

Crustacean Diversity Among the *Cystoseira* Facies of the Aegean Coast of Turkey

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Abstract: This study focused on the crustacean fauna of *Cystoseira* facies in the upper infralittoral zone of the Turkish Aegean coast. Investigations were carried out at 9 stations along a depth gradient of 2 to 5 m in June and July 1995.

A total of 2179 specimens belonging to 81 species were identified. Among the species encountered, *Ampithoe ramondi* was the most common, with a dominance value of 11%, followed by *Leptochelia savignyi* (7%). *Caprella rapax* is recorded for the first time from the Aegean coast of Turkey; *Corophium acutum*, *Corophium rotundirostre* and *Hippolyte varians* are new records for the entire Turkish coast.

Key Words: Diversity, *Cystoseira*, Crustacea, Aegean Sea, Turkey

Türkiye'nin Ege Denizi Kıyıları *Cystoseira* Fasiesinin Crustacea Çeşitliliği

Özet: Bu çalışma Türkiye'nin Ege Denizi kıyıları üst infralittoral zonunda yer alan *Cystoseira* fasieslerinin Crustacea faunasının ortaya çıkarılması amacıyla gerçekleştirilmiştir. Araştırmalar Haziran ve Temmuz 1995 tarihleri arasında 9 istasyonda 2-5 m derinliklerde yürütülmüştür.

Araştırmalar sonucunda 81 tür ve bu türlere ait 2179 birey tespit edilmiştir. Elde edilen türler arasında *Ampithoe ramondi* % 11'lik dominansi değeri ile en yaygın tür olurken bunu *Leptochelia savignyi* (% 7) takip etmiştir. *Caprella rapax* Türkiye'nin Ege Denizi kıyılarından; *Corophium acutum*, *Corophium rotundirostre* ve *Hippolyte varians* Türkiye kıyılarından ilk kez rapor edilmektedir.

Anahtar Sözcükler: Diversite, *Cystoseira*, Crustacea, Ege Denizi, Türkiye

Introduction

The Aegean Sea comprises an important part of the Mediterranean ecosystem, due to its geographical location, geomorphological structure and hydrographical and ecological characteristics. From the biological point of view, 2 sub-regions are prominent, i.e. the northern and southern Aegean Sea, since the ecological features of the 2 basins differ widely (Kocataş and Bilecik, 1992).

Faunistic studies on Turkish Seas were first began in the Aegean Sea by Forbes (1843), concentrated on the Sea of Marmara and İstanbul strait during the 1950s, and then extended to the Aegean Sea and İzmir Bay after 1965.

The genus *Cystoseira* includes species with various ecological requirements, represented by over 50 species in the Mediterranean Sea (Delepine et al. 1987) and by 16 species in the Aegean Sea (Güner et al. 1985; Zeybek et al. 1993). Existing studies concerning the faunal structure of *Cystoseira* facies were previously carried out on the Black Sea by Zavodnik (1965) and Tigānus (1972), the Mediterranean Sea by Bellan-Santini (1969) and Boudresque (1969) and Turkish seas by Kocataş (1978) and Ergen (1980); Ergen and Çınar (1994).

Previous studies in Turkish seas were conducted on the vicinity of İzmir Bay. Therefore, sampling in this study was performed at a wider geographical range that could

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represent the Turkish Aegean coast, with the aim of examining the crustacean fauna associated with *Cystoseira* facies based on qualitative and quantitative data.

Materials and Methods

In order to determine the crustacean species associated with *Cystoseira* facies, sampling was performed carried out at 9 different stations (Saros Bay, Dikili, Şakran, Foça, Alaçatı, Güllük, Torba, Datça and Turunç, from north to south) at the upper infralittoral zone of the Aegean Sea (Figure 1 , Table 1).

Samples were taken according to the methodology proposed by Bellan-Santini (1969), and a 400 cm² unit

area was sampled from *Cystoseira* facies. For this purpose, a metal frame (20 x 20 cm) coated with a bag made from a plankton net was used. The *Cystoseira* roots within the metal frame were excavated by a spatula, and the material collected was preserved in 4% formalin for further analysis back in the laboratory.

