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Seasonal Variations of Demersal Fish Composition in Gülbahçe Bay (İzmir Bay)

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Abstract: In the present study, the seasonal variations in demersal catch composition in Gülbahçe Bay were investigated by trawl sampling. Species identification of the samples was carried out at class, family and species levels.

The results of this study were compared to those of previous studies carried out in the same area and it was concluded that red mullet, which is the dominant species of Gülbahçe Bay, has lost this characteristic because of overfishing and marine pollution. For this reason, fishing activities and the discharge of domestic waste waters should be strictly controlled.

Key Words: Gülbahçe Bay, Bottom Trawl, Demersal Fish Composition, and Seasonal Variations

Gülbahçe Koyu (İzmir Körfezi) Demersal Balık Kompozisyonundaki Mevsimsel Değişmeler

Özet: Bu çalışmada, Gülbahçe Koyunun demersal balık kompozisyonundaki mevsimsel değişimler yapılan trol örneklemeleri ile tespit edilmeye çalışılmıştır. Tüm örneklerin tayini sırasıyla klasis, familya ve tür düzeyinde yapılmıştır.

Daha önceki yıllarda yapılan araştırmalar ile karşılaştırıldığında Gülbahçe Koyunda her mevsim baskın tür olarak tespit edilen barbunya (*Mullus barbatus* L.), yoğun avcılık baskısı ve ikinci konutlardan kaynaklanan kirlilik nedeniyle bu özelliğini bazı dönemler yitirmektedir. Bu nedenle avcılık faaliyetleri ve ikinci konutların atıkları sıkı denetim altında tutulmalıdır.

Anahtar Sözcükler: Gülbahçe Koyu, Dip Trolü, Demersal Balık Kompozisyonu, Mevsimsel Değişimler

Introduction

İzmir Bay is an important fishing area because of its abundance of economically valuable demersal fish. However, these stocks are affected by urbanization, overpopulation and industrial development. In addition, huge fishing vessels coming from the Black Sea and the Marmara Sea give rise to additional fishing pressure on these stocks.

Gülbahçe Bay, where the experiments were carried out, has sandy, muddy and flat ground at average depths of 28-30m. It is an attractive area for illegal fishing because of the availability of valuable demersal stocks. A number of studies on the demersal fish stocks (1-4) of this productive fishing ground have been carried out in addition to selectivity studies on different cod-end configurations.

Selectivity studies have concentrated particularly on different cod-end configurations: mesh size and shape (5), cod-end design (6) and covered cod-end technique (7).

In addition to the physical and biological changes in fishing ground, seasonal variations in particular can play a very important role in catch composition. Light intensity and temperature in the fishing ground have an important effect on the visual senses and swimming performance of the fish, so gear avoidance in the fish may change with different environmental conditions (8).

This paper presents a summary of the composition of catches according to seasonal variations obtained by means of bottom trawl nets in Gülbahçe Bay during 1997. These results are compared with other results from previous studies.

Materials and Methods

Materials

This study was performed at depths of 28-30 metres in Gülbahçe Bay in 1997 Figure 1. In order to identify the catch composition, sampling were made by means of a high-opening bottom trawl (Figure 2). The trawl cod end was made with a net of 12 mm mesh for sampling all sizes and species groups.

The experiments were conducted on R/V Egesüf (27 metres in length with a 500-hp engine).

An electronic balance (1 g sensitivity) and mechanical balance (5 g sensitivity) were used for measuring the total catch weights.

Methods

To analyse the variations in catch composition, 12 trawl operations were performed during the study period. The operations were conducted at a speed of 2-2.5 knots and the time period was limited to an hour. At the end of the trawling process, the whole catch was sorted at class, family and species levels. All the species were counted and the total weights were determined.

The frequencies and the weights of the specimens are shown in tables at class and species level and in graphics at family level.

