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Environmental relationships of the vascular flora alongside the railway tracks between Haydarpaşa and Gebze (Istanbul-Kocaeli/ Turkey)

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Abstract

The vascular flora alongside the railway track between Haydarpasa and Gebze in Turkey was investigated and the floristic features of the study area are presented here. The investigation was undertaken during 2003-2009. In total 194 plant taxa were determined. Out of these 174 were naturally growing and 20 were exotics and cultivated. Native taxa within the flora belonged to 135 genera and 50 families, exotic and cultivated taxa belonged to 20 genera and 15 families. The members of Dicotyledonae constituted of 82.76% and Monocotyledonae 16.09% of the native taxa. The highest number of these taxa belonged to Asteraceae family (25 species), while the exotics were from Rosaceae (5 species). The plant distributional features, phytogeographical elements, life forms, archaeophytes and neophytes and status of invasive plants have also been included.

Key words

Istanbul, Kocaeli, Railway track flora, Turkey

Introduction

The synanthropic flora of railway stations and adjacent areas are strongly affected by diversity of transported and transshipped loads of plant origin. The site specificity of railway grounds favors the appearance and spread of many interesting taxa. Native vegetation is cleared at certain interval from railway tracks and their surroundings; hence the alien plants face no competition from native plants. The natural species here are accidentally introduced ones but their proportion is little despite the convenient site conditions. Some other plant taxa appear only spontaneously and die quickly. There are continuous changes in the floristic composition alongside the railway tracks and routes (Dony, 1955; Brandes, 2002; Czarna, 2005). The flora of Thalkirchen Station near Munich has been identified as part of alien species that rail traffic has provided. 84 taxa are associated with the transport of grains, dominated particularly by annuals and biennials from Brassicaceae (19 spp.) and Asteraceae (22 spp.) (Kreuzpointner, 1876). A large proportion of such habitats in Switzerland are well associated with railways (Thellung, 1905). Muhlenbach studied adventive flora of the railroads in Riga, Latvia for 20 years (1924-1944). During these years, 128 species recorded were not native to Latvia, but were introduced by railroads (Muhlenbach, 1927, 1979). Further, the adventive flora of railroads of St. Louis from 1954 to 1971, which has the second largest railroad network in the United States was also reported. During 563 excursions, 393 synanthropes (adventive plants not native to the flora of Missouri) were found on the railroad network (Muhlenbach, 1957, 1960, 1969). Similarly, over a decade after the railway flora in Bedfordshire in the United Kingdom was published by Dony (1955), another study was carried out on the railway flora of Rutland by Messenger (1968). These were

followed by the studies on the railway vegetation by Sargent (1984). The information on the ferns of 63 Central European railway stations had been given by Wittig (2002). A total of 183 species have been recorded from Luchow Railway Station in Lower Saxony, Germany (Brandes, 2002). Earlier the flora of railway station in northern Germany (Brandes, 1984), the vascular flora of Trento Railway Station in Italy (Brandes, 2003 a) and the urban and railway flora of Strasbourg (Brandes, 2003 b) was also reported.

Till date, no studies have been carried out on the vascular flora alongside the railway tracks of Turkey. Therefore, the present study was carried out on the railway vascular flora between Haydarpasa and Gebze (Istanbul and Kocaeli / Turkey) together with their some ecological features.

Materials and Methods

Study area : Haydarpasa Railway Station is the biggest station in Istanbul and it is the starting point of the railways from Istanbul to Anatolia. The study area located between Haydarpasa to Gebze line is about 50 km long, located parallel to the North-East of Marmara Sea (Fig. 1). There are 26 stations (Table 1), and the main stations are numbered in Fig. 1. This railway line lies along Haydarpasa within the boundaries of Kadikoy District-Istanbul to Gebze District-Kocaeli from east to west. It is of great importance because of lightening the traffic load of the Anatolian side of Istanbul and 35% of the passengers are transported on this line (Koday, 2000).

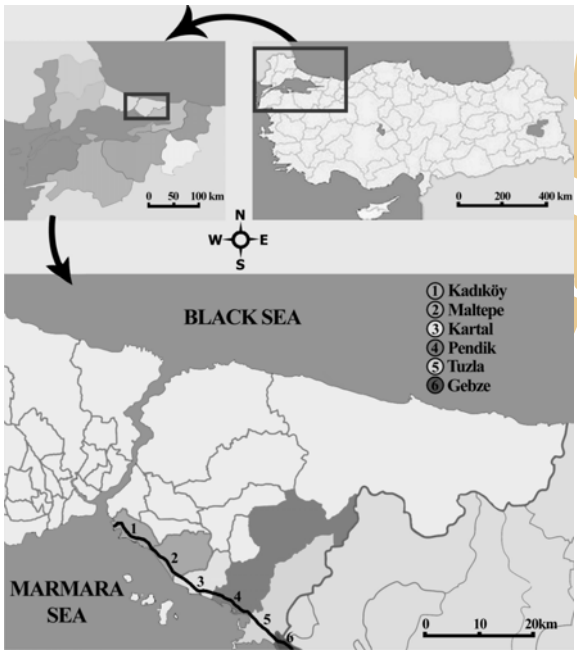

Fig. 1: Map showing the areas investigated in Istanbul and Kocaeli Cities (line depicts Haydarpasa Gebze railway line)

The climate of the study area is of Mediterranean type, semi-arid with little-rains, mixed up with the oceanic climate of the Black Sea region. Average annual temperature is 14.5 ºC. January is the coldest month with a monthly average temperature of 2.8 ˚C, while August is the hottest month with monthly average temperature of 29.2 ˚C. Precipitation is spread over year round, but is concentrated during December and January. The rain regime is W. A. Sp. Su. (winter, autumn, spring, summer). Average annual rainfall is about 771.7 mm (DMI, 2006). The type of rain regime is "central-little rainfall Mediterranean regime" (Akman, 1999).

