauverd.	Asteraceae	Euxine	Ch
Clinopodium vulgare L.subsp. *arundanum* (Boiss.) Nyman	Lamiaceae		Ch
Clinopodium vulgare L.subsp. *vulgare*	Lamiaceae		Ch
Coronilla varia L. subsp. *Varia*	Fabaceae		Ch
Deschampsia flexuosa (L.) Trin.	Poaceae		Ch
Digitalis ferruginea L.subsp. *schischkinii* (Ivan.)Werner	Scrophulariaceae		Ch
Dorycnium graecum (L.) Ser.	Asteraceae		Ch
Dorycnium orientale Hoffm.	Asteraceae		Ch
Ebenus laguroides Boiss.var. *laguroides*	Fabaceae		Ch
Elymus caninus (L.) L.	Fabaceae	Euro-Sib.	Ch
Epimedium pinnatum Fischer	Berberidaceae		Ch
Erigeron acer L. subsp. *pycnotrichus* (Vier.)Frier	Asteraceae		Ch
Euonymus latifolius (L.)Miller subsp. *latifolius*	Celastraceae	Euro-Sib.	Ch
Euphrasia pectinata Ten.	Scrophulariaceae		Ch
Galega officinalis L.	Fabaceae		Ch
Gentiana asclepiadea L.	Gentianaceae		Ch
Geranium asphodeloides Burn.fil. subsp. *sintenisii* (Freyn) Davis	Geraniaceae		Ch
Geranium purpureum Vill.	Geraniaceae		Ch
Geum coccineum Sm.	Rosaceae		Ch
Helianthemum nummularium (L.)Mill.subsp. *nummularium*	Cistaceae		Ch
Helichrysum armenium DC. subsp. *araxinum* (Kirp.)Takht.	Asteraceae	İr.-Tur.	Ch
Inula montbretiana DC.subsp. *elongatum*	Asteraceae	İr.-Tur.	Ch
Inula oculus-christi L.	Asteraceae	Euro.-Sib.	Ch
Lamium album L.	Lamiaceae	Euro-Sib.	Ch

Table 1a continued

Lapsana comminus L. subsp. *intermedia* (Bieb.) Hayek	Asteraceae			Ch
Lapsana comminus L. subsp. *grandiflora* (Bieb.)Sell.	Asteraceae			Ch
Laser trilobum (L.)Borkh.	Apiaceae			Ch
Laserpitium hispidum Bieb.	Apiaceae	Euro.-Sib.		Ch
Lathyrus aureus (Stev.) Brandza	Fabaceae	Euxine		Ch
Lathyrus czeczottianus Bassler	Fabaceae		+	Ch
Lathyrus laxiflorus (Desf.) O.Kuntze	Fabaceae			Ch
Lathyrus roseus Stev.	Fabaceae	Euxine		Ch
Lathyrus tukhtensis Czecz.	Fabaceae		+	Ch
Lilium ciliatum P.H.Davis	Liliaceae	Euxine	+	Ch
Linaria corifolia Dest.	Scrophulariaceae	İr.-Tur.	+	Ch
Linaria genistifolia (L.)Mill.subsp.linifolia (Boiss.)Davis	Scrophulariaceae			Ch
Linum aroanium Boiss. & Orph.	Linaceae			Ch
Linum hypericifolium Salisb.	Linaceae			Ch
Luzula campestris (L.) DC.	Juncaceae	Euro-Sib.		Ch
Luzula forsteri (Sm.) DC.	Juncaceae	Euro-Sib.		Ch
Luzula multiflora (Ehrh.ex Retz.)Lej.	Juncaceae			Ch
Minuartia anatolica (Boiss.)Woran.subsp. *arachnoidea* Mc.Neil	Caryophyllaceae	İr.-Tur.	+	Ch
Minuartia hirsuta (Bieb.)Hand-Mazz. subsp. *falcata* (Gris.)Mattf.	Caryophyllaceae			Ch
Moehringia trinerva (L.)Clairv.	Caryophyllaceae			Ch
Monoses uniflora (L.) A.Gray	Pyrolaceae			Ch
Monotropa hypopithys L.	Monotropaceae			Ch
Myosotis lithospermifolia (Willd.)Hornem.	Boraginaceae			Ch
Myosotis sylvatica Ehrh. Ex Hoffm.subsp. *cyanea* Vestergen	Boraginaceae			Ch
Nepeta nuda L.subsp. *albiflora* (Boiss.)Gams	Lamiaceae			Ch
Nonea stenosolen Boiss.et Ball.	Boraginaceae			Ch
Ononis adenotricha Boiss.var. *adenotricha*	Fabaceae			Ch
Onosma aucheranum DC.	Boraginaceae			Ch
Onosma isauricum Boiss.et Heldr.	Boraginaceae			Ch
Petrorhagia alpina (Habl.) Ball & Heywood	Caryophyllaceae			Ch
Phleum montanatum C.Koch	Poaceae			Ch
Platanthera chlorantha Cust.ex.Rechb.	Orchidaceae			Ch
Prenanthes cacaliifolia (Bieb.) Beauverd	Asteraceae			Ch
Primula veris L. subsp. *macrocalyx* (Bunge) Ludi.	Primulaceae	Euro-Sib.		Ch
Primula vulgaris Huds.subsp.*vulgaris*	Primulaceae	Euro-Sib.		Ch
Pyracantha coccinea Roemer	Rosaceae			Ch
Pyrola chlorantha Swartz	Pyrolaceae			Ch
Ranunculus dissectus Bieb.subsp. *napellifolius* (DC.)Davis	Ranunculaceae			Ch
Rubus ideaus L.	Rosaceae			Ch