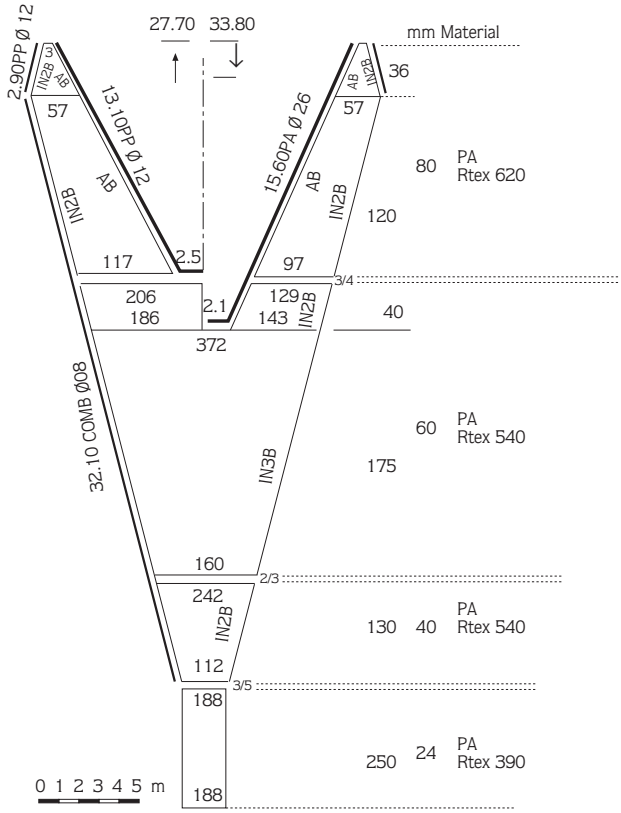
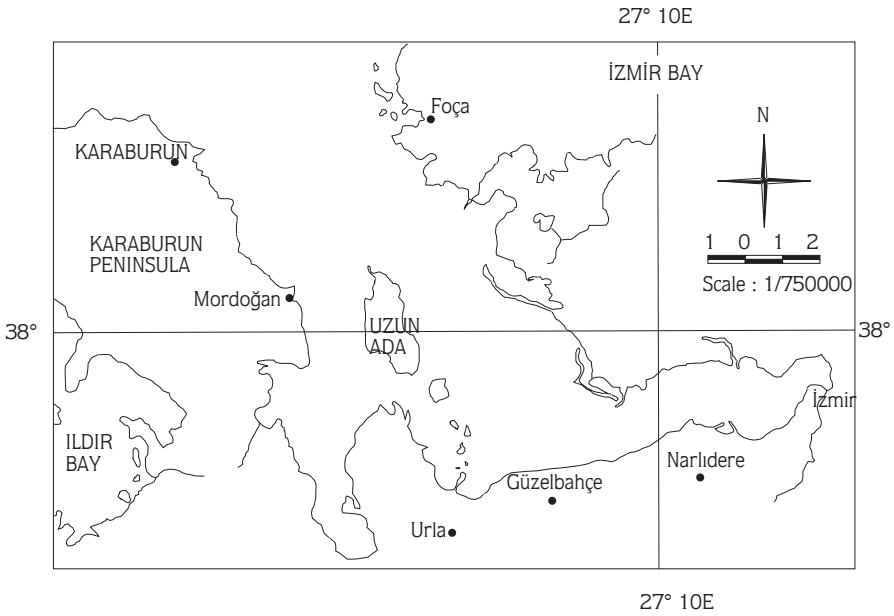


Figure 2. The structural and technical specifications of the high-opening bottom trawl used in sampling.

Figure 1. Study area, Gülbahçe Bay



Results

Catch Composition at Class Level

The weights and frequency of fishes caught by trawl in the present seasonal study are shown in Tables 1, 2, 3 and 4.

Table 1. Numbers and weights of spring catch at class level

Class	Frequency	Percentage	Weight(g)	Percentage
Chondrichtyes	5	0.05	14900	6.32
Osteichtyes	10263	99.95	221028	93.68

In the spring catch, *Osteichtyes* was dominant. During this season, only 5 fish from the *Chondrichtyes* class were captured (representing 0.05% of the total catch). This proportion increases to 6.32%, according to weight.

Table 2. Numbers and weights of summer catch at class level

Class	Frequency	Percentage	Weight(g)	Percentage
Chondrichtyes	35	0.44	19527	10.18
Osteichtyes	7889	99.56	172197	89.82

As may be seen in Table 2, the summer catch comprised a great deal of the *Osteichtyes* class, while there was a significant increase in both the number and proportion of fish belonging to the *Chondrichtyes* class in respect of the spring catch (35 individuals representing 44%).

Table 3. Numbers and weights of fish caught in autumn at class level

Class	Frequency	Percentage	Weight(g)	Percentage
Chondrichtyes	37	0.44	19527	10.19
Osteichtyes	8451	99.56	172197	89.81

It may be seen in Table 3 that a great part of the catch was the *Osteichtyes* class. Similar catch rates and frequencies were obtained for *Chondrichtyes* in the summer and autumn catches.

