AN INVESTIGATION ON THE DIVERSITY, DISTRIBUTION AND CONSERVATION OF POACEAE SPECIES GROWING NATURALLY IN ESKIŞEHİR PROVINCE (CENTRAL ANATOLIA–TURKEY)

CENGİZ TÜRE* AND HARUN BÖCÜK

Department of Biology, Faculty of Science, Anadolu University, Eskişehir, Turkey
*Author for Correspondence (e-mail: cture@anadolu.edu.tr, fax: +90 222 320 49 10)

Abstract

Turkey is located in the region where natural forms of important cultivated plant species show genetic diversity. In the present study, plant distribution and conservation strategies of Poaceae (Gramineae) species distributing naturally on steppe vegetation, getting important contributions to the plant diversity under anthropogenic effects were studied. During the study, 125 plant taxa belonging to 57 genera were determined. The research area is situated in the B3 square according to Davis’ grid system. Total number of species of the larger genera in the study area are as follows: Bromus L. 10, Poa L. 9, Aegilops L. 8, Phleum L., Stipa L. and Hordeum L. 6, Avena L. 5, Elymus L., Eremopyrum (Ledeb.) Jaub. & Spach, Lolium L., Alopecurus L., Melica L. and Secale L. 3. The phytogeographic elements represented in the research area are as follows: Euro-Siberian 20 (16.0%), Irano-Turanian 12 (9.6%), Mediterranean 6 (4.8%) and East Mediterranean 3 (2.4%). When the risk categories of the plant taxa are considered, it can be seen that 1 taxon is in VU (Vulnerable), 1 taxa in DD (Data Deficient) and 3 in LC (Least Concern) categories. Four (3.2%) species are endemic for Turkey.

Introduction

Turkey is located at the intersection of two important gene centers like Mediterranean and Near East and in the ninth order among all continental countries in terms of biodiversity. Natural races of most cereals cultivated as human food grow on steppe ecosystems (Vavilov, 1951; Anon., 2001a). The Poaceae (Gramineae), an important part of steppe ecosystems, is one of the largest families of flowering plants, with approximately 600 genera and 10,000 species in the World. The members of the family are widespread in all climates and regions. Grasslands, which make up 20% of the world’s vegetational cover, are composed of Poaceae members (Arabaci & Yıldız, 2004). The family has been mostly studied systematically, ecologically and genetically (Hubbard, 1948).

It is important to search the Poaceae members specially used in agricultural activities. Because the gene center of the most members of Poaceae family is Southwest Asia including Turkey (Davis, 1985). The main starch source of both human and animals except potato (Solanum tuberosum) is plant taxa belonging to Poaceae. Of the Poaceae genera mostly used in agricultural activities now, Triticum, Hordeum, Panicum and Avena, sown 7000 years ago in Central and East Anatolia (Harlon & Zohary, 1966; Türe, 2003), in the same regions where sowing of the plants belonging to the genera Oryza, Zea and Secale was started much more later (Charles, 1984). Although the species number belonging to Poaceae used in agricultural activities seems to be low, it comes in the first order among the plants used in agricultural activities.
Besides the nourishment values in ecosystems, some Poaceae taxa have also ecologically important functions like carrying out the most of the primer productivity, preserving the soil against erosion and getting the soil richer in terms of organic matters. These plants distribute in different habitats from subalpinic and xerophyte areas to aquatic ecosystems (Clayton & Renvoize, 1986).

Poaceae members distributing naturally are used as a gene source for their close relatives phylogenetically to achieve new and economically advanced characteristics (Mennan et al., 2003). Hybrid forms getting from natural populations of Hordeum vulgare L., Aegilops sp., Agropyrum elongatum (Host) Beauv., because of their rich protein contents (Reitz, 1976; Olson et al., 1987), Triticum, Elymus, Avena, Alopecurus, Agropyrum, Haynaldia, Scale, Eromopyrum are used because of their tolerance to the environmental conditions (Mennan et al., 2003). Specially, Elymus sp., Agropyrum elongatum L., have a wide tolerance to salinity and Triticum turgidum L., Aegilops squarrosa L., Agropyrum intermedium (Host) P. Beauv., Lophopyrum elongatum (Host) A. Love show resistance to drought (Farooq et al., 1994; Wynjones et al., 1984, Ebrahimzadeh et al., 2000) and Catapodium rigidum (L.) C.E. Hubbard ex Dony subsp. rigidum var. rigidum shows resistance to boron toxicity (Türe & Bell, 2004).