Table 1a continued

Ruscus hypoglossum L.	Liliaceae			Ch
Salvia forskahlei L.	Lamiaceae	Euxine		Ch
Salvia glutinosa L.	Lamiaceae			Ch
Sambucus ebulus L.	Caprifoliaceae			Ch
Sanicula europaea L.	Apiaceae	Euro-Sib.		Ch
Satureja hortensis L.	Lamiaceae			Ch
Saxifraga rotundifolia L.	Saxifragaceae	Euro-Sib.		Ch
Scilla bifolia L.	Liliaceae	Medit		Ch
Scorzonera mollis Bieb. subsp. *szowitsii* (DC.)Chamb.	Asteraceae			Ch
Senecio taraxacifolia (Bieb.)DC.	Asteraceae	İr.-Tur.		Ch
Seseli andronakii Woron	Apiaceae			Ch
Silene italica (L.)Pers.	Caryophyllaceae			Ch
Silene sclerophylla Chowdh.	Caryophyllaceae	İr.-Tur.	+	Ch
Smilax excelsa L.	Liliaceae	Euxine		Ch
Sorbus torminalis (L.) Crantz. var. *torminalis*	Rosaceae	Euro-Sib.		Ch
Sorbus umbellata (Desf.) Fritsch var. *Umbellata*	Rosaceae			Ch
Stachys lavandulaefolia Vahl.	Lamiaceae			Ch
Stachys macrantha (C.Koch) Stearn	Lamiaceae	Euxine		Ch
Symphytum orientale L.	Boraginaceae	Euro-Sib.		Ch
Tanacetum parthenium (L.) Schultz Bip.	Asteraceae			Ch
Tanacetum poteriifolium (Ledeb.) Grierson	Asteraceae	Euxine		Ch
Teucrium chamaedrys L.subsp. *syspirense* (C.Koch) Rech.fil	Lamiaceae			Ch
Tripleurospermum monticolum (Boiss.& Huet)Bornm.	Asteraceae			Ch
Trisetum flavescens (L.)P.Beauv	Poaceae	Euro-Sib.		Ch
Turritis laxa (Sibth. & Sm.)Hayek	Brassicaceae			Ch
Uechritzia armena Freyn & Sint.	Asteraceae			Ch
Valeriana alliariifolia Adams	Valerianaceae			Ch
Veronica chamaedrys L.	Scrophulariaceae	Euro-Sib.		Ch
Veronica officinalis L.	Scrophulariaceae	Euro-Sib.		Ch
Veronica peduncularis Bieb.	Scrophulariaceae			Ch
Vicia balansae Boiss.	Fabaceae	Euxine		Ch
Viola odorata L.	Violaceae			Ch
Viola sieheana Becker	Violaceae			Ch
Ziziphora tenuior L.	Lamiaceae			Ch

The name *Carpinus betulus* has been first given by Linnaeus (1753) (Davis, 1982). Some authors have included it in Coryllaceae, others in Betulaceae or Fagaceae. *Carpinus betulus* locally known as “Adi Gurgen” reaches a height of 20-25 m with grooves on the trunk.The tree has smooth, thin, light grey bark. Young shoots are brown, bright, sometimes hairy; buds reddish-brown, without hairs or with sparse hairs. Leaves are 3-10 cm long, light green when young, silky, soft, egg shaped, basal part is rounded, apex is acute, margins are bidentate, lower surface has projections, in older leaves bunch

of hairs at the vein intersections. Flowers open at the same time with the appearance of young leaves, these are 6-15 cm long, drooping down. Fruits mature in autumn, 5-10 cm long, adpressed egg shaped, upper side projecting, with lobulte cover (Canakcioglu, 1983; Yaltirik, 1994). The synonyms of Carpinus are *Carpinus betulus* f. *pendula* (H. Massé) G. Kirchn. and *Carpinus caucasica*. *Carpinus betulus* cv. 'Purpurea', *Carpinus betulus* cv. 'Qercifolia', *Carpinus betulus* cv. 'Fastigiata', *Carpinus betulus* cv. 'Pendula', *Carpinus betulus* cv. 'Variegata' are the cultivars of *Carpinus betulus* which are grown in parks and gardens (Yaltirik, 1988).

