Chapter 9
Mountainous Vegetation of Central Black Sea Region

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9.1 Introduction

The vegetation of Central Black Sea Region belongs to Euxinian sector of Euro-Siberian phytogeographical region. In the east of Melet River, which flows through Ordu city, Colchic sector occurs. Mean annual precipitation in this region is higher than that in the western part of Melet River. The most diagnostic feature of the vegetation of Central Black Sea Region is the difficulty of the separation of different vegetation strata. It is too difficult to draw a demarcation line among communities

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Fig. 9.1 General aspect of the vegetation of Central Black Sea Region (Kutbay and Kılınç 1995)

in most vegetation types. The vegetation of Central Black Sea Region has been changed with elevation. The vegetation of Central Black Sea Region has been separated into three different groups, namely Mediterranean, prepontic, and Euxinian by Quezel et al. (1980). There are seven different vegetation strata, namely coastal Mediterranean strata, Mediterranean intrapontic strata, upper Mediterranean prepontic strata, mountainous prepontic strata, low mountain Euxine strata, high mountain Euxine strata, and subalpine Euxine strata in Central Black Sea Region from sea level to subalpine regions of mountains (Kutbay and Kılınc 1995; Özen and Kılınç 1995; Fig. 9.1).

9.2 Soil Traits

Brown and noncalcareous brown forest soils are widespread in higher parts of Central Black Sea Region. However, chestnut soils are also found especially in inner parts of the region. Clay loam and loamy textured soils are found in higher parts of Central Black Sea Region. Slightly and moderate alkaline soils are dominant, while *Fagus orientalis* associations occurred in moderate-to-extreme acidic soils. Organic matter content (%) of soils ranged from moderate to high. $CaCO_3$ (%) content of soils is low to moderate. However, soils under *Pinus* and steppe communities may be rich in $CaCO_3$ (Kutbay and Kılınc 1995; Cansaran and Aydogdu 2001; Cansaran et al. 2010; Korkmaz et al. 2011).

9.3 High Mountainous Vegetation of Central Black Sea Region

Mountainous prepontic strata is characterized by *Abies nordmanniana* (Stev.) Spach subsp. *bornmuelleriana* (Mattf.) Coode and Cullen and *F. orientalis* Lipsky mixed forests at 800–900 m. *Quercus pubescens* is also characteristic for this strata.

These forests are characterized by *Fago orientalis–Abietum nordmannianae* (Akman et al. 1983a). The diagnostic species of this association are *F. orientalis* and *A. nordmaniana* subsp. *bornmuelleriana*. *Rhododendro-Fagetalia orientalis* is characterized mainly by *Daphne pontica, Smilax excelsa, Hypericum androsaemum, Ilex colchica*, and *Rubus hirtus*. Querco-Carpinetalia orientalis is characterized by *Quercus petraea* subsp. *iberica, Carpinus betulus, Pyracantha coccinea, Cyclamen coum* var. *coum,* and *Asperula involucrata*. Carpino-Acerion alliance is represented by *Helleborus orientalis*. *Quercetea Pubescentis* class is represented by *Genista tinctoria, Hypericum perforatum, Campanula rapunculoides* subsp. *rapunculoides,* and *Cotinus coggyria*. *Fagetalia Sylvaticae* is represented by *Sanicula europaea* and *Cardamine bulbifera*. *Ulmus glabra, Hedera helix, Crataegus monogyna* subsp. *monogyna, Sambucus ebulus, Staphylea pinnata, Fragaria vesca, Euphorbia amygdaloides* var. *amygdaloides, Clinopodium vulgare* subsp. *arundanum, Geranium robertianum*, and *Campanula glomerata* are diagnostic species of Querco-Fagetea. These forests are widely destroyed mainly due to agricultural activities and only locally occurred. A.*nordmanniana* subsp. *bornmuelleriana* forests also penetrated in inner parts of Central Black Sea Region in Dutman Mountain around Alacam between 900-1400 m and represented by *Saniculo-Abietetum bornmuellerianae* on northern slopes. This association includes two subassociations namely *fagetosum orientalis* and *rhododendretosum lutei* (Ozen and Kılınc 1995). Prepontic strata is also characterised by *Carpino-Fagetum orientalis*. This association is found around Nebyan Mountain (Kutbay and Kılınc 1995) and southern parts of Alacam (Ozen and Kılınc 1995).

