

## A STUDY OF THE ROADSIDE PLANTS OF WEST ANATOLIA, TURKEY

YUNUS DOGAN<sup>1</sup>, SULEYMAN BASLAR<sup>1</sup>, ALI CELIK<sup>2</sup>,  
HASAN HUSEYIN MERT<sup>3</sup> & MUNIR OZTURK<sup>4</sup>

<sup>1</sup>Dokuz Eylul University Faculty of Education, Department of Biology, 35160 Buca, Izmir-Turkey (Phone: + 90 232 420 48 82, Fax: +90 232 420 48 95, e-mails: yunus.dogan@deu.edu.tr, suleyman.baslar@deu.edu.tr)

<sup>2</sup>Pamukkale University Faculty of Science-Art, Dept. of Biology, 20020 Denizli-Turkey (e-mail: acelik@pamukkale.edu.tr)

<sup>3</sup>Dokuz Eylul University Faculty of Education, Department of Biology, 35160 Buca, Izmir-Turkey (e-mail: hasan.mert@deu.edu.tr)

<sup>4</sup>Center for Environmental Studies (A Block) Ege University, Bornova, Izmir-Turkey (e-mail: munirozturk@hotmail.com)

Dogan, Y., Baslar, S., Celik, A., Mert, H. H. & Ozturk, M.: A study of the roadside plants of West Anatolia, Turkey. *Nat. Croat.*, Vol. 13, No. 1., 63–80, 2004, Zagreb.

In this study, roadside plants distributed throughout the link roads of all the cities in West Anatolia in Turkey were investigated. The length of the selected 17 roads is around 2700 km. The total number of samples collected from the study area is 271 taxa belonging to 57 families. Among them, Asteraceae, Fabaceae, Poaceae are the families that have the largest number of taxa, and *Bromus* L., *Rumex* L. and *Silene* L. are the genera that have the largest number of taxa. The most frequently found taxon throughout the selected roads is *Valerianella coronata* (L.) DC. and therophytes are the most frequently found life form.

**Keywords:** Roadside plant, ruderal, West Anatolia

Dogan, Y., Baslar, S., Celik, A., Mert, H. H. & Ozturk, M.: Studija o biljkama uz rub cesta (Zapadna Anatolija, Turska). *Nat. Croat.*, Vol. 13, No. 1., 63–80, 2004, Zagreb.

Istraživane su biljke uz rub svih cesta koje povezuju gradove u Zapadnoj Anatoliji u Turskoj. Duljina 17 izabranih cesta je iznosila oko 2700 km. Prikupljeni uzorci pripadali su 271 svojiti, odnosno 57 biljnih porodica. Među njima su najzastupljenije bile porodice Asteraceae, Fabaceae i Poaceae, a među rodovima to su bili *Bromus* L., *Rumex* L. i *Silene* L. Najčešće nađena svojita uz istraživane ceste bila je *Valerianella coronata* (L.) DC., a najčešći biljni oblik su bili terofiti.

**Cljučne riječi:** biljke uz rub cesta, ruderalna vegetacija, Zapadna Anatolija

## INTRODUCTION

HAMEL & DANSEREAU (1949) classified weed habitats according to ecological criteria. They grouped these habitats under the names of natural, degraded, ruderal, cultivated and artificial habitats. Roads and roadsides are included in the group »ruderal habitat«. Roads and roadsides provide an exceptional type of distribution habitat. Ruderal coenoses develop on walls, ruins, dumps along roadsides and slopes (POLDINI, 1992). Ruderal plants can be seen in places where human activities take place. As a result of human activities some species not natural in an area can migrate there, and therefore, other than the natural flora of the area, a ruderal flora is developed. Some other factors also affect the development of a ruderal flora in the area, for example, winds, animals, vehicles, etc. (FRENKEL, 1977).

Since the concept of ruderal is wide, this study has focused one of they elements, the roadside. The structure of the roadside habitat is basically formed by roads and road margins. Road substrata are generally formed by transported soil and compressed stones of different size. The road margin substrate is often completely different from that found at a distance from the road (FRENKEL, 1977). Roadsides are characterized by numerous ecological modifications including: treading, soil compaction, confined drainage, increased run-off, removal of organic matter and sometimes the addition of litter or waste material of frequently high nitrogen content, moving or crushing of tall vegetation, herbicide application, soil and rock additions related to slumping and rock falls, and altered microclimatic conditions associated with pavement and road right-of-way structures (FRENKEL, 1977).

The study area reflects the characteristics of the Mediterranean phytogeographic area, in the coastal parts; and the characteristics of the transition zone between the Mediterranean and the Irano-Turanian phytogeographic areas, in the inner parts. The mountains of the region go right up to the coastal zone. Therefore, the characteristics of Mediterranean phytogeographic area can be seen through mountain passes where the roads were built towards the inner parts. Since there is no study to be found in the literature on this topic it was thought to be valuable to identify the ruderal flora of the Western Anatolian part of Turkey.

## MATERIALS AND METHODS

In this study, 17 link roads between the cities of Canakkale, Balikesir, Manisa, Izmir, Usak, Denizli, Mugla and Aydin in Western Anatolia were selected. This study was carried out between 1999-2001. Each year during the months of July and October samples were collected from each road mentioned in Fig. 1. These roads and their lengths in kilometers were as follows: 1. Izmir-Ahmetbeyli-Kusadasi (73 km); 2. Kusadasi-Milas-Bodrum (170 km); 3. Milas-Mugla-Fethiye (230 km); 4. Yatagan-Aydin-Izmir (200 km); 5. Izmir-Bayindir-Tire-Odemis-Beydag-Nazilli (180 km); 6. Nazilli-Denizli (83 km); 7. Denizli-Kale (83 km); 8. Denizli-Civril-Cal-Alasehir (245 km); 9. Alasehir-Salihli (46 km); 10. Salihli-Turgutlu-Izmir (100 km); 11. Izmir-Manisa-Akhisar (90 km); 12. Akhisar-Demirci-Simav (193 km); 13. Simav-Gediz-Usak (106 km);