Table 4. Numbers and weights of winter catch at class level

Class	Frequency	Percentage	Weight(g)	Percentage
Chondrichtyes	4	0.04	7310	3.26
Osteichtyes	9263	99.96	216945	96.74

As shown in Table 4, a decrease in the number of fish from the *Chondrichtyes* class was observed in respect of the summer catch, while the percentages wese similar to those for the spring.

Despite the fact that the catch rates (in number) of fishes in the *Chondrichtyes* class were low in all seasons, the weight values were high owing to the larger bodies of these fish.

Catch Composition at Family Level

The frequency distributions of fish caught by means of trawl gear are given in Figures 3, 5, 7 and 9 at family level, while the weight distribution is presented in Figures 4, 6, 8, and 10.

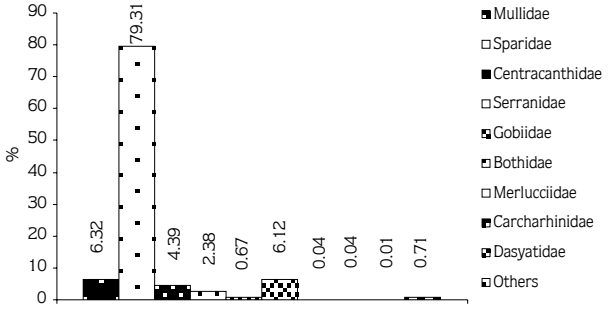


Figure 3. Frequency distribution of fish caught in spring period according to family.

In the spring season, 10268 individuals representing 14 families were caught. *Sparidae,* representing 77.95% of the total catch, was the dominant family. This was followed by *Mullidae* (6.21%), *Bothidae* (6.02%) and *Centracanthidae* (4.3%).

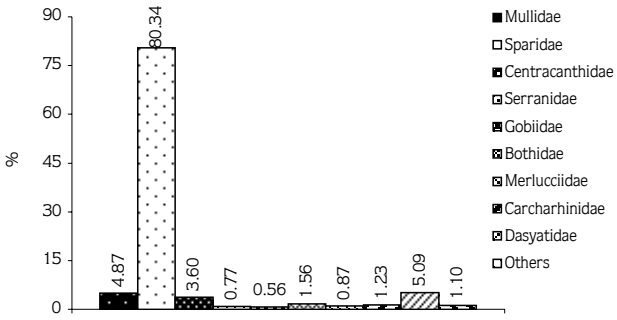


Figure 4. Weight distributions of fish caught in spring period according to family.

In the spring season, a total of 235928 g fish representing 14 families was caught. *Sparidae* was the largest family by weight (80.34%) followed by *Dasyatidae* (4.87%) and *Centracathidae* (3.63%).

7924 individuals representing 16 families were caught in summer. *Sparidae* was the dominant family (29.09%), followed by *Mullidae* (24.09%), *Bothidae* (16.82%) and *Gobiidae* (13.01%).

A total of 189484 g fish representing 16 families was caught in summer. In terms of weight, *Sparidae* comprised 32.37% of the total catch weight.

8488 individuals representing 17 families were caught in the autumn period. Significantly, the *Mullidae* family, comprising 43.59% of the total catch, was the largest, followed by *Sparidae* (35.29%), *Bothidae* (11.91%) and *Gobiidae* (3.62%).

In the autumn, 310610 g fish representing 17 families was caught. *Mullidae* was the dominant family (51.79%), followed by *Sparidae* (31.98%) *Bothidae* 2.14%) and *Gobiidae* (2.02%) (Figure 8).

9254 individuals representing 17 families were caught in winter. *Sparidae* was the dominant family with the highest proportion of the catch composition (43.76%).

The total weight of fish caught in winter was 224255 g *Sparidae* was the principal family with the highest percentage (53.72%). *Mullidae, Merlucciidae* and *Centracanthidae* are the other families comprising 18.27%, 11.49% and 5.11% of the total catch, respectively.