The present study was carried out during growth season between 2003 to 2009. The plant samples were collected between the rail tracks and the area three meters around the lines during the vegetation periods. The plant samples were dried using standard herbarium techniques. Plant samples were identified with the help of "Flora of Turkey and the East Aegean Islands", (Davis, 1965-1985; Davis *et al*., 1988; Guner *et al*., 2000). The specimens were deposited at the MUFE Herbarium (Marmara University, Science and Arts Faculty Herbarium). The flora is listed in the appendix 1-2 and the floristic list is arranged in alphabetical order as genera and species. Life forms [phanerophytes (Ph), chaemaphytes (Ch), hemicryptophytes (H), therophytes (Th), geophytes (G), helophytes (He)] were identified

Table 1 : Names of the stations on Haydarpasa-Gebze line, their establishment dates and altitudes

Station	Year established	Altitude (m)
(1) Haydarpasa	1908	5
(2) Söğütlüçeşme	1872-1985	12
(3) Kızıltoprak	1872	12
(4) Feneryolu	1872	22
(5) Göztepe	1876	35
(6) Erenköy	1872	30
(7) Suadiye	1872	18
(8) Bostancı	1872	5
(9) Küçükyalı	1872	5
(10) İdealtepe	1966	10
(11) Süreyya plajı	1966	9
(12) Maltepe	1954	8
(13) Cevizli	1872	10
(14) Atalar	1977	8
(15) Kartal	1872	5
(16) Yunus	1872	5
(17) Pendik	1936	5
(18) Kaynarca	1967	5
(19) Tersane	-	8
(20) Güzelyalı	1959	5
(21) Aydıntepe	-	5
(22) İçmeler	1954	5
(23) Tuzla	1915	12
(24) Fatih	-	5
(25) Osmangazi	1954	16
(26) Gebze	1954	60

following Raunkiaer system (Raunkiaer, 1934) and phytogeographical elements [Euro-Siberian (Euro.-Sib. El.), Irano-Turanian (Ir.-Tur. El.), Mediterranean (Medit. El.), East Mediterranean (E. Medit. El.) and Euxine (Euxine El.)] were included with the scientific names of collected taxa. Following the taxa names, first the locality, station number (including altitude), date, phytogeographic origin (if known) and the life forms are given in Appendex 1-2.

The archaeophyte, neophyte and invasive plants have been classified following Pysek *et al*. (2002). The 1492 was an important year for archaeophytic and neophytic species because early voyages of Europeans in the American continent started a very active exchange between the flora of old world and the flora of new world (Wittig, 2004). Moreover some American and European authors used the terms aliens or invaders for these new species (Richardson *et al*., 2000; Wittig, 2004).

Results and Discussion

In total of 194 vascular plant species were identified. Out of these, 174 taxa were natural and 20 were exotics and cultivated. 174 native taxa belonged to 135 genera and 50 families. 20 exotics and cultivated belonged to 20 genera and 15 families (Appendix 1-2). A total of 144 native taxa (82.76%) were dicots, while 28 (16.09%) were monocots. Two native species (1.15%) were gymnosperms. Furthermore, 86 taxa (49.43%) were perennials, 84 taxa (48.28%) were annuals and 4 taxa (2.29%) were biennials in native flora. Families with highest number of native taxa were; Asteraceae (25 taxa, 14.37%), Fabaceae (22 taxa, 12.64%), Poaceae (18 taxa, 10.34%), Brassicaceae, Apiaceae, Lamiaceae and Liliaceae (7 taxa, 4.02%). Asteraceae had the highest proportion in the floristic list as compared to other families. Similar findings were earlier reported by Brandes (1992), Altay *et al*., (2010a) and Osma *et al*., (2010). Pavlova and Tonkov (2005) emphasized that Asteraceae had a wide range with its high species number in Central Europe due to remarkable success of this family in terms of dispersal and establishment. When compared with other studies around the railway sites in other countries, similar results were reported from Northern Germany, Italy and France (Table 2). In this study, native species of Fabaceae comprised of the second most abundant family, although Poaceae was second in some other published works (Brandes, 1984; 2003a). The reason could be that, other countries were located further north of Europe rather than the study area, therefore some differences in their floristic structure could be attributed to the difference in latitudes related with climatic variances. The most common genera were *Trifolium* (6 taxa, 3.45%), *Plantago* (4 taxa, 2.30%), *Geranium, Ranunculus, Polygonum, Erodium, Vicia, Euphorbia* and *Veronica* (3 taxa each, 1.72%). These findings differ from other published data mentioned above and could be due to differences of latitude and climate (Table 3).