The samples were washed through a 1 mm sieve and the crustacean individuals were sorted. All species were identified under the reflected light of a stereomicroscope. The total number of species and individuals belonging to crustacean groups were determined, and the frequency index (Soyer, 1970), diversity index (Shannon-Weaver, 1949), evenness index (Pielou, 1975) and similarity index (Bray-Curtis, 1957) were calculated for the interpretation of the data obtained.

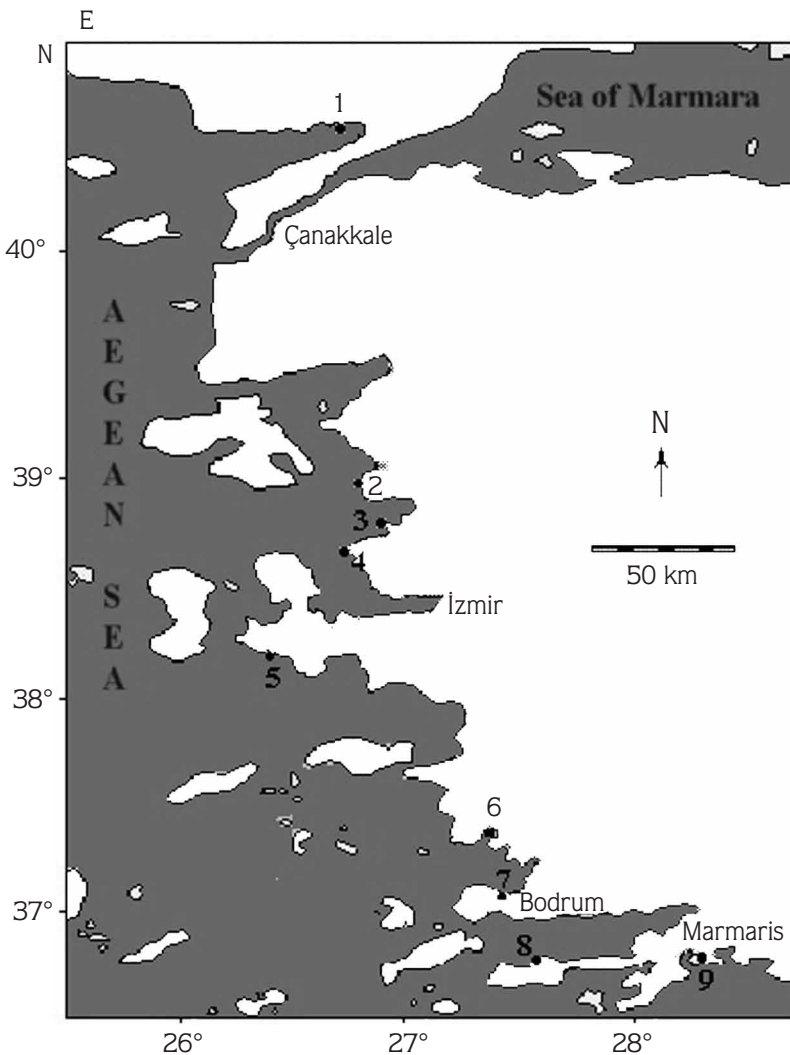


Figure 1. Study area with sampling sites.

Table 1. Stations and facies.

No.	Stations	Facies
1	Saros Bay	<i>C. crinita</i> DUBY
2	Dikili	<i>C. crinita</i> , <i>C. corniculata</i> (Turner) Zanardini, 1841, <i>C. schiffneri</i> G. Hamel, 1939
3	Şakran	<i>C. compressa</i> (Esper) Gerloff & Nizamuddin, 1975
4	Foça	<i>C. crinita</i> DUBY
5	Alaçatı	<i>C. crinita</i> DUBY
6	Güllük	<i>C. schiffneri</i> G. Hamel, 1939
7	Torba	<i>C. crinita</i> DUBY
8	Datça	<i>C. crinita</i> DUBY
9	Marmaris	<i>C. amentacea</i> BORY

Results

As a result of sampling carried out at 9 different localities along the Turkish Aegean coast, 2179 individuals belonging to 81 species (1 Cumacea, 2 Tanaidacea, 23 Isopoda, 36 Amphipoda and 19 Decapoda) were determined (Figure 2, Table 2).