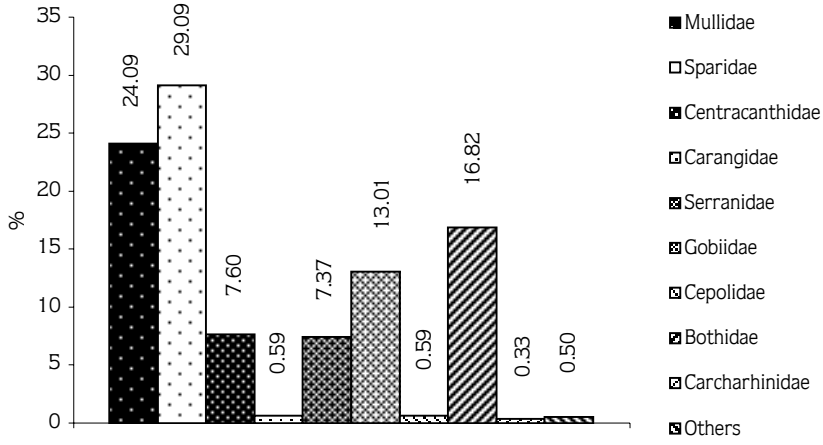


Figure 5. Frequency distributions of fish caught in summer period according to family.

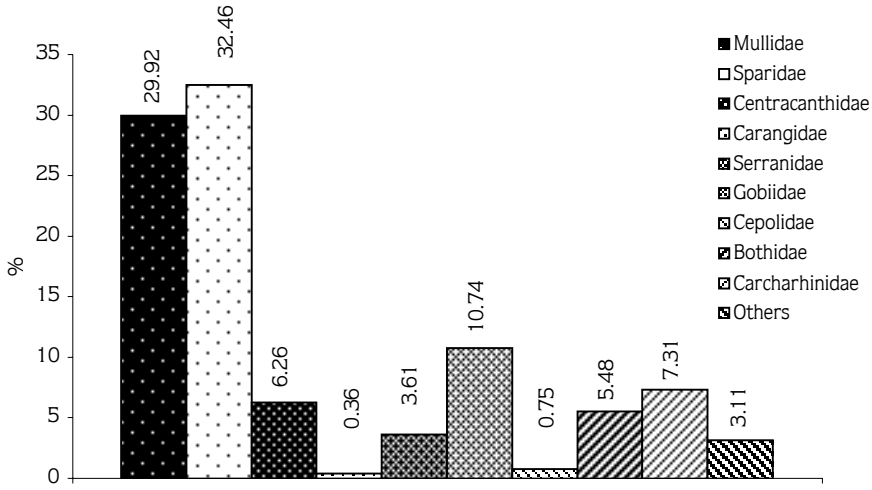


Figure 6. Weight distribution of fish caught in summer according to family.

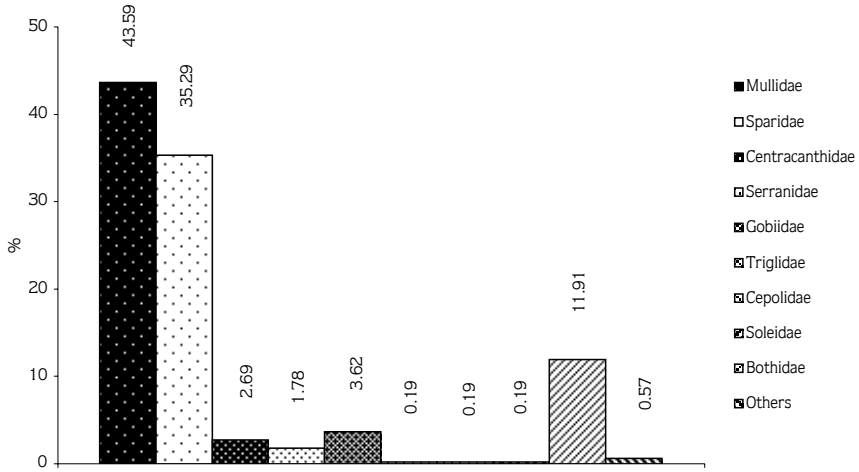


Figure 7. Frequency distributions of fish caught in autumn according to family.