Carpinus betulus forests are usually distributed on moist habitats mainly in the Black Sea region of Turkey, with a restricted distribution on Amanos mountains in the south. Most healthy groves are found in Thrace region around Demirkoy. Generally forms mixed forests with beech, chestnut, alder and oaks.The tree lives for 150 years, having a widespread crown and is useful in soil reclamation. The leaves contain tanen, resin and several minerals. They are used for blood flow, as astringent, powder is used as infusion and medicinal wine, water from boiled leaves is used as eye lotion. These forests prefer mild temperatures and medium light and moist habitats. The trees are resistant to the frost (Canakcioglu, 1983). They generally prefer north facing slopes with climatic conditions affected by Marmara and Black Sea. The soils supporting these forests together with other leafy trees are slightly acidic, rich in organic matter, loamy textured brown forest and podsolic, which develop on noncalcareous brown forest soils with good organic matter content. The rootseasily penetrate in wet, cold and sticky soils (Saatcioglu, 1976). The growth is prolific on soils rich in humus and calcareous. It continuously produces new shoots and height is very low in trees growing in unfavourable habitats. Original distribution area of Hornbeam is Middle, South and South East Europe, but also it grows in Crimean peninsula, Baltic countries, Caucasus Mountains, Anatolia and Elburz mountains in north Iran (Zohary, 1973, Yaltirik, 1982). Mountainous areas are the natural distribution regions of this species in Thrace, Marmara and Blacksea regions lying between between 1200-1300 m altitudes, generally occupying northern humid slopes and prefers moist river beds. Locally present in Marmara region on the northern slopes of Istranca and Ganos mountains, in the northern part of Kocaeli peninsula, mountainous regions effected by sea breese on the south parts of Marmara, on the coastal and northern humid parts of inland mountains of Blacksea region, at Murat mountain in Central west Anatolia and around Goller locality on Sultan mountains (Gunal, 1997).. Its common on the northern parts of Northwest Anatolia. Locally grows at humid places from the south of Marmara in the vicinity of Eskisehir, especially on the regions facing Blacksea at Mudurnu upto *Pinus nigra* distribution areas. Also grows in Kirklareli, Balıkesir, Istanbul, Bursa, Adapazarı, Ankara, Sinop, Samsun, Gumushane,Rize, Artvin, Kutahya, Konya (Davis, 1982). It is represented by the following associations in Turkey; (Fig. 2b)

1. *Carpinus betulus-Scaligeria tripartita* (Akman, Barbero, Quezel, 1978): Exists all around the northern parts of Northwest Anatolia, particularly on degraded soils in Eskisehir and areas around the Marmara Sea coast.In Mudurnu area it occurrs on marn-calcareous bedrock, on green rocks around Sundiken mountains in Eskisehir -Turkmen mountains,wet rocks of Mezit valley as well as on marn calcareous siols on Sundiken mountain.It also exists in the environs of Ankara Karagol on andesites.Cover percentage varies between 70-100 percent.

Table 1b: The species composition of Scots Pine associations.

Herb layer				
Plant	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Achillea biserrata Bieb.	Asteraceae	Euxine		H
Achillea millefolium L.ssp. *millefolium*	Asteraceae	Euro.-Sib.		H
Ajuga chamaephyta (L.)Schreb. subsp. *chia*(Schreb.) Arc.var.*ciliata*	Lamiaceae			H
Alyssum longistylum (Somm.& Lev.) Grossh.& Schisck.	Brassicaceae			Cr
Blechnum spicant (L.) Roth.	Blechnaceae			Cr
Carex sylvatica Hudson subsp. *latifrons* (V.Krecz.) Ö.Nilsson	Cyperaceae			Cr
Centaura aggregata Fisch.et Mey.ex.DC.subsp. *aggregata*	Asteraceae			H
Centaura hypoleucum DC.	Asteraceae			H
Centaurea mucronifera DC.	Asteraceae			Cr
Cirsium hypoleucum DC.	Asteraceae	Euxine		Cr
Corydalis solida (L.) Swartz subsp. *solida*	Fumariaceae			H
Crepis smymaea DC. Ex Froehlich	Asteraceae			H
Cyclamen coum Miller var. *coum*	Primulaceae			Cr
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	Poaceae			T
Dactylorhiza romanna (Seb.et Naur)Soo.	Orchidaceae			Cr
Dianthus calocephalus Boiss.	Caryophyllaceae			H
Dianthus micranthus Boiss.et Heldr.	Caryophyllaceae			H
Dryopteris borreri Newm.	Aspidiaceae			Cr
Dryopteris filix-mas (L.) Schott	Aspidiaceae			Cr
Epilobium montanum L.	Onagraceae			H
Euphorbia amygdaloides L. Var. *amygdalois*	Euphorbiaceae	Euro-Sib.		T
Euphorbia anacamposeras Boiss.	Euphorbiaceae			T
Euphorbia stricta L.	Euphorbiaceae	Euro-Sib		T
Ferulago setifolia C.Koch	Apiaceae			T
Festuca drymeja Mertens & Koch	Poaceae			T
Festuca gigantea (L.) Vill.	Poaceae	Euro-Sib.		T
Festuca heterophylla Lam.	Poaceae	Euro-Sib.		T
Fragaria vesca L.	Rosaceae			H
Galium aperina L.	Rubiaceae			H
Galium fissurense Ehrend.& Schönb.-Tem.	Rubiaceae	Euxine	+	H
Galium odoratum (L.) Scop.	Rubiaceae	Euro-Sib.		H
Galium peplidifolium Boiss.	Rubiaceae	E.Medit	+	H
Galium rotundifolium L.	Rubiaceae	Euro-Sib.		H
Galium spurium L.	Rubiaceae			H
Galium vurum L. Subsp. *glabroscens*	Rubiaceae			H
Genista albida Willd.	Fabaceae			Cr
Genista lydia Boiss.var. *lydia*	Fabaceae			Cr