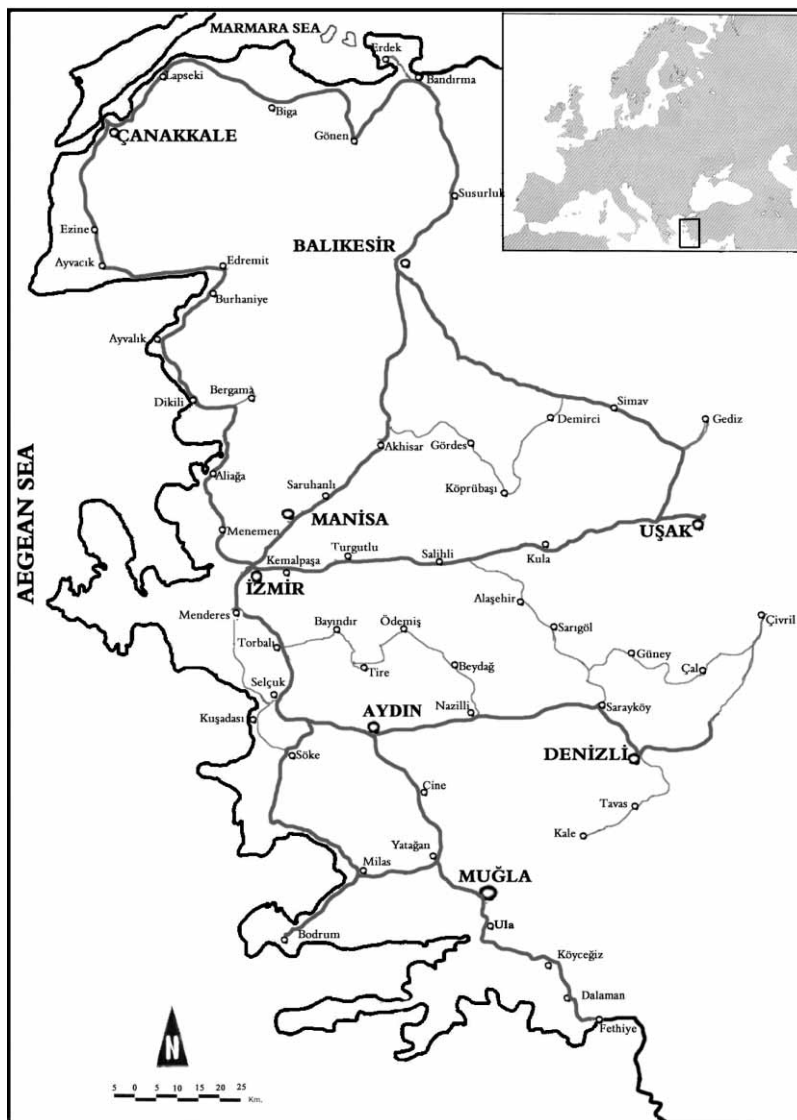


Fig. 1. Map of the study area.

14. Uşak-Salihli (121 km); 15. İzmir-Edremit-Canakkale (325 km); 16. Canakkale-Bandırma-Erdek (213 km); 17. Bandırma-Susurluk-Balıkesir-Akhisar (214 km).

Plant samples were collected from Zone A and Zone B of these roads according to FRENKEL's (1977) roadside zone arrangement. Collected samples were identified according to DAVIS (1965–1988) and kept in Buca Faculty of Education Herbarium. Life forms were classified according to RAUNKIAER (AKMAN & KETENOGLU, 1992).

Collected plants are presented in table form by families and genera in alphabetical order. The table shows the endemic plants, the roads where the plant samples were collected and the life form category. Moreover, in the table, plants referred to as roadside plant in different studies are also shown by a symbol referring to that study.

## RESULTS

The aim of this study is to identify roadside plants distributed along the main roads of Western Anatolian part of Turkey. The study area, the Western Anatolian part of Turkey, is about 100,000 square kilometers. The total length of the roads where the samples were collected is around 2700 km.

The number of samples collected in this study is 271 taxa under 54 families (Tab. 1). Among these families, Asteraceae are represented by 49 taxa, followed by Fabaceae (29), Poaceae (28), Lamiaceae (14) (Fig. 2). Genera represented by more than two species in the study area are presented in Fig. 3. Among these genera *Bromus* L. is represented by 7 taxa, followed by *Rumex* L. (5) and *Silene* L. (5).

**Tab. 1.** Plant samples collected from 17 roadsides in West Anatolia in Turkey.

Family and Taxa	Life forms	Roads	References
<b>Amaranthaceae</b>			
<i>Amaranthus albus</i> L.	Th	9,17	Davis (1965–1988), Polunin (1997)
<i>Amaranthus retroflexus</i> L.	Th	14	Davis (1965–1988), Polunin (1997)
<b>Anacardiaceae</b>			
<i>Pistacia lentiscus</i> L.	Ph	1,2,3	
<i>Pistacia terebinthus</i> L. subsp. <i>palaestina</i> (Boiss.) Engler	Ph	1,3,5,11,12,16	
<i>Rhus coriaria</i> L.	Ph	1,2,7,16	
<b>Apiaceae (Umbelliferae)</b>			
<i>Ammi visnaga</i> (L.) Lam.	Th	1,3	
<i>Coriandrum sativum</i> L.	Th	15,16	
<i>Daucus carota</i> L.	He	9,12	Polunin (1997)
<i>Echinophora tenuifolia</i> L. subsp. <i>sibthorpiana</i> (Guss.) Tutin	He	1,2,5,15,16	
<i>Echinophora tournefortii</i> Jaup & Spach	He	6,8	
<i>Ferula communis</i> L. subsp. <i>communis</i>	He	4,5,17	
<i>Foeniculum vulgare</i> Miller.	He	12,15,16	Polunin (1997)
<i>Scandix pecten-veneris</i> L.	Th	3,7	Davis (1965–1988)
<i>Tordylium apolum</i> L.	Th	1,5,8,15	Davis (1965–1988), Polunin (1997)
<b>Apocynaceae</b>			
<i>Nerium oleander</i> L.	Ph	4,11	