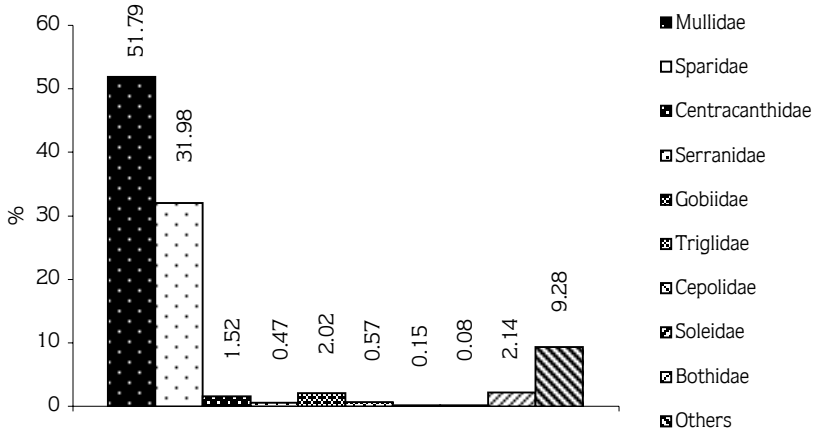


Figure 8. Weight distribution of fish caught in autumn according to family.

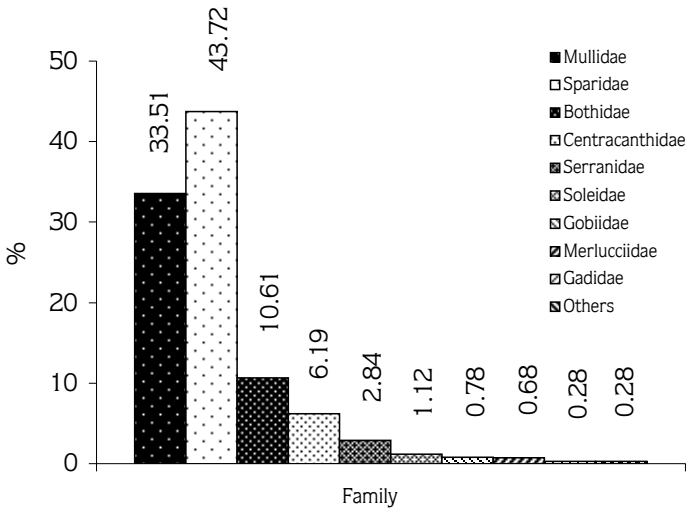


Figure 9. Frequency distributions of fish caught in winter according to family.

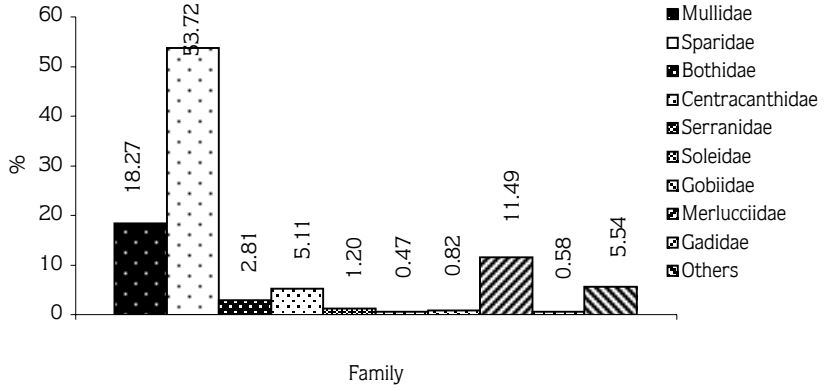


Figure 10. Weight distribution of fish caught in winter according to family.

Catch Composition at Species Level

The catch species composition, determined by means of seasonal trawl samplings, is given in Table 5. 21 different species were caught in the spring season in the study area. Most of the catch was composed of *Diplodus annularis,* both in terms of number (78%) and weight (78.5%). The other species shown in Table 5 are *M. barbatus* (6.32%), *Arnaglosus laterna* (6.12%), and *Spicare smaris* (4.03%).

The species diversity increased considerably in the summer season (32 species). The total catch was composed of *D. annularis* (25.85%), *M. barbatus* (24.07%), *A laterna* (16.82%), *Gobis niger* (13.01%), *S. hepatus* (7.35%), *S. smaris* (6.42%), *P. erythrinus* (1.38%), *P. acarne* (1.17%) *M. mustelus* (0.32) in terms of number; and *M. barbatus* (29.89 %), *D. annularis* (25.54%), *G. niger* (10.92%), *M. mustelus* (7.31%), *A. laterna* (5.48%), *S. smaris* (4.61%), *S. hepatus* (3.45%), *P. erythrinus* (3.31%), *P. acarne* (1.33%) in terms of weight.

