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SPECIES IMPORTANCE IN COASTAL DUNE ECOSYSTEMS IN NORTHERN TURKEY

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Abstract - Species importance in coastal dune ecosystems in typical dune zones in Black Sea Region on the north of Turkey was studied by using species conservation index (SCI) approach. SCI scores have significantly differed among dune zones. Additionally, coastal dune species were compared by using seven different criteria (geographic distribution, life span, growth form, conservation status, commonness, the utilitarian and the ecological importance). All of the studied criteria were found to be significant for studied coastal dune species. All of the studied species were moderate to high importance. The highest mean SCI score was found in E zone, while *Xanthium strumarium* subsp. *cavanillesii* and *Digitaria ischaemum* had the lowest SCI scores, and both species occurred in A zone. The highest SCI scores were found in *Imperata cylindrica*, *Eleagnus rhamnoides* and *Jurinea kilea*. The highest Site conservation values (SCV) were found in embryonic-shifting or primary dune, while the lowest SCVs were found in driftline zone. There were significant differences among coastal dune zones regarding selected criteria.

Keywords: central black sea region; coastal sand dunes; conservation values; disturbance factors; dune zones; species conservation index.

Introduction

Coastal dune ecosystems are known to be highly dynamic systems, and they have a vital role in nitrogen cycling, water filtration, dune erosion, salt spray, etc. However, they are prone to alteration even under natural conditions. Due to global warming, they serve as a natural guard versus coastal erosion, an increasing danger in associate with sea-level rising. Due to their sustained coastal erosion and anthropogenic effects, they are particularly fragile and unprotected environments, so specific ecosystem functions of coastal dune are worthy of attention. Moreover, they presented key services to human such as coastal shield, raw materials, saltwater catchment, wildlife protection, and carbon binding among others (Del Vecchio et al., 2016; Malavasi et al., 2016; Bertacchi, 2017). The seashore-inland gradient detects the zonation of varied plant communities because of environmental effects resulting in a typical vegetation zonation in coastal dune ecosystems (Acosta et al., 2006; Carranza et al., 2008; Abdelaal et al., 2017). Coastal dunes ecosystems have been continuously modified due to the rising requirement for using dune resources and industrial growth all around the world. The most common disturbance factors are tree plantation, road construction, agriculture and tourism facilities and waste disposal. (Faggi & Dadon, 2011; Monserrat et al., 2012; Ağır et al., 2014). These factors caused the reduction of the area of coastal dune landscape and extinction of characteristic species and made sensitive to coastal erosion (Stancheva et al., 2011). Especially anthropogenic disturbance factors such as tourism activities and sand extraction are increasingly endangering the structure and function of coastal sand dune ecosystems (Parra-Tabla et al., 2018).

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Well-developed dune systems characterize the Black Sea coasts. However, coastal regions have the potential for inundation and in particular, the Turkish area, are exposed to landslide hazards. Over the past century, water volume in Black Sea coasts was increased by two-third. Coastal dunes have a particular plant community differentiation from the seashore to the inland and include significant plant species in each dune zone (Tzonev et al., 2005; Alpar, 2009; Ağır et al., 2014, 2016b). In order to protect specific taxonomic groups in specific habitats, the approach of the species according to the conservation value was applied to evaluate the conservation value and importance of plants (Salem, 2003; Halmy & Salem, 2015). Indexes used according to this approach assess vascular plant significance based on the inclusion of phenological, biogeographic and conservation criteria accounting to various aspects of species importance. The main aim of this study is to determine the site conservation value (SCV) index to compare typical coastal dune zones according to their importance for the conservation of vascular plants (Halmy & Salem, 2015). Species conservation importance index (SCI) values of dune species in N of Turkey in different coastal dune zones were calculated by using the approach of Halmy & Salem (2015) to examine the protection status of different plant species and zones. For the assessment of coastal plant species importance with regard to the rarity, ecological importance, conservation status; life form and utilitarian importance were calculated, and conservation value of the site (SCV) was used to compare coastal dune vegetation with respect to their importance for conservation (Salem, 2003; Salem & Waseem, 2006). The studied coastal dune species were also classified according to their conservation importance category.

Materials and Methods

The Study Area

The research area is located between Kızılırmak and Yesilirmak deltas, and this area has the broadest coastal dune area in Central Black Sea Region (Ağır et al., 2016a; Sürmen et al., 2019). The studied area lies 149 km and involves coastal dunes in the eastern and western part of Central Black Sea Region of Turkey between Terme (41°15’52’’N and 36°57’56’’E) and Alacam (41°29’27’’N and 36°33’12’’E) provinces (Figure 1). They are characterized by hydromorphic alluvial soils (Akkan, 1970). The dam construction in the study area prevents the transportation of alluvial material, and the development of delta is ceased. The total area of the delta is still being narrowed due to severe coastal erosion (Turoğlu, 2010). The western part of the research area has Mediterranean climate, while the eastern part has an oceanic climate, and a climatic gradient is created from eastern to the western part of the research area. Summer rainfall (PE)

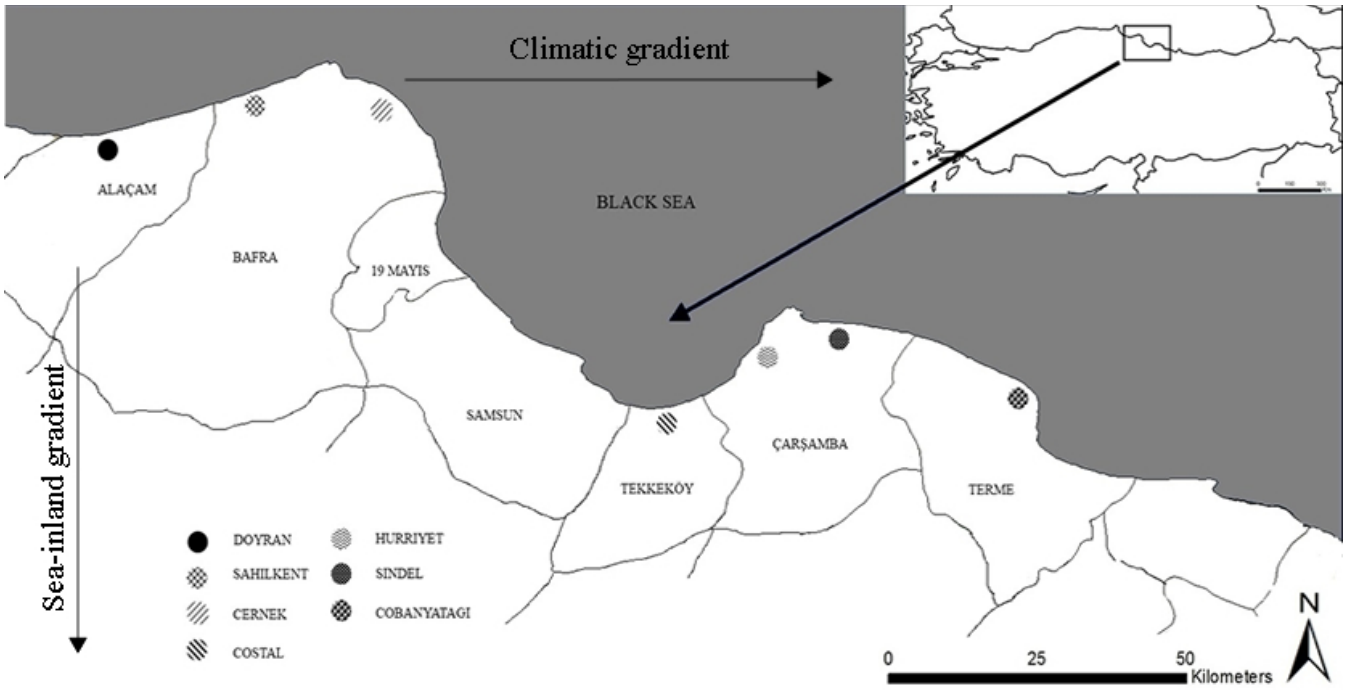

Figure 1. Studied coastal dune localities in the north of Turkey.

is 105.0 and 173.7 mm, in the western and eastern parts, respectively. The pluviometric quotient (Q) is 85.4 and 121.3 in the western and eastern parts, respectively. Precipitation regime is East Mediterranean in the western part, while it is an oceanic marine type I in the eastern part (Yalcin et al., 2011; Ağır et al., 2014; Ağır et al., 2016b).