The highest number of species was observed at stations 5 (Foça) and 7 (Torba) (30 species for each), whereas the lowest (23 species) was observed at station 3 (Şakran). According to the number of individuals, station 6 (Güllük) had the highest number and station 8 (Datça) the lowest (Figure 3).

Diversity index values among the sampling stations were in accordance with species richness. For example, the species diversity index was the highest for station 8

(Datça), with a value of 4.85, whereas the lowest value (3.64) was obtained from station 3 (Şakran) (Figure 3).

The evenness index values were generally over 0.60, ranging mainly between 0.80 and 0.94, revealing that the distribution of the number of individuals among species is regular. The exception is for *L. savignyi* (Tanaidacea), which is represented by 120 individuals at the station 9, thus decreasing the evenness index value (Figure 4).

For the relative importance of crustacean species sampled from 9 the stations, a frequency index (Soyer, 1970) was computed, and 28 species (35%) were designated as continuous, 16 (20%) as common and 37 (45%) as rare (Figure 5). Three species, namely *Ampithoe ramondi*, *Dexamine spinosa* and *Acanthonyx lunulatus*, had a value of 88%, and are the most common

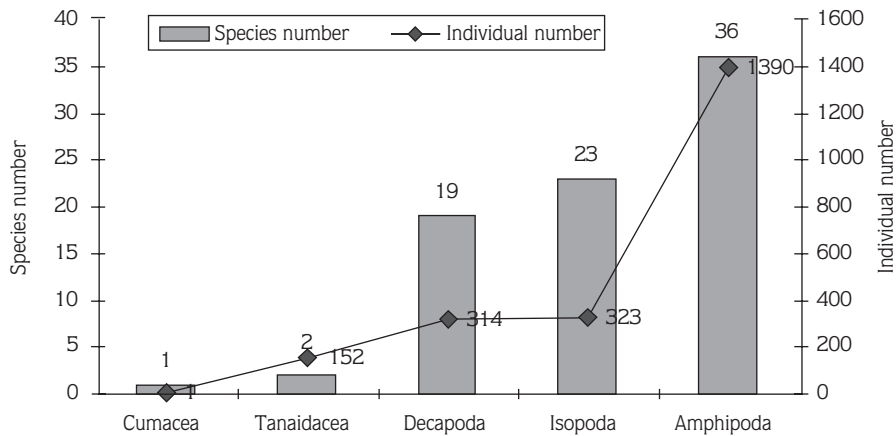


Figure 2. Species and specimen numbers of crustacean groups.

Table 2. List of crustacean species and their presence, abundance and dominance at each station.