Family and Taxa	Life forms	Roads	References
<b>Araceae</b>			
<i>Arum nickellii</i> Schott	Cr	1,9,14,17	Davis (1965–1988)
<b>Asclepiadaceae</b>			
<i>Cynanchum acutum</i> L. subsp. <i>acutum</i>	He	3,5,6	Davis (1965–1988)
<b>Asteraceae (Compositae)</b>			
<i>Achillea falcata</i> L.	He	3,4	
<i>Achillea lycanica</i> Boiss et Heldr.	He	6,8	
<i>Achillea nobilis</i> L. subsp. <i>neilreichii</i> (Kerner) Formanek	He	6,7,11,13	
<i>Anthemis chia</i> L.	Th	1,3,4,5	Davis (1965–1988)
<i>Anthemis coelopoda</i> Boiss. var. <i>coelopoda</i>	Th	4,5,6,7,8	
<i>Anthemis cotula</i> L.	Th	1,4,5,15,	Davis (1965–1988)
<i>Anthemis tinctoria</i> L. var. <i>tinctoria</i>	He	8,13,15	
<i>Calendula arvensis</i> L.	Th	1,4,5,6,16	Davis (1965–1988)
<i>Cardopatum corymbosum</i> (L.) Pers	He	4,6,11,15	
<i>Centaurea melitensis</i> L.	Th	1,3,7,9,17	Frenkel (1977)
<i>Centaurea solstitialis</i> L. subsp. <i>solstitialis</i>	Th	1,2,4,6	Davis (1965–1988), Poldini (1992)
<i>Centaurea virgata</i> Lam.	He	6,8,13	Davis (1965–1988)
<i>Cichorium intybus</i> L.	He	12,13,15	Davis (1965–1988), Ozturk <i>et al.</i> (1990), Ozcelik & Ozturk (1991)
<i>Cirsium vulgare</i> (Savi) Ten.	He	7	Frenkel (1977), Davis (1965–1988)
<i>Cnicus benedictus</i> L. var. <i>benedictus</i>	Th	1,11	Davis (1965–1988), Ozcelik & Ozturk (1991)
<i>Conyza bonariensis</i> (L.) Cronq.	Th	1,4,11	Davis (1965–1988)
<i>Crepis foetida</i> L. subsp. <i>commutata</i> (Spreng) Babcock	Th	2,6,8,14,16,17	
<i>Crepis foetida</i> L. subsp. <i>rhoeadifolia</i> (Bich) Celal.	Th	11,13,16	
<i>Crepis zacintha</i> (L.) Babcock	Th	5,15,16,	
<i>Echinops pungens</i> Trautv. var. <i>pungens</i>	He	13	Davis (1965–1988), Ozcelik & Ozturk (1991)
<i>Echinops ritro</i> L.	He	7,9,16	
<i>Echinops viscosus</i> DC. subsp. <i>bithynicus</i> (Boiss.) Rechi	He	3,11,15	Davis (1965–1988),
<i>Filago pyramidata</i> L.	Th	1,4,6,8,16	Davis (1965–1988)
<i>Helianthus annuus</i> L.	Th	16	Frenkel (1977)
<i>Helichrysum stoechas</i> (L.) Moench. subsp. <i>barrelieri</i> (Ten.) Nyman	He	3,4,15,16,17	
<i>Hypochoeris glabra</i> L.	Th	1,3,16	Frenkel (1977)
<i>Hypochoeris radicata</i> L.	He	16,17	Frenkel (1977), Davis (1965–1988), Polunin (1997)
<i>Inula anatolica</i> Boiss.	He	3,7	

Family and Taxa	Life forms	Roads	References
<i>Inula graveolens</i> (L.) Desf.	He	2,4,5	
<i>Inula viscosa</i> (L.) Aiton.	He	3,5,15,16	Davis (1965–1988)
<i>Jurinea mollis</i> (L.) Reichb.	He	2,3,15	
<i>Lactuca serriola</i> L.	He	2,3,16	Frenkel (1977), Polunin (1997)
<i>Logfia gallica</i> (L.) Cossam & Germ.	Th	2,10,16	Frenkel (1977), Davis (1965–1988)
<i>Matricaria chamomilla</i> L. var. <i>chamomilla</i>	Th	2,5,6	Davis (1965–1988)
<i>Onopordum illyricum</i> L.	He	1,2,10,11,15	Davis (1965–1988)
<i>Picnemon acarna</i> (L.) Cass.	Th	5,15,17	
<i>Ptilestemon chamaepeuce</i> (L.) Less.	Ch	4,5	
<i>Scolymus hispanicus</i> L.	He	10,17	Davis (1965–1988), Ozturk <i>et al.</i> (1990)
<i>Scorzonera cana</i> (C.A. Meyer) Hoffm. var. <i>cana</i>	He	10,13	
<i>Scorzonera elata</i> Boiss.	He	3,4,10,11	
<i>Senecio vernalis</i> Waldst. & Kit.	Th	10,14	Davis (1965–1988), Ozturk <i>et al.</i> (1990)
<i>Senecio vulgaris</i> L.	Th	2,10,16	Davis (1965–1988), Ozturk <i>et al.</i> (1990)
<i>Silybum marianum</i> (L.) Gaertner	He	1,2,15	Davis (1965–1988), Polunin (1997)
<i>Sonchus oleraceus</i> L.	Th	5	Frenkel (1977), Davis (1965–1988)
<i>Tragopogon longirostris</i> Bisch. ex Schultz Bip. var. <i>longirostris</i>	Th	1,3,17	Davis (1965–1988)
<i>Tragopogon porrifolius</i> L.	Th	15	
<i>Xeranthemum annuum</i> L.	Th	11	
<i>Xanthium spinosum</i> L.	Th	1,13	Davis (1965–1988), Ozturk <i>et al.</i> (1990)
<i>Xanthium strumarium</i> L. subsp. <i>cavanillesii</i> (Schouw) D. Löve & P. Dansereau	Th	8,11	Ozturk <i>et al.</i> (1990)
<b>Boraginaceae</b>			
<i>Echium italicum</i> L.	He	6,8,13,14	
<i>Echium parviflorum</i> Moench	He	3,4	
<i>Echium plantagineum</i> L.	He	1,2,3	
<i>Heliotropium hirsutissimum</i> Grauer.	Th	1,5,9,11	
<b>Brassicaceae (Cruciferae)</b>			
<i>Alyssum desertorum</i> Stapf. var. <i>desertorum</i> .	Th	1,5,7,15	
<i>Alyssum fulvescens</i> Sibth. & Sm. var. <i>fulvescens</i>	Th	2,4,5	
<i>Capsella bursa-pastoris</i> L.	Th	1,4,9,14,17	
<i>Cardamine hirsuta</i> L.	Th	3,4,9,14,15,16	
<i>Cardaria draba</i> (L.) Desv. subsp. <i>draba</i>	He	1,2,6,8,9,10,	
<i>Hirschfeldia incana</i> (L.) Lag-Foss.	He	1,2,15	