Six dune zones are present in the study area. In herbaceous habitats listed in the European Habitat Directive (92/43/EEC) (European Commission, 1992). Specifically, we considered the following EU Habitats: drift line or upper beach (EU 1210), embryonic shifting or primary dunes (EU 2110), mobile dunes (EU 2120), semi-fixed or transitional dunes (EU 2230 and 2210), grey dunes with herbaceous (EU 2130), fixed dunes (EU 2160). These represent a coastal vegetation zonation including structurally and functionally distinct plant communities closely related to the sea-inland gradient (Acosta et al., 2009; Bazzichetto et al., 2016). The taxonomic nomenclature for plant species followed that of Güner et al. (2012).Vegetation of drift line or upper beach (A) zone is represented by EU 1210 Habitat type (*Euphorbio paralias–Eryngietum maritimi* and *Salsolo ruthenicae – Cakiletum maritimae*). The most characteristic species were *Salsola ruthenica* L., *Cakile maritima* Scop., *Tournefortia sibirica* L. var. *sibirica* and *Xanthium strumarium* subsp. *cavanillesii* (Schouw) D.Löve & Dans.. Vegetation of embryonic shifting or primary dunes (B) zone is represented by EU 2110 Habitat

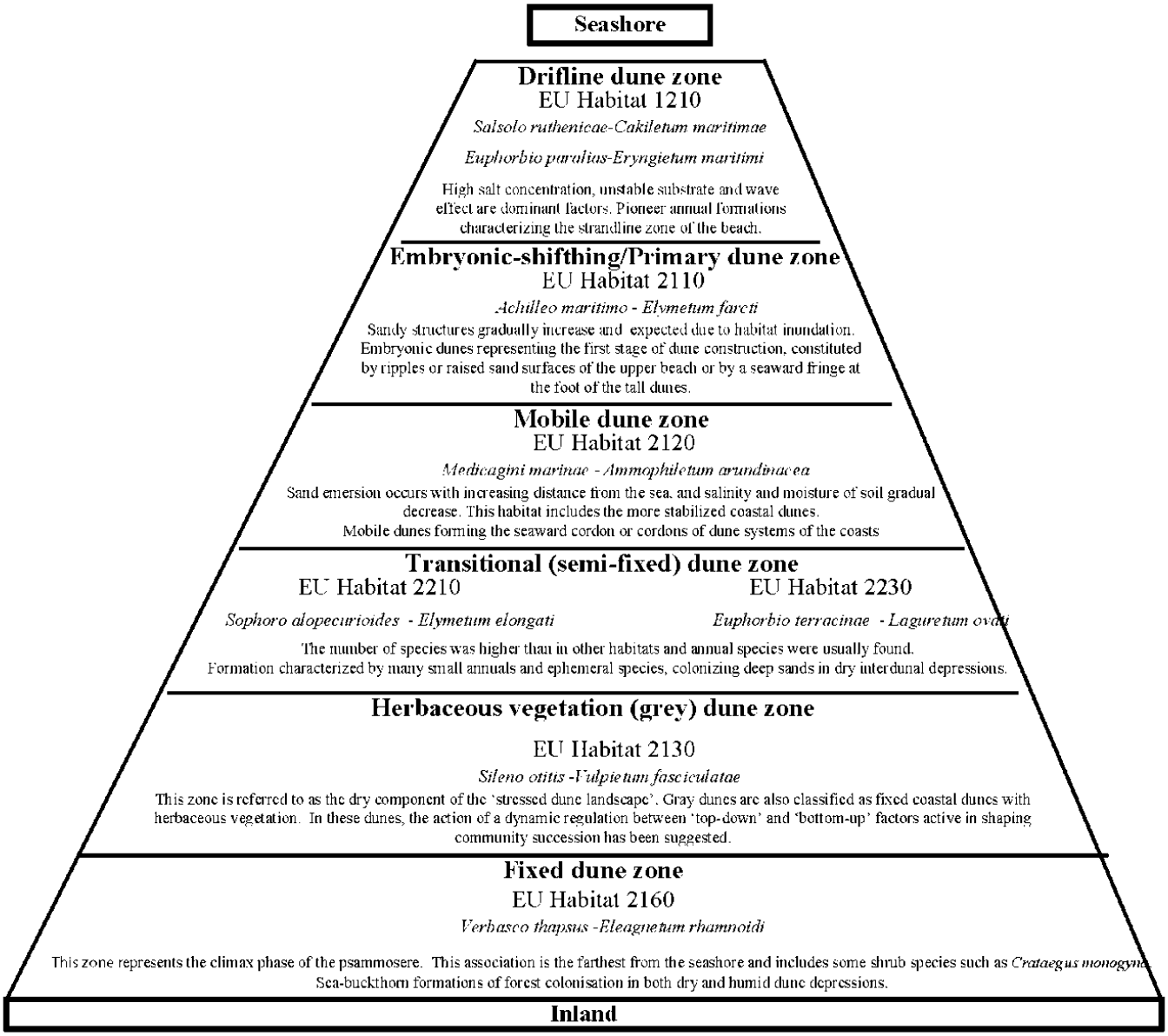

Figure 2. Schematic representation of the different habitats along the coastal dune zonation.

type (*Achilleo maritimo – Elymetum farcti*). *Achillea maritima* (L.) Ehrend. & Y.P.Guo subsp. *maritima*, *Elymus farctus* (Viv.) Runemark ex Melderis subsp. *bessarabicus* (Savul. et Rayss) Melderis var. *bessarabicus*, *Glaucium flavum* Crantz, and *Crepis foetida* L. subsp. *rhoaedifolia* (Bieb.) Celak were the most characteristic species in that zone. Vegetation of mobile dunes (C) zone is represented by EU 2120 Habitat types (*Medicagini marinae– Ammophiletum arundinacea*). Mobile dunes is characterized by *Ammophila arenaria* (L.) Link subsp. *arundinacea* H. Lindb. Fil., *Medicago marina* L., *Gundelia tournefortii* L., *Scolymus hispanicus* L., *Cynanchum acutum* L. subsp. *acutum* L., *Pancratium maritimum* L., and *Hypochoeris radicata* L. Vegetation of semi-fixed or transitional dunes (D) zone are represented by EU 2230 and 2210 Habitat types (respectively, *Euphorbio terracinae – Laguretum ovati* and *Sophoro alopecurioides – Elymetum elongati*). *Sophora alopecuroides* L. var. *alopecuroides*, *Elymus elongatus* (Host) Runemark subsp. *elongatus*, *Medicago littoralis* Rohde ex Lois. var. *littoralis*, *Anagallis arvensis* L.var. *arvensis*, and *Plantago scabra* Moench. were dominated in that zone. Vegetation of grey dunes with herbaceous (E) zone is represented by EU 2130 Habitat type (*Sileno otitis–Vulpietum fasciculatae*). *Silene otites* (L.) Wibel, *Vulpia fasciculata* (Forsskal) Fritsch, and *Cenchrus incertus* M. A. Curtis were the most widespread species. The fixed dunes (F) zone is represented by EU 2160 Habitat type *(Verbasco thapsus–Eleagnetum rhamnoidi*) (Figure 2). This is the most distant dunes from the seashore and characterizes the climax stage of psammosere and includes a few shrub species like *Eleagnus rhamnoides* (L.) A. (Ağır et al., 2014; Ağır et al., 2017). In this area, coastal dune ecosystems are highly threatened by urbanization, tourism and agricultural facilities; moreover, harbour and road construction facilities are widespread in the study area.

Sampling and Data Collection

Seven transects from seashore to the inner land included driftline, embryonic-shifting/primary dunes, mobile dunes, transitional (semi-fixed) dunes, herbaceous (grey) vegetation dunes and fixed dunes. Transects were orthogonal to the seashore and varied from 25 to 700 m depending on dune morphology and on the length of the natural vegetation strip. A total number of 351 sampling units were considered, and cover-abundance values were determined in contiguous 4 m^2 areas (Table 1).

Minimal area method is used to determine the sampling unit size (Braun-Blanquet, 1964). Sampling units were collected from each vegetation plots included all dune zones from homogenous areas between April-September from 2012 to 2014. Cover-abundance data of species were calculated using Braun-Blanquet method (Braun-Blanquet, 1964).

Structural features were analysed by grouping EUNIS habitats in each site, according to Peìrez-Harguindeguy et al. (2013). Structural features (growth forms) are determined their leaf-stem architectural, as an indicator of adjustment to environmental factors. Six growth forms were identified: shrubs, trees, dwarf shrubs, erect leafy; tussock forming; rosette forming and creeping.

Table 1. The number of plots and species per zone.