Table 1b continued

Genista tinctoria L.	Fabaceae			Cr
Haplophyllum telephioides Boiss., End.	Rutaceae	İr.-Tur.	+	Cr
Helianthemum nummularia (L.) Miller subsp. *tomentosum* (Scop.) Schinz &Thellung	Cistaceae			Cr
Helloborus orientalis Lam.	Ranunculaceae	Euxine		H
Hieracium medianiforme (Litw.& Zahn) Juxip.	Asteraceae	Euxine		H
Hieracium oblongum Jordan	Asteraceae	Euro-Sib.		H
Hieracium sylvularum Jordan ex Bor.	Asteraceae	Euro-Sib.		H
Hypericum androsaemum L.	Hypericaceae			H
Hypericum bithynicum Boiss.	Hypericaceae	Euxine		H
Iris lazica Albov	Iridaceae	Euxine		Cr
Koelaria cristata (L.) Pers.	Poaceae			T
Lycopodium complanatum L. subsp.*chamaecyparissus* (A.Br.)Döll	Lycopodiaceae			Cr
Muscari casicasicum (Griseb.)Beker	Liliaceae			Cr
Orchis mascula L.subsp. *pinetorum* (Boiss.et Key)Gaus	Orchidaceae			Cr
Ornithogalum sphaerocarpum Kerner	Liliaceae			Cr
Orthilia secunda (L.) Housa	Pyrolaceae			Cr
Osmundo regalis L.	Polypodiales			Cr
Pilosella echinoides (Lumn.) C.H.et F.W.Schulz subsp. *procera* (Fries)Sell et West	Asteraceae			Cr
Pimpenella tragium Vill.subsp.*polyclado* (Boiss.et Heldr.)Tutin	Apiaceae			Cr
Pimpinella tragium Vill subsp. *lithophila* (Schischkin)Tutin	Apiaceae			Cr
Poa bulbosa L.	Poaceae			T
Poa comprema L.	Poaceae			T
Poa diversifolia Boiss.et Bal.	Poaceae			T
Poa nemolaris L.	Poaceae			T
Poa sterilis Bied.	Poaceae			T
Polygala alpestris Reichb.	Polygalaceae			Cr
Polygala anatolica Boiss.et Heldr.	Polygalaceae			Cr
Polygala pruniosa Boiss.subsp. *pruniosa*	Polygalaceae			Cr
Polygala supina Schreb.	Polygalaceae			Cr
Potentilla micrantha Ramond ex DC.	Rosaceae			H
Ranunculus brachylobus Boiss.& Hoh. subsp. *Brachylobus*	Ranunculaceae			H
Ranunculus brutius Ten.	Ranunculaceae	Euro-Sib.		H
Ranunculus constantinopolitanus (DC.)d'Urv.	Ranunculaceae			H
Ranunculus reuterianus Boiss.	Ranunculaceae		+	H
Rubus caucasicus Focke	Rosaceae			H
Rubus hirtus Waldst.& Kit.	Rosaceae			H
Rumex crispus L.	Polygonaceae			H
Sedum hispanicum L.subsp. *hispanicum*	Crassulaceae			Cr
Stellaria holostea L.	Caryophyllaceae	Euro-Sib.		T

Table 1b continued

Trifolium ambiguum Bieb.	Fabaceae			H
Trifolium caudatum Boiss.	Fabaceae		+	H
Trifolium medium L.var. *medium*	Fabaceae			H
Trifolium pannonicum Jacq. ssp. *elongatum* (Willd.) Zoh.	Fabaceae			H
Trifolium physodes Stev.ex.Bieb.var. *physodes*	Fabaceae			H
Trifolium pratense L.var. *pratense*	Fabaceae			H
Trifolium pratense var.*sativum* Schreb.	Fabaceae			H
Trifolium trichocephalum Bieb.	Fabaceae			H
Vicia balansae Boiss.	Fabaceae	Euxine		T
Vicia cracca L.ssp.*tenuifolia* (Roth) Gaudin.	Fabaceae			T
Vicia freyniani Bornm.	Fabaceae			T
Vicia truncatula Fischer ex Bieb.	Fabaceae			T

2. *Carpinus betulus-Acer campestre* (Yarcı, 1994, 2002): This association is found around Kirklareli Demirkoy region and in the Longos Forests along the shoreline of Erikli lagoon from 5 to 10 m. Forest layer cover is 100 percent, shrub layer cover is 20-25 percent and herb layer cover is 10-20 percent.

3. *Quercus petraea* ssp. *iberica-Carpinus betulus* (Yurdakulol, Demirors, Yildiz, 2002): This association is found in Abana-Inebolu region Yemeni and Kaymazlar village, around Hacihasan and Karamanlar wood storage,on the western and southern 15-40 percent slopes, between 500-1350 m, on grey and flysich. It prefers very deep soils(40-50 cm.) and has a dense plant cover 65-85 percent.