Q. pubescens forest is characteristic of mountainous prepontic strata and occurs in inner parts of Central Black Sea Region from 850 to 1200 m. However, they have not formed close canopies due to some disturbance factors (overgrazing, erosion, etc.) and canopy closure is rather low. These forests are represented by *Onobrychido tournefortii–Quercetum pubescentis* (Karaer et al. 1999) and *Leontodonto asperi–Quercetum pubescentis* (Cansaran and Aydogdu 2001). *Q. pubescens, Leontodon crispus* subsp. *asper* var. *asper, Myosotis arvensis* subsp. *arvensis,* and *Melampyrum arvense* var. *arvense* are diagnostic species of *Leontodonto asperi–Quercetum pubescentis* (Cansaran and Aydogdu 2001) association. *Lonicera caucasica* subsp. *orientalis, Laser trilobum,* and *Asyneuma rigidum* subsp. *rigidum* are some of the diagnostic species of *Carpino betuli–Acerion hyrcani* alliance. *Chamaecytisus pygmaeus, Astragalus glycyphyllos* subsp. *glycyphyllos, Colutea cilicica,* and *Polygala supina* are diagnostic species of *Querco cerridis–Carpinetalia orientalis* order. *Quercetea pubescentis* class is represented by *Cotoneaster nummularia, Dorycnium pentaphyllum* subsp. *herbaceum, Cotinus coggyria,* and *Lithospermum purpurocaeruleum*. Steppic species namely *Dactylis glomerata* subsp. *hispanica, Helianthemum nummularium* subsp. *nummularium, Polygala pruinosa* subsp. *pruinosa*, and *Festuca valesiaca* are diagnostic species of *Astragalo microcephali–Brometea tomentelli* class. *Q. pubescens, Onobrychis tournefortii,* and *Phlomis pungens* are diagnostic species of *Onobrychido tournefortii–Quercetum pubescentis* (Karaer et al. 1999). Steppic *Astragalo-Brometea* class is represented by *Astragalus microcephalus, Acantholimon acerosum, Iberis taurica, Helianthemum canum, Paronychia chionesa, Cruciata taurica*, and *Minuartia anatolica* var. *anatolica, Jurinea consanguinea, Allium flavum* subsp. *tauricum, Polygala pruinosa, Silene supina* subsp.

Fig. 9.2 *Fago orientalis–Abietum nordmannianae*. (Akman et al. 1983a)

pruinosa, Bungea trifida, Onobrychis armena, and *Helianthemum nummularium* are diagnostic species of steppic *Onobrychido–Thymetalia leucostomi* order. *Querco-Fagetea* class is represented by a few species namely *Lapsana communis, Geum urbanum, Epipactis helleborine, Campanula glomerata, Clinopodium vulgare,* and *Moehringia trinervia*. This strata is represented by *Corno mari-Quercetum cerridis* (Korkmaz et al. 2011) in inner parts around Vezirköprü and Osmancık (Çorum city) from 750 to 1250 m. *Quercus cerris* var. *cerris Carpinus orientalis* subsp. *orientalis Cornus mas* and *Scutellaria velenovsky* are diagnostic species of that association. This association is composed of two sub-associations, namely *loniceretosum etruscae* and *lathyretosum rosei*. *Lonicera etrusca* var. *etrusca Alliaria petiolata* and *Tanacetum parthenium* are differential taxa of *loniceretosum etruscae*, while *Lathyrus roseus, Nepeta nuda* subsp. *albiflora* and *Campanula rapunculoides* subsp. *rapunculoides* are differential taxa of *Lathyretosum rosei*. *Lathyrus laxiflorus* subsp. *laxiflorus, Asyneuma rigidum* subsp. *sibthorpianum, Vicia truncatula*, and *Viola sieheana* are some of the diagnostic species of *Carpino betuli–Acerion hyrcani* alliance. *Lathyrus tukhtensis, Colutea cilicica*, and *Trifolium medium* var. *medium* are some of the diagnostic species of *Querco cerridis–Carpinetalia orientalis* order. *Querco pseudocerridis–Cedretalia libani* order is represented by *Doronicum orientale* and *Vicia cracca* subsp. *stenophylla*. Some diagnostic species of *Quercetea pubescentis* class are *Silene italica, Geum urbanum, Epipactis condensata*, and *Crepis reuterana* subsp. *reuterana*. *Querco-Fagetea* class is represented by *Viola odorata, Athyrium filix-foemina,* and *Stellaria holostea*. *Juniperus oxycedrus* subsp. *oxycedrus, Ruscus aculeatus* var. *angustifolius, Geranium purpureum, Hedysarum varium,* and *Veronica orientalis* subsp. *orientalis* are some of the diagnostic species of *Quercetea ilicis* class (Korkmaz et al. 2011; Fig. 9.2).

In northern slopes at 900 m, low mountainous Euxine strata occurred and this strata is typically characterized by *F. orientalis–Castanetum sativae* (Akman et al. 1983b association, Fig. 9.3).

This association consists of tree, shrub, and herb layers. Characteristic species are *Castanea sativa, F. orientalis, Smilax excels,* and *Arum euxium*. *Rhododendro-Fagetalia orientalis* is characterized by *Rhododendron luteum, Vaccinium arctastaphyllos, Daphne pontica, Gentiana asclepiadea, Salvia forskahlei*, and *Trachystemon orientalis*. Querco-Carpinetalia orientalis is characterized by *Mespilus germanica,*

Fig. 9.3 *Fago orientalis–Castanetum sativae.* (Akman et al. 1983b)

Lathyrus laxiflorus subsp. *laxiflorus, Oenanthe pimpinelloides*, and *Dorynium pentaphllum* subsp. *anatolicum Hypericum perforatum, Coronilla varia*, and *Campanula rapunculoides* subsp. *rapunculoides* are the diagnostic species of Quercetea Pubescentis. Querco-Fagetea is represented by many species, namely *Populus tremula, Crataegus monogyna* subsp. *monogyna, Tamus communis* subsp. *communis, Veronica chamaedrys, Stachys sylvatica*, and *Poa nemoralis*.

