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FLORA AND HABITAT DIVERSITY OF KAVUNCU SALTMARSH

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ABSTRACT. Turkey attracts attention with its high habitat and species diversity, and one of the important habitat type is saltmarsh. Kavuncu Saltmarsh which is relatively small is located at Central Anatolia between Ankara and Eskişehir and under the threat of some factors like expansion of agricultural areas, pollution from pesticides and fertilizers, and drainage of water for reclamation. There are 102 plant taxa of which 31 are halophytes and 8 are endemic. The plant communities defined from the area are as follows; *Thypha domingensis-Phragmites australis, Salicornia perennans, Juncus heldreichianus, Suaeda cucullata-Petrosimonia nigdeensis, Lepidium cartilagineum, Microcnemum coralloides-Aeluropus littoralis, Artemisia santonicum.*

1. INTRODUCTION

Kavuncu saltmarsh is a characteristic saline habitat with halophytic flora and plant communities. In general, saline areas can be occurred around a salt lake, at the coast of a sea or at areas having high saline water table. Turkey has diverse saline habitats with high plant diversity. Especially Tuz Lake and its surrounding areas are very important for halophyte diversity and endemic species. Saline areas of Turkey can be divided into two major parts; terrestrial and coastal. Terrestrial saline areas can occur around a salt marsh, or at the areas where the saline water table is high and forms seasonal small water bodies. Some of the taxa found at these areas are cosmopolitan species with high ecological tolerance especially against soil salinity other plant species are the ones that have adaptations to high salinity and called as halophytes. The plant species determined from saline areas are about 600 taxa and 30 of them are euhalophytes that cannot survive outside of saline ecosystems [1] and the endemism ratio is about 12,5% [2]. Kavuncu is an inland saline habitat with some fresh water sources and high saline water table, which forms small ponds. In saline ecosystems according to the soil salinity and some biological factors like competition, parasitism etc. plant communities show a characteristic zonation pattern [3, 4, 5, 6, 7, 8, 9, 10, 11]. At Kavuncu, because of

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drainage canals and freshwater sources, however zonation is quite like patchwork pattern obvious communities can easily differentiated from each other (Figure 1).

FIGURE 1. Distinctive plant communities.

FIGURE 2. Map of Turkey (● study area) and satellite view of the study area.

2. Materials And Methods

During the field studies that started at 2006, and the flora and communities of the area were determined. The study area is situated at the border of Ankara and Eskişehir provinces (Figure 2). The plant specimens were identified according to Flora of Turkey and East Aegean Islands [12, 13], and plant names were checked with the Türkiye Bitkileri Listesi (Damarlı bitkiler) [14]. The plant taxa determined from the study area were listed in Table 1. Plant communities were defined according to the dominance of specific species and also evaluated according to EUNIS habitat classification system.

TABLE 1. Plant List

Plant name	Endemism	Chorotype	Collection date	Collector number	IUCN
AMARYLLIDACEAE					
Allium atroviolaceum Boiss.			29/05/2006	AE.Yaprak 2006-93	
			25/05/2007	AE.Yaprak 2007-123	
APIACEAE					
Bifora radians M. Bieb.			29/05/2006	AE.Yaprak 2006-100	
Caucalis platycarpos L.			29/05/2006	AE.Yaprak 2006-113	
Turgenia latifolia (L.) Hoffm.			29/05/2006	AE.Yaprak 2006-106	
			25/05/2007	AE.Yaprak 2007-130	
APOCYANACEA					
Cynanchum acutum L. subsp. *acutum*			25/05/2007	AE.Yaprak 2007-115	
ASTERACEAE					
Achillea santolinoides Lag. subsp. *wilhelmsii* (K.Koch) Greuter		Ir-Tur	29/05/2006	AE.Yaprak 2006-120	
			25/05/2007	AE.Yaprak 2007-172	
Anthemis fumarifolia Boiss.	Endemic	Ir-Tur	29/05/2006	AE.Yaprak 2006-107	LC
			25/05/2007	AE.Yaprak 2007-173	
Artemisia santonicum L. subsp. *santonicum*			25/05/2007	AE.Yaprak 2007-118	
Carduus nutans. L.			25/05/2007	AE.Yaprak 2007-135	
C. pycnocephalus L. subsp. *albidus* (M.Bieb.) Kazmi			25/05/2007	AE.Yaprak 2007-109	