The species diversity reached its peak level, 33 species, in the autumn season. The dominant species was *M. barbatus* in terms of both number and weight. The catch composition was *D. annularis* (27%), *A laterna* (11%), *P. acarne* (6.60%), *G. niger* (3.61%) in terms of number; and *D. annularis* (22.14%), *P. acarne* (5.32%), *A. laterna* (2.14%) and *G. niger* (2.01%) in terms of weight.

The winter samplings contained 26 species. In both weight and number, *D. annularis* was the dominant species, followed by *M. barbatus.* The other significant species were *A. laterna* (10.61%) and *S. smaris* (6.15%) in terms of number; and *M. merluccius* (11.49%), *S. smaris* (5.02%) and *A. laterna* (2.81%) in terms of weight.

Discussion and Conclusion

The present fish composition of Gülbahçe Bay is explained by comparing the previous research carried out throughout 1997 in Gülbahçe Bay with studies done by Toğulga and Mater in 1973 and 1990 concerning the fish composition of the bay. There is overexploitation of the demersal fish stocks, but this bay still continues to be productive.

Toğulga and Mater reported 15 families in their research on the trawl catch composition of Gülbahçe Bay (İzmir Gulf, Aegean Sea) in the spring of 1973 (2). The most dominant family was *Mullidae* (59.2%). The *Sparidae* (18.2%) and *Centracandiae* (17.3%) were the next largest. They found 9 families in spring 1990: the *Mullidae* family was dominant with 57.92%, and then came *Sparidae* (19.87%) and *Pleuronectidae* (15.52%). 14 families were found in the spring of 1997 in this study. The dominant family was *Sparidae* with 77.95% and 80.34% frequency, respectively. This was followed by the *Mullidae* family with 6.21% and with a weight percentage of 4.87% and *Centracantidae* with 4.41% and with a weight percentage of 3.63%. There are a great many differences between these results and those of Toğulga and Mater in terms of frequency percentages and families in this season. Toğulga and Mater reported 9 families in the summer of 1973 (2). They stated that the *Mullidae* family was dominant with 58.3%, followed by the *Sparidae* family with 19.1%, *Centarcantidae* family with 10.3% and *Serranidae* family with 9.3% and that

Table 5. Seasonal variation of fish amount (weight and number) in trawl-caught composition

		SPRING		SUMMER		AUTUMN		WINTER	
		Number	Weight (g)	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)
Class	CHONDRICHTHYES								
Family	Carcharhinidae								
	Mustelus mustelus	4	2900	26	13880	8	5640	1	620
Family	Torpedinidae								
	Torpedo torpedo			4	512	13	2260		
	Torpedo marmorato			1	50				
Family	Rajidae								
	Raja clavata			1	935	1	975		
	Raja radula			2	2250			2	6350
Family	Dasyatidae								
	Dasyatis pastinaca	1	12000	1	1900	3	9270		
Family	Myliobatidae								
	Myliobatis aquila					12	9990	1	340
Class	OSTEICHTHYES								
Family	Clupeidae								
	Sardina pilchardus					1	15		
	Sardinella aurita					2	110		
	Alosa falax nilotica					4	270	3	110
Family	Merluccidae								
	Merluccius merluccius	4	2050			1	160	63	25760
Family	Gadidae								
	Trisopterus minutus capelanus							26	1300
Family	Zeidae								
	Zeus faber							7	3070
Family	Serranidae								
	Serranus cabrilla	5	220	4	250			5	50
	Serranus hepatus	235	1600	579	6563	151	1460	258	2640
	Serranus scriba			1	30				
Family	Cepolidae								
	Cepola rubescens	16	440	47	1422	16	460	3	85
Family	Carangidae								
	Trachurus trachurus			47	690	1	15	2	230
	Trachurus mediterraneus	2	180			2	105		
Family	Mullidae								
	Mullus barbatus	638	11480	1908	56730	3699	160855	3102	40900
	Mullus surmuletus			1	35	1	10	2	70
Family	Sparidae								
	Sparus aurata			6	840	16	3590	20	2770
	Pagrus pagrus			1	120	1	100		
	Boops boops	3	150	7	405	32	1670		
	Diplodus annularis	7945	185225	2049	48470	2252	68800	3895	109550
	Diplodus vulgaris	4	340	24	1200	13	800	33	1390
	Lithognathus mormyrus	1	80	13	1730	22	3720	2	230
	Pagellus erythrinus	48	3608	110	6295	57	4120	91	6230
	Pagellus acarne	3	130	93	2540	561	16530	8	280
	Pagellus bogaraveo					1	15	1	20
Family	Centracanthidae								
	Spicara smaris	407	7320	509	8750	68	1410	570	11280
	Spicara flexuosa	36	1235	57	1650	24	770	3	180
	Spicara maena maena			41	1475	136	2550		
Family	Trachinidae								
	Trachinus draco			6	240				
Family	Gobiidae								
	Gobius niger	68	1310	1031	20375	307	6270	72	1830
Family	Callionymidae								
	Callionymus ıyra			1	10				
Family	Triglidae								
	Trigla lucerna	3	735	5	1260	15	1720	7	1610
	Lepidotrigla cavillone			7	230	1	40		
Family	Citharidae								
	Citharus linguatula	3	180						
Family	Bothidae								
	Arnoglossus laterna	618	3685	1333	10405	1011	6650	983	6310
Family	Soleidae								
	Solea solea			1	350	2	200		
	Microchirus variegatus	48	1060	12	60	14	60	104	1050