Species	Stations											Dom.%
	1	2	3	4	5	6	7	8	9	N		
Cumacea												
<i>Cumella limicola</i> G.O. Sars, 1879			1								1	0.05
Tanaidacea												
<i>Tanais dulongii</i> (Audoin, 1826)							7				7	0.32
<i>Leptocheilia savignyi</i> (Kroyer, 1842)		4	9		12					120	145	6.66
Isopoda												
<i>Anthura</i> sp.						1					1	0.04
<i>Bopyrus squillarum</i> Latreille, 1803			2	1	2	3	2		2		12	0.56
<i>Carpis stebbingi</i> (Monod, 1933)	8		12	9			4	9	7		49	2.25
<i>Cirolana</i> sp.	2					4	3				9	0.41
<i>Cymodoce emarginata</i> Leach, 1818	5	6		2		3	6				22	1.00
<i>Cymodoce spinosa</i> (Risso, 1816)		4	2	3	7						16	0.73
<i>Cymodoce tuberculata</i> Costa in Hope, 1851									3		3	0.14
<i>Cymodoce turuncata</i> Leach, 1814							10	3			13	0.60
<i>Dynamene edwardsi</i> (Lucas, 1849)					4						4	0.18
<i>Dynamene magnitorata</i> Holdich, 1968	6		7	4					4		21	0.96
<i>Dynamene torelliae</i> Holdich, 1968	9	3						8	5		25	1.15
<i>Eurydice</i> sp.1			4	2		3	3				12	0.55
<i>Eurydice</i> sp.2	9	6			4						19	0.87
<i>Jaera nordmanni massilensis</i> Lemerrier, 1960					4						4	0.18
<i>Jaeropsis brevicornis littoralis</i> Amar, 1949							2	7	2		11	0.50
<i>Gnathia vorax</i> (Lucas, 1849)		2					2		3		7	0.32
<i>Paranthura costana</i> Bate & Westwood, 1868	3		2	3	2	5	4				19	0.87
<i>Paranthura nigropunctata</i> (Lucas, 1846)		2				2	3	2	2		11	0.50
<i>Pleurocripta porcellanae</i> Hesse, 1861					3						3	0.14
<i>Sphaeroma</i> sp.1			5								5	0.23
<i>Sphaeroma</i> sp.2			3				6				9	0.41
<i>Synisoma capito</i> (Rathke, 1837)	5	4	5	6	3			4	7		34	1.56
<i>Synisoma appendiculata</i> (Risso, 1816)		3				3		4	3		13	0.60
Amphipoda												
<i>Amphilocheus neopolitanus</i> Della Valle, 1893	4		6	14					9		33	1.51
<i>Ampithoe ramondi</i> Audouin, 1826	7	17	85	2	34	45	29	15			234	10.73
<i>Apherusa bispinosa</i> (Bate, 1857)	10		4	12							26	1.19
<i>Apherusa chierighinii</i> Giordani-Soika, 1950				15	15			5			35	1.61
<i>Apherusa vexatrix</i> Krapp-Schickel, 1969							3				3	0.14
<i>Apherusa</i> sp.						18					18	0.83
<i>Caprella acanthifera</i> Leach, 1814		4		4	22		7	12	1		50	2.29
<i>Caprella danilevskii</i> Czerniavski, 1868		7		2							9	0.41
<i>Caprella grandimana</i> Mayer, 1882					3	22					25	1.15
<i>Caprella mitis</i> Mayer, 1890							4				4	0.18
<i>Caprella rapax</i> Mayer, 1890			15		17	8					40	1.84
<i>Corophium acutum</i> Chevreux, 1908			34	4		35					73	3.35
<i>Corophium rotundirostre</i> Stephensen, 1915				3							3	0.14

Table 2. Continued

Species	Stations										N	Dom.%
	1	2	3	4	5	6	7	8	9			
<i>Dexamine spiniventris</i> (A.Costa,1853)	7	17			8	10		4			46	2.11
<i>Dexamine spinosa</i> (Montagu,1813)	12	10	10	14	14	37	7	10			114	5.23
<i>Elasmopus brasiliensis</i> (Dana,1855)							4	3			7	0,32
<i>Elasmopus pocillimanus</i> (Bate, 1862)		50	9	4	10	35			7		115	5.28
<i>Erichthonius brasiliensis</i> (Dana,1855)	9	2	11	29		3	12				66	3.03
<i>Hyale camptonyx</i> (Heller,1866)		6			4						10	0.46
<i>Hyale grimaldii</i> Chevreux,1891						14					14	0.64
<i>Hyale schmidtii</i> (Heller,1866)				25							25	1.15
<i>Iphimedia minuta</i> G.O.Sars,1882	2										2	0.09
<i>Leptocheirus guttatus</i> (Grube,1864)					18						18	0.83
<i>Leucothoe spinicarpa</i> (Abildgaard,1789)			10		8			2	5		25	1.15
<i>Lysianassa caesarea</i> Ruffo,1987					15	15		3			33	1.51
<i>Lysianassa costae</i> Milne Edwards,1830						7					7	0.32
<i>Maera inaequipes</i> (A.Costa,1853)	5	36				50			18		109	5.00
<i>Microdeutopus gryllotalpa</i> A.Costa,1853								2			2	0.09
<i>Microdeutopus</i> sp.					4						4	0.18
<i>Monoculodes carinatus</i> (Bate, 1857)	2										2	0.09
<i>Orchomene humulis</i> (A.Costa,1853)							2				2	0.09
<i>Pereinotus testudo</i> (Montagu,1808)		13	16		6	15		2			52	2.39
<i>Phtisica marina</i> Slabber,1769	5				2						7	0.32
<i>Podocerus variegatus</i> Leach,1814		22		21	7	30	4		15		99	4.54
<i>Stenothoe monoculoides</i> (Montagu,1813)	6				10			5			21	0.96
<i>Stenothoe tergestina</i> (Nebeski,1880)		9	14	20		12			2		57	2.62
Decapoda												
<i>Acanthonyx lunulatus</i> (Risso,1816)	1	1		4	1	1	12	3	2		25	1.15
<i>Athanas nitescens</i> (Leach,1814)		1				1			4		6	0.28
<i>Cestopagurus timidus</i> (Roux,1830)		6		5			2	2			15	0.69
<i>Clibanarius erythropus</i> (Latreille,1818)				9							9	0.41
<i>Galathea bolivari</i> Zariquiey-Alvarez,1950								4	1		5	0.23
<i>Hippolyte leptocerus</i> (Heller,1863)	4					4		6			14	0.64
<i>Hippolyte varians</i> Leach,1814				1			2				3	0.14
<i>Macropodia longirostris</i> (Fabricius,1775)	1										1	0.05
<i>Macropodia rostrata</i> (Linnaeus,1761)					2	1					3	0.14
<i>Pagurus chevreuxi</i> (Bouvier,1896)		3			1		1				5	0.23
<i>Palaemon serratus</i> (Pennant,1777)							3				3	0.14
<i>Pilimnus hirtellus</i> (Linnaeus,1761)		14				3	2		46		65	2.98
<i>Pisa hirticornis</i> (Herbst,1804)					2		3	6			11	0.50
<i>Pisidia bluteli</i> (Risso,1816)		10					1		25		36	1.65
<i>Pisidia longimana</i> (Risso,1816)		8	2						73		83	3.81
<i>Primela denticulata</i> (Montagu,1808)	1										1	0.05
<i>Synalpheus gambarelloides</i> (Nardo,1847)									3		3	0.14
<i>Thoralus cranchii</i> (Leach,1817)	22						2	1			25	1.15
<i>Xantho poressa</i> (Oliv,1792)		1									1	0.05
Total numbers of individuals	145	271	268	218	244	390	152	122	369	2179	-	
Total numbers of species	24	29	23	26	30	29	30	24	25	81	-	