Family and Taxa	Life forms	Roads	References
<i>Raphanus raphanistrum</i> L.	Th	2,3,15	
<i>Sinapis alba</i> L.	Th	2	Davis (1965–1988)
<i>Sinapis arvensis</i> L.	Th	5,15	Davis (1965–1988), Ozcelik & Ozturk (1991)
<i>Sisymbrium altissimum</i> L.	Th	2,3,6,7,12	Frenkel (1977)
<i>Sisymbrium orientale</i> L.	Th	10,13	Davis (1965–1988)
<b>Cactaceae</b>			
<i>Opuntia ficus-indica</i> (L.) Miller	Ph	3	
<b>Campanulaceae</b>			
<i>Campanula lyrata</i> Lam. subsp. <i>lyrata</i>	He	2,9	
<b>Endemic</b>			
<b>Capparaceae</b>			
<i>Capparis ovata</i> Desf. var. <i>herbacea</i> (Willd.) Zoh.	He	1,2,15	
<i>Capparis spinosa</i> L. var. <i>spinosa</i>	He	11,16	
<b>Caprifoliaceae</b>			
<i>Sambucus nigra</i> L.	Ph	5	
<b>Caryophyllaceae</b>			
<i>Silene compacta</i> Fischer.	He	4,13,15	
<i>Silene conoidea</i> L.	Th	14	
<i>Silene dichotoma</i> Ehrh. subsp. <i>dichotoma</i>	Th	10,15	
<i>Silene gallica</i> L.	Th	3,10,16	Frenkel (1977)
<i>Silene subconica</i> Friv.	Th	4,5,15	
<i>Spergularia rubra</i> (L.) J. & C. Presl	Th	15	Frenkel (1977)
<b>Chenopodiaceae</b>			
<i>Chenopodium album</i> L. subsp. <i>album</i> var. <i>album</i>	Th	6	Davis (1965–1988)
<i>Chenopodium botrys</i> L.	Th	9,17	Frenkel (1977), Davis (1965–1988)
<b>Cistaceae</b>			
<i>Cistus creticus</i> L.	Ch	1,4,5,10,11,16	
<i>Cistus parviflorus</i> Lam.	Ch	2,5,11	
<i>Cistus salvifolius</i> L.	Ch	3,4,5,8,17	
<i>Fumana thymifolia</i> (L.) Verlot var. <i>thymifolia</i>	Ch	5	
<b>Clusiaceae</b>			
<i>Hypericum atomarium</i> Boiss.	Ch	12	
<i>Hypericum empetrifolium</i> Willd.	Ch	2	
<i>Hypericum perforatum</i> L.	He	5	
<i>Hypericum triquetrifolium</i> Turra	He	8	
<b>Convolvulaceae</b>			
<i>Convolvulus arvensis</i> L.	He	4,6,7,9,10	Davis (1965–1988), Polunin (1997)
<i>Convolvulus compactus</i> Boiss.	Ch	4	

Family and Taxa	Life forms	Roads	References
<b>Cucurbitaceae</b>			
<i>Ecbalium elaterium</i> (L.) A. Rich.	He	1,2,3,4,5,8,14	Davis (1965–1988), Ozcelik & Ozturk (1991), Polunin (1997)
<b>Dipsacaceae</b>			
<i>Cephalaria transsylvanica</i> (L.) Schrader	Th	11,13	
<i>Knaulia integrifolia</i> (L.) Bertol. var. <i>bidens</i> (Sm) Borbas	Th	1,2,3,5,11,12	
<i>Scabiosa argentea</i> L.	He	1,2,6,9,11	
<i>Scabiosa calocephala</i> Boiss.	Th	8	Davis (1965–1988)
<b>Elaeagnaceae</b>			
<i>Elaeagnus angustifolia</i> L.	Ph	8	
<b>Ericaceae</b>			
<i>Arbutus andrachne</i> L.	Ph	1,15	
<i>Arbutus unedo</i> L.	Ph	1,4	
<i>Erica arborea</i> L.	Ch	1	
<b>Euphorbiaceae</b>			
<i>Chrozophora tinctoria</i> (L.) Rafin.	Th	1,2,5,11	Ozcelik & Ozturk (1991)
<i>Euphorbia falcata</i> L. subsp. <i>falcata</i> var. <i>falcata</i>	Th	3,15	
<i>Euphorbia platyphyllos</i> L.	Th	3	Polunin (1997)
<b>Fabaceae (Leguminosae)</b>			
<i>Anthyllis hermanniae</i> L.	Ch	1,3,15	
<i>Caesalpinia gilliesii</i> Wall. Ex Hook.		5	
<i>Cercis siliquastrum</i> L. subsp. <i>siliquastrum</i>	Ch	5	
<i>Coronilla emerus</i> L. subsp. <i>emeroides</i> (Boiss. & Sprun.) Uhrova	Ch	9,13,14	
<i>Genista acanthoclada</i> DC.	Ch	2,3,4	
<i>Genista anatolica</i> Boiss.	Ch	3,7	
<i>Genista lydia</i> Boiss. var. <i>lydia</i>	Ch	6,7	
<i>Glycyrrhiza glabra</i> L. var. <i>glandulifera</i> (Waldst. & Kit.) Boiss.	He	2,9,15	
<i>Lupinus angustifolius</i> L. subsp. <i>angustifolius</i>	Th	2,6,15	
<i>Medicago polymorpha</i> L. var. <i>vulgaris</i> (Benth.) Shinnars	Th	5	Polunin (1997)
<i>Medicago orbicularis</i> (L.) Bart.	Th	10	
<i>Melilotus alba</i> Desf.	Th	7	Polunin (1997)
<i>Melilotus indica</i> (L.) All.	Th	1	
<i>Melilotus officinalis</i> (L.) Desr.	Th	16	
<i>Onobrychis aequidentata</i> (Sibth. & Sm.) dUrv.	Th	8,10	
<i>Onobrychis caput-galli</i> (L.) Lam.	Th	2,10,13	Polunin (1997)