	Plot number	Species number	Localities
Drifline	67	10	All
Embryonic-shifthing/Primary	39	6	All
Mobile	52	14	All
Transitional (semi-fixed)	71	19	All
Herbaceous vegetation (grey)	75	11	All
Fixed	47	16	All
Total	**351**	**76**	

Coastal dunes include several significant species and should be protected, and the protection status can be determined by using some criteria including ecological, biogeographical and phonological status of a particular plant species. These criteria need to account for the rarity, conservation status, degree of endemism, geographic distribution, economic, and ecological importance of the species (Halmy & Salem, 2015). To calculate species conservation index (SCI) values of each species seven different criteria (geographic distribution, life span, growth form, conservation status, commonness, the utilitarian and the ecological importance) were used for evaluating the significance of the plant species. Ten point scoring system was performed to each criterion (Table 2).

So, species SCI values were calculated from seven criteria (each scored by 10) as indicated below:

$$SCI = \frac{\sum_{i=1}^{n} W_i C_i}{10}$$

In formula: *Ci*; score of species for criterion i, W_i; weighting factor for iterion i

Wi is calculated according to below formula

$$w_i = \frac{wf_i}{\sum_{i=1}^{n} wf_i}$$

In formula: W_i; weighting factor for iteration i;

wfi; was taken as "*wf* = 2" because of emphasizing the species value with sea–inland gradient cases.

"wf = 1" was taken for other criteria because they have same weight. "n" is the criteria for calculating the species importance. The minimum score (zero) was given to the undocumented species. SCI values ranges from "0.2" to "1".

Table 2. The list of the scoring system and criterion used in calculating the conservation importance index (SCI) for the studied coastal dune species and the base for their selection. (criterions 1-5: Salem 2003, Salem & Waseem 2006; criterions 6 and 7: Waseem & Salem 2015; citerion 8: Current study).

Criterion	Score
1. Conservation status	
Not threatened-not evaluated	*2*
Threatened	*4*
Vulnerable	*6*
Endangered-vulnerable	*8*
Endangered	*10*
2. Rarity	
Very common	*2*
Common	*4*
Fairly common-occasional	*6*
Fairly rare	*8*
Rare	*10*
3. Life span	
Annual	*2*
Perennial herb or grass	*4*
Shrub or dwarf shrub	*6*
Small tree or large shrub	*8*
Tree	*10*
4. Growth form	
Therophyt	*2*
Geophyte	*4*
Hemicryptophyte	*6*
Chamaephyte	*8*
Phanerophyte/Phanerophytic lianas	*10*
5. Utilitarian importance	
Undocumented	*2*
One use	*4*
Two uses	*6*
Three uses	*8*
More than three uses	*10*
6. Ecological importance	
Undocumented	*2*
One important ecological service	*4*
Two important ecological service	*6*
Three important ecological service	*8*
More than three important ecological service	*10*
7. Geographic Distribution	
Cosmopolitan distribution	*2*
Occurs in more than on eglobal floristic region	*4*
Occurs in one globalfloristic region	*6*
Restricted national distribution	*8*
Endemic or nearly endemic	*10*
8. Coastal dune zone	
Drift line	*1*
Embryonic-shifting/Primary dune	*3*
Mobile dune	*5*
Transitional (semi-fixed) dune	*6*
Herbaceous vegetation (Grey) dune	*8*

The values nearing "1" indicate a high importance species but those nearing "0" indicate low importance specie. For all species in the area, the SCI values collected to generate a cumulative value of conservation considering the species by species value of conservation approachment. Such an approach could be used to ensure a basis for relative comparisons of conservation importance of varied coastal dune zones and the localities.

For each EUNIS habitats, we calculated habitat conservation index was calculated by weighted average using species importance values and mean total species cover per plot.

Sites' conservation value (SCV) was calculated using SCI scores. Conservation importance value was also calculated to compare coastal dune zones.

$$SCV_j = \frac{\sum_{ij}^{n} SCI_{ij}}{\sum_{i=1}^{N} SCI_i}\left(\frac{N - n_j}{n_j}\right)$$

In formula: SCI_{ij}: SCI for plant species "I" registered at site "j", N; total number of species in studied area,
n_j: number of species identified at studied area "j".
Coastal dune zones were compared by one-way ANOVA test regarding SCI, SCV, and used criteria followed by Tukey's post hoc HSD test (IBM Corporation, 2012).

Results

Ten species in drift line dune zone, six species embryonic-shifthing/primary dune zone, 14 species in mobile dune zone, 19 species in transitional (semi-fixed), 11 species in herbaceous (grey) vegetation dune zone and 16 species in fixed dune zone were determined (Table 1). Geographic distribution, life span, growth form, conservation status, life

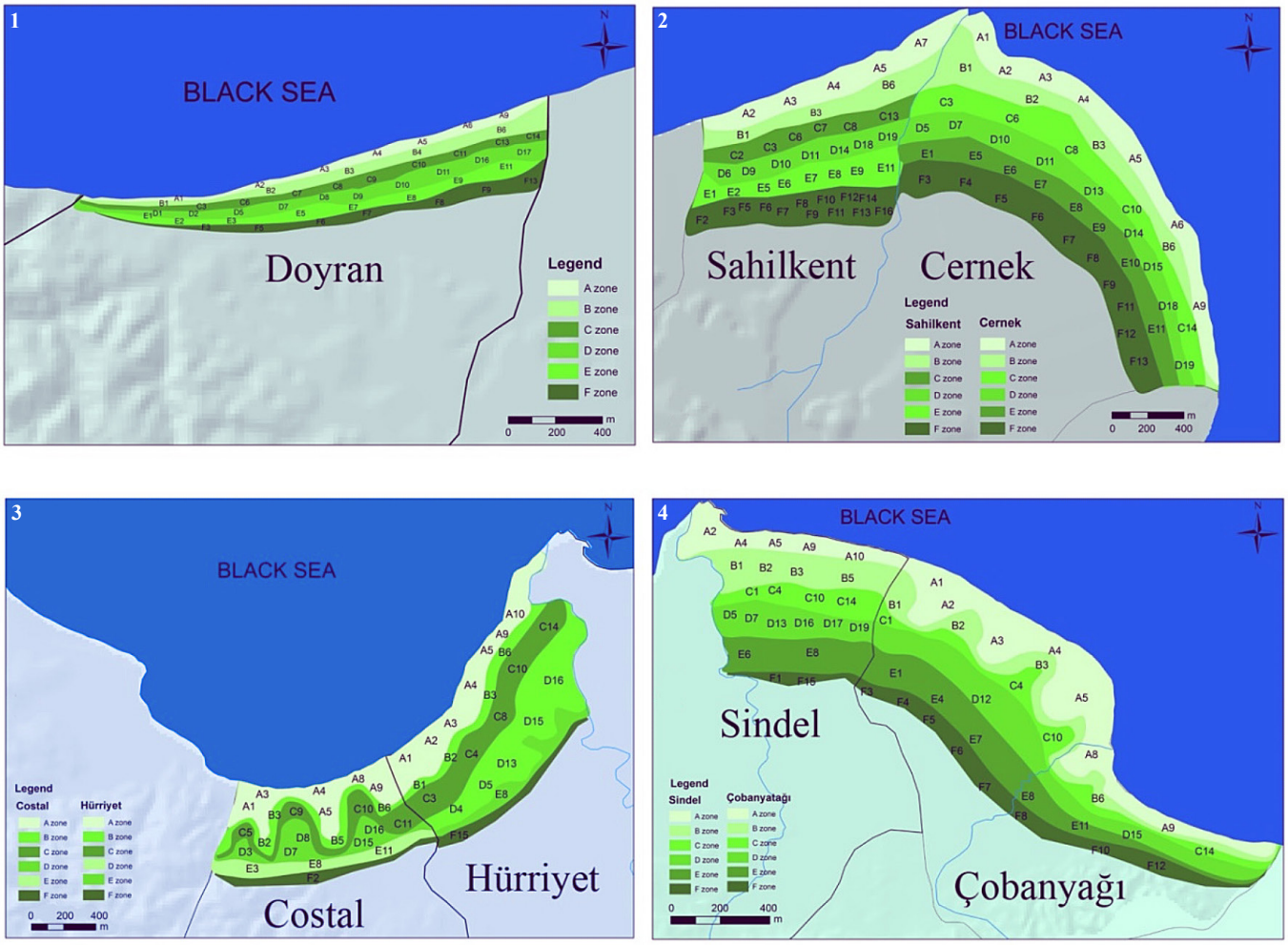

Figure 3. The distribution of characteristic dune zones in the studied localities from the west (1) to the east (4). Plant abbreviations are given in Appendix 1.

form, utilitarian importance, commonness and ecological importance of the species were determined (Appendix 3). Distribution of dune plant species in the studied dune zones and localities were shown in maps of localities (Figure 3). The highest SCI scores were found in *Imperata cylindrica*, *Eleagnus rhamnoides* and *Jurinea kilea* on the basis of studied coastal species. The highest SCI score was found in *Apocynum venetum* subsp. *sermatiense* in drift line. The highest SCI score was found in *Achillea maritima* in plant communities of embryonic-shifting/primary dune zone. The highest SCI score was found in *Pancratium maritimum* and *Gundelia tournefortii* in mobile dune zone. *Jurinea kilea* had the highest SCI score in transitional (semi-fixed) dune zone. The highest SCI scores were found in *Imperata cylindrica* and *Eleagnus rhamnoides* in grey and fixed dune zones, respectively (Appendix 2). SCI scores were significantly differed among dune zones (Figure 4).