Centaurea patula DC.		Ir-Tur	25/05/2007	AE.Yaprak 2007-137	
Cyanus depressus (M. Bieb.) Soják			29/05/2006	AE.Yaprak 2006-90	
			25/05/2007	AE.Yaprak 2007-133	
C. triumfettii (All.) Dostál ex A.Löve & D. Löve subsp. *triumfettii*			06/07/2006	AE.Yaprak 2006-134	
Scorzonera parviflora Jacq.			29/05/2006	AE.Yaprak 2006-125	
			25/05/2007	AE.Yaprak 2007-150	
S. cana (C.A.Mey.) Griseb. var. *cana*			25/05/2007	AE.Yaprak 2007-103	
Tragopogon coloratus C.A.Mey.		Ir-Tur	25/05/2007	AE.Yaprak 2007-111	
BORAGINACEAE					
Heliotropium europaeum L.		Ir-Tur	06/07/2006	AE.Yaprak 2006-136	
Lappula patula (Lehm.) Asch. ex Gürke			29/05/2006	AE.Yaprak 2006-92	
Rochelia disperma (L.f.) K.Koch var. *disperma*			25/05/2007	AE.Yaprak 2007-142	
BRASSICACEAE					
Alyssum blepharocarpum T.R.Dudley & Hub.-Mor.	Endemic	Ir-Tur	25/05/2007	AE.Yaprak 2007-138	NT
A. linifolium Stephan ex. Willd. var. *linifolium*			06/07/2006	AE.Yaprak 2006-140	
			25/05/2007	AE.Yaprak 2007-156	
A. pateri Nyár subsp. *pateri*	Endemic	Ir-Tur			LC
Boreava orientalis Jaub. & Spach			25/05/2007	AE.Yaprak 2007-146	
Brassica elongata Ehrh.			06/07/2006	AE.Yaprak 2006-133	
			25/05/2007	AE.Yaprak 2007-157	
Camelina rumelica Velen.			29/05/2006	AE.Yaprak 2006-91	
Descurainia sofia (L.) Webb ex Prantl. subsp. *sofia*			25/05/2007	AE.Yaprak 2007-148	
Erysimum sisymbrioides C.A. Mey.			25/05/2007	AE.Yaprak 2007-110	
Lepidium cartilagineum (J. Mayer) Thell. subsp. *cartilagineum*			25/05/2007	AE.Yaprak 2007-155	

L. cartilagineum (J. Mayer) Thell. subsp. *caespitosum* (Desv.) Thell.			29/05/2006	AE.Yaprak 2006-121	
L. draba L.			25/05/2007	AE.Yaprak2007-158	
CAPRIFOLIACEAE					
Cephalaria syriaca (L.) Syhrad.			06/07/2006	AE.Yaprak 2006-137	
Scabiosa rotata M.Bieb.			25/05/2007	AE.Yaprak2007-116	
CARYOPHYLLACEAE					
Gypsophila perfoliata L. var. *perfoliata*			06/07/2006	AE.Yaprak 2006-144	
Minuartia urumiensis (Bornm.) Bornm.			29/05/2006	AE.Yaprak 2006-95	
			25/05/2007	AE.Yaprak 2007-160	
Spergularia media (L.) C.Presl			29/05/2006	AE.Yaprak 2006-122	
CHENOPODIACEAE					
Atriplex laevis Ledeb.			06/07/2006	AE.Yaprak 2006-135	
			25/05/2007	AE.Yaprak2007-102	
A. tatarica L. var. *tatarica*			06/07/2006	AE.Yaprak 2006-150	
			25/05/2007	AE.Yaprak 2007-163	
Chenopodium chenopodioides (L.) Aellen			06/07/2006	AE.Yaprak 2006-157	
			25/05/2007	AE.Yaprak 2007-165	
C. murale L.			06/07/2006	AE.Yaprak 2006-149	
			25/05/2007	AE.Yaprak 2007-161	
Microcnemum coralloides (Loscos.) J.Pardo subsp. *anatolicum* Wagenitz			06/07/2006	AE.Yaprak 2006-154	VU
			25/05/2007	AE.Yaprak 2007-167	
Petrosimonia brachiata (Pall.) Bunge			29/05/2006	AE.Yaprak 2006-114	
			06/07/2006	AE.Yaprak 2006-160	
			25/05/2007	AE.Yaprak 2007-167	
P. nigdeensis Aellen	Endemic	Ir-Tur	29/05/2006	AE.Yaprak 2006-110	
			06/07/2006	AE.Yaprak 2006-159	
			25/05/2007	AE.Yaprak 2007-168	
Salicornia perennans			29/05/2006	AE.Yaprak 2006-	