Above 800 m, mountainous Euxine strata occurs. This strata is characterized by pure *F. orientalis* forests and *Pinus sylvestris* L. forests in northern slopes, while in southern slopes *Pinus nigra* Arn. subsp. *pallasiana* (Lamb.) Holmboe forests are replaced. Pure *F. orientalis* are widespread in Central Black Sea Region. In Eastern Black Sea Region, pure *F. orientalis* forests are not found and these forests are usually replaced by *Picea orientalis* forests. *F. orientalis* forests usually form mixed forests with the other deciduous species in Eastern Black Sea Region.

Rhododendron luteum, Veronica magna, and *Prenanthes cacaliifola* are the diagnostic species of *Rhododendro-Fagetum orientalis* (Kutbay and Kılınc 1995) association. Diagnostic species of Rhododendro-Fagetalia orientalis are *Hypericum androsaemum, Daphne pontica, Rubus hirtus, Salvia forskahlei*, and *Gentiana asclepiadea*. Querco-Carpinetalia orientalis is represented by a few species, namely *H. orientalis, Cyclamen coum* var. *coum*, and *Lathyrus laxiflorus* subsp. *laxiflorus*. However, Querco-Fagetea is represented by many species, namely *Populus tremula, Ulmus glabra, Stachys sylvatica, Cardamine impatiens* var. *pectinata, C. bulbifera*, *Salvia forskahlei, S. glutinosa*, and *Geranium robertianum* (Kutbay and Kılınc 1995). Pure *F. orientalis* forests are also widespread in inner parts of Black Sea Region in northern slopes. For example, *Veronico melissaefoliace–Fagetum orientalis* (Quezel et al. 1980) association is occurrs around Erbaa in Kelkit valley (Karaer et al. 1999). *F. orientalis, Veronica magna, Arum euxinum,* and *Salvia glutinosa* are the diagnostic species of this association. *Veronico-Fagion* alliance is represented by *Veronica peduncularis* and *Arum orientale*. *Cardamine bulbifera* and *Neottia nidus-avis* are the diagnostic species of *Fagetalia sylvatica*. Two prominent species of this association are *Cyclamen coum* var. *caucasica* and *Paris incompleta* which are the diagnostic species of *Pino-Piceetalia orientalis*. *Quercetea Pubescentis* are represented by *Doronicum orientale, Tanacetum parthenium*, and

Cephalanthera rubra. *Rhododendro-Fagetum orientalis* and *Querco-Fagetea* are also represented in this association. *Myosotis alpestris, Luzula forsteri*, and *Brachypodim sylvaticum* are most prominent species in herb layer of *Querco-Fagetea*. *F. orientalis* forests are also found in inner parts of river valleys. In Kızılırmak valley, *Galio odorati-Fagetum orientalis* (Özen and Kılınç 2002) is found from 1250 to 1500 m. *F. orientalis, Lathyrus aureus, Galium odoratum*, and *Melica uniflora* are diagnostic species of that association. This association comprises two subassociations. *A. nordmanniana* subsp. *bornmuelleriana, Pyrola media, Moneses uniflora, and Orthilia secunda* are differential species of *Abietetosum bornmuellerianae*, while *Vicia crocea, Poa pratensis*, and *Astragalus glycyphyllos* subsp. *glycyphylloides* are differential species of *Vicietosum* croceae. *Carpinus betulus, Lonicera caucasica* subsp. *orientalis, Crataegus tanacetifolia, Cyclamen coum* var. *coum*, and *Lathyrus laxiflorus* subsp. *laxiflorus* are diagnostic species of *Carpino betuli–Acerion hyrcani* alliance. *Querco cerridis–Carpinetalia orientalis* is represented by *Euonymus latifolius* subsp. *latifolius, Sorbus torminalis* var. *torminalis, Knautia involucrata, Dorycnium pentaphyllum* subsp. *herbaceum*, and *Primula vulgaris* subsp. *vulgaris*. *Vicia cracca* subsp. *gerardi, Sorbus umbellata* var. *umbellata*, and *Doronicum orientale* are diagnostic species of *Querco pseudocerridis–Cedretalia libani* order. *Quercetea pubescentis* class, *Fagetalia sylvaticae*, and *Rhododendro pontici–Fagetalia orientalis* order are also represented and their floristic composition is similar to the other *F. orientalis* associations. This strata also penetrated the inner parts. For example, *Crataego microphyllae–Carpinetum betuli* (Cansaran and Aydogdu 2001) is found around Egerli Mountain (Amasya city) from 1000 to 1230 m. Diagnostic species of this association is *Carpinus betulus, Crataegus microphylla, Prunus spinosa* subsp. *dasyphylla, Echinops galaticus,* and *Achillea millefolium* subsp. *pannonica*. The floristic composition is similar to *Populo tremulae–Quercetum syspirensis* (Cansaran and Aydogdu 2001; Fig. 9.4).