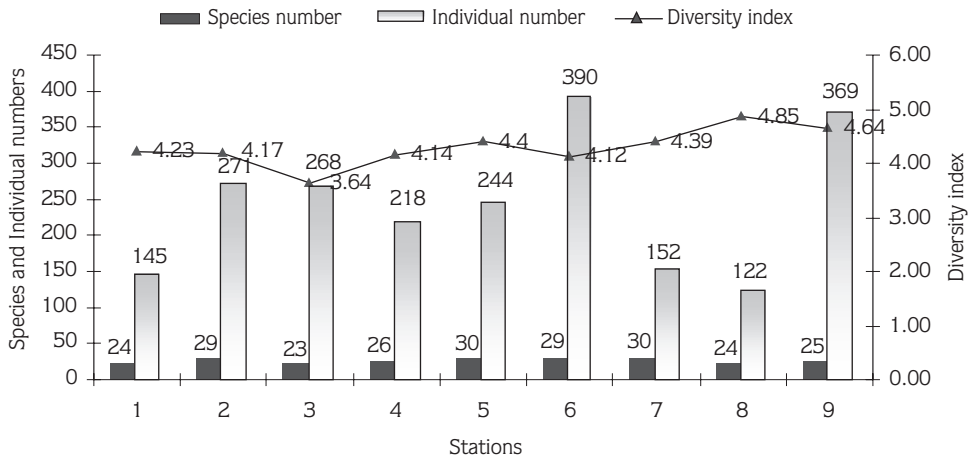


Figure 3. Distribution of identified species, specimen numbers and diversity index values among the stations.

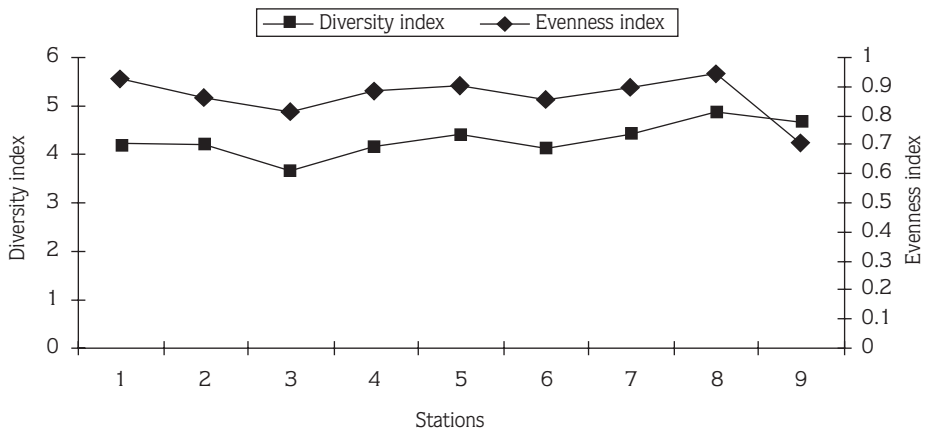


Figure 4. Relation between the evenness and diversity indices.