Except some Poaceae taxa used in perfume sector (Clayton & Renvoize, 1986), some Lolium taxa are also used to produce paper, flavor, fibers and board (MDF) (Anon., 2002). Poaceae taxa could be used for their genetic characteristics like Aegilops umbellulata Zhuk., Aegilops bicornis (Forsskal) Jaub. & Spach, Agropyrum elongatum, Agropyrum intermedium, Triticum dicoccum Schrank, Triticum monococcum L., Triticum timopheevi Zhuk., Agropyrum glaucum (Desf. ex DC.) Roemer & Schultes. showing quite resistance to rust and diseases (Anon., 1972; Parlevliet, 1981; Zitelli, 1974).

Genetically modified 96 different wheat races have been used in agricultural areas for the last 30 years in Turkey. But Triticum monococcum and Triticum dicoccum, natural race of the region, is about to be extinct because of not being used in agriculture any longer (Anon., 2001a).

Because of increased industrial activities, urbanization, tourism activities, creating new agricultural areas, mining activities, using agricultural methods and overgrazing, the natural structures of steppe ecosystems have been getting destroyed. So, development of Poaceae members is obstructed and the natural distribution areas of them are getting limited day by day (Mishra & Rawat, 1998; Ghazanfar, 1998; Ojeda et al., 2000; Victor & Dold, 2003; Türkmen et al., 2004).

The aim of the study was to determine the plant diversity, natural distribution and conservation characteristics of Poaceae family in Eskişehir region which could be used in different areas in future except the known characteristics.

**Study area:** Eskişehir, northwest of Central Anatolia, lies down between 29° 58' and 32° 04' east longitudes and 39° 06' and 40° 09' north latitudes and covers about 13.652 square kilometer. This province is with Black Sea region on the north, Marmara region on the northwest, Aegean region on the southwest. It is bordered by Bozdağ and Sündiken mountains on the north, Emirdağ mountain on the south, Sakarya valley on the east and Türkmen mountain on the west (Fig. 1) (Anon., 1981-1984; Türe, 2000a, Erdir & Türe, 2003).

**Major soil groups:** Agricultural activities are carried out nearly 42% of soils in Eskişehir. All types of major soil groups are available in the province. Specially, alluvial and colluvial soils covering about 100.000 ha lie down the level lands along the rivers. Agricultural activities can be mostly seen in these kind of areas (Türe & Bell, 2004; Türe & Köse, 2000).
Table 1. Some analysis values belonging to major soil groups in Eskişehir province.

<table>
<thead>
<tr>
<th>Major soil type</th>
<th>pH</th>
<th>Salt (%)</th>
<th>Calcerous (%)</th>
<th>Organic matter (%)</th>
<th>P₂O₅ (kg/d)</th>
<th>K₂O (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvial</td>
<td>7.77</td>
<td>0.079</td>
<td>11.73</td>
<td>2.31</td>
<td>9.36</td>
<td>198.6</td>
</tr>
<tr>
<td>Brown soil</td>
<td>7.86</td>
<td>0.069</td>
<td>13.61</td>
<td>1.93</td>
<td>6.47</td>
<td>161.1</td>
</tr>
<tr>
<td>Non-calcerous brown forest</td>
<td>7.42</td>
<td>0.049</td>
<td>12.2</td>
<td>2.33</td>
<td>6.79</td>
<td>130.5</td>
</tr>
<tr>
<td>Brown Forest</td>
<td>7.14</td>
<td>0.056</td>
<td>10.05</td>
<td>2.1</td>
<td>6.8</td>
<td>134.2</td>
</tr>
<tr>
<td>Non-calcerous brown</td>
<td>6.58</td>
<td>0.078</td>
<td>11.29</td>
<td>1.54</td>
<td>5.85</td>
<td>76.1</td>
</tr>
<tr>
<td>Hydromorphic alluvial</td>
<td>7.77</td>
<td>0.112</td>
<td>16.23</td>
<td>2.4</td>
<td>11</td>
<td>207.5</td>
</tr>
<tr>
<td>Red brown</td>
<td>7.66</td>
<td>0.047</td>
<td>19</td>
<td>1.59</td>
<td>5.13</td>
<td>123.4</td>
</tr>
<tr>
<td>Colluvial</td>
<td>7.71</td>
<td>0.083</td>
<td>18.34</td>
<td>1.56</td>
<td>7.06</td>
<td>160.6</td>
</tr>
</tbody>
</table>