Family and Taxa	Life forms	Roads	References
<i>Ononis natrix</i> L. subsp. <i>natrix</i>	Ch	2,4	
<i>Ononis pubescens</i> L.	Th	3,4	
<i>Ononis spinosa</i> L. subsp. <i>antiquorum</i> (L.) Briq.	Ch	3,6	Ozturk <i>et al.</i> (1990), Polunin (1997)
<i>Psorelea butiminosa</i> L.	He	3,15,16	Polunin (1997)
<i>Spartium junceum</i> L.	Ch	1,4,5,10,15	Ozturk <i>et al.</i> (1990)
<i>Trifolium angustifolium</i> L. var. <i>angustifolium</i>	Th	2,8,11	Davis (1965–1988)
<i>Trifolium purpureum</i> Lois. var. <i>purpureum</i>	Th	4,12	Davis (1965–1988)
<i>Trifolium resupinatum</i> L. var. <i>resupinatum</i>	Th	5,15	Davis (1965–1988)
<i>Trifolium stellatum</i> L. var. <i>stellatum</i>	Th	2,3,10	Davis (1965–1988)
<i>Vicia faba</i> L.	Th	5,7	Frenkel (1977)
<i>Vicia pubescens</i> (DC.) Link	Th	2,5	Davis (1965–1988)
<i>Vicia sativa</i> L. var. <i>sativa</i>	Th	9,17	Frenkel (1977)
<i>Vicia villosa</i> Roth. subsp. <i>eriocarpa</i> (Hauskn.) P.W. Ball	Th	1,2,3,14	
<b>Fagaceae</b>			
<i>Quercus coccifera</i> L.	Ph	1,5,11,15	
<i>Quercus infectoria</i> Oliver subsp. <i>boissieri</i> (Reuter) O.Schwarz	Ph	3,12,17	
<i>Quercus ithaburensis</i> Dence. subsp. <i>macrolepis</i> (Kotschy) Hedge et Yalt.	Ph	5,7,12	
<b>Geraniaceae</b>			
<i>Erodium malacoides</i> (L.) LHérit	Th	3,4,15	Polunin (1997)
<i>Erodium botrys</i> (Cav.) Bertol.	He	2,11	Frenkel (1977), Davis (1965–1988)
<i>Erodium cicutarium</i> (L.) LHérit subsp. <i>cutarium</i>	Th	4,15	Frenkel (1977), Polunin (1997)
<i>Erodium moschatum</i> (L.) LHérit	Th	3	Frenkel (1977), Davis (1965–1988), Polunin (1997)
<i>Geranium dissectum</i> L.	Th	4,15	Frenkel (1977), Davis (1965–1988)
<b>Hamamelidaceae</b>			
<i>Liquidambar orientalis</i> Mill. var. <i>orientalis</i>	Ph	3	
<b>Endemic</b>			
<b>Juncaceae</b>			
<i>Juncus hybridus</i> Brot.	Th	1,4,11	
<i>Juncus inflexus</i> L.	Ch	11,12	Davis (1965–1988)
<i>Juncus compressus</i> Jack.	Ch	3	Frenkel (1977), Davis (1965–1988)
<b>Lamiaceae (Labiatae)</b>			
<i>Coridothymus capitatus</i> (L.) Reichb.	Ch	1,3,4,15	
<i>Lamium amplexicaule</i> L.	Th	4,16	Davis (1965–1988)
<i>Lavandula stoechas</i> L. subsp. <i>stoechas</i>	Ch	1,3	Davis (1965–1988)
<i>Marrubium vulgare</i> L.	He	7,11	Davis (1965–1988), Polunin (1997)

Family and Taxa	Life forms	Roads	References
<i>Mentha longifolia</i> (L.) Hudson. subsp. <i>typhoides</i> (Briq.) Harley var. <i>typhoides</i>	He	6,12	
<i>Mentha pulegium</i> L.	He	5,15	
<i>Mentha spicata</i> L. subsp. <i>tomentosa</i> (Briq.) Harley	He	2,11,15	
<i>Micromeria juliana</i> (L.) Bentham ex Reichb.	Ch	2	
<i>Origanum onites</i> L.	Ch	3,11	
<i>Prasium majus</i> L.	Ch	1,4	Davis (1965–1988)
<i>Salvia argentea</i> L.	He	15	
<i>Salvia virgata</i> Jacq.	He	1,11	Davis (1965–1988)
<i>Satureja thymbra</i> L.	Ch	3,10	
<i>Stachys cretica</i> L. subsp. <i>smyrnaea</i> Rech. <b>Endemic</b>	He	3,15	
<b>Liliaceae</b>			
<i>Allium scorodoprasum</i> L. subsp. <i>rotundum</i> (L.) Stearn.	Cr	3,12,15	
<i>Asparagus acutifolius</i> L.	Ch	6,15	Davis (1965–1988)
<i>Asparagus tenuifolius</i> Lam.	Ch	15	
<i>Asphodelus aestivus</i> Brot.	Cr	4,5,10,15	
<i>Ornithogalum nutans</i> L.	Cr	2,7,11,13,15	Davis (1965–1988)
<i>Similax aspera</i> L.	Ch	1,3	
<i>Tulipa orphanidea</i> Boiss. ex Heldr.	Cr	3,10,15	Davis (1965–1988)
<b>Malvaceae</b>			
<i>Alcea pallida</i> Waldst. et Kit.	He	7,8,17	Davis (1965–1988)
<i>Althaea officinalis</i> L.	He	3,11	
<i>Malva sylvestris</i> L.	He	5,7,10,15	Polunin (1997)
<b>Moraceae</b>			
<i>Ficus carica</i> L. subsp. <i>carica</i>	Ph	4,5	
<b>Morinaceae</b>			
<i>Morina persica</i> L.	He	13	Davis (1965–1988), Ozturk <i>et al.</i> (1990)
<b>Myrtaceae</b>			
<i>Eucalyptus camadulensis</i> Dehnh.	Ph	3	Davis (1965–1988)
<i>Myrtus communis</i> L. subsp. <i>communis</i>	Ph	1,5	
<b>Oleaceae</b>			
<i>Fraxinus ornus</i> L. subsp. <i>ornus</i>	Ph	16	
<i>Jasminum fruticans</i> L.	Ch	4	
<i>Olea europaea</i> L. var. <i>sylvestris</i> (Miller) Lehr	Ph	1,2,3,5	
<i>Phillyrea latifolia</i> L.	Ph	2,3	
<b>Onagraceae</b>			

Family and Taxa	Life forms	Roads	References
<i>Epilobium hirsutum</i> L.	He	15	
<b>Papaveraceae</b>			
<i>Glaucium flavum</i> Crantz	Th	1,3	Ozturk <i>et al.</i> (1990)
<i>Papaver rhoeas</i> L.	Th	4,5,10,15	
<i>Papaver somniferum</i> L.	Th	10	
<b>Plantaginaceae</b>			
<i>Plantago coronopus</i> L. subsp. <i>commutata</i> (Guss.) Pilger	Th	11	Davis (1965–1988)
<i>Plantago coronopus</i> L. subsp. <i>coronopus</i>	Th	11,16	Davis (1965–1988), Polunin (1997)
<i>Plantago cretica</i> L.	Th	2,3,10,11	Davis (1965–1988)
<i>Plantago lagopus</i> L.	Th	3,5,16	Davis (1965–1988)
<i>Plantago lanceolata</i> L.	Th	5,14	Frenkel (1977), Davis (1965–1988)
<b>Platanaceae</b>			
<i>Platanus orientalis</i> L.	Ph	3,5	
<b>Poaceae (Graminae)</b>			
<i>Aegilops triuncialis</i> L. subsp. <i>triuncialis</i>	Th	1,15	
<i>Aeluropus littoralis</i> (Gouan) Parl.	He	2,4	
<i>Arundo donax</i> L.	Cr	4,10	
<i>Avena barbata</i> Pott ex Link. subsp. <i>barbata</i>	Th	4	Frenkel (1977), Poldini (1992)
<i>Briza maxima</i> L.	Th	3,10	
<i>Bromus hordeaceus</i> L. subsp. <i>hordeaceus</i>	Th	2,6	Frenkel (1977), Davis (1965–1988)
<i>Bromus intermedius</i> Guss.	Th	3	
<i>Bromus lanceolatus</i> Roth	Th	3,5	
<i>Bromus madritensis</i> L.	Th	3,6	
<i>Bromus rigidus</i> Roth	Th	1,10	Frenkel (1977)
<i>Bromus rubens</i> L.	Th	1	Frenkel (1977)
<i>Bromus tectorum</i> L.	Th	9,11,17	Frenkel (1977), Davis (1965–1988), Polunin (1997)
<i>Cynodon dactylon</i> (L.) Pers. var. <i>dactylon</i>	He	5,8,11	Davis (1965–1988), Poldini (1992)
<i>Cynosurus echinatus</i> L.	Th	17	Frenkel (1977), Davis (1965–1988)
<i>Dactylis glomerata</i> L. subsp. <i>hispanica</i> (Roth) Nyman	He	6,7	Frenkel (1977), Davis (1965–1988), Poldini (1992), Polunin (1997)
<i>Eragrostis pilosa</i> (L.) P. Beavv.	Th	16	Frenkel (1977), Davis (1965–1988)
<i>Hordeum murinum</i> L. subsp. <i>glaucum</i> (Steudel) Tzvelev	Th	11,17	Davis (1965–1988), Polunin (1997)
<i>Hordeum vulgare</i> L.	Th	5,8	
<i>Lolium perenne</i> L.	He	11	Frenkel (1977), Ozturk <i>et al.</i> (1990), Polunin (1997)
<i>Lolium temulentum</i> L. var. <i>temulentum</i>	Th	17	Davis (1965–1988)
<i>Phleum exaratum</i> Hochst. Ex Griseb. subsp. <i>exaratum</i>	Th	13,17	