4. *Carpinus betulus-Quercus petrae* ssp. *iberica* (Yurdakulol, Demirors, Yildiz, 2002): This association is found in the Kastamonu province in the west of Black Sea region, at Devrekani on the south and around Inebolu and Abana on the North. Mostly on sandy stone and flysich bedrock; west and south facing slopes, with an inclination of 15-40 percent. Cover percentage varies between 60-85 percent.

5. *Fagus orientalis-Carpinus betulus* (Ozen, Kilinc, 1995): This association occurs in Barmag, Kapakli, Ayinderesi in the south of Alacam and in Kavsak, Kayalik and Guzelcecay village at the south of Yakakent from 300 to 900 m. The slope is 15-40 percent.

6. *Fagus orientalis-Carpinus betulus* (Kilinc, Karaer, 1995): Distribution areas of this association are Sarikum, Dibekli and Sogucak villages of Sinop and Hamsiloz harbour and Siyamkoy mountain region from 10 to 120 m. Mostly on reddish yellow podsolic soils on the slopes with a slope of 10-40 percent. Forest layer covers 70- 90 percent and herb layer 40-70 percent.

The geobotanical study of Scots Pine distribution areas in Turkey reveals that nine different plant associations are distributed in Turkey. These embody 275 taxa covering trees, shrubs, herbs and mosses. 25 taxa distributed in these areas are endemic and the percentage is 9.02 percent. The families evaluated according to their total taxon numbers are; Fabaceae (16%), Asteraceae (10%), Rosaceae (5%), Poaceae (5%), Lamiaceae (5%)

Table 2: The species composition of Hornbeam associations.

Forest layer				
Plant	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Abies nordmannia (Mattf.) Coode & Cullen subsp. *bornmuelleriana* (Stev.) Spach	*Pinaceae*	Euxine	-	Ph
Acer campestre L. subsp. *campestre*	*Aceraceae*	-	-	Ph
Acer hyrcanum Fisch. & Mey subsp. *hyrcanum*	*Aceraceae*	Euro-Sib	-	Ph
Cardamine impatiens L.subsp. *pectinata* (Pallas) Trautv.	*Brassicaceae*	Euro-Sib	-	Ph
Carpinus betulus L.	*Corylaceae*	Euro-Sib	-	Ph
Catapodium rigidum (L.) C.E. Hubbard ex Dony var. *rigidum*	*Poaceae*	-	-	Ph
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	*Poaceae*	Euro-Sib	-	Ph
Euphorbia amygdaloides L. subsp. *amygdaloides*	*Euphorbiaceae*	Euro-Sib	-	Ph
Fagus orientalis Lipsky	*Fagaceae*	Euro-Sib	-	Ph
Fraxinus angustifolia Vahl subsp. *syriaca* (Boiss.) Valt	*Oleaceae*	Ir-Tur	-	Ph
Galium rotundifolium L.	*Rubiaceae*	Euro-Sib	-	Ph
Lolium perenne L.	*Poaceae*	Euro-Sib	-	Ph
Populus tremula L.	*Salicaceae*	Euro-Sib	-	Ph
Prunella vulgaris L.	*Lamiaceae*	Euro-Sib	-	Ph
Prunus x domestica L.	*Rosaceae*	-	-	Ph
Quercus cerris L. var. *cerris*	*Fagaceae*	Medit	-	Ph
Quercus petrae (Mattuschka) Liebl. subsp. *iberica* (Steven ex Bieb.) Krossi	*Fagaceae*	-	-	Ph
Quercus petrae (Mattuschka) Liebl. subsp. *petrae*	*Fagaceae*	-	-	Ph
Quercus pubescens Willd.	*Fagaceae*	-	-	Ph
Rhododendron luteum Sweet	*Ericaceae*	Euxine	-	Ph
Rubus canescens DC.	*Rosaceae*	-	-	Ph
Ulmus minor Miller subsp. *minor*	*Ulmaceae*	Medit	-	Ph
Viburnum lantana L.	*Caprifoliaceae*	Euro-Sib	-	Ph
Shrub layer				
Plant	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Argyrolobium biebersteinii Ball	*Fabaceae*	-	-	Ch
Asperula cymulosa (Post) Post	*Rubiaceae*	Medit	+	Ch
Asperula involucrata Wahlenb.	*Rubiaceae*	Euxine	-	Ch
Brachypodium pinnatum (L.) R. Beauv.	*Poaceae*	Euro-Sib	-	Ch
Cerasus avium L. Moench	*Rosaceae*	-	-	Ch
Cerasus mahaleb (L.) Miller. subsp. *mahaleb*	*Rosaceae*	-	-	Ch
Chamaecytisus hirsutus (L.) Link	*Fabaceae*	-	-	Ch
Cornus australis (C.A.Meyer)	*Cornaceae*	-	-	Ch
Cornus mas L.	*Cornaceae*	Euro-Sib	-	Ch
Cornus sanguinea L. subsp. *australis* (C.A.Meyer) Jav.	*Cornaceae*	Euro-Sib	-	Ch
Corylus avellana L. var. *avellana*	*Corylaceae*	Euro-Sib	-	Ch
Cotoneaster nummularia Fisch.& Mey.	*Rosaceae*	-	-	Ch