Table 2. Bioclimate zone of the study area according to Emberger formula (1952).

<table>
<thead>
<tr>
<th>Station</th>
<th>Altitude</th>
<th>P</th>
<th>PE</th>
<th>M</th>
<th>m</th>
<th>S</th>
<th>Q</th>
<th>Bioclimate zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eskişehir</td>
<td>801 m</td>
<td>379,2</td>
<td>59,52</td>
<td>28,7</td>
<td>-3,7</td>
<td>2,1</td>
<td>40,9</td>
<td>Semi-dry Medit.</td>
</tr>
</tbody>
</table>

(P: Annual average precipitation (mm/m²), PE: Annual summer precipitation mm/m²), M: Average temperature of the hottest month (°C), m: Average temperature of the coldest month (°C), S: Value of dry season (PE/M), Q: Comparison of temperature-precipitation (2000.P.(M+m+546,4) . (M-m))

Table 3. Annual mean precipitation according to seasons and precipitation regime types according to data obtained from Eskişehir Meteorology Station (mm).

<table>
<thead>
<tr>
<th></th>
<th>Spring (Sp)</th>
<th>Summer (S)</th>
<th>Fall (F)</th>
<th>Winter (W)</th>
<th>Annual</th>
<th>Precipitation regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eskişehir</td>
<td>120,68</td>
<td>59,52</td>
<td>74,31</td>
<td>124,67</td>
<td>379,2</td>
<td>W.Sp.F.S.</td>
</tr>
</tbody>
</table>

Natural and common plant associations of brown soils in the area are short and middle meadow herbs. Brown forest soils are covered by deciduous trees and shrubs. Natural plants of non-calcareous brown forest soils of the area are deciduous forest trees. No specific climate type or plant taxa are available for alluvial soils. Usually, non-calcareous brown soils are covered by herbs and shrubs. Natural plants of red brown soils are short and middle meadow herbs (Anon., 1984). Some chemical and physical analyses of the major soil groups in the area are given in Table 1.

**Climate:** Although it seems to be a transition zone between the West and Central Anatolian climates, the climate of Eskişehir is hard and terrestrial. The altitudes of some areas like Porsuk and upper Sakarya plains can reach to 800-1000 m. The city is surrounded by mountains from south and north, and high plateaus from west. Because of this situation, the effects of Black Sea and Mediterranean climates on the city are blocked, but the west Anatolian climate can reach into the Eskişehir (Anon., 1981-1984). The annual mean temperature of the city is 10.9°C. December is the most rainy month, annual mean precipitation is determined as 386.6 mm. When the area is evaluated according to precipitation regime, it shows the characteristics of East Mediterranean Precipitation Regime Type 1 (WSpFS). When the meteorologic data is considered according to Emberger formula, it can be seen that the study area is in semi-dry Mediterranean bioclimate zone (Table 2 & 3) (Akman, 1990; Anon., 2000).