For native plants, the largest group of life forms was therophytes (48.28%) and hemicryptophytes (27.59%). The percentages of other life forms were as follows: phanerophytes (14.37%), geophytes (8.04%), helophytes (1.15%) and chamaephytes (0.57%). Therophytes and hemicryptophytes were common in areas where Mediterranean climate was predominant (Akman and Ketenoglu, 1987), and showed highest ratio in the study area (Table 4). This situation could be explained due to environmental conditions, favoring plants with short life cycle (Zukowski *et al*., 1995; Piotrowska *et al*., 1997; Czarna 2005).

The most common phytogeographical elements found were Medit. El. (29 taxa, 16.67%), Euro-Sib. El. (14 taxa, 8.05%), E. Medit. El. (1 taxon, 0.57%) and Ir.-Tur. El. (1 taxon, 0.57%) for native plants. This can be attributed to the fact that the research area was mostly affected by Mediterranean climate, and northern side was partly affected by the oceanic climate, which explains the growth of plant taxa belonging to the Euro-Sib. El. (Altay *et al*., 2010 a, b; Osma *et al*., 2010).

Table 2 : A comparison of percentage of families including highest number of taxa alongside Haydarpasa-Gebze railway and other studied railways in other countries

Family	Study Area	Northern Germany	Trento Italy	Strasburg France
Asteraceae	14.37	17.07	14.86	18.42
Fabaceae	12.64	1.21	5.40	3.50
Poaceae	10.34	15.85	16.21	12.28
Brassicaceae	4.02	4.87	4.05	3.50

References: Northern Germany (Brandes, 1984), Trento-Italy (Brandes, 2003a), Strasburg-France (Brandes, 2003b)

Table 3 : A comparison of ratios of some large genera (%) collected from Haydarpasa-Gebze railway and other studied railways (references given in Table 2)

Genera	Study area	Northern Germany	Trentoltaly	Strasburg France
Trifolium	3.45	-	1.35	1.75
Euphorbia	2.30	1.21	2.70	1.75
Vicia	1.72	-	-	-
Veronica	1.72	-	1.35	-

Table 4 : A comparison of the life forms ratios around Haydarpasa-Gebze railway and other studied railways (references given in the Table 2)

Life form	Study area	Northern Germany	Trentoltaly	Strasburg France
Therophytes (Th)	48.28	41.46	45.94	26.31
Hemicryptophytes (H)	27.59	24.39	24.32	25.94
Phanerophytes (Ph)	14.37	15.85	10.81	15.78
Geophytes (G)	8.04	2.43	6.75	8.77
Chaemaphytes (Ch)	0.57	1.21	1.35	1.75

Table 5 : A comparison of ratios of phytogeographic elements in the flora of Haydarpasa-Gebze railway and other studied railways (references in the Table 2)

Phytogeographic Origin	Study Area	Northern Germany	Trentoltaly France	Strasburg
Medit. and E. Medit. El.	17.24	5.21	12.20	18.87
Euro-Sib. El.	8.05	10.97	6.75	7.28
Ir. Tur. El.	0.57	-	-	-

In the research area, 5 taxa (2.87%) were cosmopolitan and 36 taxa (20.69%) were widespread. No endemic taxa were recorded from the study area. The most common native plant species were *Avena sterilis* L., *Bromus sterilis* L., *Agrostis capillaris* L., *Rubus canescens* DC. var. *canescens, Ailanthus altissima* (Miller) Swingle and *Parietaria judaica* L. (the last taxon was only found on the station walls).

There were 36 (18.56%) archaeophytes and 33 (17.01%) neophytes, 7 being invasive. The changes in environmental factors in human altered sites provide specific niches, which were colonized by aliens better than the native species (Wittig, 2004). High temperature and more limited soil moisture are the characteristic features on rural to urban gradients and alien species in temperate zones originate from warmer areas (Scholz, 1960; Saarisalo-Taubert, 1963; Wittig, 2004).

In the present study, three of the invasive taxa were woody plants (*Ailanthus altissima*, *Robinia pseudacacia* and *Acer negundo*), which showed common distribution here as well as in the urban flora of Istanbul (Altay *et al*., 2010 a; Osma *et al*., 2010). However, *Ailanthus altissima* mostly appeared along the railway lines, since municipalities removed this plant from the city. Moreover, few species like *Calendula officinalis* L. and *Mirabilis jalapa* L. escaped from gardens, found along the railways, joined the railway flora.

Ailanthus altissima one of invasive species, in the research area had a natural distribution in China and North Vietnam. The most important features of this plant are that it produces a plenty of fruit and its seeds are easily germinate. It was considered as one of the most common invasive plant in Europe as well. This tree was also reported to be highly resistant to air pollution (Kowarik and Samuel, 2007). Another invasive species found in the study area was *Acer negundo*, whose natural range was North and Central America. It was found in parks and near roadsides because of its fast growth (Medrzycki, 2007).

In the present study, 22 tree species were recorded (11.34% of the total Railway vascular flora), 11 of these were indigenous, and 11 were exotics and cultivated. Amongst the indigenous flora of central Europe only 1.8% were trees (Ellenberg, 1996; Brandes, 2002).