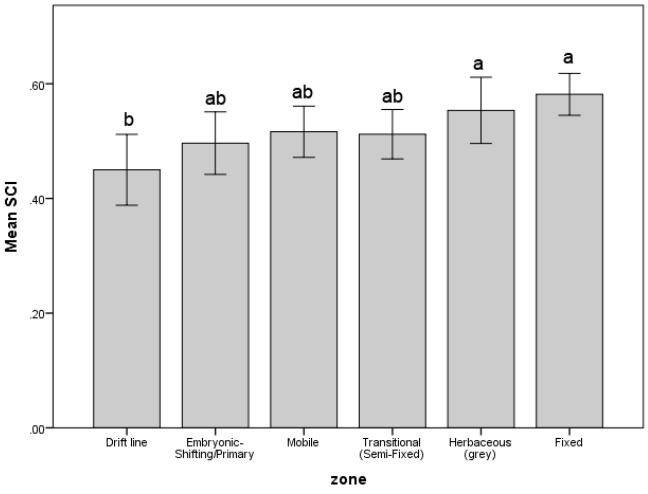

Figure 4. Mean SCI values for each dune zone ($p<0.05$).

Table 3. The classification of coastal dune species according to their SCI values.

SCI value	Category of conservation importance	Species number	% of recorded species
0.75-1.00	High importance	4	5.26
0.50-0.75	Important	48	63.16
0.25-0.50	Moderate importance	24	31.58
0.20-0.25	Low importance	-	-

All criteria were significant for studied coastal dune species. The highest mean SCI score was found in E zone, while *Xanthium strumarium* subsp. *cavanillesii* and *Digitaria ischaemum* had the lowest SCI scores, and both species occurred in A zone (Appendix 2). All of the studied species were moderate to high importance (Table 3).
Fixed dune zone has highest SCI values (EU 2160) followed by mobile dune zone (EU 2120) and transitional (semi-fixed) dune zone (EU 2230) at the community level (Table 4).

Table 4. SCI values of EUNIS habitats at community levels.

Dune zone/EU habitats	SCI
Drifline dune zone	
EU 1210	0.372
Embryonic-shifthing/Primary dune zone	
EU 2110	0.522
Mobile dune zone	
EU 2120	0.670
Transitional (semi-fixed) dune zone	
EU 2210	0.544
EU 2230	0.610
Herbaceous vegetation (grey) dune zone	
EU 2130	0.503
Fixed dune zone	
EU 2160	0.685

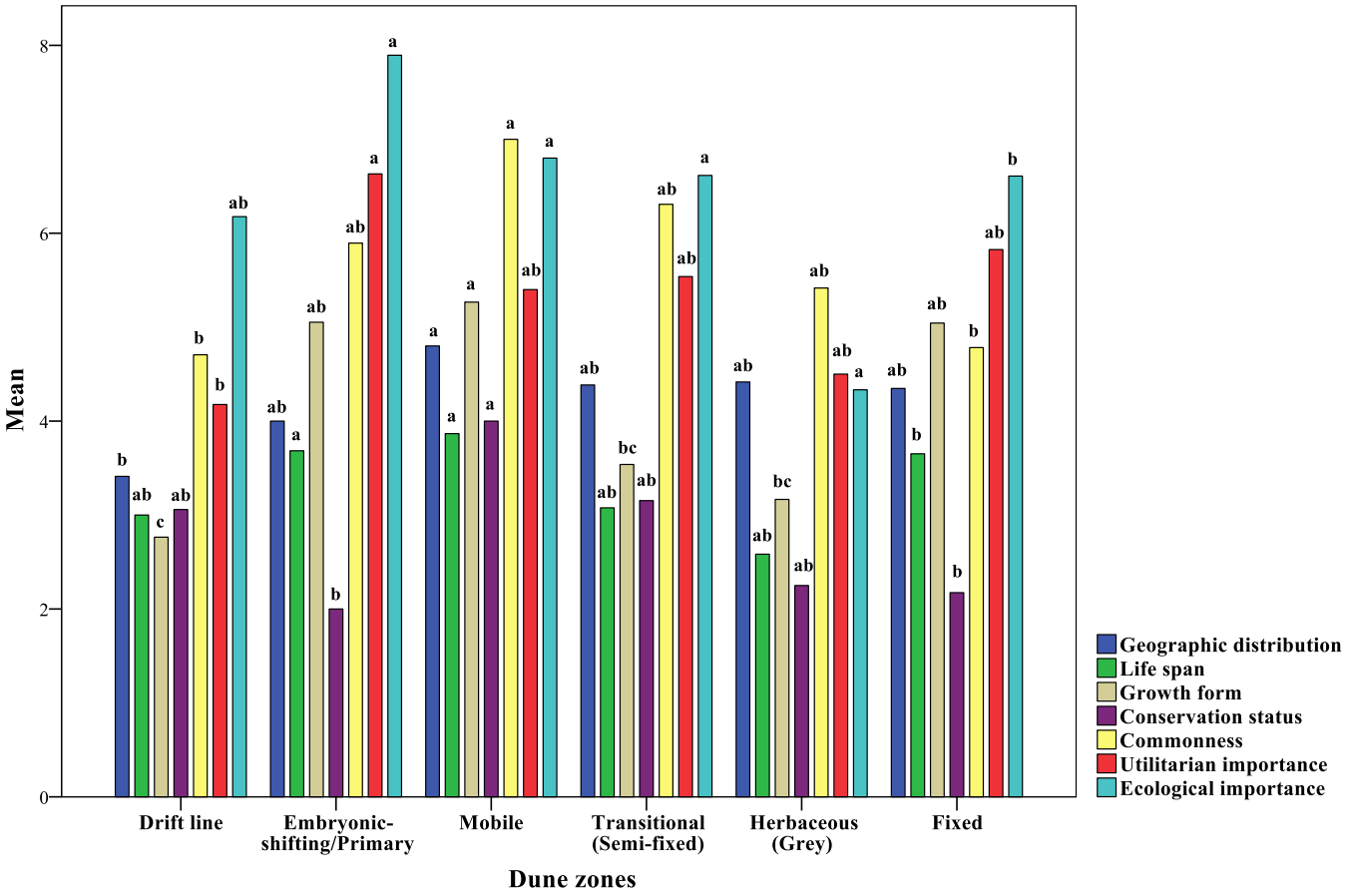

Figure 5. The comparison of species conservation index (SCI) scores among the studied dune zones ($p < 0.05$).

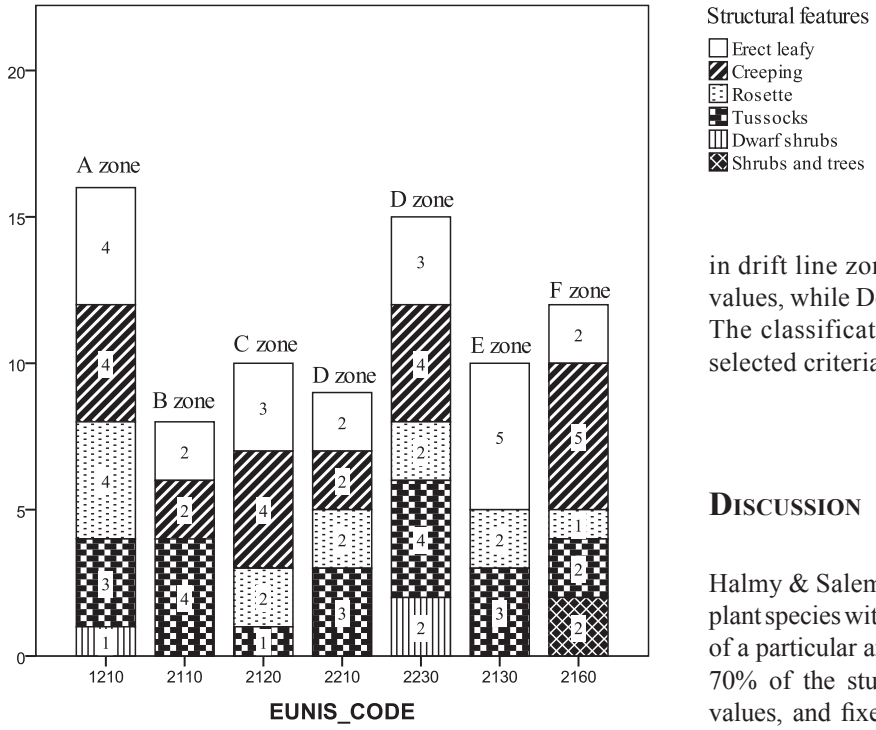

Figure 6. Distribution of structural features (growth forms) for studied species in the coastal dunes.