F. orientalis forests are also found in inner parts of Central Black Sea Region where oceanic climate is seen. *Euonymo verrucosi–Fagetum orientalis* (Cansaran et al. 2010) is found around Borabay Lake (Amasya city) and diagnostic species

Fig. 9.4 *Rhododendro-Fagetum orientalis*. (Kutbay and Kılınc 1995)

Fig. 9.5 *Daphno pontica–Pinetum sylvestris*. (Ekim and Akman 1991)

are *Euonymus verrucosus* Scop. *Draba rigida* Willd. var. *rigida, Symphytum bornmuelleri* Bucknall, *Melampyrum arvense* L. var. *arvense, Epimedium pubigerum* (DC.) Morr. & Decne, and *Heracleum platytaenium* Boiss. *Carpino betuli–Acerion hyrcani* alliance is represented by *Carpino betuli–Acerion hyrcani, Cyclamen coum* Miller var. *coum, Asperula involucrata* Wahlenb. *Querco cerridis–Carpinetalia orientalis* order is represented by *Trifolium pannonicum* Jacq. subsp. *elongatum* (Willd.) Zoh., *Coronilla varia* L. subsp. *varia, Lathyrus aureus* (Stev.) Brandza, *Vicia cracca* L. subsp. *stenophylla* Vel., *Viburnum lantana* L., and *Cephalanthera rubra* (L.) L.M.C. Richard are the diagnostic species of *Quercetea pubescentis* class. The most diagnostic species of *Querco-Fagetea* class are *Rubus hirtus* Waldst. & Kit., *Lapsana communis* L. subsp. *intermedia* (Bieb.) Hayek, and *Geum urbanum* L.

P. sylvestris forests also belong to Euxine strata. These forests are characterized by *Daphno pontica–Pinetum sylvestris* (Ekim and Akman 1991) association which includes tree, shrub, and herb layers (Fig. 9.5).

Carpinus orientalis subsp. *orientalis, Geranium asphodeloides* subsp. *asphodeloides,* and *Polygala supina* are diagnostic species of *Querco-Carpinetalia orientalis*. *H. orientalis, Lathyrus laxiflorus* subsp. *laxiflorus,* and *Cyclamen coum* var. *coum* are diagnostic species for *Carpino-Acerion*. *Pino-Piceetalia orientalis* and *Rhododendro-Fagetalia orientalis* are represented by a single species, namely *A. nordmanniana* subsp. *bornmuelleriana* and *Rubus hirtus*, respectively. *Pinus. nigra* subsp. *pallasiana, Pyracantha coccinea, Ligustrum vulgare,* and *Trifolium pannonicum* subsp. *elongatum* are diagnostic species of *Quercetea Pubescentis*. *Querco-Fagetea* are represented by *Primula vulgaris* subsp. *sibthorpii, Salvia forskahlei, Fragaria vesca, Brachypodium sylvaticum*, and *Teucrium chamaedrys* subsp. *chamaedrys*. *P. sylvestris* forests are also distributed in inner parts of Central Black Sea Region like *F. orientalis* forests. These forests is also found in Dutman Mountain around Alacam between 1000-1400 m in iner parts of Central Black Sea Region and represented by Abieti-Pinetum sylvestris association (Özen and Kılınç 1995). *P. sylvestris, Ranunculus buhsei* Boiss, *Juniperus communis* subsp. *alpina, Daphne pontica* L., *Crepis macropus* Boiss & Heldr., and *Pyrola media* Swartz are diagnostic species of *Ranunculo buhsei–Pinetum sylvestris* (Karaer et al. 1999) association.

This association occurred between 1350 and 1480 m. *Carpino-Acerion* alliance is represented by *Asperula involucrata, Lathyrus laxiflorus, L. aureus, Tanacetum poteriifolium,* and *H. orientalis*. Floristic composition of *Quercetea Pubescentis* is similar to *Daphno pontica–Pinetum sylvestris* association except for *Euonymus verrucosus* and *Sorbus torminalis*. Floristic composition of *Rhododendro-Fagetalia orientalis* and *Querco-Fagetae* is very similar to *Daphno pontica–Pinetum sylvestris* association. *P. sylvestris* forests also formed closed canopies around Kızılırmak valley at 1600 m. The diagnostic species of *Rumi scutati–Pinetum hamatae* (Korkmaz et al. 2011) association are *P. sylvestris* var. *hamata, Juniperus communis* var. *saxatilis, Myosotis lithospermifolia, Rumex scutatus*, and *Potentilla speciosa* subsp. *speciosa*. *Chamaecytisus pygmaeus* and *Ranunculus illyricus* subsp. *illyricus* are diagnostic species of *Carpino betuli–Acerion hyrcani* alliance. *Bunium microcarpum* subsp. *bourgaei, Geranium macrostylum*, and *Genista lydia* var. *lydia* are some of the diagnostic species of *Querco pseudocerridis–Cedretalia libani* order. *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis* class, and *Rhododendro pontici-Fagetalia orientalis* order and *Fagetalia sylvaticae* order are also represented by several species and their floristic compositions are very similar to the other associations. *Astragalus squalidus, Thymus praecox* subsp. *jankae* var. *jankae, Poa bulbosa, Stachys iberica* subsp. *iberica* var. *iberica, Cynoglossum montanum*, and *Melica ciliata* subsp. *ciliata* are some of the diagnostic species of *Astragalo microcephali–Brometea tomentelli* class. The representation of Astragalo microcephali–Brometea tomentelli indicates the effects of continental climate in *P. sylvestris* forests along stream valleys. *P. sylvestris* also penetrates the inner parts of Central Black Sea Region between 1200 and 1700 m in subalpine region. *Petrorhagio olympicae–Pinetum sylvestris* (Cansaran and Aydogdu 2001) is found between 1400 and 1500 m. *P. sylvestris, Juniperus communis* subsp. *alpina, Petrorhagia alpina* subsp. *olympica*, and *Lathyrus tukhtensis* are diagnostic species of that association. The floristic composition of *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, and *Quercetea pubescentis* and steppic *Astragalo microcephali–Brometea tomentelli* are very similar to that of the other *P. sylvestris* associations. The other subalpine *P. sylvestris* association is *Lathyro tukthensis–Pinetum sylvestris* (Cansaran et al. 2010) association. *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis* class, and *Querco-Fagetea* class are represented by several species.