Willd.				94	
			06/07/2006	AE.Yaprak 2006-158	
			25/05/2007	AE.Yaprak 2007-169	
Suaeda altissima Pall.			29/05/2006	AE.Yaprak 2006-97	
S. carnosisima Post			06/07/2006	AE.Yaprak 2006-141	
			25/05/2007	AE.Yaprak 2007-125	
S. cucullata Aellen	Endemic		06/07/2006	AE.Yaprak 2006-151	VU
			25/05/2007	AE.Yaprak 2007-139	
CONVOLVULACEAE					
Convolvulus arvensis L.		Cosm.	29/05/2006	AE.Yaprak 2006-116	
C. lineatus L.			29/05/2006	AE.Yaprak 2006-127	
			25/05/2007	AE.Yaprak 2007-120	
Cuscuta balansae Boiss. & Reuter ex Yunck			06/07/2006	AE.Yaprak 2006-139	
CYPERACEAE					
Carex divisa Huds.			25/05/2007	AE.Yaprak2007-101	
FABACEAE					
Alhagi maurorum Medik. subsp. *maurorum*		Ir-Tur	29/05/2006	AE.Yaprak 2006-98	
			06/07/2006	AE.Yaprak 2006-161	
			25/05/2007	AE.Yaprak 2007-119	
Astragalus lycius Boiss.	Endemic		25/05/2007	AE.Yaprak2007-136	LC
A. mesogitanus Boiss.	Endemic	Ir-Tur	29/05/2006	AE.Yaprak 2006-115	LC
A. strigillosus Bunge		Ir-Tur	29/05/2006	AE.Yaprak 2006-126	
			25/05/2007	AE.Yaprak 2007-153	
Melilotus officinalis (L.) Desr.			25/05/2007	AE.Yaprak 2007-114	
Trigonella capitata Boiss.			25/05/2007	AE.Yaprak 2007-117	
FRANKENIACEAE					
Frankenia hirsuta L.			06/07/2006	AE.Yaprak 2006-138	
			25/05/2007	AE.Yaprak 2007-126	
JUNCACEAE					

Juncus heldreichianus T.Marsson ex Parl. subsp. *orientalis* Snogerup			29/05/2006	AE.Yaprak 2006-99	
			06/07/2006	AE.Yaprak 2006-142	
			25/05/2007	AE.Yaprak 2007-127	
J. inflexus L. subsp. *inflexus*			29/05/2006	AE.Yaprak 2006-129	
			06/07/2006	AE.Yaprak 2006-156	
			25/05/2007	AE.Yaprak 2007-122	
Juncus persicus Boiss. subsp. *libanoticus* (J.Thiebaut) Novikov & Snogerup			25/05/2007	AE.Yaprak 2007-142	
LAMIACEAE					
Lamium orientale (Fisch. & C.A.Mey.) E.H.L.Krause		Ir-Tur	29/05/2006	AE.Yaprak 2006-102	
L. purpureum L. var. *purpureum*		Euro-Sib	25/05/2007	AE.Yaprak 2007-128	
Phlomis armeniaca Willd.		Ir-Tur	06/07/2006	AE.Yaprak 2006-145	
OROBANCHACEAE					
Orobanche oxyloba Beck			06/07/2006	AE.Yaprak 2006-152	
PAPAVERACEAE					
Fumaria vaillantii Loisel.			29/05/2006	AE.Yaprak 2006-123	
Hypecoum pendullum L.			29/05/2006	AE.Yaprak 2006-130	
PLANTAGINACEAE					
Linaria genistifolia (L.) Mill. var. *confertiflora* (Boiss.) P.H.Davis	Endemic (?)	Ir-Tur	29/05/2006	AE.Yaprak 2006-109	LC
Plantago holosteum Scop.		Med	06/07/2006	AE.Yaprak 2006-143	
			25/05/2007	AE.Yaprak 2007-141	
P. lanceolata L.			29/05/2006	AE.Yaprak 2006117	
POACEAE					
Aegilops cylindrica Host		Ir-Tur	29/05/2006	AE.Yaprak 2006-101	
			25/05/2007	AE.Yaprak2007-121	
Aeluropus littoralis (Gouan) Parl.			29/05/2006	AE.Yaprak2006-128	
			25/05/2007	AE.Yaprak2007-154	