A comparison with the railway flora studies in different countries, *Convolvulus arvensis* was seen as a common species (Sargent, 1984; Brandes 1984, 2002, 2003 a,b; Czarna 2005; Warcholinska and Suwara-Szmigelska, 2009). This plant showed Archeophyte features, when considered as a ruderal plant. It was native of Eurasia (Saad, 1967) but spread to many parts of the world and presently grows as a cosmopolitan species between 60° N and 45° S latitudes. The species has been found successful in many types of climates, including temperate, tropical, and Mediterranean. In addition, it is also accepted as a serious weed in Argentina, Australia, Borneo, Sri Lanka, France, Germany, Greece, India, Iran, Lebanon, New Zealand, Pakistan, South Africa, the Balkan Peninsula, and forms a "principle" or "common" weed in 34 other countries including Japan, the former Russia and Finland (Holm *et al*., 1991).

Conyza canadensis was found with majority of invasive species in other railway floral studies. In stressed habitat; summer-drought, nutrient deficiency and moderate disturbance combined to favor small annuals and short-lived perennials like *Conyza canadensis*. This plant is more typical of warmer and drier parts, but can penetrate marginally to suitable climatic zones by exploiting the xerothermic habitats (Gilbert, 1989).

It was observed that from Bostanci station to Haydarpasa, exotic floral elements increased while native floral elements decreased. The general situation was opposite in the area from Bostanci station to Gebze. In analyzing the socio-economic position of the people and urban structure from Bostancı to Haydarpasa, the increased urbanization and socio-economic structure of inhabitants resulted in cultivation of exotic plants, especially near stations for landscaping by municipalities. Nevertheless, when same analysis was made from Bostancı to Gebze, due to poor socio-economic structure of inhabitants, rural and agricultural areas increased and resulted in increased native floral elements. During the past decade, increased urbanization and socioeconomic structure of Kartal and Pendik districts has changed and as a result, Pendik district became the new border line for the exotic and native plants, instead of Bostanci district.

In addition, mowing of lawns, even uprooting of some perennial herbs and trimming of trees especially near railroads by the municipalities reduce plant diversity of railways and it is believed that, population of exotic plants in railways will increase in near future. Furthermore, during periodic maintenance and repair periods of railroad tracks, addition of gravel and gravelly soils results in thinning of vegetation, and in this thinned area new ruderal plants start growing, so the structure of flora keeps on changing.

Although railway plants are growing in both urban and rural areas, railways are stressed habitats and include cinder and ballast, masonry and rock cuttings. Plants that are growing in these areas have more ecological tolerance than the plants growing away from this habitat. Use of specific term "Railway

Plants" is not a possible cause of the continuous change and incomings to the flora. The results of this study may be used as a basis for comparative analysis of railway floras in Turkey and nearby countries.

Railway and roadside flora are usually affected by the diversity of transport and transshipped loads of plants of different origin (Dogan *et al.*, 2004). The site specificity of railway grounds favors the appearance and spread of many plant taxa. Native vegetation is regularly divided into two parts by railway tracks and so the native plants do not make a very strong competition for the alien plants.

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Appendix-1: List of Naturally Growing Plants

SPERMATOPHYTA

GYMNOSPERMAE

CUPRESSACEAE

Cupressus sempervirens L. Kocaeli: Gebze; 26, 25.04.2005, Ph.

EPHEDRACEAE

Ephedra campylopoda C.A. Meyer Istanbul: Kartal; between 15 and 16, 12.05.2003, Ph.

ANGIOSPERMAE

MAGNOLIOPSIDA / DICOTYLEDONEAE

RANUNCULACEAE

Anemone coronaria L. Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Medit. El.

Ranunculus constantinopolitanus (DC.) d'Urv. Istanbul: Kartal; between 14 and 15, 12.05.2003, H, Widespread.

R. marginatus d'Urv. var. *marginatus* Istanbul: Kartal; between 14 and 15, 12.05.2003, Th.

R. muricatus L. Istanbul: Kartal; between 14 and 15, 12.05.2003, Th.

PAPAVERACEAE

Glaucium flavum Crantz Istanbul: Kartal; between 15 and 16, 12.05.2003, H, Widespread, Neophyte.

Papaver rhoeas L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread, Archaeophyte.

BRASSICACEAE

Capsella bursa-pastoris (L.) Medik. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, cosmopolitan, Archaeophyte.

Cardaria draba (L.) Desv. subsp. *draba* Istanbul: Kartal; between 15 and 16, 20.06.2004, H, Widespread, Archaeophyte, Invasive.

Lepidium graminifolium L. Istanbul: Kartal; between 15 and 16, 20.06.2004, H.

Raphanus raphanistrum L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.

Rapistrum rugosum (L.) All. Istanbul: Kartal; between 13 and 14, 25.05.2003, Th, Neophyte.

Sinapis arvensis L. Istanbul: Kartal; between 13 and 14, 25.05.2003, Th, Widespread, Archaeophyte.

Sisymbrium officinale (L.) Scop. Istanbul: Kadiköy; 6, 25.05.2003, Th, Widespread, Archaeophyte.