Family and Taxa	Life forms	Roads	References
<i>Phleum subulatum</i> (Savi) Aschers. et Graebn. subsp. <i>subulatum</i>	Th	6,11,15	
<i>Phragmites australis</i> (Cav.) Trin. Ex Steudel	He	15	
<i>Poa annua</i> L.	Th	3,16	Frenkel (1977), Ozturk <i>et al.</i> (1990)
<i>Poa bulbosa</i> L.	He	6	Frenkel (1977)
<i>Polypogon monspeliensis</i> (L.) Desf.	Th	9	Frenkel (1977)
<i>Triticum aestivum</i> L.	Th	5,8,14	Davis (1965–1988)
<i>Vulpia muralis</i> (Kunth) Nees	Th	1,15	Davis (1965–1988)
<b>Polygonaceae</b>			
<i>Polygonum arenastrum</i> Bor.	Th	4	Davis (1965–1988)
<i>Polygonum aviculare</i> L.	Th	12	Frenkel (1977), Davis (1965–1988)
<i>Polygonum cognatum</i> Meissn.	He	12	Davis (1965–1988), Ozelik & Ozturk (1991)
<i>Rumex acetosella</i> L.	He	11,12	Frenkel (1977), Davis (1965–1988)
<i>Rumex crispus</i> L.	He	5,15	Frenkel (1977), Davis (1965–1988)
<i>Rumex cristatus</i> DC.	He	7,11,16	
<i>Rumex obtusifolius</i> L. subsp. <i>subalpinus</i> (Schur) Čelak.	He	12	Davis (1965–1988)
<i>Rumex tuberosus</i> L. subsp. <i>tuberosus</i>	Cr	6,13	
<b>Portulacaceae</b>			
<i>Portulaca oleracea</i> L.	Th	7,16	
<b>Ranunculaceae</b>			
<i>Clamatis cirrhosa</i> L.	Ph	1,5	
<b>Resedaceae</b>			
<i>Reseda lutea</i> L.	He	11,15	Davis (1965–1988), Ozturk <i>et al.</i> (1990), Ozelik & Ozturk (1991)
<i>Reseda luteola</i> L.	He	2	
<b>Rhamnaceae</b>			
<i>Paliurus spina-christi</i> Miller	Ch	14,17	Davis (1965–1988)
<b>Rosaceae</b>			
<i>Amygdalus communis</i> L.	Ph	7	
<i>Crataegus monogyna</i> Jacq. subsp. <i>monogyna</i>	Ph	5,11	Davis (1965–1988)
<i>Prunus divaricata</i> Ledep. subsp. <i>divaricata</i>	Ph	11	
<i>Prunus x domestica</i> L.	Ph	4,6	Davis (1965–1988)
<i>Pyrus amygdaliformis</i> Vill. var. <i>amygdaliformis</i>	Ph	5,6,8,11	
<i>Rosa canina</i> L.	Ch	5,8,	Ozturk <i>et al.</i> (1990)
<i>Rubus canescens</i> DC. var. <i>canescens</i>	Ch	5,7	
<i>Rubus sanctus</i> Schreber	Ch	2,3,13	

Family and Taxa	Life forms	Roads	References
<i>Sarcopoterium spinosum</i> (L.) Spach	Ch	2	
<i>Sorbus umbellata</i> (Desf.) Fritsch	Ch	17	
<b>Rubiaceae</b>			
<i>Galium aparine</i> L.	Th	4,8	
<i>Galium debile</i> Desf.	Th	4	
<i>Rubia tinctorum</i> L.	Th	11	
<b>Santalaceae</b>			
<i>Osyris alba</i> L.	Ch	10,16	
<b>Scrophulariaceae</b>			
<i>Scrophularia canina</i> L. subsp. <i>bicolor</i> (Sm.) Greuter	He	10	
<i>Scrophularia rimarum</i> Bornm.	He	7	
<i>Verbascum glomeratum</i> Boiss.	He	2,8,9,15	
<i>Verbascum lasianthum</i> Boiss. ex Bentham	He	4	
<i>Verbascum sinuatum</i> L. var. <i>sinuatum</i>	He	2,7,16	Davis (1965–1988)
<b>Solanaceae</b>			
<i>Hyoscyamus niger</i> L.	He	15	Davis (1965–1988), Ozcelik & Ozturk (1991), Polunin (1997)
<i>Nicotiana glauca</i> Graham	Ch	2,4	
<i>Datura stramonium</i> L.	Th	3,9	Davis (1965–1988), Ozcelik & Ozturk (1991)
<b>Sytracaceae</b>			
<i>Sytrax officinalis</i> L.	Ph	5	
<b>Tamaricaceae</b>			
<i>Tamarix smyrnensis</i> Bunge	Ph	5,14	
<b>Ulmaceae</b>			
<i>Ulmus minor</i> Miller. subsp. <i>canascens</i> (Melville) Browicz et Zielinski	Ph	2,5	Ozturk <i>et al.</i> (1990), Polunin (1997)
<b>Urticaceae</b>			
<i>Urtica dioica</i> L.	Th	1,5,7	Poldini (1992)
<i>Urtica pilulifera</i> L.	Th	4,9	Polunin (1997)
<b>Valerianaceae</b>			
<i>Valerianella coronata</i> (L.) DC.	Th	1,2,3,5,6,8,9,13,16,17	Davis (1965–1988)
<i>Valeriana dioscoridis</i> Sm.	Th	3	
<b>Verbenaceae</b>			
<i>Vitex angus-castus</i> L.	Ch	3,5,15	
<b>Vitaceae</b>			
<i>Vitis sylvestris</i> CC. Gmel.	Ph	5	

Ph: Phanerophyte, Ch: Chamaephyte, Th: Therophyte, Cr: Cryptophyte, He: Hemicryptophyte.