Table 1b continued

Doronicum orientalis Hoffm	*Asteraceae*	-	-	Ch
Hedera helix L.	*Araliaceae*	-	-	Ch
Lapsana communis L. subsp. *intermedia* (Bieb.) Hayek	*Asteraceae*	-	-	Ch
Lathyrus aureus (Stev.) Brandza	*Fabaceae*	Euxine	-	Ch
Lathyrus laxiflorus (Desf.) O. Kuntze subsp. *laxiflorus*	*Fabaceae*	-	-	Ch
Ligustrum vulgare L.	*Oleaceae*	Euro-Sib	-	Ch
Lonicera caucasica Pallas subsp. *orientalis* (Lam.) Chamb. & Long	*Caprifoliaceae*	-	+	Ch
Luzula forsteri (Sm.) DC.	*Juncaceae*	Euro-Sib	-	Ch
Mespilus germanica L.	*Rosaceae*	Hyrcano-Euxine	-	Ch
Oenanthe pimpinelloides L.	*Apiaceae*	-	-	Ch
Phillyrea latifolia L.	*Oleaceae*	Medit	-	Ch
Pteridum aquilinum (L.) Kuhn	*Hypolepidaceae*	-	-	Ch
Pyracantha coccinea Roemer	*Rosaceae*	-	-	Ch
Rubus canescens DC. var. *glabratus* (Gordon) Davis & Meikle	*Rosaceae*	Euro-Sib	-	Ch
Rubus hirtus Waldst. & Kit.	*Rosaceae*	Euro-Sib	-	Ch
Ruscus aculeatus L.	*Liliaceae*	-	-	Ch
Salvia forskahlei L.	*Lamiaceae*	Euxine	-	Ch
Sambucus ebulus L.	*Caprifoliaceae*	Euro-Sib	-	Ch
Silene dichotoma Ehrh. subsp. *dichotoma*	*Caryophyllaceae*	-	-	Ch
Silene italica (L.) Pers.	*Caryophyllaceae*	-	-	Ch
Smilax excelsa L.	*Liliaceae*	Euxine	-	Ch
Sorbus umbellata (Desf.) Fritsch var. *cretica*	*Rosaceae*	-	-	Ch
Tanacetum parthenium (L.) Schultz Bip.	*Asteraceae*	-	-	Ch
Tanacetum poterrifolium (Ledeb.) Grierson	*Asteraceae*	Euxine	-	Ch
Trifolium campestre Schreb	*Fabaceae*	-	-	Ch
Trifolium pratense L. var. *pratense*	*Fabaceae*	-	-	Ch
Viola sieheana Becker	*Violaceae*	-	-	Ch

Herb layer

Plant	***Family***	**Phytogeographic region**	***Endemic***	**Life Form**
Aira elegantissima Schur subsp. *elegantissima*	*Poaceae*	Medit	-	T
Astragalus glycyphyllos L. subsp. *glycyphylloides* (DC.) Mattehews	*Fabaceae*	Euro-Sib	-	Cr
Astrantia maxima Pallas subsp. *haradjianii* (Grintz.) Rech. fil.	*Apiaceae*	Euxine	+	H
Asyneuma amplexicaule (Willd.) Hand.-Mazz. subsp. *amplexicaule*	*Campanulaceae*	-	-	H
Asyneuma rigidum (Willd.) Grossh. subsp. *rigidum*	*Campanulaceae*	Ir-Tur	-	H
Calamintha grandiflora (L.) Moench	*Lamiaceae*	Euro-Sib	-	H
Campanula glomerata L. subsp. *hispida* (Witasek) Hayek	*Campanulaceae*	Euro-Sib	-	H
Campanula rapunculoides L. subsp. *cordifolia* (C. Koch) Damboldt	*Campanulaceae*	-	-	H
Campanula rapunculoides L. subsp. *rapunculoides*	*Campanulaceae*	Euro-Sib	-	T
Cirsium hypoleucum DC.	*Asteraceae*	Euxine	-	H