RESEDACEAE

Reseda lutea L. var. *lutea* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread, Archaeophyte.

CISTACEAE

Cistus creticus L. Istanbul: Tuzla; between 22 and 23, 01.05.2003, Ph, Medit. El.

PORTULACACEAE

Portulaca oleracea L. Istanbul: Kartal; between 15 and 16, 20.06.2004, Th, Archaeophyte.

CARYOPHYLLACEAE

Cerastium glomeratum Thuill. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, cosmopolitan, Archaeophyte.

Dianthus leptopetalus Willd. Istanbul: Tuzla; between 22 and 23, 15.06.2003, H.

Silene nocturna L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.

S. vulgaris (Moench) Garcke var. *vulgaris* Istanbul: Pendik; between 19 and 20, 02.05.2003, H.

Stellaria media (L.) Vill. subsp. *media* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.

POLYGONACEAE

Polygonum arenastrum Bor. Istanbul: Tuzla; between 22 and 23, 10.08.2004, Th.

P. aviculare L. Istanbul: Tuzla; between 22 and 23, 10.08.2004, Th, cosmopolitan, Archaeophyte.

P. lapathifolium L. Istanbul: Tuzla; between 22 and 23 (moisture soil in siding), 25.05.2003, Th.

Rumex crispus L. Istanbul: Maltepe; between 8 and 9, 25.05.2003, H.

R. pulcher L. Istanbul: Maltepe; between 8 and 9, 25.05.2003, H.

CHENOPODIACEAE

Chenopodium album L. subsp. *album* var. *album* Istanbul: Maltepe; between 8 and 9, 10.08.2004, Th.

MALVACEAE

Alcea pallida Waldst. & Kit. Istanbul: Kartal; between 15 and 16, 25.06.2005, H.

Malva sylvestris L. Istanbul: Kartal; between 15 and 16, 12.05.2003, H, Archaeophyte.

LINACEAE

Linum bienne Miller Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.
L. trigynum L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.

GERANIACEAE

Erodium cicutarium (L.) L'Hérit subsp. *cicutarium* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.
E. malacoides (L.) L'Herit. Istanbul: Tuzla; between 19 and 20, 10.05.2004, Th, Medit. El.
E. moschatum (L.) L'Herit Istanbul: Kadiköy; between 4 and 5, 10.05.2004, Th, Neophyte.
Geranium molle L. subsp. *molle* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.
G. purpureum Vill. Istanbul: Tuzla; between 22 and 23, 15.06.2003, Th.
G. rotundifolium L. Istanbul: Pendik; between 18 and 19, 10.05.2004, Th, Neophyte.

OXALIDACEAE

Oxalis corniculata L. Istanbul: Kadiköy; between 4 and 5, 10.05.2004, Th, cosmopolitan, Neophyte.

SIMAROUBACEAE

Ailanthus altissima (Miller) Swingle Istanbul: Kartal; between 15 and 16, 10.08.2004, Ph, Neophyte, Invasive.

RHAMNACEAE

Paliurus spina-christii Miller Istanbul: Tuzla; between 22 and 23, 15.06.2003, Ph.

ANACARDIACEAE

Pistacia terebinthus L. subsp. *terebinthus* Istanbul: Tuzla; between 22 and 23, 15.06.2003, Ph.

FABACEAE

Cercis siliquastrum L. var. *siliquastrum* Istanbul: Tuzla; between 22 and 23, 04.05.2003, Ph.
Dorycnium pentaphyllum Scop. subsp. *herbaceum* (Vill.) Rouy Istanbul:Tuzla;between 22 and 23,15.06.2003, H.
Hymenocarpus circinnatus (L.) Savi Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.
Lathyrus inconspicuus L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Th, Widespread.
Lotus corniculatus L. var. *corniculatus* Istanbul: Tuzla; between 22 and 23, 25.05.2003, H, Widespread.
Medicago orbicularis (L.) Bart. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Neophyte.
M. polymorpha L. var. *vulgaris* (Benth.) Shin. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread.
Melilotus officinalis (L.) Desr. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread, Archaeophyte.
Onobrychis oxydonta Boiss. Istanbul: Tuzla; between 22 and 23, 15.06.2003, H, Widespread.
Ornithopus compressus L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.
Psoralea bituminosa L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H, Medit. El.
Robinia pseudoacacia L. Istanbul: Kadiköy; 4, 05.06.2004, Ph, Neophyte, Invasive.
Spartium junceum L. Istanbul: Tuzla; between 22 and 23, 04.05.2003, Ph, Medit. El.
Trifolium angustifolium L. var. *angustifolium* Istanbul: Tuzla; between 22 and 23, 15.06.2003, Th, Neophyte.
T. campestre Schreb. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread.
T. nigrescens Viv. subsp. *nigrescens* Istanbul: Tuzla; between 22 and 23, 15.06.2003, Th.
T. pratense L. Istanbul: Kartal; between 15 and 16, 12.05.2003, H.
T. resupinatum L. var. *resupinatum* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Neophyte.
T. stellatum L. var. *stellatum* Istanbul: Tuzla; between 22 and 23, 25.05.2003, Th.
Vicia cracca L. subsp. *cracca* Istanbul: Kartal; between 15 and 16, 12.05.2003, H, Euro-Sib. El.
V. hybrida L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread.
V. sativa L. subsp. *nigra* (L.) Ehrh. var. *segetalis* (Thuill) Ser Istanbul: Maltepe; 12, 20.06.2004, Th.