The dry period of Eskişehir is between June-September period according to Walter method (Fig. 2).
Fig. 1. Location of Eskişehir province

Fig. 2. Ombrothermic diagram of Eskişehir province
(a: City name, b: Altitude, c: Temperature and observation year number d: Mean annual temperature, e: Mean annual precipitation, f: Mean monthly temperature curve, g: Mean monthly precipitation curve, h: Dry period, i: Rainy period, k: Minimum temperature of the coldest month, l: Annual absolute minimum temperature, m: Absolute maximum temperature, n: Maximum temperature of the hottest month)
Poaceae (Gramineae) list of Eskişehir province

1. **Phyllostachys bambusoides**  Sieb. & Zucc.

2. **Brachypodium sylvaticum** (Hudson) P. Beauv.

3. **Brachypodium pinnatum** (L.) P. Beauv.

4. **Trachynia distachya** (L.) Link

5. **Agropyron cristatum** (L.) Gaertner subsp. *pectinatum* (Bieb.) Tzvelev var. *pectinatum*

6. **Elymus lazicus** (Boiss.) Melderis subsp. *divaricatus* (Boiss. & Bul.) Melderis

7. **Elymus hispidus** (Opiz) Melderis subsp. *barbulatus* (Schur) Melderis

8. **Elymus farctus** (Viv.) Runemark ex Melderis subsp. *farctus* var. *bessarabicus* (Savul & Rayss) Melderis

9. **Eremopyrum bonaepartis** (Sprengel) Nevski subsp. *bonaepartis*

10. **Eremopyrum bonaepartis** (Sprengel) Nevski subsp. *hirsutum* (Bertol.) Melderis

11. **Eremopyrum orientale** (L.) Jaub. & Spach.

12. **Ambylopyrum muticum** (Boiss.) Eig var. *loliaceum* (Jaub. & Spach) Eig

13. **Ambylopyrum muticum** (Boiss.) Eig var. *muticum* (Jaub. & Spach) Eig


15. **Aegilops cylindrica** Host.

16. **Aegilops umbellulata** Zhukovsky subsp. *umbellulata*

17. **Aegilops peregerina** (Hackel) Maire & Weiller

18. **Aegilops triuncialis** L. subsp. *triuncialis*

19. **Aegilops biuncialis** Vis.
20. Aegilops columnaris Zhukovsky
   Ir.-Tur. El.

   Medit. El.

22. Triticum baeoticum Boiss. subsp. baeoticum

23. Triticum aestivum L.


25. Secale cereale L. var. cereale

26. Secale cereale L. var. ancestrale (Zhuk.) Kit Tan
   End., VU.

27. Hordeum violaceum Boiss. & Huet
   Ir.-Tur. El.

28. Hordeum geniculatum All.
   Euro.-Sib. El.

29. Hordeum murinum L. subsp. glaucum (Steudel) Tzvelev

30. Hordeum murinum L. subsp. leporinum (Link) Arc. var. leporinum

31. Hordeum bulbosum L.

32. Hordeum distichon L.

33. Taeniatherum caput-medusae (L.) Nevski subsp. asper (Simonkai) Melderis

34. Taeniatherum caput-medusae (L.) Nevski subsp. crinitum (Schreber) Melderis

35. Henrardia persica (Boiss.) C.E. Hubbard var. persica
   Ir.-Tur. El.

36. Bromus racemosus L.
   Euro.-Sib. El.

37. Bromus intermedius Guss.

38. Bromus japonicus Thunb. subsp japonicus

39. Bromus scoparius L.

40. Bromus danthoniae Trin.
41. *Bromus tectorum* L.

42. *Bromus sterilis* L.

43. *Bromus cappadocicus* Boiss. & Ball. subsp. *cappadocicus*

44. *Bromus tomentollus* Boiss.

45. *Bromus benekenii* (Lange) Trim.

46. *Avena clauda* Durieu

47. *Avena barbata* Pott ex Link subsp. *barbata*

48. *Avena fatua* L. var. *fatua*

49. *Avena sativa* L.

50. *Avena byzantina* C. Koch.