In southern slopes, Euxine strata is characterized by *P. nigra* subsp. *pallasiana* forests and different associations are formed. *Genisto tinctorae–Pinetum nigrae* (Kutbay and Kılınc 1995) is widespread at high altitudes around Samsun city from 850 to 1150 m (Fig. 9.6).

Carpino-Acerion is represented by *H. orientalis, Viola siehana,* and *Lathyrus laxiflorus* subsp. *laxiflorus*. *Carpinus orietalis* subsp. *orientalis, Argyrolobium biebersteinii, Polygala supina,* and *Dorycnium pentaphyllum* subsp. *anatolicum* are the diagnostic species of *Querco-Carpinetalia orientalis*. *Quercetea Pubescentis* is represented by *Juniperus oxycedrus* subsp. *oxycedrus, Acer campestre* subsp. *campestre, Ligustrum vulgare, Sorbus torminalis* var. *pinnatifida, Hypericum perforatum, Cornus mas,* and *Cotinus coggyria*. *Cisto-Micromerietea* class belong-

Fig. 9.6 *Genisto tinctorae–Pinetum nigrae*. (Kutbay and Kılınc 1995)

ing to Mediterranean region is also represented by *Origanum vulgare* subsp. *vulgare, Salvia tomentosa*, and *Teucrium polium*. This shows that Mediterranean climate can be penetrated to high altitudes in Black Sea Region and it is impossible to separate different vegetation layers in some cases (Kutbay and Kılınc 1995). *Rhododendro-Fagetalia orientalis* is represented by *Ilex colchica, Rhododendron luteum, Daphne pontica,* and *Salvia forskahlei*. *F. orientalis, A. nordmanniana* subsp. *bornmuelleriana, Crataegus monogyna* subsp. *monogyna, P. sylvestris, Hedera helix, Cardamine bulbifera, Primula vulgaris* subsp. *sibthorpii, Clinopodium vulgare* subsp. *arundanum, Salvia glutinosa, Geranium robertianum, Lapsana communis* subsp. *intermedia, Fragaria vesca, Neottia nidus-avis,* and *Sanicula europaea* are diagnostic species of *Querco-Fagetea*. In inner parts of Central Black Sea Region, *P. nigra* subsp. *pallasiana* forest is represented by *Astragalo aucheri–Pinetum pallasianae* (Karaer et al. 1999) around Erbaa from 1000 to 1100 m and *Junipero-Pinetum nigrae* association in Kunduz Forests, Vezirköprü (Özen and Kılınç 2002).

Characteristic and differential species of the association are *Pinus nigra* subsp. *pallasiana*, *Juniperus oxycedrus* subsp. *oxycedrus* and *Dorycnium pentaphyllum* subsp. *anatolicum*. Characteristic species of different syntaxonomic units are found in that association. *Rhododendro-Fagetalia orientalis, Quercetea ilicis, Quercetea pubescentis* and *Querco-Carpinetalia orientalis* are represented in *Junipero-Pinetum nigrae*. The representation of *Cisto-Micromerietea* indicates antropogenic impact (Özen and Kılınç 2002).

The floristic composition of *Astragalo aucheri -Pinetum pallasianae* is different from *Genisto tinctorae–Pinetum nigrae* and it has a steppic character. Steppic *Astragalo-Brometea* class is represented by *Hypericum lydium, Linaria coriifolia, Fibigia eriocalycina, Polygala pruinosa, Minuartia anatolica* var. *anatolica,* and *Pilosella hoppeana*. *Jurinea consanguinea, Silene supina* subsp. *pruinosa,* and *Salvia cryptantha* are diagnostic species of steppic *Onobrychido-Thymetalia leucostomi* order. *Querco–Carpinetalia orientalis* order and *Carpino-Acerion* alliance are also represented and their floristic compositions are similar to *Genisto tinctorae–Pinetum nigrae*. In Kızılırmak valley, *Trifolio canescentis–Pinetum caramanicae*