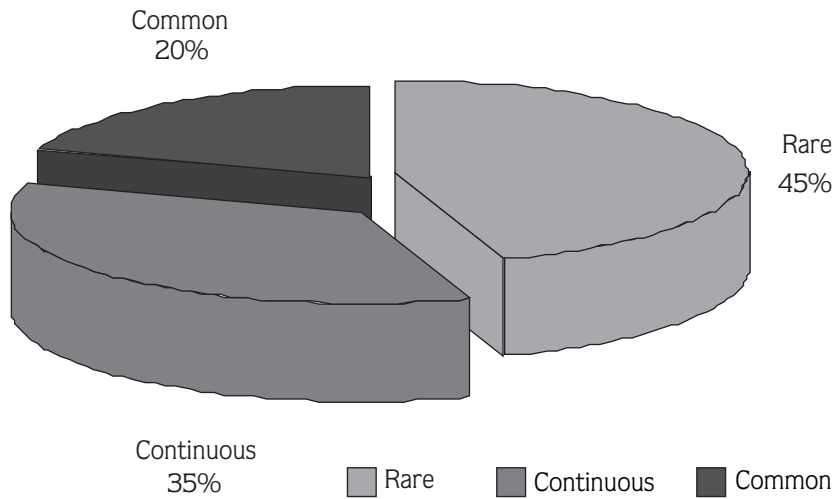


Figure 5. Distribution of species to 3 frequency index values groups.

species encountered at *Cystoseira* facies in the Aegean Sea. The highest dominance value belongs to *A. ramondi* (11%), followed by *L. savignyi* (7%), *E. pocillimanus* (6%), *D. spinosa*, *M. inaequipes* and *P. variegatus* (5%), *P. longimana* (4%), *C. acutum* and *E. brasiliensis* (3%) (Figure 6).

According to the results of the Bray-Curtis similarity analysis, 6 stations, namely Saros Bay (1), Şakran (3), Foça (4), Dikili (2), Güllük (6) and Alaçatı (5), shared the same group, where the highest similarity was observed between the stations 3 and 4 (55%) and 2 and 6 (53%) (Figure 7).

Discussion

Some 2179 individuals belonging to 81 crustacean species were determined from 5 different *Cystoseira* facies (Table 2), along the Aegean Sea coast of Turkey. Of the Amphipod species identified, *Caprella rapax* is a new record for the Turkish Aegean coast, and *Corophium acutum*, *Corophium rotundirostre* and the decapod species *Hippolyte varians* are new for the Turkish seas.

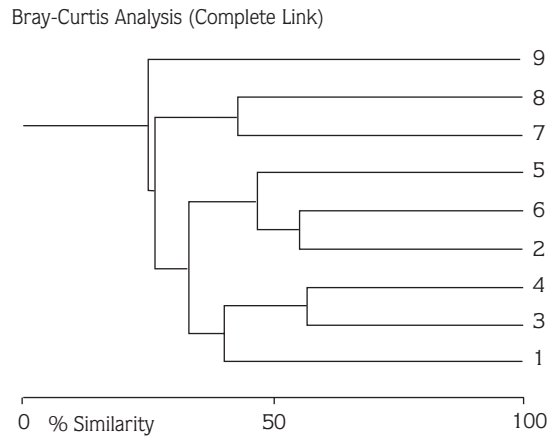


Figure 7. Bray-Curtis similarity between the stations.