Agropyron cristatum (L.) Gaertn. subsp. *pectinatum* (M. Bieb) Tzvelev var. *pectinatum*			25/05/2007	AE.Yaprak 2007-142	
Brachiaria eruciformis (sm.) Griseb.			25/05/2007	AE.Yaprak 2007-100	
Bromus intermedius Guss.			29/05/2006	AE.Yaprak 2006-104	
			25/05/2007	AE.Yaprak 2007-166	
B. japonicus Thunb. subsp. *japonicas*			29/05/2006	AE.Yaprak 2006-118	
			25/05/2007	AE.Yaprak 2007-152	
B. madritensis L.			29/05/2006	AE.Yaprak 2006-131	
B. squarrosus L.			29/05/2006	AE.Yaprak 2006-132	
B. tectorum L.			06/07/2006	AE.Yaprak 2006-153	
			25/05/2007	AE.Yaprak 2007-170	
Elymus elongatiformis (Drobow) Assadi		Ir-Tur	06/07/2006	AE.Yaprak 2006-147	
Elymus elongatus (Host) Runemark subsp. *salsus* Melderis	Endemic		06/07/2006	AE.Yaprak 2006-155	DD
			25/05/2007	AE.Yaprak 2007-164	
Eremopyrum distans (K.Koch) Nevski		Ir-Tur	25/05/2007	AE.Yaprak 2007-113	
E. orientale (L.) Jaub.& Spach		Ir-Tur	29/05/2006	AE.Yaprak 2006-103	
			25/05/2007	AE.Yaprak 2007-171	
Festuca valesiaca Schleich. ex Gaudin			25/05/2007	AE.Yaprak 2007-145	
Hordeum geniculatum All.		Euro-Sib	25/05/2007	AE.Yaprak 2007-162	
H. murinum L. subsp. *leporinum* (Link) Arcang		Ir-Tur	29/05/2006	AE.Yaprak 2006-112	
			25/05/2007	AE.Yaprak 2007-151	
Leymus cappadocicus (Boiss. & Balansa) Melderis			29/05/2006	AE.Yaprak 2006-119	VU
			06/07/2006	AE.Yaprak 2006-162	
Phragmites australis			29/05/2006	Observation	

(Cav.) Trin. Ex Steud.					
Poa pratensis L.			29/05/2006	AE.Yaprak 2006-124	
			25/05/2007	AE.Yaprak 2007-149	
P. trivialis L.			25/05/2007	AE.Yaprak 2007-147	
Puccinellia distans (Jacq.) Parl. subsp. *distans*			06/07/2006	AE.Yaprak 2006-146	
			25/05/2007	AE.Yaprak 2007-159	
Stipa ehrenbergiana Trin. & Rupr.		Ir-Tur	25/05/2007	AE.Yaprak 2007-112	
POLYGONACEAE					
Polygonum aviculare L.			06/07/2006	AE.Yaprak 2006-148	
P. patulum Bieb. subsp. *patulum*			29/05/2006	AE.Yaprak 2006-105	
RANUNCULACEAE					
Adonis annua L.		Med	25/05/2007	AE.Yaprak 2007-144	
A. flammea Jacq.			29/05/2006	AE.Yaprak 2006-108	
A. microcarpa DC.			29/05/2006	AE.Yaprak 2006-111	
Consolida orientalis (J.Gay) Schrödinger			25/05/2007	AE.Yaprak 2007-131	
Nigella segetalis M.Bieb.			25/05/2007	AE.Yaprak 2007-140	
RUBIACEAE					
Galium verum L. subsp. *verum*		Euro-Sib	25/05/2007	AE.Yaprak 2007-134	
TAMARICACEAE					
Tamarix parviflora DC.		Med	25/05/2007	AE.Yaprak 2007-124	
TYPHACEAE					
Typha domingensis Pers.			25/05/2007	AE.Yaprak 2007-129	
ZYGOPHYLLACEAE					
Zygophyllum fabago L.		Ir-Tur	25/05/2007	AE.Yaprak 2007-132	