12 families included the *Mullidae* family with 47.07%, the *Sparidae* family with 40.14% and the *Pleuronectidae* family with 6.04% in the summer of 1990 (2). 16 families were determined in this study in the summer season. The dominant family was the *Sparidae* family with 29.09% and a weight percentage of 32.37%. Then came the *Mullidae* family with 24.09% and with a weight percentage of 29.99%, the *Bothidae* family with 16.82% and a weight percentage of 5.42%, and the *Gobiidae* family with 13.01% and a weight percentage of 10.75%. There are great differences between the frequencies and families determined by Toğulga and Mater in the summer of 1973 and those of this study (2). Moreover, *Arnoglossus laterna,* which is included in the *Pleuronectidae* family and written in the paper and is ranked third in terms of catch density in the summer of 1990 belongs to the *Bothidae* family (9 and 10). According to this, the findings for the summer of 1990 by Toğulga and Mater indicate similarities except for the dominant species (2). Nevertheless, they determined 12 families in the autumn of 1973 (2). The *Centracantidae* family was the dominant species with 54.3% in this season, followed by the *Mullidae* family with 27% and the *Sparidae* family with 15.5%. They found 14 families in the spring of 1990. They reported that the *Mullidae* family was the dominant family with 60.73%, followed by the *Pleuronectidae* family with 13.83% and *Sparidae* family with 12.75%. The *Mullidae* family was the dominant family with 43.59% and with a weight percentage of 51.79% in this study in the autumn of 1997. Then came the *Sparidae* family with 35.29% and with a weight percentage of 31.98%. Although there are differences in respect of the autumn season between the results of Toğulga and Mater and the results of this study (2), both studies have similar results for the spring season. Toğulga and Mater identified 13 families in the winter of 1973 (2). The *Mullidae* family was the dominant family with 69.6%. The *Sparidae* family constituted 16.7% and the *Centracantidae* family 9.5%. They identified 12 families in the winter of 1990. It was reported that the *Mullidae* family was the dominant family with 13.17%, followed by the *Pleuronectidae* family with 12.19%. 17 families were determined in this study in the winter of 1997. The *Sparidae* family was the largest with 43.76% and with a weight percentage of 53.73%. After this came the *Mullidae* family with 33.54% and a weight percentage of 18.27% and the *Bothidae* family with 10.62% and weight of 2.81%. There are differences between Toğulga and Mater's data for the winter of 1973 and 1990 and the findings of our study.