Table 1b continued

Cirsium pseudopersonata Boiss. & Bal. subsp. *pseudopersonata*	*Brassicaceae*	Euxine	+	H
Clematis vitalba L.	*Ranunculaceae*	-	-	H
Clinipodium vulgare L. subsp. *arundanum* (Boiss.) Nyman	*Lamiaceae*	-	-	H
Coronilla varia L.	*Fabaceae*	Medit	-	H
Crataegus microphylla C. Koch	*Rosaceae*	Hyrcano-Euxine	-	Cr
Crataegus monogyna Jacq. subsp. *monogyna*	*Rosaceae*	-	-	H
Cyclamen coum Miller var.*coum*	*Primulaceae*	-	-	Cr
Daphne pontica L.	*Thymelaeaceae*	Euxine	-	H
Digitalis ferruginea L. subsp. *ferruginea*	*Scrophulariaceae*	Euro-Sib	-	T
Digitalis grandiflora Miller	*Scrophulariaceae*	Euro-Sib	-	T
Dorycinum graecum (L.) Ser.	*Fabaceae*	Euxine	-	H
Dorycinum pentaphyllum Scop. subsp. *herbaceum* (Vill.) Rouy	*Fabaceae*	-	-	H
Epilobium montanum L.	*Onagraceae*	Euro-Sib	-	Cr
Epimedium pubigerum (DC.) Moren & Decaisne	*Berberidaceae*	Euxine	-	T
Festuca drymeja Mertens & Koch	*Poaceae*	Euro-Sib	-	T
Festuca heterophylla Lam.	*Poaceae*	Euro-Sib	-	Cr
Filipendula vulgaris Moench	*Rosaceae*	Euro-Sib	-	H
Fragaria vesca L.	*Rosaceae*	-	-	H
Fraxinus ornus L. subsp. *ornus*	*Oleaceae*	Euro-Sib	-	H
Galium longifolium (Sm.) Griseb.	*Rubiaceae*	-	-	H
Galium odaratum (L.) Scop.	*Rubiaceae*	Euro-Sib	-	Cr
Galium paschale Forsskall	*Rubiaceae*	Medit	-	H
Geranium asphodeloides Burm. fil. subsp. *asphodeloides*	*Geraniaceae*	Euro-Sib	-	Cr
Helleborus orientalis Lam.	*Ranunculaceae*	Euxine	-	H
Ilex colchia Poj.	*Anacardiaceae*	Euxine	-	H
Knautina involucrata Somm.&Lev	*Dipsacaceae*	Euxine	-	T
Lathyrus digitatus (Bieb.) Fiori	*Fabaceae*	Medit	-	Cr
Myosatis sylvatica Ehrh. ex Hoffm. subsp. *cyanea vestergren*	*Boraginaceae*	-	-	H
Neottia nidus-avis (L.) L.C.M. Richard	*Orchidaceae*	Euro-Sib	-	Cr
Phlomis samia L	*Lamiaceae*	Medit	-	H
Physospermum cornubiense (L.) DC.	*Apiaceae*	-	-	Cr
Pinus sylvestris L.	*Pinaceae*	Euro-Sib	-	H
Plantago major L. subsp. *major*	*Plantaginaceae*	-	-	H
Polygala pruniosa Boiss. subsp. *pruinosa*	*Polygalaceae*	-	-	Cr
Polyganatum multiflorum (L.) All.	*Liliaceae*	-	-	Cr
Primula vulgaris Huds subsp. *vulgaris*	*Primulaceae*	Euro-Sib	-	H
Ruscus aculeatus L. var. *aculeatus*	*Liliaceae*	-	-	H
Sanicula europaea L.	*Apiaceae*	-	-	H
Saponaria glutinosa Bieb.	*Caryophyllaceae*	-	-	H
Scaligera tripartita (Kalen.) Tamamsch.	*Apiaceae*	Euxine	-	Cr
Scutellaria velenovsky Rech. fil.	*Lamiaceae*	Medit	-	H
Sorbus torminalis (L.) Crantz var. *torminalis*	*Rosaceae*	Euro-Sib	-	H
Sorbus umbellata (Desf.) Fritsch var. *cretica* (Lindl.) Schneider	*Rosaceae*	-	-	T
Stellaria holostea L.	*Caryophyllaceae*	Euro-Sib	-	H

Table 1b continued

Trachystemon orientalis (L.) G. Don	*Boraginaceae*	Euxine	-	H
Trifolium caudatum Boiss.	*Fabaceae*	-	+	H
Vaccinium arctostaphylos L.	*Ericaceae*	-	-	Cr
Veronica chamaedrys L.	*Scrophulariaceae*	Euro-Sib	-	Cr
Veronica officinalis L.	*Scrophulariaceae*	Euro-Sib	-	H

Abbreviations used: Life forms according to Ranunkiaer (1905): Ph; Phanerophytes, Ch; Chamaephytes, H; Hemicryptophytes, Cr; Cryptophytes, T; Terophytes +; Endemic -; Non Endemic

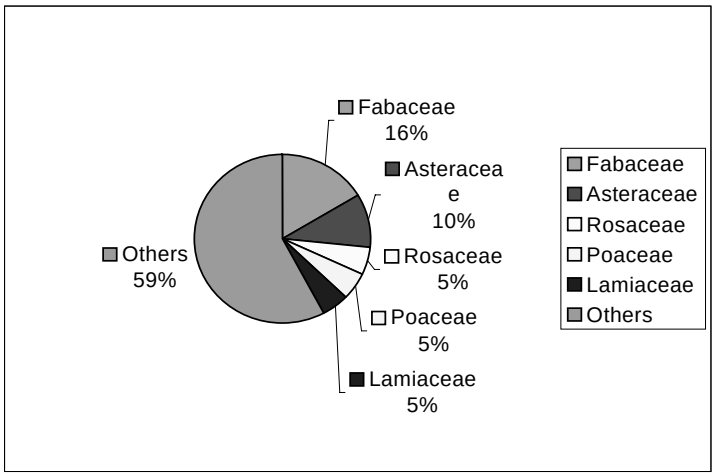

Fig.3:The distribution od families in *Pinus sylvestris* associations.