In previous studies carried out on İzmir Bay and its vicinity, concerning crustacean diversity associated with *C. crinata* facies, Kocataş (1978) reported 56 species, Çalış (1984) 32 species, and Ergen and Çınar (1994) 48 species. In another study, Gülperçin (1990) determined 47 species from *C. mediterranea*. According to a study

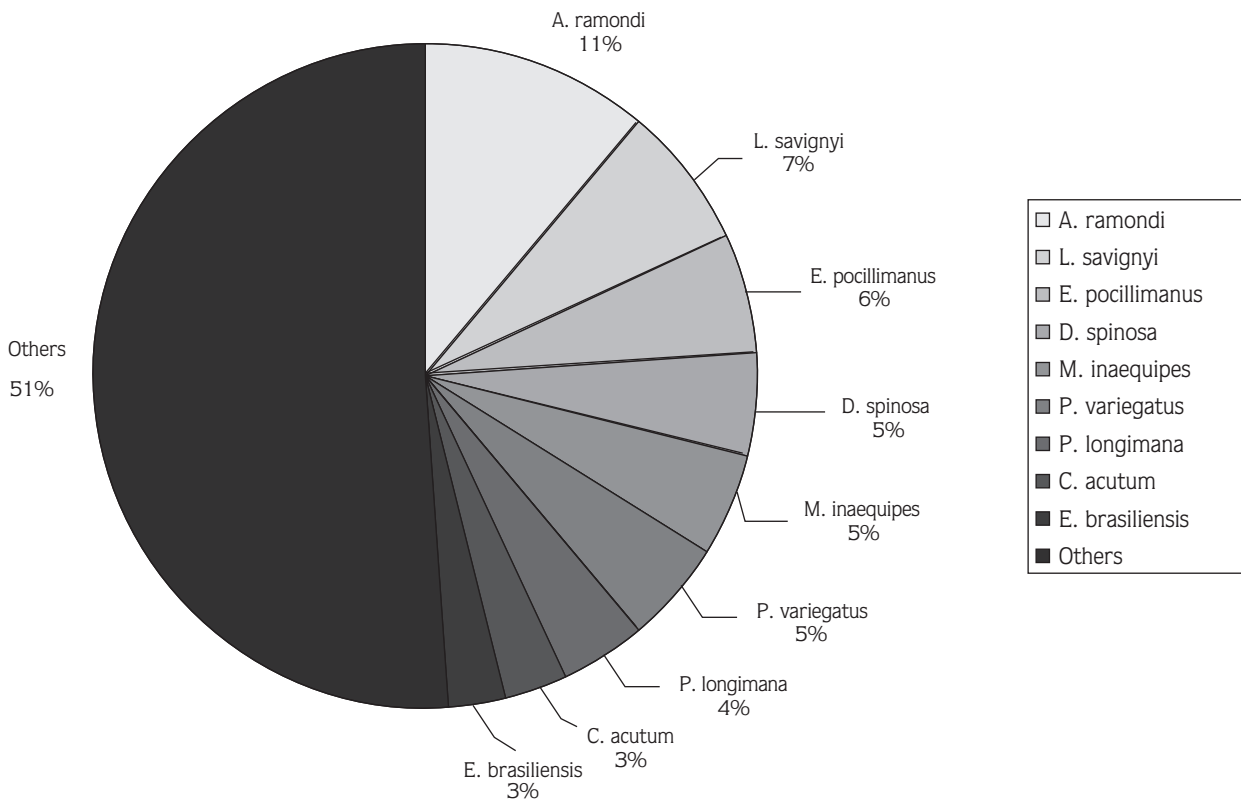


Figure 6. Dominance values of species.

carried out at the coast at Marseille on France, Bellan-Santini (1969) determined 38 crustacean species from *C. crinita* facies. All previous studies mentioned above compared the faunal and floral structure of facies; therefore, our study is comparable to those only in terms of number of species.

A comparison of the sampling stations, in terms of northern Aegean (1, 2, 3 and 4) and southern Aegean Sea (5, 6, 7, 8 and 9) revealed that the crustacean species diversity is somewhat higher in the southern Aegean Sea.

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Moreover, the number of species determined in our study is remarkably higher than in other previous studies. This fact can be explained by the wider range of sampling stations that represent various geographical localities. Consequently, the samplings from *Cystoseira* facies exposed to different hydrographical conditions differ locally in the Aegean Sea, which serves as a transition zone between the Mediterranean and Black Seas, and this impacts on the distribution of marine organisms (Kocataş and Bilecik, 1992).