51. *Helicorotrichon compressum* (Heuffel) Henrard

52. *Arrhenatherum elatius* (L.) P. Beauv. ex J. & C. Presl. subsp. *elatius*

53. *Venantata dubia* (Leers) Cosson

54. *Rostarira cristata* (L.) Tzvelev var. *cristata*

55. *Koeleria brevis* Steven


57. *Deschampsia caespitosa* (L.) P. Beauv.

58. *Aira elegantissima* Schur subsp. *ambigua* (Arc.) M. Doğan

59. *Aira caryophyllea* L.

60. *Calamogrostis pseudophragmites* (Haller fil.) Koeler

61. *Apera spica-venti* (L.) P. Beauv.


64. **Milium vernale** Bieb. subsp. montianum (Parl.) Jah. & Marie Euro.-Sib. El.

65. **Zingeria pistida** (Boiss.) Tutin Euro.-Sib. El.


67. **Alopecurus arundinaceus** Poiret Euro.-Sib. El.

68. **Alopecurus lanatus** Sm. End., E. Medit. El., LC.

69. **Alopecurus myosuroides** Hudson, var. myosuroides Euro.-Sib. El.

70. **Beckmannia eruciformis** (L.) Host. Euro.-Sib. El.

71. **Phleum alpinum** L. Euro.-Sib. El.

72. **Phleum pratense** L. Euro.-Sib. El.

73. **Phleum bertolonii** DC. Euro.-Sib. El.

74. **Phleum montanum** C. Koch. subsp. montanum Euro.-Sib. El.


76. **Phleum exaratum** Hochst. ex Griseb. subsp. exaratum Euro.-Sib. El.

77. **Festuca valesiaca** Schleicher ex Gaudin Ir.-Tur. El.

78. **Festuca callieri** (Hackel ex St-Yves) F. Markgraf subsp. callieri Ir.-Tur. El.

79. **Lolium perenne** L. Euro.-Sib. El.

80. **Lolium persicum** Boiss. & Hohen Ir.-Tur. El.

81. **Lolium rigidum** Gaudin var. rigidum Ir.-Tur. El.

82. **Catapodium rigidum** subsp. rigidum var. rigidum Ir.-Tur. El.
83. *Poa annua* L.

84. *Poa trivialis* L.

85. *Poa pratensis* L.

86. *Poa angustifolia* L.

87. *Poa compressa* L.

88. *Poa nemoralis* L.

89. *Poa sterilis* Bieb.

90. *Poa alpina* L. subsp. *fallax* F. Hermann


92. *Poa bulbosa* L.

93. *Catabrosa aquatica* (L.) P. Beauv.

94. *Puccinella distans* (Jacq.) Parl. subsp. *distans*

95. *Puccinella convoluta* (Hornem.) P. Fourr.

96. *Sclerochloa dura* (L.) P. Beauv.

97. *Dactylis glomerata* L. subsp. *glomerata*

98. *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman

99. *Cynosorus crisatus* L.

100. *Cynosorus effusus* Link.

101. *Briza media* L.

102. *Briza humulis* Bieb.

103. *Melica uniflora* Retz.

104. *Melica ciliata* L. subsp. *ciliata*
105. Melica persica Kunth subsp. jacquemontii (Decne. ex Jacq.) P.H.Davis
   Ir.-Tur. El.

106. Glyceria plicata (Fries) Fries

107. Stipa bromoides (L.) Dörfler
   Euro.-Sib. El.

108. Stipa capillata L.

   Ir.-Tur. El.