ROSACEAE

Crataegus monogyna Jacq. subsp. *monogyna* Istanbul: Tuzla; between 22 and 23, 04.05.2003, Ph.
Potentilla reptans L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H, Widespread.
Rosa canina L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Ph.
Rubus canescens DC. var. *canescens* Kocaeli: Gebze; between 24 and 25, 04.05.2003, Ph, Widespread.
Sanguisorba minor Scop. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H.
Sarcopoterium spinosum (L.) Spach Istanbul: Tuzla; between 22 and 23, 15.06.2003, Ph, E. Medit. El.

CUCURBITACEAE

Ecballium elaterium (L.) A. Rich. Istanbul: Maltepe; between 8 and 9, 20.06.2004, H, Medit. El., Neophyte.

APIACEAE

Ammi visnaga (L.) Lam. Istanbul:Maltepe; between 8 and 9, 20.06.2004, Th, Neophyte.
Conium maculatum L. Istanbul: Kadiköy; between 6 and 7, 05.06.2004, Th, Invasive.
Daucus guttatus Sm. Istanbul:Maltepe; between 8 and 9, 20.06.2004, Th.
Eryngium campestre L. var. *virens* Link Istanbul: Kartal; between 15 and 16, 10.08.2004, H, Widespread.
Foeniculum vulgare Miller Istanbul: Kartal; between 15 and 16, 12.05.2003, H, Archaeophyte.
Scandix pecten-veneris L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread.
Tordylium apulum L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Medit. El.

ARALIACEAE
Hedera helix L. Istanbul: Kartal; between 15 and 16 (on the walls), 20.06.2004, Ph.
CAPRIFOLIACEAE
Sambucus ebulus L. Istanbul:Pendik; between 17 and 18, 20.06.2004, H, Euro-Sib. El., Archaeophyte.
VALERIANACEAE
Centranthus ruber (L.) DC. Istanbul:Pendik; 20, 20.06.2004, G, Neophyte.
DIPSACACEAE
Scabiosa columbaria L. subsp. *columbaria* var. *columbaria* Istanbul: Kartal; between 15 and 16, 20.06.2004, H
ASTERACEAE
Anthemis cf. *chia* L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.
A. cretica L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H.
Bellis perennis L. Istanbul: Kartal; between 15 and 16, 12.05.2003, H, Euro-Sib. El.
Calendula arvensis L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.
Carduus nutans L. Istanbul: Kartal; between 15 and 16, 12.05.2003, H.
C. pycnocephalus L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.
Carlina corymbosa L. Istanbul: Kartal; between 15 and 16, 10.08.2004, H, Medit. El.
Centaurea iberica Trev. ex Sprengel Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread.
C. solstitialis L. subsp. *solstitialis* Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, Widespread, Neophyte.
Cichorium intybus L. Istanbul: Kartal; between 15 and 16, 10.08.2004, H, Widespread, Archaeophyte.
Conyza canadensis (L.) Cronguist Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, Neophyte, Invasive.
C*repis neglecta* L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.
Echinops ritro L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H.
Helminthotheca echioides (L.) Holub Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, Neophyte.
Leontodon tuberosus L. Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Medit. El.
Matricaria chamomilla L. Istanbul: Kartal; between 15 and 16, 15.06.2003, Th.
Pallenis spinosa (L.) Cass. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Th.
Picris hieracioides L. Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, Euro-Sib. El.
Scolymus hispanicus L. Istanbul: Kartal; between 15 and 16, 20.06.2004, H, Medit. El.
Senecio vulgaris L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.
Silybum marianum (L.) Gaertner Istanbul: Kartal; between 15 and 16, 25.05.2003, H, Medit. El., Neophyte.
Sonchus asper (L.) Hill subsp. *glaucescens* (Jordan) Ball Istanbul: Kartal; between 15 and 16, 25.05.2003, Th, Widespread.
Tragopogon longirostris Bisch. ex. Schultz Istanbul: Tuzla; between 22 and 23, 25.05.2003, H
Urospermum picroides (L.) F.W. Schmidt Istanbul: Kartal; between 15 and 16, 25.04.2005, Th, Medit. El.
Xanthium strumarium L. subsp. *cavanillesii* (Scouw) D. Löve P. Dansereau Istanbul:Pendik; between 17 and 18, 20.06.2004, Th.
PRIMULACEAE
Anagallis arvensis L. var. *arvensis* Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.
A. arvensis L. var. *caerulea* (L.) Gouan Istanbul: Kartal; between 15 and 16, 12.05.2003, Th.
OLEACEAE
Ligustrum vulgare L. Istanbul: Kadiköy, 4, 20.06.2004, Ph, Euro-Sib. El.
Olea europaea L. var. *sylvestris* (Miller) Lehr. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Ph.
Phillyrea latifolia L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Ph, Medit. El.
APOCYNACEAE
Nerium oleander L. Istanbul: Kadiköy; 4, 20.06.2004, Ph, Medit. El.
CONVOLVULACEAE
Convolvulus arvensis L. Istanbul: Pendik; 17, 20.06.2004, H, Archaeophyte.
C. cantabrica L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H.
BORAGINACEAE
Echium vulgare L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, H, Archaeophyte.
Heliotropium europaeum L. Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, Archaeophyte.
SOLANACEAE
Solanum nigrum L. subsp. *nigrum* Istanbul: Kartal; between 15 and 16, 10.08.2004, Th, cosmopolitan, Archaeophyte.
SCROPHULARIACEAE
Veronica chamaedrys L. Istanbul: Tuzla; between 22 and 23, 06.05.2003, H, Euro-Sib. El.
V. cymbalaria Bodard Istanbul: Tuzla; between 22 and 23, 06.05.2003, Th, Medit. El.
V. persica Poiret Istanbul: Tuzla; between 22 and 23, 06.05.2003, Th, Neophyte, Invasive.
LAMIACEAE
Lamium amplexicaule L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Widespread, Euro-Sib. El., Archaeophyte.
L. purpureum L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Euro-Sib. El., Archaeophyte.
Rosmarinus officinalis L. Istanbul: Kadiköy; 4, 15.05.2005, Ph, Medit. El.