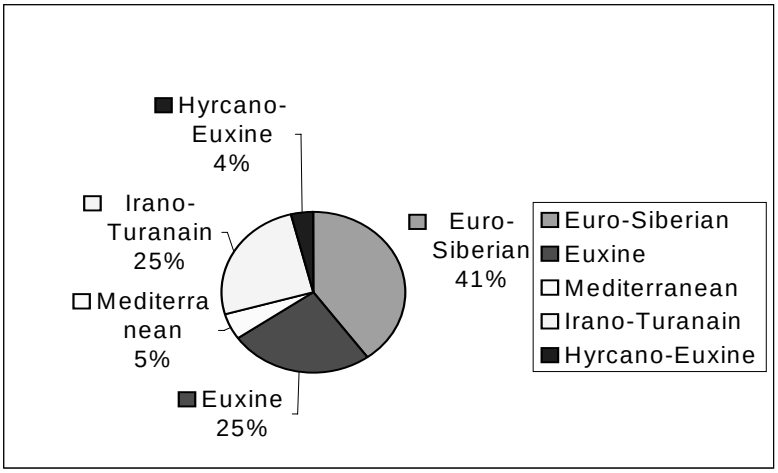

Fig. 4: Phytogeographical origins of plant species in *Pinus sylvestris* associations.

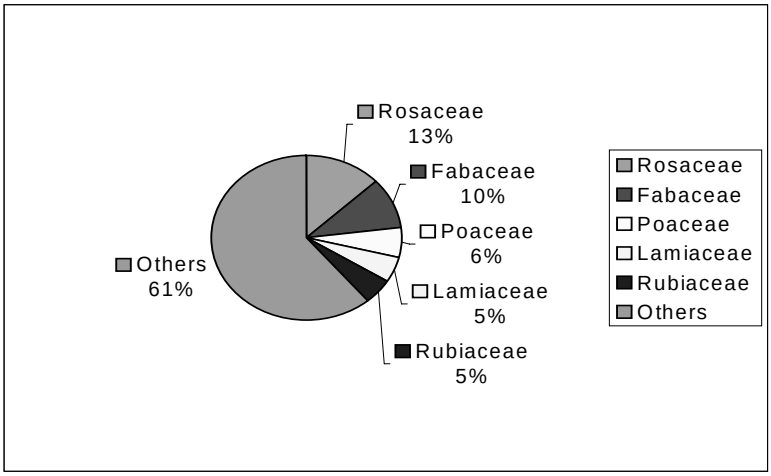

Fig. 5: The distribution of families in *Carpinus betulus* associations.

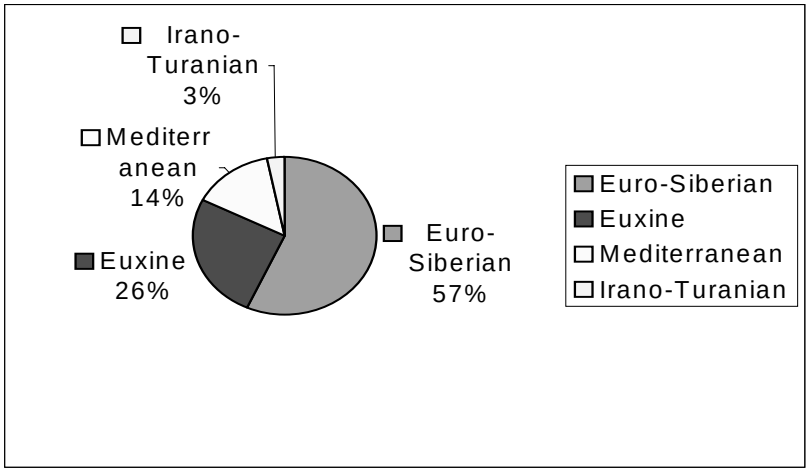

Fig. 6 Phytogeographical origins of plant species in *Carpinus betulus* associations.

and others 59 % (Fig. 3). The phytogeographical status of the taxa was also investigated and distribution was observed as follows; Irano-Turanian 25 (6.4 %), Euro-Siberian 67 (24.4 %) and the Mediterranean (1.4 %) (Fig. 4). An evaluation of the life form spectrum shows that 146 taxa (52.7 %) are chamaephytes, 44 (15.9%) hemicryptophytes, 40 (14.4%) phanerophytes, 28 (10.1 %) cryptophytes and 17 (%6.1) therophytes. These results clearly depict that geobotanically *Pinus sylvesltris* forests have better distribution in Euro-Sib. region (%24.4) and chamaephytes are the dominant life form (52.7 %) in different plant associations.

The 6 associations of *Carpinus betulus* are represented by 121 taxa belonging to 39 families, 5 being endemics. The families evaluated according to their total taxon numbers are; Rosaceae (13%), Fabaceae (10%), Poaceae (6%), Lamiaceae (5%), Rubiaceae (5%) and others 61 % (Fig. 5). The life form spectrum of these taxa was; 23 phanerophytes

(19.1 %), 39 chamephytes (32.5%), 36 hemicryptophytes (30 %),14 cryptophytes (11.7%) and 8 therophytes (6.7%). The distribution of phytogeographical elements was as follows; Irano-Turanian 3 %, the Mediterranean 14 %, Euxine 26 %, Euro-Siberian 57 % (Fig. 6) Generally associations are composed of forest, shrub and herb layers.

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(Received for publication 21 April, 2008)