(Korkmaz et al. 2011) is found between 1100 and 1250 m. *Pinus nigra* subsp. *pallasiana* var. *caramanica, Q. pubescens, Trifolium canescens, Rubus canescens* var. *canescens, Cistus laurifolius,* and *Polygala anatolica* are diagnostic species. *Carpinus betulus, Tanacetum poteriifolium, Lathyrus tukhtensis,* and *Cirsium hypoleucum* are diagnostic species of *Carpino betuli–Acerion hyrcani* alliance. *Vicia cracca* subsp. *stenophylla, Doronicum orientale, Sorbus umbellata* var. *umbellata,* and *Genista lydia* var. *lydia* are diagnostic species of *Querco pseudocerridis–Cedretalia libani* order. *Epipactis condensata,* and *Limodorum abortivum* are some of the diagnostic species of Qu*ercetea pubescentis* class. *Polygonatum multiflorum* and *Neottia nidus-avis* are character species of *Fagetalia sylvaticae* order. *Querco cerridis–Carpinetalia orientalis* order and *Querco-Fagetea* class are also represented by several species which are very similar to the other *P. nigra* associations. *Astragalo microcephali–Brometea tomentelli* class is represented by several species, namely *Anthemis tinctoria* var. *pallida, Galium verum* subsp. *glabrescens Koeleria cristata,* and *Alyssum murale* var. *murale*. The floristic composition of *Trifolio canescentis–Pinetum caramanicae* (Korkmaz et al. 2011) includes Euxinian, Mediterranean, and steppe species because stream valleys have been influenced by oceanic, continental, and Mediterranean climates. *Pinus nigra* J.F. Arnold subsp. var. *caramanica* (Loudon) Rehder has also formed associations in inner parts of Central Black Sea Region above 1000 m. For example, *Chamaecytiso pygmaei–Pinetum pallasianae* (Cansaran and Aydogdu 2001) is found between 1230 and 1280 m. *Pinus nigra* subsp. *pallasiana, Chamaecytisus pygmaeus,* and *Juniperus oxycedrus* subsp. *oxycedrus* are the diagnostic species of that association. *Carpino betuli–Acerion hyrcani* alliance is represented by *Carpinus betulus, Lathyrus tukhtensis, Tanacetum poteriifolium, Cyclamen coum* var. *coum,* and *Lonicera caucasica* subsp. *orientalis*. Diagnostic species of *Querco cerridis–Carpinetalia orientalis* order and *Quercetea pubescentis* class are similar to that of the other *P. nigra* subsp. *pallasiana* associations. Steppic *Astragalo microcephali–Brometea tomentelli* class is represented by *Festuca jeanpertii* subsp. *jeanpertii, Anthemis tinctoria* var. *tinctoria Helianthemum nummularium* subsp. *nummularium, Teucrium chamaedrys* subsp. *chamaedrys*. *Galium verum* subsp. *verum* and *Alyssum murale* var. *murale*. One of the most diagnostic *P. nigra* subsp. *pallasiana* association is *Digitalido lamarckii–Pinetum caramanicae* (Cansaran et al. 2010). *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia* orientalis order, and *Quercetea pubescentis* class are represented by several species like *Lathyro tukthensis–Pinetum sylvestris* (Cansaran et al. 2010) association. *Querco-Fagetea* class is also represented.

Oceanic climate can be penetrated in inner parts of Central Black Sea Region. *Crataego microphyllae–Carpinetum betuli* (Cansaran and Aydogdu 2001) is found between 1000 and 1230 m. *Carpinus betulus, Crataegus microphylla, Prunus spinosa* subsp. *dasyphylla, Echinops galaticus,* and *Achillea millefolium* subsp. *pannonica* are diagnostic species of this association. Floristic composition composed of the diagnostic species of *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis,* and *Astragalo microcephali–Brometea tomentelli* classes and diagnostic species of those syntaxonomic units are similar to those of the other associations. In more moist parts of inner

parts of Central Black Sea Region, *Populo tremulae–Quercetum syspirensis* (Cansaran and Aydogdu 2001) association is also found from 1275 to 1350 m. *Quercus macranthera* subsp. *syspirensis* and *Populus tremula* are diagnostic species of that association. Diagnostic species of *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis* and *Astragalo microcephali–Brometea tomentelli* classes are represented.

A peculiar characteristic of Central Black Sea Region is the penetrance of Mediterranean climate to the inner parts. Mediterranean maquis and phrygana vegetation occur from sea level to 500 m. However, Mediterranean-type vegetation is also found above 1000 m in inner parts, especially along stream valleys (Kutbay and Kılınc 1995; Cansaran and Aydogdu, 2001; Karaer et al. 2010). For example, *Trifolio hirti-Cistetum laurifolii* (Cansaran and Aydogdu 2001) is found around Amasya city from 1000 to 1050 m. *Cistus laurifolius, Trifolium hirtum, Medicago coronata, Genista tinctoria, Lathyrus sphaericus, Psoralea bituminosa,* and *Scutellaria salviifolia* are diagnostic species. Diagnostic species of *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis, Astragalo microcephali–Brometea tomentelli,* and *Querco–Fagetea* class are represented in that association (Cansaran and Aydogdu 2001). In inner parts of Central Black Sea Region, it is also possible to see the effects of Mediterranean climate even in high altitudes and Mediterranean-type vegetation occurred above 1000 m. *Trifolio hirti–Cistetum laurifolii* (Cansaran and Aydogdu 2001) is found between 1000 and 1050 m. Diagnostic species are *Cistus laurifolius, Trifolium hirtum, Medicago coronata, Genista tinctoria, Lathyrus sphaericus, Psoralea bituminosa,* and *Scutellaria salviifolia*. Diagnostic species of *Carpino betuli–Acerion hyrcani* alliance, *Querco cerridis–Carpinetalia orientalis* order, *Quercetea pubescentis,* and *Astragalo microcephali–Brometea tomentelli* classes are represented. This also shows the difficulty of drawing a border between different vegetation types in Central Black Sea Region because different climate types are mixed (Kutbay and Kılınc 1995).