There were significant differences among characteristic coastal dune zones regarding seven criteria (geographic distribution, life span, growth form, conservation status, commonness, the utilitarian and the ecological importance) for calculated SCI values (Figure 4). Ecological and utility scores were found to be higher than the other criteria (Figure 5).

Among the EUNIS habitats, erect and tussocks leafy species from structural features (growth forms) were found in all habitat types. Most of creeping forming plants were found in transitional (semi-fixed) dunes (D zone) (Figure 6).

The highest SCV values were found in embryonic-shifting or primary dune, while the lowest SCV values were found in drift line zone (Figure 7). Costal had the highest SCV values, while Doyran had the lowest SCV values (Figure 8). The classifications of coastal dune species according to selected criteria, were presented in Appendix 3.

Discussion

Halmy & Salem (2015) stated that the considerable ratio of plant species with SCI > 0.5 indicates that floristic composition of a particular area is rich in terms of specific species. About 70% of the studied coastal dune plants had the SCI > 0.5 values, and fixed dunes had the highest SCI values. Fixed dunes had the highest SCI scores. The salt content of coastal dunes has been decreased along the seashore-inland gradient. Coastal dune erosion and eutrophication caused by seawater rich in terms of nitrogen from excessive agronomic practices in contiguous land areas (Acosta et al., 2006). E zone is less exposed to sand burial, salt spray and coastal dune erosion, so environmental factors in E zone is more stable and coastal dune species are incrementally less exposed to the harsh environmental conditions and gradually less tolerance to salt spray, sand winds and sand burial. As a result of this many species were allowed to establish and coastal dune species in E and F zones are precious for nature conservation (Da Silva et al., 2008; Isermann, 2011; Prisco et al., 2012; Del Vecchio et al., 2016). It has been stated that some disturbance factors such as chewing appears to be harmful to fixed dunes in the future and severe disturbance factors create serious injury in

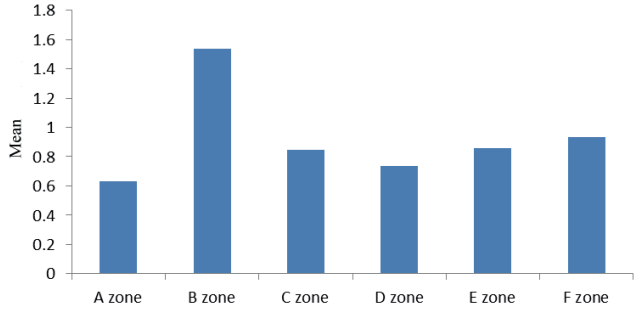

Figure 7. Site conservation values (SCV) among the studied coastal dune zones.

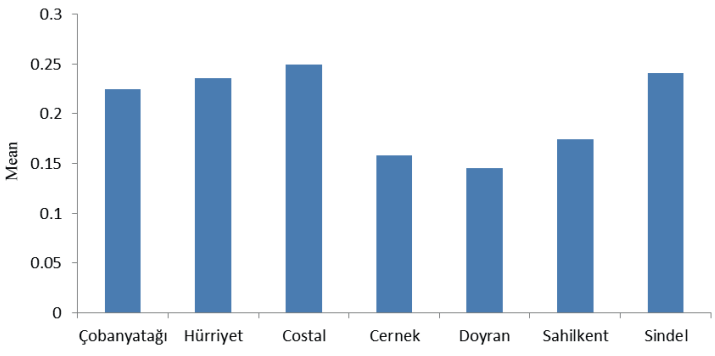

Figure 8. Site conservation values (SCV) values among the studied localities.

fixed coastal dunes (Lemauviel & Rozé, 2003; Lemauviel et al., 2003). Abdelaal et al. (2017) emphasized that vegetation of fixed dunes has the highest species richness, evenness and cover, followed by communities of mobile dunes, but the primary/embryonic dunes have the lowest diversity (Fenu et al., 2012; Ciccarelli et al., 2017).

Fixed dunes were followed by mobile dune zone (EU 2120) concerning SCI scores, and mobile dunes include a tufted plant, *Ammophila arenaria*. Tufted plants usually reproduce with their belowground organs and also very resistant to sand burial (Maun, 2009; Del Vecchio et al., 2016). Ecological scores were found to be high in B zone, and this zone also had the highest SCV scores. *Eryngium maritimum* is very widespread in B zone, and this species has a secondary role in the accumulation of sand that supporting a graduated change in the structure of the dune accumulation. It has been reported that plant communities play an important role on the stabilization of coastal dunes (Fenu et al., 2012). These species are classified as rare and vulnerable species and growing on dry coastal dune, and they are very threatened (De Lillis et al., 2004; Łabuz, 2004). Many coastal plant species include specialized coastal dune plants that have the talent to resist sand burial and sand substrate changeability. However, they usually suffer from continuous sand movement and very fragile to topographical and shoreline dynamics and develop on sandy substrate with having high salinity content. They inhabited by specialized plant species which can tolerate the burial of their shoot system in sand and capable of producing adventitious roots from the buried vegetative parts. (Calvão et al., 2013; Fenu et al., 2013; Ahmed et al., 2014; Del Vecchio et al., 2016).

Transitional (semi-fixed) dunes contained a mosaic of two compositionally different plant communities between fixed and grey (herbaceous) dunes so that they influence the functional species-habitat association (Ricotta et al., 2015). SCI values in C (mobile dune) zone were found to be higher with respect to A, B and D zones. C zone includes *Pancratium maritimum* which is an indicator species of accretion processes. On the other hand, this species suffered from over-collection due to its ornamental value and included important alkaloids in its bulbs (Bogdanova et al., 2009; Takos & Rook, 2013). *Jurinea kilea* was found to be a significant species in transitional dune zone (D zone) and has very important in landscape studies (Avcı, 2008). The lowest SCI values were found in A zone. Salt spray and wave effect were the most noticeable factors in that zone. Acosta et al. (2007) stated that the species in A zone (drift line) are associated with harsh conditions such as wave effect, high salinity and changeability substrate.

Apocynum venetum subsp. *sermatiense*, *Pancratium maritimum*, *Gundelia tournefortii*, *Jurinea* kilea, *Imperata cylindrica* and *Eleagnus rhamnoides* had high SCI scores. However, these plant species have suffered from road construction facilities in the study area. Moreover, over-collection for domestic medicinal uses and local trade by the public are other threatening factors (Abdelaal et al., 2017; Ağır et al., 2017). Coastal dune species in the study area have high ecological importance because ecological importance scores were found to be higher than the other scores.

Growth form was found to be significant criteria in the study area. It has been reported that growth form plays a major role in dune ecosystem organization and functioning, referring main constituents of vegetation identity in coastal ecosystems and may provide easily noticeable evidence of existing processes of habitat modification. In addition to these, growth form also may provide some valuable clues with respect to ongoing processes of habitat modification and play a vital role to determine the variability of the response to anthropogenic disturbance (Martínez et al., 2006; Maun, 2008; Maun, 2009; Del Vechio et al., 2016). Some grass species like *Vulpia fasciculata, Euphorbia platyphyllos* and *E. palustris* had low SCI values in herbaceous vegetation in grey dunes (EU 2130). The significance reduction in the abundance of therophytes and dune plants with high leaf intensity (primarily grassland dune) underlines the sensibility of particular herbaceous species to disturbances coupled with crushing and habitat deterioration, which are anticipated to be ongoing despite the general raise in terms of total vegetation canopy on coastal dunes. As compared to other criteria, they can help assess changes and trends caused by anthropogenic and disturbance stresses (Martínez et al., 2006; Prisco et al., 2016). In both fixed and mobile dune zones, rosette-forming plants were constituted to the vast majority of growth forms. Plant species which used for coastal protection should be both tolerant to burial and flooding. Rosette-forming plants are very important in building and stabilizing coastal dunes and may affect the results of restoration efforts (Martinez et al., 2016; Stešević et al., 2017; Brown & Zinnert, 2018).