110. Stipa lessingiana Trin. & Rupr.

111. Stipa pontica P. Smirnov

112. Stipa pulcherrima C. Koch. subsp. crassiculmis (P. Smirnov) Tzvelev

113. Piptatherum coerulescens (Desf.) P. Beauv.

114. Phragmites australis (Cav.) Trin ex Steudel
   Euro.-Sib. El.

115. Aeluropus littoralis (Gouan) Parl.

116. Cynodon dactylon (L.) Pers. var. dactylon

117. Cryptis aculeata (L.) Aiton

118. Echinochloa crus-galli (L.) P. Beauv.

119. Paspalum paspalodes (Michx.) Scribner

120. Setaria viridis (L.) P. Beauv.
   Ir.-Tur. El.

121. Pennisetum orientale L.C.M. Richard

122. Saccharum strictum (Host.) Sprengel

123. Sorghum halepense (L.) Pers. var. halepense

124. Chrysopogon gryllus (L.) Trin. subsp. gryllus

125. Botriochloa ischaemum (L.) Keng.
**General vegetation structure:** The province is between the West Anatolia forest region and Central Anatolia steps (Atalay, 1994). The dominant plant taxa in Dursunbey region on east, the part of the city located in west Anatolia, is *Pinus nigra* forests. The same plant cover cannot be seen on the plateaus of Kütahya, Afyonkarahisar and Eskişehir. In the mountainous areas among the plateaus, plant cover can be rich with increasing humidity (Türe, 2003). This restricted plant cover is completely disappeared in the border of Central Anatolia steppe. The part in the West Anatolia of the city is rich in terms of forests. The areas, taking more and periodic precipitation during the year are Bozdağ-Sündiken mountains and their extensions on the north and Türkmen mountains and their extensions on the west. In these areas, the forests has the needle leaved plants like *Pinus sylvestris* L., *Pinus nigra* Arnold., *Pinus brutia* Ten. and *Juniperus* sp. The needle leaved forests are surrounded by forests consisting of *Quercus* sp., and other decidous plants (Çetik, 1985).

Most of the upper Sakarya river basin, locating on the south of Eskişehir, is in the Central Anatolia steppe region. In this region, precipitations are low and non-periodic. Forests in the border of Sakarya river basin is damaged because of being destroyed. Foots of the river basins are changed to steppy areas because of hard grazing. Dominant plant taxa of steppe are *Astragalus* sp., *Capsella* sp., *Peganum* sp., and *Cirsium* sp., (Atalay, 1994; Akman, 1993; Akman, 1995).

The present reports gives an account on the diversity distribution and conservation of *Poaceae* species growing naturally in Eskisehir province in Central Anatolia, Turkey.

**Material and Methods**

The materials of the present study are the plant taxa belonging to *Poaceae* collected during the field studies carried out during the vegetation periods in different years and other studies carried out in the region until now (Davis, 1985; Davis, 1988; Ekm, 1977; Ekm, 1978; Ekm & Akman, 1991; Türe et al., 1999; Türe, 2000a; Türe et al., 1996; Erdir & Türe, 2003; Ocak & Türe, 2001; Türe & Köse, 2000; Türe & Böcük, 2001; Böcük, 2002; Uryan, 2000; Türe & Bell, 2004).

The herbaria of Middle East Technical University, Ankara University and Gazi University were used for checking and identification of the plant materials. The flora of Turkey and other resources were used for identification (Davis, 1985, Güner et al., 2000; Heywood, 1963-1980; Doğan, 1991; Doğan, 1999). The *Poaceae* species were either identified or checked by Prof. Dr. Musa Dogan from the Middle East Technical University. The author names of the plants were checked according to Brummitt & Powell (1992). Except the plant scientific names phylogenetically, phytogeographic areas, endemism and risk categories were also given under the coordinated distribution map in the plant list. Besides, the distribution of the plant taxa determined in the area are shown on a map. Abbreviations were used to indicate the phytogeographic regions of taxa if known, Irano-Turanian as Ir.-Tur., Euro-Siberian as Euro.-Sib., Mediterranean as Medit., East Mediterranean as E. Medit., endemic as End. And risk categories if known, Vulnerable as VU, Data Deficient as DD, Least concern as LC (Anon., 2001b; Ekim et al., 2000).