In inner parts of Central Black Sea Region, continental climate is seen. Steppe vegetation is found above 1000 m.

Steppe vegetation is seen especially along stream valleys. For example, *Daphno oleoidis–Astragaletum angustifolii* (Korkmaz et al. 2011) belongs to Mountainous Prepontic Belt and found in Kargı (Çorum city) between 1600 and 1700 m. *Astragalus angustifolius* subsp. *angustifolius* var. *angustifolius, Daphne oleoides* subsp. *oleoides, Marrubium cephalanthum, Euphorbia erythrodon, Euphorbia anacampseros* var. *anacampseros*, and *Polygala alpestris* are diagnostic species of that association. *Helianthemum nummularium* subsp. *tomentosum, Thymus spyleus* subsp. *rosulans, Teucrium chamaedrys* subsp. *chamaedrys, Myosotis alpestris* subsp. *alpestris, and Poa alpina* subsp. *fallax* are diagnostic species of *Onobrychido armenae–Thymetalia leucostomi* order. *Astragalo microcephali–Brometea tomentelli* class is represented by *Asperula nitida* subsp. *subcapitellata, Plantago holosteum, Hypericum orientale, Veronica orientalis* subsp. *orientalis, Hypericum linarioides, Erysimum smyrnaeum, Iberis taurica, Ajuga chamaepitys* subsp. *chia* var. chia, and *Helianthemum canum*. *Quercetea pubescentis* class is represented by only a few

species (*Bunium microcarpum* subsp. *bourgaei, Carex halleriana,* and *Rubus canescens* var. *glabratus*). *Linario corifoliae–Astragaletum microcephali* (Korkmaz et al. 2011) is found around Kargı and Osmancık (Çorum city) between 550 and 1300 m. *Astragalus microcephalus Callipeltis cucullaria* and *Linaria corifolia* are diagnostic species of that association. This association is composed of two subassociations, namely *stipetosum arabico* and *alyssetosum desertorum*. *Stipa arabica, Onosma isauricum, Erysimum crassipes,* and *Silene subconica* and *Alyssum desertorum* var. *desertorum, Morina persica* var. *persica, Bromus benekenii,* and *Cruciata pedemontana* are diagnostic species of *stipetosum arabico* and *alyssetosum desertorum*, respectively. *Lappula barbata, Ziziphora tenuior, Taeniatherum caput-medusae* subsp. *crinitum,* and *Ziziphora taurica* subsp. *taurica* are diagnostic species of *Astragalo karamasici-Gypsophilion eriocalycis* alliance. *Onobrychido armenae-Thymetalia leucostomi order* is represented by several species, namely *Astragalus leucothrix, Acantholimon acerosum* var. *acerosum,* and *Nepeta nuda* subsp. *albiflora. Logfia arvensis, Alkanna orientalis* var. *orientalis, Apera intermedia, Centaurea urvillei* subsp. *urvillei,* and *Hypericum origanifolium are* some of the diagnostic species of *Astragalo microcephali–Brometea tomentelli* class. Steppe vegetation is also widespread in inner parts of Central Black Sea Region where continental climate is dominant. For example, *Stachyi byzantinae–Astragaletum microcephali* (Cansaran and Aydogdu 2001) is found between 1050 and 1150 m in Eregli Mountain, Amasya city. *Astragalus microcephalus, Stachys byzantina, Carduus acanthodies* subsp. *acanthoides, Elymus repens* subsp. *elongatiformis, Peucedanum palimbioides, Alkanna orientalis* var. *orientalis, Astrodaucus orientalis, Verbascum caudatum, Paracaryum ancyritanum,* and *Astragalus albifolius* are diagnostic species of that association. *Teucrium chamaedrys* subsp. *chamaedrys, Marrubium parviflorum* subsp. *parviflorum,* and *Phlomis armeniaca* are diagnostic species of *Phlomido armeniacae–Astragalion microcephali* alliance. *Scabiosa argentea, Silene supina* subsp. *pruinosa,* and *Alyssum pateri* subsp. pateri are diagnostic species of *Onobrychido armenae–Thymetalia leucostomi* order. *Scutellaria orientalis* subsp. *pinnatifida, Acantholimon acerosum* (Willd.) Boiss. var. *acerosum,* and *Thymus sipyleus* subsp. *rosulans* are some of the diagnostic species of *Astragalo microcephali–Brometea tomentelli* class. In subalpine region of Amasya city, steppic *Saponario prostratae–Astragaletum microcephali* (Cansaran et al. 2010) association is found. Diagnostic species of this association are *Astragalus microcephalus* Willd., *Saponaria prostrata* Willd. var. *prostrata, Paracaryum ancyritanum* Boiss., *Cruciata laevipes* Opiz, *Paracaryum paphlagonicum* (Bornm.) R. Mill, and *Astragalus acmophyllus* Bunge. *Phlomido armeniacae–Astragalion microcephalit alliance* is characterized by *Teucrium chamaedrys* L. var. *chamaedrys*. *Linaria corifolia* Desf., *Anthemis tinctoria* L. var. *tinctoria*, *Lappula barbata* (Bieb.) Gürke, and *Centaurea virgata* Lam. are diagnostic species of *Onobrychido armenae–Thymetalia lecostomi* order. The most diagnostic species of *Astragalo microcephali–Brometea tomentelli* are *Herniaria incana* Lam., *Veronica multifida* L., *Cruciata taurica* (Pallas ex Willd.) Ehrend., *Centaurea triumfettii* All., and *Anthemis cretica* L. subsp. *anatolica* (Boiss.) Grierson. *Pilosello isauricae–Marrubietum astracanici* (Cansaran et al. 2010) is found between 1400 and 1570 m. *Marrubium astracanicum* Jacq. subsp. *astracanicum, Pilosella hoppeana* (Schultes) C.H. & F.W.