There were two different disturbance factors in coastal dune ecosystems. Pioneer stages of coastal dunes are disturbed mainly by tourism activities and coastal dune erosion, while fixed dune communities are affected by road construction facilities, agriculture and plantations, grazing and seawater catchment (Acosta et al., 2006). If disturbance factors such as anthropogenic pressures (the enlargement of urban settlements and the development of seaside tourism) intense or prolonged in time coastal dune species are disappeared **(**Acosta et al., 2009; De Luca et al., 2011**;** Calvão et al., 2013**).** Coastal dune vegetation plays a major role in stabilizing and building of dunes, so effective coastal dune habitat management requires a better understanding of plant populations of coastal sand dunes (Frosini et al., 2012). Mobile dune zone (EU 2120) had found to be significant regarding SCI scores and characterized by a tufted plant, *Ammophila arenaria*.

So companion sowing with dune stabilising plants such as *Ammophila* sp. will lead to increase plant diversity on newly restored coastal sand dune areas (Hanley et al., 2014). High vulnerability sites for distribution factors like coastal sand dunes might need restoration practices in order to enhance the ecosystem quality and to do this conservation status of plant species and communities should be known (Martínez et al., 2006; Halmy & Salem, 2015; Ciccarelli et al., 2017).
In conclusion the studied coastal dune species were moderate to high importance values, and SCI scores were increased along the seashore-inland gradient. It has been found that embryonic-shifting or primary dune zone had the highest SCV values. The using of SCI and SCV values is of great importance in determining a strategy for the conservation of plant species in biogeographically important habitats. High vulnerability sites for distribution factors like coastal dunes might need restoration practices in order to enhance the ecosystem quality and to do this conservation status of plant species and communities should be known.

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Appendixes

Appendix 1. Abbreviations of coastal dune plant species in the studied dune zones and localities according to present-absent status.

Species	Species code	Zone	Çobanyatağı	Hürriyet	Costal	Çernek	Doyran	Sahilkent	Sindel
Cakile maritima	*A1*	A	+	+	+	+	+	0	0
Calystegia soldanella	*A2*	A	+	+	0	+	+	+	+
Digitaria ischaemum	*A3*	A	+	+	+	+	+	+	0
Eryngium maritimum	*A4*	A	+	+	+	+	+	+	+
Euphorbia paralias	*A5*	A	+	+	+	+	+	+	+
Parapholis incurva	*A6*	A	0	0	0	+	+	0	0
Salsola ruthenica	*A7*	A	0	0	0	0	0	+	0
Apocynum venetum subsp. *sermatiense*	*A8*	A	+	0	+	0	0	0	0
Xanthium strumarium subsp. *cavanillesii*	*A9*	A	+	+	+	+	+	0	+
Tournefortia sibirica var. *sibirica*	*A10*	A	0	+	0	0	0	0	+
Achillea maritima	*B1*	B	+	+	0	+	+	+	+
Crepis foetida subsp. *rhoeadifolia*	*B2*	B	+	+	+	+	+	0	+
Elymus farctus subsp. *bessarabicus* var. *bessarabicus*	*B3*	B	+	+	+	+	+	+	+
Glaucium flavum	*B4*	B	0	0	0	0	+	0	0
Cionura erecta	*B5*	B	0	0	+	0	0	0	0
Polygonum maritimum	*B6*	B	+	+	+	+	+	+	+
Agrostis stolonifera	*C1*	C	+	0	0	0	0	0	+
Ammophila arenaria subsp. *arundinacea*	*C2*	C	0	0	0	0	0	+	0
Cynanchum acutum subsp. *acutum*	*C3*	C	+	+	0	+	+	+	0
Cynoglossum creticum	*C4*	C	0	+	0	0	0	0	+
Gundelia tournefortii	*C5*	C	0	0	+	0	0	0	0
Hypochoeris radicata	*C6*	C	0	0	0	+	+	+	0
Juncus littoralis	*C7*	C	0	0	0	0	+	+	0
Medicago marina	*C8*	C	0	+	0	+	+	+	0
Medicag polymorpha var. *polymorpha*	*C9*	C	0	0	+	0	+	0	0
Pancratium maritimum	*C10*	C	+	+	+	+	+	0	+
Raphanus raphanistrum	*C11*	C	0	0	+	0	+	0	0
Schoenoplectus triqueter	*C12*	C	0	0	0	0	0	+	0
Scolymus hispanicus	*C13*	C	0	0	0	0	+	0	0
Euphorbia peplis	*C14*	C	+	+	0	+	+	0	+
Centaurea iberica	*D1*	D	0	0	0	0	+	0	0
Cenchrus incertus	*D2*	D	0	0	0	0	+	0	0
Echinops orientalis	*D3*	D	0	0	+	0	0	0	0
Xanthium spinosum	*D4*	D	0	+	0	0	0	0	0
Anagallis arvensis var. *arvensis*	*D5*	D	0	+	0	+	+	0	+
Anchusa hybrida	*D6*	D	0	0	0	0	0	+	0
Bromus racemosus	*D7*	D	0	0	+	+	+	0	+

Species	Species code	Zone	Çobanyatağı	Hürriyet	Costal	Çernek	Doyran	Sahilkent	Sindel
Echium plantagineum	*D8*	D	0	0	+	0	+	0	0
Jurinea kilaea	*D9*	D	0	0	0	0	+	+	0
Kickxia commutata subsp. *commutata*	*D10*	D	0	0	0	+	+	+	0
Lagurus ovatus	*D11*	D	0	0	0	+	+	+	0
Medicago littoralis var. *littoralis*	*D12*	D	+	0	0	0	0	0	0
Plantago scabra	*D13*	D	0	+	0	+	0	0	+
Satureja hortensis	*D14*	D	0	0	0	+	0	+	0
Sophora alopecuroides var. *alopecuroides*	*D15*	D	+	+	+	+	0	0	0
Cynodon dactylon var. dactylon	*D16*	D	0	+	+	0	+	0	+
Euphorbia terracina	*D17*	D	0	0	0	0	+	0	+
Galium spurium	*D18*	D	0	0	0	+	0	+	0
Trifolium resupinatum var. *resupinatum*	*D19*	D	0	0	0	+	0	+	+
Cyperus capitatus	*E1*	E	+	0	0	+	+	+	0
Silene otites	*E2*	E	0	0	0	0	+	+	0
Vulpia fasciculata	*E3*	E	0	0	+	0	+	0	0
Imperata cylindrica	*E4*	E	+	0	0	0	0	0	0
Medicago x varia	*E5*	E	0	0	0	+	+	+	0
Trifolium stellatum.	*E6*	E	0	0	0	+	0	+	+
Cota tinctoria tinctoria	*E7*	E	+	0	0	+	+	+	0
Daucus broteri	*E8*	E	+	+	+	+	+	+	+
Euphorbia palustris	*E9*	E	0	0	0	+	+	+	0
Euphorbia platyphyllos	*E10*	E	0	0	0	+	0	0	0
Silene dichotoma var. *dichotoma*	*E11*	E	+	0	+	+	+	+	0
Polypogon monspeliensis	*F1*	F	0	0	0	0	0	0	+
Crataegus monogyna var. *monogyna*	*F2*	F	0	0	+	0	0	+	0
Eleagnus rhamnoides	*F3*	F	+	0	0	+	+	+	0
Petrorhagia saxifraga	*F4*	F	+	0	0	+	0	0	0
Phleum exaratum subsp. *exaratum*	*F5*	F	+	0	0	+	+	+	0
Teucrium chamaedrys subsp. *chamaedrys*	*F6*	F	+	0	0	+	+	+	0
Verbascum sinuatum var. *sinuatum*	*F7*	F	+	0	0	+	+	+	0
Elymus elongatus subsp. *elongatus*	*F8*	F	+	0	0	+	+	+	0
Teucrium polium	*F9*	F	0	0	0	+	+	+	0
Artemisia scoparia	*F10*	F	+	0	0	0	0	+	0
Blackstonia perfoliata subsp. serotine	*F11*	F	0	0	0	+	0	+	0
Centaurium pulchellum	*F12*	F	+	0	0	+	0	+	0
Hordeum vulgare	*F13*	F	0	0	0	+	+	+	0
Juncus pygmaeus	*F14*	F	0	0	0	0	0	+	0
Trifolium campestre	*F15*	F	0	+	0	0	0	0	+
Trifolium arvense var. *arvense*	*F16*	F	0	0	0	0	0	+	0

Appendix 2. SCI values of the studied coastal dune species.