Salvia verbenaca L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Ch, Neophyte.
Stachys byzantina C. Koch Istanbul: Tuzla; between 22 and 23, 25.06.2005, H, Euro-Sib. El., Neophyte.
S. officinalis (L.) Trevisan subsp. *balkanica* (P. W. Ball) Bhat. Istanbul: Tuzla; between 22 and 23, 25.06.2005, H, Euro-Sib. El.
Teucrium chamaedrys L. Istanbul: Tuzla; between 22 and 23, 04.06.2006, G.

PLANTAGINACEAE

Plantago lagopus L. Istanbul: Kartal; between 15 and 16, 25.04.2005, Th, Medit. El.
P. lanceolata L. Istanbul: Kartal; between 15 and 16, 12.05.2003, H.
P. major L. subsp. *intermedia* (Gilib.) Lange Istanbul: Tuzla; between 22 and 23, 25.05.2003, H, Widespread.
P. scabra Moench Istanbul: Tuzla; between 22 and 23, 06.05.2003, Th, Widespread.

ELAEAGNACEAE

Elaeagnus angustifolia L. Istanbul: Kartal; 16, 20.06.2004, Ph, Widespread, Neophyte.

LAURACEAE

Laurus nobilis L. Istanbul: Tuzla; between 22 and 23, 20.06.2004, Ph, Medit. El.

SANTALACEAE

Osyris alba L. Istanbul: Tuzla; between 22 and 23, 06.05.2003, H, Medit. El.

EUPHORBIACEAE

Euphorbia helioscopia L. Istanbul: Kartal; between 15 and 16, 12.05.2003, Th, Archaeophyte.
E. peplus L. var. *peplus* Istanbul: Kartal; between 15 and 16, 20.06.2004, Th, Archaeophyte.
E. segueriana Necker subsp. *niciciana* (Borbas ex Novak) Rech. fil. Istanbul: Tuzla; between 22 and 23, 06.05.2003, H.
Mercurialis annua L. Istanbul: Tuzla; between 22 and 23, 06.05.2003, Th, Archaeophyte.

URTICACEAE

Parietaria judaica L. Istanbul: Kadiköy; between 1 and 2 (on the walls), 10.05.2003, H, Widespread, Neophyte.

ULMACEAE

Celtis australis L. Istanbul: Tuzla; between 22 and 23, 06.05.2003, Ph, Medit. El.

PLATANACEAE

Platanus orientalis L. Istanbul: Kartal; between 15 and 16, 20.06.2004, Ph, Widespread.

SALICACEAE

Populus tremula L. Istanbul: Kadiköy; 1, 10.05.2003, Ph, Widespread, Euro-Sib. El.

RUBIACEAE

Galium aparine L. Istanbul: Tuzla; between 22 and 23, 06.05.2003, Th.
Rubia tinctorum L. Istanbul: Tuzla; between 22 and 23, 20.06.2004, H, Widespread, Ir.-Tur. El., Neophyte.

MONOCOTYLEDONEAE

LILIACEAE

Asparagus acutifolius L. Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Medit. El.
Allium scorodoprasum L. subsp. *rotundum* (L.) Stearn Istanbul: Maltepe; between 12 and 13, 20.06.2004, G, Widespread, Medit. El.
Asphodelus fistulosus L. Istanbul: Kartal; between 15 and 16, 25.05.2003, G, Medit. El.
Muscari comosum (L.) Miller Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Widespread.
M. neglectum Guss. Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Widespread.
Ornithogalum sigmoideum Freyn and Sint. Istanbul: Kartal; between 15 and 16, 12.05.2003, G, Euro-Sib. El.
O. umbellatum L. Istanbul: Kartal; between 15 and 16, 12.05.2003, G.

DIOSCOREACEAE

Tamus communis L. Istanbul: Tuzla; between 22 and 23, 20.06.2004, Ph.

TYPHACEAE

Typha latifolia L. Istanbul: Kartal; between 15 and 16 (by the canal under the railway), 12.05.2003, He.