**Results and Discussion**

Most of the plant taxa in the study area between the Anatolia forest region and Central Anatolia steppies are composed by the plant taxa belonging to *Poaceae* (Çetik, 1985; Atalay, 1994). So, it is therefore important to know the *Poaceae* diversity when the general plant diversity and ecological structure of the area is determined.
Over 130 Poaceae genera in Turkey are available and 634 Poaceae taxa are distributed in Turkey (Davis, 1985; Davis et al., 1988; Güner et al., 2000; Seçmen et al., 1986). Eleven genera and 29 species are cultivated (Arabaci & Yıldız, 2004).

In Eskişehir province and its environs, 57 Poaceae genera were determined when the genera revisions related to Poaceae in the Flora of Turkey were considered (Table 4) (Davis 1985). These data show that Eskişehir region has 42.5% of all Poaceae genera in Turkey. This ratio is quite important if the borders of the study area are considered.

At the end of the studies, 125 plant taxa were determined in the study area. According to these data, 19.7% of Poaceae taxa in Turkey distributed in Eskişehir province.

The phytogeographical distribution of the plant taxa determined in the study area are given in Table 5. It can be seen that Euro-Siberian Elements have the most number of plant taxa in the study area and it is followed by Irano-Turanian and Mediterranean Elements, respectively. Although the study area is in the Irano-Turanian phytogeographic region, it is really remarkable that Euro-Siberian elements have the greater number of plant taxa.

Nearly 14% of Poaceae species and 30% of total plant taxa are also endemic for Turkey (Davis, 1985). Poaceae family thus contributes about 2% to the endemism ratio of Turkey. When the relationship between the endemism ratio and phytogeographical region in Turkey is checked, it can be seen that Irano-Turanian phytogeographic region have the most number of plant taxa. And it is followed by Mediterranean and Euro-Siberian Elements, respectively. This situation can be explained by the change during the geological ages and topographic structure of the country (Seçmen, 1986; Türe, 2000b; Türk & Güner, 2003; Türe et al., 2004). Four (3.2%) endemic Poaceae taxa were determined for Eskişehir region. Although the study area is in the Irano-Turanian phytogeographical region, the number of endemic plant taxa are quite low. It is thought that low endemism ratio of Poaceae taxa in the study area is because of the contribution of Euro-Siberian elements to the flora (Seçmen, 1986; Türe & Tokur, 2000).

Risk categories of the determined plant taxa were considered in plant list (Table 6) according to Red Data Book of Turkish plants (Anon., 2001b; Ekim et al., 2000). It is determined that 3 plant taxa were in LC (least concern), 1 was in VU (vulnerable) and 1 in DD (data deficient) risk categories. Monitoring of these taxa are quite important for preserving the biological diversity. Currently, a lot of plant taxa become extinct and lost their distributing areas because of both anthropogenic and natural causes (Cepel, 1997; Stohlgren et al., 2000; Stohlgren et al., 1997, Türkmen et al., 2004). About 28% of Turkey’s total area is covered by steppe ecosystems. But some of these steppe ecosystems is changed into agricultural areas, the rest (about 90% of total steppe ecosystems) is getting destroyed and barren as a result of overgrazing (Anon., 2001a).

To prevent this situation and reacquire the biological sources, it must be secured that land owners in the area should be in rehabilitation projects related to conservation from planning stage to application. Advanced rehabilitation-restoration studies and new conservation strategies is needed to be developed by considering potential effects on ecosystems and species under the light of scientific researches.

The plant taxa distributed naturally in the study area are shown on a coordinated map with the information related to phytogeographical characteristics, endemism and risk categories to know the distributing localities and monitor the taxa easily.
In this study Poaceae diversity and distribution which should be known because of their economic and ecological values in Eskişehir province were determined. Monitoring opportunity of the species with the help of the coordinated maps will be able to help to know the biological diversity and preserve the gene sources.

**Acknowledgement**

We want to thank to Prof. Dr Musa Doğan of the Middle East Technical University, Ankara, Turkey for his encouragement and support.
References


POACEAE GROWING IN ESKİŞEHİR PROVINCE CENTRAL ANATOLIA–TURKEY


(Received for publication 15 May 2005)