Abbreviations: Cosm: Cosmopolitan, Ir-Tur: Irano-Turanian, Med: Mediterranean, DD: Data Deficient, LC: Least Concern, NT: Near Threaten, VU: Vulnerable.

3. Results

In total, 102 plant species were identified from the area and nearly 30% of them are halophytes. There are 8 endemic species and the endemism ratio is 8%. The richest families are as follows; Poaceae (22 spp.), Asteraceae (11 spp.), Chenopodiaceae (11 spp.), Brassicaceae (11 spp.) and Fabaceae (6 spp.). These 5 families correspond to more than 50 % of the total species.

FIGURE 3. *Salicornia perennans* community

According to the dominance, plant communities were defined as;
Typha domingensis-Phragmites australis
Salicornia perennans (Figure 3)
Juncus heldreichianus (Figure 4)
Suaeda cucullata- Petrosimonia nigdeensis
Lepidium cartilagineum (Figure 5)
Microcnemum coralloides- Aeluropus littoralis
Artemisia santonicum

FIGURE 4. *Juncus heldreichianus* community

FIGURE 5. *Lepidium cartilagineum* community

The communities defined from the study area were evaluated according to EUNIS Habitat Classification System and the habitats determined from the area are as follows,

D- Mires, bogs and fens

D6- Inland saline and brackish marshes and reedbeds

D6.1- Inland salt marshes

D6.16- Interior Cental European and anatolian *Salicornia, Microcnemum, Suaeda* and *Salsola* swards

D6.163- Central Eurasian glasswort swards

D6.2- Inland saline or brackish species-poor helophyte beds normally without free-standing water

D6.21- Dry halophile *Phragmites* bed

E- Grasslands and lands dominated by forbs, mosses or lichens

E6- Inland salt steppes

E6.2- Continental inland salt steppes

Especially for the steppic areas, the EUNIS habitat classification is not suits to the saline steppes of the area. They are mainly resembles the Pannonic salt steppes and salt marshes but the geographical distribution is not cover the Anatolia. For this reason, Central Anatolian Salt Steppes should be included as a new habitat type in EUNIS Habitat Classification for the steppes of saline areas at Central Anatolia.

4. Discussion

Agricultural areas and gypsaceous or marly steppes and halophytic areas show different floral and habitat characteristics surround Kavuncu saltmarsh. The study area is a kind of refuge for halophytes because of its distinct location with the other halophytic areas. Even though its importance for biodiversity and genetic source as salt resistance, it is under the influence of heavy agriculture. Halophytic areas are generally low in habitat diversity, eventhough these areas are very important biological diversity areas and endemism centers. Central Eurasian glasswort swards, dry halophile phragmites beds and continental inland salt steppes are the main habitat types according to EUNIS habitat classification system. Central Eurasian glassworth swards are included in a resolution 4 habitat type at a higher level (d 6.1). Continental inland salt steppes are the habitat types

that cover salt steppes and their associated salt-tolerant herbaceous communities outside the mediterranean zone, it has 4 subtypes but the salt steppes around Kavuncu saltmarhes cannot be included in one of these because of the floristic differences. Also, the drainage canals cause the loss of characteristics of soils and water. Saline soils are not suitable for agriculture, by drainage, the salinity was decreased, and by addition of fertilizers, productivity is increased. However, leakage of fertilizers to the water sources cause eutrophication of the shallow ponds, which are the main causes of loss of habitat and species diversity.

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