CYPERACEAE

Carex flacca Schreber subsp. *serrulata* (Biv.) Greuter Istanbul: Kartal; between 15 and 16, 25.05.2003, G.

POACEAE

Aegilops geniculata Roth. Istanbul: Tuzla; between 21 and 22, 04.06.2006, Th, Medit. El., Neophyte.
Agrostis capillaris L. var. c*apillaris* Istanbul: Kadiköy; between 4 and 5, 20.06.2004, H.
Alopecurus myosuroides Hudson Istanbul: Kartal; between 15 and 16, 20.06.2004, Th, Archaeophyte.
Avena barbata Pott ex Link Istanbul: Maltepe; between 8 and 9, 25.05.2003, Th, Neophyte.
A. sterilis L. subsp. *sterilis* Istanbul: Kartal; between 15 and 16, 25.04.2005, Th, Neophyte.
Briza maxima L. Istanbul: Tuzla; between 21 and 22, 04.06.2006, Th, Neophyte.
B. media L. Istanbul: Tuzla; between 21 and 22, 04.06.2006, G.
Bromus hordeaceus L. Istanbul: Kadiköy; 5, 25.05.2003, Th, Archaeophyte.
B. sterilis L. Istanbul: Kartal; between 15 and 16, 25.05.2003, Th, Widespread, Archaeophyte.
Catapodium rigidum (L.) C. E. Hubbard ex Dony Istanbul: Kartal; between 15 and 16, 25.05.2003, Th.
Cynodon dactylon (L.) Pers var. *dactylon* Istanbul: Tuzla; between 21 and 22, 10.08.2004, H, Archaeophyte.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman Istanbul: Kartal; between 15 and 16, 25.05.2003, H.

Hordeum bulbosum L. Istanbul: Kartal; between 15 and 16, 25.04.2005, G, Widespread.
H. murinum L. subsp. *leporinum* (Link) Arc. var. *leporinum* Istanbul:Kartal; between 15 and 16, 25.05.2003, Th.
Koeleria cristata (L.) Pers. Istanbul: Kadiköy; between 4 and 5, 20.06.2004, Th.
Lolium perenne L. Istanbul: Kartal; between 15 and 16, 25.05.2003, H, Euro-Sib. El.
Phragmites australis (Cav.) Trin. ex Steudel Istanbul: Maltepe; between 10 and 11 (by the canal under the railway), 10.05.2003, He, Widespread, Euro-Sib. El.
Poa infirma Kunth. Istanbul: Kartal; between 15 and 16, 25.05.2003, Th.

Appendix-2: List of Exotics and Cultivated Plants

ACERACEAE
Acer negundo L.
Istanbul: Kadiköy; between 4 and 5, 20.06.2004, Neophyte, Invasive.

AGAVACEAE
Agave americana L. Istanbul: Kartal; between 15 and 16, 10.05.2003.
Yucca gloriosa L. Istanbul: Kartal; between 15 and 16, 25.05.2003.

ARECACEAE
Chamaerops excelsa Thumb. Istanbul: Kadiköy; 4, 25.04.2005.

ASTERACEAE
Calendula officinalis L. Istanbul: Kartal; between 15 and 16, 25.04.2005, Neophyte.

BERBERIDACEAE
Berberis thunbergii (Koch) DC. var. *atropurpurea* Chenault Istanbul: Tuzla; between 22 and 23, 01.05.2003

CUPRESSACEAE
Thuja orientalis L. Istanbul: Kadiköy; 2, 01.05.2003.

FABACEAE
Wisteria sinensis (Sim.) DC. Istanbul: Kadiköy; 4, 04.05.2003.

HIPPOCASTANACEAE
Aesculus hippocastanum L. Istanbul: Kadiköy; 4, 20.06.2004, Neophyte.

IRIDACEAE
Iris germanica L. Kocaeli: Gebze; 26, 10.05.2003, Neophyte.

MAGNOLIACEAE
Magnolia grandiflora L. Istanbul: Kadiköy; 4, 12.05.2003.

MORACEAE
Ficus carica L. Istanbul: Kartal; between 15 and 16, 25.05.2003, Neophyte.

NYCTAGINACEAE
Mirabilis jalapa L. Istanbul: Kartal; between 15 and 16, 04.06.2006, Neophyte.

OXALIDACEAE
Oxalis floribunda Linn. Istanbul: Tuzla; between 22 and 23, 15.05.2005.

ROSACEAE
Cotoneaster franchetii Boiss. Istanbul: Tuzla; between 22 and 23, 04.05.2003.
Cydonia oblonga Miller Istanbul: Tuzla; between 22 and 23, 25.05.2003, Archaeophyte.
Malus sylvestris Miller Istanbul: Tuzla; between 22 and 23, 25.05.2003, Archaeophyte.
Prunus domestica L. Istanbul: Tuzla; between 22 and 23, 04.05.2003, Archaeophyte.
Pyrus communis L. Istanbul: Tuzla; between 22 and 23, 25.05.2003, Archaeophyte.

TAMARICACEAE
Tamarix parviflora DC. Istanbul: Kadiköy; 5, 04.05.2003.