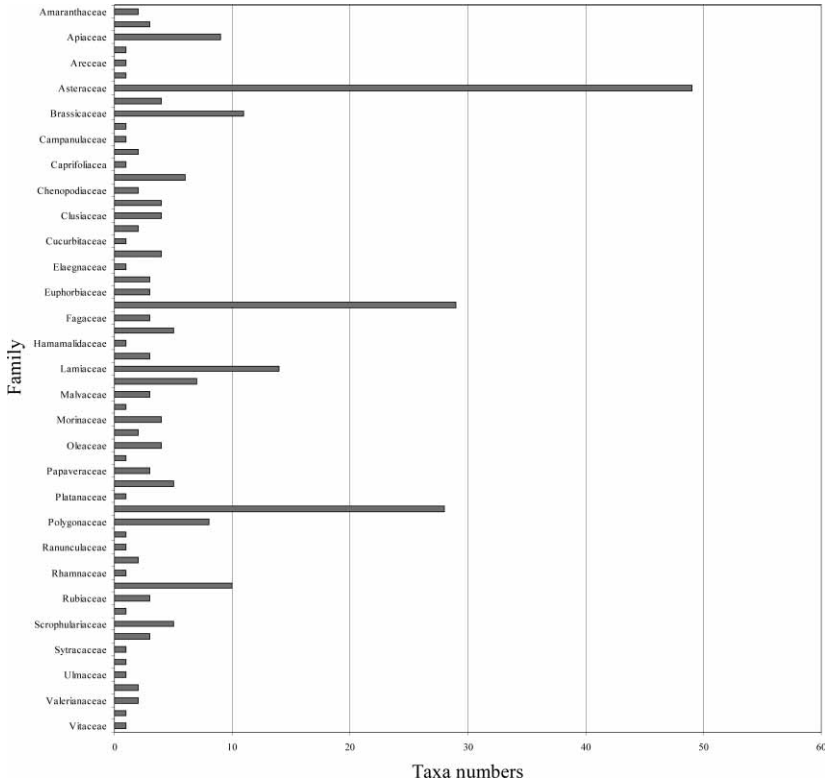


Fig. 2. Taxa numbers by families.

The frequency of commonly found taxa in the study field is presented in Tab. 2. As can be seen from the table the most commonly found taxon among them is *Valerianella coronata* (L.) DC., found in 10 roads.

In the investigation of the biological spectrum of roadside vegetation, the following ratios were found: therophytes 43%, hemicryptophytes 28%, chamaephytes 15%, phanerophytes 11% and cryptophytes 3% (Fig. 4).

Among the 271 taxa collected from the study area, 3 were identified as endemics for Turkey (Tab. 1). These endemics and their families are as the followings: *Campanula lyrata* Lam. subsp. *lyrata* (Campanulaceae), *Liquidambar orientalis* Mill. var. *orientalis* (Hamamelidaceae), *Stachys cretica* L. subsp. *smyrnaea* Rech. (Lamiaceae).

## DISCUSSION

In various studies done in the field, it was reported that some plants are distributed along the roadsides (DAVIS, 1965–1985; FRENKEL, 1977; OZTURK *et al.*, 1990; OZCELIK & OZTURK, 1991; POLDINI, 1992; POLUNIN, 1992; POLUNIN, 1997). Roadside

plants in various legends are shown in Tab. 1. Among them, some roadside plants identified by FRENKEL (1977) in California, USA, were also found in our study area. These findings indicate that they are cosmopolitan species. The other studies were used for reference purpose; for example, one of them was carried out in a close (neighborhood) area (Europe, i.e. POLUNIN, 1997), or carried out in the same catchment area (Mediterranean area, i.e. POLUNIN, 1992), or they were related to the flora of Turkey (i.e. DAVIS, 1965-1985; OZTURK *et al.*, 1990; OZCELIK & OZTURK, 1991). Among the 271 taxa identified in this study, 123 were confirmed by these studies as roadside plants (Tab. 1). No information about the other taxa identified in this study could be found in the mentioned literatures.

Exotic and planted species in the area are not included in the list in Tab. 1. *Acacia* Willd., *Cupressus* L., *Pinus* L., *Populus* L., *Salix* L. etc. are species generally planted in the area. In other words, they do not show any natural distribution in the area and were planted for either decoration or shade purpose.

Plant samples were mostly collected from Zone A and rarely from Zone B of these roads. Zone A represents the shoulder of the road. This zone received frequent disturbance by tire treading and was heavily influenced by pavement run off and by traffic-induced wind eddies; and usually it was less than one meter wide.

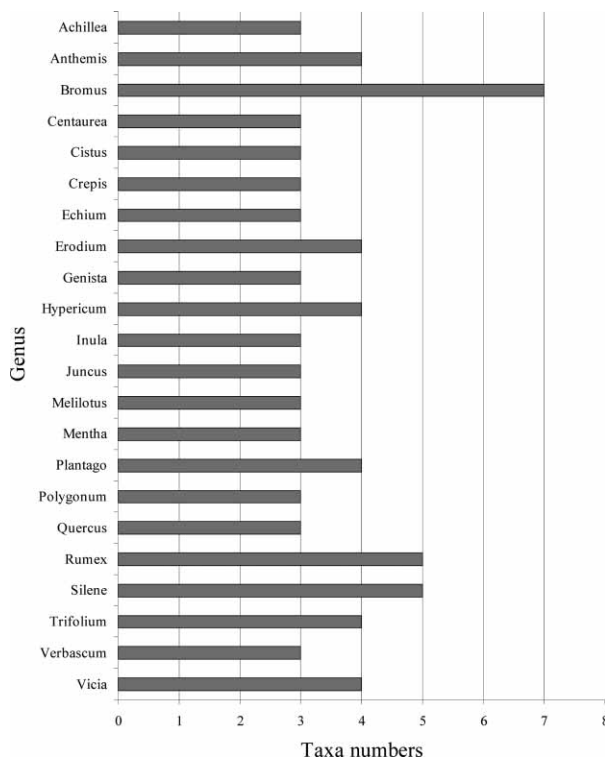
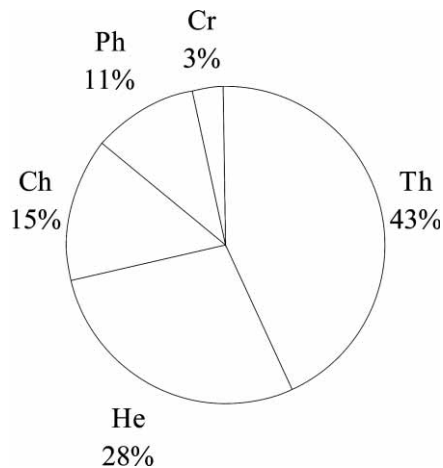


Fig. 3. The number of taxa by genera along roadside.