Schultz subsp. *isaurica* Hub.-Mor., *Onobrychis bornmuelleri* Freyn, and *Erysimum thyrsoideum* Boiss. subsp. *ponticum* (Hausskn. & Bornm.) Cullen are the diagnostic species of that association. The same syntaxonomical units with *Saponario prostratae–Astragaletum microcephali* (Cansaran et al. 2010) are found. For example, *Anthemis tinctoria* L. var. *tinctoria* and *Allium scorodoprasum* L. subsp. *rotundum* (L.) Stearn are diagnostic for of *Onobrychido armenae–Thymetalia lecostomi* order. *Polygala supina* Schreb., *Helianthemum canum* (L.) Baumg., *Ziziphora tenuior* L., *Nepeta nuda* L. var. *nuda,* and *Poa bulbosa* L. are diagnostic species of *Astragalo microcephali–Brometea tomentelli* class. *Sideritido dichotomae–Daphnetum oleoidis* association is found in subalpine region around Amasya city above 1400 m. *Daphne oleoides* Schreb. subsp. *oleoides, Sideritis dichotoma* Huter, *Thymus pubescens* Boiss & Kotschy ex Čk., *Morina persica* L. var. *decussatifolia* S. Erik & N. Demirkuş, and *Astragalus densifolius* Lam. subsp. *amasiensis* (Freyn & Bornm.) Z. Aytaç & Ekim are diagnostic species of that association. *Allium scorodoprasum* L. subsp. *rotundum* (L.) Stearn, *Centaurea virgata* Lam., and *Alyssum sibiricum* Willd. are diagnostic species of *Onobrychido armenae–Thymetalia lecostomi*. *Astragalo microcephali–Brometea tomentelli* class is characterized by several species, namely *Acantholimon acerosum* var. acerosum, *Festuca valesiaca* Schleicher ex Gaudin, *Sanguisorba minor* Scop. var. *muricata* (Spach) Briq., and *Koeleria cristata* (L.) Pers.

9.3.1 Probable Effects of Climatic Change

Ozturk et al. (2010) stated that global climate change is an integrated system of several atmospheric phenomena and their products. It has been expected that average global air temperature has increased by about 0.8 °C and this will take place by the year 2100. This phenomenon is called as "global warming." However, local climate in different geographical areas may become warmer and drier, cooler and wetter, or remain unchanged (Ozturk et al. 2010).

It has been found that oak forests in Europe have declined under conditions of global warming mainly due to oomycete root pathogen *Phytophthora cinnamomi* and the survival and degree of root disease caused by this fungus seem likely to be enhanced (Brasier and Scott 1994). Turkish forests also have a global relevance because Turkey has a unique geographical location. As a result of this, Turkey will play an important role under global climate change scenarios. First of all, Turkey may have an important phytogeographical role as a reservoir for species transfer both within Turkey and from Turkey to Europe and protect key gene pool reserves (Colak and Rotherham 2006).

Annual mean temperature will increase around 3–4 °C in the Central Black Sea Region, and reductions are expected in summer precipitation up to −10 % (ec.europa.eu/agriculture/analysis/external). After 1990's precipitation regime was changed in Black Sea Region and uniform rainfall distribution was not observed (Aslan et al. 2005).

Fig. 9.7 Steppe vegetation in inner parts of Central Black Sea Region

Forest vegetation is constantly disturbed as a result of clear-cutting and overgrazing in Central Black Sea Region (Karaer et al. 2010). As a result of the combined effects of the mentioned anthropogenic factors and global warming, the border of steppe vegetation may be extended and replaced by forest vegetation in Central Black Sea Region, especially in inner parts of the region (Fig. 9.7).

Conclusion

Central Black Sea Region has a unique vegetation because different climate types are mixed. Mediterranean, oceanic, and continental climates are seen. Mediterranean climate is seen from the sea level to 500 m. However, Mediterranean climate is also penetrated above 1000 m and along stream valleys. Oceanic climate is dominant in whole region. Continental climate is seen in inner parts. As a result of this, Euxine, Mediterranean, and steppe vegetation types are found. Different syntaxonomical units are found in associations belonging to these vegetation types. Syntaxonomical classification and interpretation of the vegetation of Central Black Sea region are too difficult. In addition to this, the vegetation of Central Black Sea Region may probably be changed due to anthropogenic factors and global warming. Owing to these factors, forest vegetation will be disturbed and the border of steppe and Mediterranean vegetation types may be extended.

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