Species	Zone	SCI
Apocynum venetum subsp. *sermatiense*	Drift line dune	0.575
Cakile maritima	Drift line dune	0.450
Calystegia soldanella	Drift line dune	0.425
Digitaria ischaemum	Drift line dune	0.300
Eryngium maritimum	Drift line dune	0.350
Euphorbia paralias	Drift line dune	0.325
Parapholis incurva	Drift line dune	0.425
Salsola ruthenica	Drift line dune	0.375
Tournefortia sibirica var. *sibirica*	Drift line dune	0.525
Xanthium strumarium subsp. *cavanillesii*	Drift line dune	0.300
Achillea maritima	Embryonic-shifting/Primary dune	0.600
Cionura erecta	Embryonic-shifting/Primary dune	0.575
Crepis foetida subsp. *rhoeadifolia*	Embryonic-shifting/Primary dune	0.450
Elymus farctus subsp. *bessarabicus* var. *bessarabicus*	Embryonic-shifting/Primary dune	0.450
Glaucium flavum	Embryonic-shifting/Primary dune	0.475
Polygonum maritimum	Embryonic-shifting/Primary dune	0.575
Agrostis stolonifera	Mobile dune	0.600
Ammophila arenaria subsp. *arundinacea*	Mobile dune	0.600
Cynanchum acutum subsp. *acutum*	Mobile dune	0.550
Cynoglossum creticum	Mobile dune	0.550
Euphorbia peplis	Mobile dune	0.425
Gundelia tournefortii	Mobile dune	0.725
Hypochoeris radicata	Mobile dune	0.675
Juncus littoralis	Mobile dune	0.600
Medicag polymorpha var. *polymorpha*	Mobile dune	0.450
Medicago marina	Mobile dune	0.550
Pancratium maritimum	Mobile dune	0.725
Raphanus raphanistrum	Mobile dune	0.500
Schoenoplectus triqueter	Mobile dune	0.450
Scolymus hispanicus	Mobile dune	0.675
Anagallis arvensis var. *arvensis*	Transitional (semi-fixed) dune	0.475
Anchusa hybrida	Transitional (semi-fixed) dune	0.550
Bromus racemosus	Transitional (semi-fixed) dune	0.425
Cenchrus incertus	Transitional (semi-fixed) dune	0.600
Centaurea iberica	Transitional (semi-fixed) dune	0.525
Cynodon dactylon var. *dactylon*	Transitional (semi-fixed) dune	0.575
Echinops orientalis	Transitional (semi-fixed) dune	0.700
Echium plantagineum	Transitional (semi-fixed) dune	0.600
Euphorbia terracina	Transitional (semi-fixed) dune	0.450
Galium spurium	Transitional (semi-fixed) dune	0.475
Jurinea kilaea	Transitional (semi-fixed) dune	0.750

Species	Zone	SCI
Kickxia commutata subsp. *commutata*	Transitional (semi-fixed) dune	0.625
Lagurus ovatus	Transitional (semi-fixed) dune	0.475
Medicago littoralis var. *littoralis*	Transitional (semi-fixed) dune	0.450
Plantago scabra	Transitional (semi-fixed) dune	0.575
Satureja hortensis	Transitional (semi-fixed) dune	0.600
Sophora alopecuroides var. *alopecuroides*	Transitional (semi-fixed) dune	0.525
Trifolium resupinatum var. *resupinatum*	Transitional (semi-fixed) dune	0.500
Xanthium spinosum	Transitional (semi-fixed) dune	0.450
Cota tinctoria	Herbaceous vegetation (Grey) dune	0.550
Cyperus capitatus	Herbaceous vegetation (Grey) dune	0.500
Daucus broteri	Herbaceous vegetation (Grey) dune	0.525
Euphorbia palustris	Herbaceous vegetation (Grey) dune	0.475
Euphorbia platyphyllos	Herbaceous vegetation (Grey) dune	0.475
Imperata cylindrica	Herbaceous vegetation (Grey) dune	0.800
Medicago x varia	Herbaceous vegetation (Grey) dune	0.575
Silene dichotoma var. *dichotoma*	Herbaceous vegetation (Grey) dune	0.525
Silene otites	Herbaceous vegetation (Grey) dune	0.625
Trifolium stellatum	Herbaceous vegetation (Grey) dune	0.575
Vulpia fasciculata	Herbaceous vegetation (Grey) dune	0.475
Artemisia scoparia	Fixed dune	0.725
Blackstonia perfoliata subsp. *serotine*	Fixed dune	0.663
Centaurium pulchellum	Fixed dune	0.625
Crataegus monogyna var. *monogyna*	Fixed dune	0.875
Eleagnus rhamnoides	Fixed dune	0.825
Elymus elongatus subsp. *elongatus*	Fixed dune	0.650
Hordeum vulgare	Fixed dune	0.500
Juncus pygmaeus	Fixed dune	0.525
Petrorhagia saxifraga	Fixed dune	0.575
Phleum exaratum subsp. *exaratum*	Fixed dune	0.525
Polypogon monspeliensis	Fixed dune	0.525
Teucrium chamaedrys subsp. *chamaedrys*	Fixed dune	0.675
Teucrium polium	Fixed dune	0.725
Trifolium arvense var. *arvense*	Fixed dune	0.675
Trifolium campestre	Fixed dune	0.675
Verbascum sinuatum var. *sinuatum*	Fixed dune	0.700

Appendix 3. List of species in the study area; their geographic distribution (Med = Mediterranean, Cosm = Cosmopolitan, Ir-Tur = Irano-Turanian, Eu-Sib = Euro-Siberian); conservation status (Thr = Threatened, End = Endangered, Un = Undocumented); commonness (RR = Very Rare, R = Rare, FR = Fairly Rare, FC = Fairly Common, C = Common, CC = Very Common); life span (Per = Perennial, Bin = Biennial, Ann = Annual); growth form (Th = Therophyte, Gh = geophyte, Hc = himecryptophyte, Ch = cheamophyte, Ph = phanerophyte); utilitarian importance (Ot = others such as in making thatches, rope making, detergent, handicraft, Or = ornamental, Fe = fencing & windbreak, Ar = Aromatic, Ed = Edible, Ta = Tanning, Fu = Fuel, Md = Medicine, Gr = Grazing); and ecological importance (Ot = others, Ws= Water storage, Wb = Windbreak (natural), W = Weed, St = Salt tolerant, Sr = Soil fertility, Sh = Shading, Sf = Sand fixation, Re = Refuge, Ph = phreatophytes, Hyd = Hydrophyte, Es = Esthetic value, BioR = bioremediationpotential, BP = Bee-plant).

Species	Geographic distribution	Life span	Growth Form	Conservation status	Life Form	Utilitarian importance	Commonness	Ecological Importance
Achillea maritima	*Med ; Ir-Tur - Eu-Sib*	*Perennial*	*Chamaephyte*	Non-Th	*Herbaceous*	Md, Gr, Fu	Fc	Sf, Sh, Es, St
Agrostis stolonifera	*Eu-Sib ; Med*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Ot	Fr	Sf, St, W
Ammophila arenaria subsp. *arundinacea*	*Med ; Eu-Sib*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Gr ; Fu	Fr	Sf, Sh, Wb, St, Ot
Anagallis arvensis var. *arvensis*	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Md	Fc	Es
Anchusa hybrida	*Med ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr	Fr	Sf,
Apocynum venetum subsp. *sermatiense*	*Med ; Eu-Sib ; Ir-Tur*	*Perennial*	*Hemicryptophyte*	Th	*Herbaceous*	Md, Ot	R	Sf, Sh, St, Ot
Artemisia scoparia	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Chamaephyte*	Non-Th	*Herbaceous*	Md, Gr, Fu	C	Sf, Sh, Wb, St, Sr, Ot
Blackstonia perfoliata subsp. *serotine*	*Med ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ar, Ot	C	Sf, Sh, Wb, St, Sr, Ot
Bromus racemosus	*Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Un	Fc	Un
Cakile maritima	*Med ; Ir-Tr ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Md, Ot	Fc	Sf, Sh, Wb, St, Sr, Ot
Calystegia soldanella	*Cosm*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Ed, Ar, Md	C	St, W, Ot
Cenchrus incertus	*Med ; Ir-Tr ; Eu-Sib*	*Annual*	*Therophyte*	En-vul	*Herbaceous*	Gr	R	Sf, Wb
Centaurea iberica	*Cosm*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ed,	Fr	Sf, Sh, Re
Centaurium pulchellum	*Med ; Ir-Tr ; Eu-Sib*	*Annual*	*Therophyte*	Th	*Herbaceous*	Un	Fc	Sf, Sh, Wb, St, Sr, Ot
Cionura erecta	*Med ; Eu-Sib*	*Perennial*	*Chamaephyte*	Non-Th	*Shrub*	Md, Ot	Fr	Sf, Sh
Cota tinctoria	*Med ; Ir-Tr ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md	C	Un
Crataegus monogyna var. *monogyna*	*Med ; Ir-Tr ; Eu-Sib*	*Perennial*	*Phanerophyte*	Non-Th	*Shrub*	Md, Ed, Or, Ot,	Fr	Es, Ph, Sh, Wb, Ot
Crepis foetida subsp. *rhoeadifolia*	*Eu-Sib, Med ; Ir-Tr*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ot	Fc	Ph, Sf, Ot
Cynanchum acutum subsp. *acutum*	*Med ; Ir-Tur*	*Perennial*	*Phanerophytic Liana*	Non-Th	*Herbaceous*	Gr	Fr	Un
Cynodon dactylon var. *dactylon*	*Cosm*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Gr, Md, Fu	C	Sf, Sr, Re, Sh
Cynoglossum creticum	*Med ; Ir-Tur*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Un	R	W; Ot
Cyperus capitatus	*Med ; Ir-Tur*	*Annual*	*Geophyte*	Non-Th	*Herbaceous*	Gr	Fc	Un
Daucus broteri	*Med ; Ir-,Tur ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Ot	C	Sr, Sf
Digitaria ischaemum	*Cosm*	*Annual*	*Therophyte*	Th	*Herbaceous*	Un	Fc	St
Echinops orientalis	*Ir-Tr ; Eu-Sib : Med*	*Annual*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md, Fu; Ed	R	Sf, Wb, Ws, Re, Sr; Ot
Echium plantagineum	*Med ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Md, Fu	Fr	Sf, Wb, Ws, Re, Sf