**Tab. 2.** The most frequently found taxa along the roadsides of the study area.

Taxa	Road number
<i>Valerianella coronata</i>	10
<i>Ecbalium elaterium</i>	7
<i>Knautia integrifolia</i> var. <i>bidens</i>	6
<i>Cistus creticus</i>	6
<i>Cardaria draba</i> subsp. <i>draba</i>	6
<i>Cardamine hirsuta</i>	6
<i>Crepis foetida</i> subsp. <i>commutata</i>	6
<i>Pistacia terebinthus</i> subsp. <i>palaestina</i>	6
<i>Ornithagalum nutans</i>	5
<i>Spartium junceum</i>	5
<i>Scabiosa argentea</i>	5
<i>Convolvulus arvensis</i>	5
<i>Cistus salviifolius</i>	5
<i>Sisymbrium altissimum</i>	5
<i>Capsella bursa-pastoris</i>	5
<i>Onopordum illyricum</i>	5
<i>Helichrysum stoechas</i> subsp. <i>barrelieri</i>	5
<i>Filago pyramidata</i>	5
<i>Centaurea melitensis</i>	5
<i>Calendula arvensis</i>	5
<i>Anthemis coelopoda</i> var. <i>coelopoda</i>	5

**Fig. 4.** Biological spectrum of roadside vegetation.



Zone B, the road approach, was the horizontal or gently sloping surface between the shoulder and ditch or embankment and it experienced less treading than did the shoulder. Its width was between one and two meters.

Along the roads, in our study area, some cultivated plants like *Vicia faba* L. (Fabaceae), *Hordeum vulgare* L. (Poaceae), *Triticum aestivum* L. (Poaceae), *Helianthus annuus* L. (Asteraceae), *Papaver somniferum* L. (Papaveraceae) were seen. Of these, the cultivation of *P. somniferum* was not established in the vicinity of the roads where the species found. It was thought that the distribution of the species to this distant area might have occurred as a result of human activities, such as transportation. In contrast to this species, other cultivated plant taxa distributed along the roadsides were planted around these roads. The distribution of these species can be explained by the seeds of these species falling from transportation or cultivation machines, or being carried by the wind or by animals, and then germinating along the roads. According to FRENKEL'S (1977) »roadside zone arrangement«, the heights of the plants seen in the pavement openings and on the shoulder of the roads (Zone A) were shorter than those of the original cultivated ones. Moreover, the flowers and fruits of these plants were smaller than the cultivated ones. The lack of water might be one of the reasons for this smallness. Another reason might be that the structures of these roads were too compacted for the roots to dig in or that there is insufficient soil content in the pavement holes where the seeds germinated. Despite these extreme conditions, these species complete their vegetation and reproduction processes in a short period of time.

POLDINI (1992) reported in his study that the families with the largest number of taxa along the roadsides were Asteraceae and Poaceae. In our study, Asteraceae (49 taxa), Fabaceae (29 taxa) and Poaceae (28 taxa) were established to be the families that had the largest number of taxa. Therefore, from these results, we can say that our findings show correlate with those of POLDINI (1992)..

In the investigation of the biological spectrum of roadside vegetation according to RAUNKIAER (AKMAN & KETENOGLU, 1992), it was found that 43% of the plants were therophytes, 28% hemicryptophytes, 15% chamaephytes, 11% phanerophytes, and 3% cryptophytes (Fig. 4). As can be clearly seen from the results and the figure, the largest plant group, represented by 43% of the identified samples in this study, was that of therophytes. This result was supported by FRENKEL (1977). In his study, it was reported that therophytes constituted the largest plant group, represented on different roads of California from 49% to 90%. According to FRENKEL (1977), in the simplification of RAUNKIAER's system for describing life forms, the following observations are pertinent. Therophytes are almost always prominent at the road shoulder and show decreasing proportions with distance from the pavement margin. There were two exceptions to this generalisation. First, under the application of herbicides, herbicide-resistant hemicryptophytes and cryptophytes frequently became dominant through vegetative spread on the graded and sprayed road shoulders. Second, on sites such as »pull-offs,« where traffic treading was important, certain hemicryptophytes were favoured. Nonetheless, the general road edge dominance of therophytes is assumed to be a response to the frequent disturbance caused by annual or biennial grading and periodic traffic treading. With the exceptions noted above, hemicryptophytes showed weak relations with respect to distance from the road margin.

In this study, roadside plants distributed throughout the link roads of all the cities in West Anatolia in Turkey have been investigated. The combined length of the 17 selected roads is around 2700 km. The total number of samples collected from the study area is constituted by 271 taxa, which belong to 57 families and therophytes are the most frequently found life form.

*Received July 7, 2003*

## REFERENCES

- AKMAN, Y. & O. KETENOGLU, 1992: *Vejetasyon Ekolojisi ve Arastirma Metodlari (Ecology of Vegetation and its Research Methods)*. Ankara Universitesi Fen Fak. Doner Sermaye Isl. Yay. No: 9, Ankara.
- DAVIS, P. H., 1965-1988: *Flora of Turkey and the East Aegean Islands*, 1-9 and Supp. Edinburgh Univ. Press, Edinburgh.
- FRENKEL, R. E., 1977: *Ruderal Vegetation along Some California Roadsides*. University of California Press, Berkeley-Los Angeles.
- HAMEL, A. & P. DANSEREAU, 1949: *L'aspect écologiqu du probleme des mauvaises herbes*. Bull. Du Serv. De Biogeographie (Univ. Montreal) 5, 1-45.
- OZTURK, M., SECMEN, O., GEMICI, Y. & G. GORK, 1990: *Plants and Landscape (Aegean Region Turkey)*. Tukelmat A.S., Izmir.
- OZTURK, M. & H. OZCELIK, 1991: *Useful plants of East Anatolia*. SISKAV, Ankara.
- POLDINI, L., 1992: *Environmental alteration and allergophytes*. *Aerobiologia* 8, 127-132.
- POLUNIN, O., 1992: *Guida agli alberi e arbusti d'Europa*. Zanichelli Editrice, Bologna.
- POLUNIN, O., 1997: *Flowers of Europe*. Oxford Univ. Press, Oxford.