In terms of species, it was determined by Toğulga and Mater in 1973 that *M. barbatus* was the dominant species with 59.2%, followed by *S. smaris* with 10.7%, *D. annularis* with 9.6% and *P. erythrinus* with 8.4% during the spring season. The same researchers also said that *M. barbatus* with 57.9%, *D. annularis* wih 18.2%, *A. laterna* with 12.5%, *S. smaris* with 3% and *P. erythrinus* with 1.7% were found in the spring of 1990 and out of 12 species formed part of the catch composition. *D. annularis* was the dominant species with 78.72% and a weight of 78.50% in this study during the spring of 1997. This was followed by *M. barbatus* with 6.32% and a weight of 4.87%, *A. laterna* with 6.32% and weight of 1.56%, *S. smaris* with 4.03% and 3.1% weight. In terms of the dominant species and percentages of catch composition, there are differences between the findings of both Toğulga and Mater (2) for this season and our findings. Toğulga and Mater determined 17 species for the summer seasons of 1973 and 1990 (2). They reported that *M. barbatus* was the dominant species with 58.2% in summer, while *D. annularis, S. scriba* and *P. erythrinus* were represented with 9.5%, 9.2% and 8.5% respectively. In the summer, *M. barbatus* with 46% was the dominant species, followed by *D. annularis* with 32.3%, *A. laterna* with 6% and *P. acarne* with 5.7%. In this study, 32 different species were identified in the catch composition. *D. annularis* was the dominant species with 25.85% and a weight percentage of 25.54%, followed by *M. barbatus* with 24.07% and weight of 29.89%, *A. laterna* with 16.82% and weight of 5.48%, and *G. niger* with 13.01% and weight of 10.92%. It is clear that there are differences between the results of Toğulga and Mater (2) and this study in terms of both dominant species and catch composition percentages for this season. Toğulga and Mater reported 21 species in the trawl catch composition for the autumn of 1973 (2). *S. smaris* was the dominant species with 54.2%, followed by *M. barbatus* with 26.7% and *P. erythrinus* with 8.7%. The same researchers also reported 18 species for the autumn of 1990. They reported that *M. barbatus* was the dominant species with 60.4%, followed by *A. laterna* with 13.8%, *D. annularis* with 9.6% and *P. erythrinus* with 2%. In this study, 33 species were identified in the catch composition. *M. barbatus* was the dominant species

with 43.57% and a weight percentage of 51.78%. *D. annularis* with 27% and weight of 22.14%, *A. laterna* with 11.91% and weight of 2.14% and *P. acarne* with 6.60% and weight of 5.32% were the next largest. There are great differences between the findings of Toğulga and Mater (2) and our findings for this season. Toğulga and Mater found 24 species in the catch composition in the winter of 1973 (2). In this season, *S. smaris* was the dominant species with 54.2%, followed by *M. barbatus* with 26.7% and *P. erythrinus* with 8.7%. The same researchers also found 16 species in the winter of 1990. *M. barbatus* was the dominant species with 47.7%, followed by *D. annularis* with 16.3%, *A. laterna* with 13.1% and *S. smaris* with 12.1%. 26 species were found in the same season. *D. annularis* was the dominant species with 42.02% and percentage weight of 48.05%, followed by *M. barbatus* with 33.48% and weight of 18.23 and *S. smaris* with 6.15% and weight of 5.02%. There are differences between the findings of Toğulga and Mater and the findings of our study in respect of this season (2).

Significant differences appeared between the results of this study and those of the research of Toğulga and Mater (2), which was conducted in the same region. For each season, a larger number of families and species were identified than had been identified in these studies. This was probably due to the use of deep trawl nets, constructional differences, the number of tows and the towing times in both studies since there was no information given on the methods of deep trawl used by Toğulga and Mater in their study, including the number of tows and the towing times (2).

Kınacıgil et al. reported that they identified 25 species (first study period) and 30 species (second study period) in Gülbahçe Bay in their research carried out over 2 study periods (June 1991-March 1992; and June 1992-January 1993) on the stock assessment of some economical demersal and pelagic fishes in İzmir Bay (3). In addition, they reported that the quantity of fish at 2 stations in Gülbahçe Bay was 4.62 tons/mile^2 and 1.38 tons/mile^2 in the first study period and 9.2 tons/mile^2 and 5.52 tons/mile^2 in the second study period. The density in the bay increased at the end of September. A similar density was obtained in this study.

Toğulga and Mater found that *M. barbatus* was the dominant species in every season in 1973 and 1990 (2). However, it was determined that *M. barbatus* was dominant only in the autumn season in our study. For this reason, it is thought that this species is being subjected to overfishing. Toğulga and Mater also pointed out the same problem (1 and 2).

However, in recent years pressures due to fishing have decreased as seine and trawl fishing have been banned and this is enforced by the relevant institutions (The Department of Protection and Control of the Ministry of Agriculture and Rural Affairs and Coast Guard). We can also see that pollution is a major problem as *D. annularis,* which was found to be the dominant species for 3 seasons, is relatively tolerant to pollution. Species that are pollution indicators were identified in research carried out on the benthos of this region (interview with Önen, M.). One reason for this is the rapid increase in the number of summer residences in this region. The waste from these residences must be checked constantly. Moreover, it is essential that similar studies be done in future to monitor the situation.

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