Species	Geographic distribution	Life span	Growth Form	Conservation status	Life Form	Utilitarian importance	Commonness	Ecological Importance
Eleagnus rhamnoides	*Ir-Tr ; Eu-Sib : Med*	*Perennial*	*Phanerophyte*	Non-Th	*Shrub*	Gr, Md, Ed, Fe, Ot	Vc	Ph, Re, Sf, Sh, Wb
Elymus elongatus subsp. *elongatus*	*Med ; Ir-Tur*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr	C	Sf, Wb, St
Elymus farctus subsp. *bessarabicus*	*Med ; Ir-Tur*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Gr	C	Sf, Wb, St
Eryngium maritimum	*Med ; Eu-Sib*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Md	Vc	Sf, Es
Euphorbia palustris	*Ir-Tr ; Eu-Sib : Med*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Un	Vc	Sr, Sf
Euphorbia paralias	*Med ; Eu Sib ;*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Md	Vc	Sf, St
Euphorbia peplis	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md	Fr	Un
Euphorbia platyphyllos	*Ir-Tr ; Eu-Sib : Med*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Un	Vc	Sr, Sf
Euphorbia terracina	*Med ; Eu Sib ;*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Md	Vc	Sf, St
Galium spurium	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ed, Ot	Vc	Sf, St
Glaucium flavum	*Med ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Md	Fr	St
Gundelia tournefortii	*Ir-Tr ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Vul	*Herbaceous*	Gr, Md, Ed	R	Re, Sf, St, Ot
Hordeum vulgare	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Md	Vc	Un
Hypochoeris radicata	*Eu-Sib*	*Perennial*	*Hemicryptophyte*	Vul	*Herbaceous*	Ed, Md	Fr	St, W, Ot
Imperata cylindrica	*Med ; Tr ; Ir-Tur ; Eu-Sib*	*Perennial*	*Geophyte*	En-vul	*Herbaceous*	Gr, Md, Or, Ot	R	Sf, Wb, Ph
Juncus littoralis	*Med ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md, Ot	C	Wb, Sf, St, Ph, Re
Juncus pygmaeus	*Eu-Sib*	*Annual*	*Therophyte*	Th	*Herbaceous*	Un	Fc	Un
Jurinea kilaea	*Eu-Sib (Near endemic)*	*Perennial*	*Hemicryptophyte*	En	*Shrub*	Un	Fc	St, Sf, Ot
Kickxia commutata subsp. *commutata*	*Med ; Eu-Sib; Ir-Tur*	*Annual*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md, Fu	Fr	Wb, Es, Sf
Lagurus ovatus	*Med ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Or, Gr	Fc	W
Medicag polymorpha var. *polymorpha*	*Cosm*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr, Md	Fc	Sf, Sr
Medicago littoralis var. *littoralis*	*Med ; Eu-Sib; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr	Fr	Un
Medicago marina	*Med ; Eu-Sib; Ir-Tur*	*Perennial*	*Chamaephyte*	Non-Th	*Shrub*	Gr	C	St, Ot
Medicago x varia	*Med ; Eu-Sib; Ir-Tur*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr	Fc	Ot
Pancratium maritimum	*Med ; Ir-Tur ; Eu-Sib*	*Perennial*	*Geophyte*	En	*Herbaceous*	Md, Or	Fc	Sf, Es, St, Sr, Ot
Parapholis incurva	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Vul	*Herbaceous*	Gr	R	St
Petrorhagia saxifraga	*Eu-Sib ; Ir-Tur*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Gr	Fr	Un
Phleum exaratum subsp. *exaratum*	*Med ; Eu-Sib ; Ir-Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr	Fc	Un
Plantago scabra	*Med ; Ir-Tr ; Eu-Sib*	*Annual*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md	Fr	Sf, Sr
Polygonum maritimum	*Med ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md, Ar, Ed	Fc	Sf, Wb, Ws

Species	Geographic distribution	Life span	Growth Form	Conservation status	Life Form	Utilitarian importance	Commonness	Ecological Importance
Polypogon monspeliensis	*Cosm*	*Perennial*	*Therophyte*	Non-Th	*Herbaceous*	Gr	C	Un
Raphanus raphanistrum	*Med ; Ir-Tur ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ed	R	Un
Salsola ruthenica	*Cosm*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ed, Ot	C	St, Sf, Re
Satureja hortensis	*Med ; Ir-Tur ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md, Ed, Ar, Fe, Ot	Fc	Sf, Sh, W, Ot
Schoenoplectus triqueter	*Cosm*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Un	R	Un
Scolymus hispanicus	*Med ; Eu-Sib*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Md, Ed, Ot	R	Re, Sf, St, Ot
Silene dichotoma var. *dichotoma*	*Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr	Fc	Bp
Silene otites	*Eu-Sib*	*Annual*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr	Fr	Bp, St
Sophora alopecuroides var. *alopecuroides*	*Med ; Ir-Tur ; Eu-Sib*	*Perennial*	*Geophyte*	Non-Th	*Herbaceous*	Md	Fc	Sf, Ot
Teucrium chamaedrys subsp. *chamaedrys*	*Med ;Eu-Sib*	*Perennial*	*Chamaephyte*	Non-Th	*Herbaceous*	Md	Fr	Ot
Teucrium polium	*Med ; Ir-Tur*	*Perennial*	*Chamaephyte*	Non-Th	*Herbaceous*	Gr, Md, Ar	Fc	Sf, St
Tournefortia sibirica var. *sibirica*	*Med ; Ir-Tur ; Eu-Sib ; Tr*	*Perennial*	*Hemicryptophyte*	En-vul	*Shrub*	Un	Fr	St
Trifolium arvense var. *arvense*	*Med ; Ir-Tur ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	G, Ed, Ot	Fr	Sf, Sf, W
Trifolium campestre	*Med ; Ir-Tur ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	G, Ed, Ot	Fr	Sf, Sf, W
Trifolium resupinatum var. *resupinatum*	*Med ; Eu-Sib; Ir_Tur*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr	Fr	Sr, St
Trifolium stellatum	*Med ; Eu-Sib*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Gr	R	Sr, St
Verbascum sinuatum var. *sinuatum*	*Med ; Eu-Sib (Near endemic)*	*Perennial*	*Hemicryptophyte*	Non-Th	*Herbaceous*	Gr, Md	C	Sf, Es
Vulpia fasciculata	*Med ; Eu-Sib; Ir-Tr*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Un	Fr	Un
Xanthium spinosum	*Ir-Tr ; Eu-Sib; Med*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Md	Fc	Sf
Xanthium strumarium subsp. *cavanillesii*	*Ir-Tr ; Eu-Sib; Med*	*Annual*	*Therophyte*	Non-Th	*Herbaceous*	Un	C	St, Ot