

The Biometric Analysis of Pipefish Species from Çamaltı Lagoon (İzmir Bay, Aegean Sea)*

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Özet: Çamaltı Lagünü'ndeki (İzmir Körfezi, Ege Denizi) denizyıldızlarının biyometrik analizleri. Bu araştırma, 2000-2002 yılları arasında İzmir Körfezi Çamaltı Lagünü'ndeki üç denizyıldızı türünün, *Syngnathus acus* Linnaeus, 1758, *Syngnathus typhle* Linnaeus, 1758 ve *Nerophis ophidion* (Linnaeus 1758), biyometrik analizleri verilmiştir. Araştırmada toplam 562 adet birey incelenmiştir. *S.acus* ve *S.typhle* için 10 morfolometrik, 5 meristik karakter, *N.ophidion* için ise 9 morfolometrik 3 meristik karakter incelenmiştir. *S.acus*'un dişi ve erkek bireyleri arasında sadece preanal (Pr.RN) ve postanal (Po.RN) halka sayıları bakımından farklılık bulunmuştur. *Syngnathus typhle*'de ise dişilerin ağız genişliği (MW), ağız yüksekliği (MH), göz çapı (ED), dorsal yüzgeç boyu (DFL) erkeklerden daha büyük olup seksüel dimorfizm olarak değerlendirilmiştir. *Nerophis ophidion*'da ise dişilerin göz çapı (ED) değerleri erkeklerine göre daha küçük olduğu belirlenmiştir.

Anahtar Kelimeler: Syngnathidae, morfolometrik karakter, biyometrik analiz, İzmir Körfezi, Ege Denizi.

Abstract: This research presents the biometry analysis of the specimens of three pipefish, *Syngnathus acus* Linnaeus, 1758 *Syngnathus typhle* Linnaeus, 1758 and *Nerophis ophidion* (Linnaeus 1758), populations in the Çamaltı Lagoon, İzmir Bay for 2000–2002. A total of 562 specimens of pipefish, were examined. For *S.acus* and *S.typhle* ten morphometric and five meristic features (external) and *N.ophidion* nine morphometric three meristic characters were determined in interspecifics. The Çamaltı population of *Syngnathus acus* were showed that their females and males were found to differentiate only in the preanal (Pr.RN) and postanal rings (Po.RN) respectively. In the population of *Syngnathus typhle* were showed significantly greater values for mouth width (MW), mouth height (MH), eye dimension (ED) and length of the dorsal fin base (DFL) belonging to females were found to be greater than males indicating a sexual dimorphism when these characters are considered. And specimens of *Nerophis ophidion*, the eye dimension (ED) in females were found to be smaller values than males.

Key Words: Syngnathidae, morphometric characteristic, biometric analysis, İzmir Bay, Aegean Sea.

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Introduction

The biometric variations are important for the descriptions of species. Morphological characters, such as body shape and meristic counts, have long been used to stocks identifications (Turan et al., 2004). As a rule, specimens originating from different areas differ from one another in morphology (Franičević et al., 2005). Fishes of the family Syngnathidae usually associated with vegetated or other complex epibenthic habitats (Lourie et al., 1999; Kuitert, 2000) is a cryptic species that can adapt to changes in the environment (Pollard, 1984). These highly specialised fishes are characterised by limited mobility due to the small size and their fins and the occurrence on their bodies of semi-rigid dermal plates that restrict flexibility (Kendrick & Hydnes 2005). The morphological characters in some pipefish specieses (*Syngnathus fuscus*, *Syngnathus floridae*, *Syngnathus abaster*, *Syngnathoides biaculeatus*, *Nerophis ophidion*, *Stigmatopora argus* and *Stigmatopora nigra*) from different areas were described by Teixeira & Musick (1995), Cakić et al. (2002), Takahashi et al. (2003), Margonski (1990) and Kendrick & Hydnes (2005) using morphometric approach. The family Syngnathidae consist

of 2 pipefish genera, which comprise 6 species distributed in İzmir Bay, Aegean Sea (*Syngnathus typhle*, *Syngnathus acus*, *Syngnathus abaster*, *Syngnathus tenuirostris*, *Syngnathus pyhlegon*, *Nerophis ophidion*) (Kence and Bilgin, 1996). And they have not commercial importance in fisheries but significantly sound management of vegetated coastal resources relies on basic knowledge on the biology of the species, including information on population structure. In this research aimed to determined the variation of meristic and morphometric characters of three pipefish caught in the coasts of İzmir Bay, Aegean Sea. Also this research is preliminary study about pipefish biometric characters in the our region.

Material and Methods

562 individuals of pipefish were obtained by monthly beach seine net (1 mm mesh size, 120 cm x 1200 cm) samplings conducted in the vicinity of Çamaltı Lagoon, İzmir Bay, in 2000-2002 (Fig.1). Total length measured (TL, mm) was taken. Sex was determined macroscopically. A morphometric and meristic characters were measured on the individuals.

The morphometric characters; TL: total length, BH: body height, BW: body width, OHH: oxipital height of the head, HL: Head length, MH: mouth height, MW: mouth width, ED: eye diameter, DFL: dorsal fin length, PFL: pectoral fin length, and meristic characters DfRN: dorsal fin ray number, PfRN: pectoral fin ray number, CfRN: caudal fin ray number, Pr.RN: preanal ring number, Po.RN: the postanal ring number. To test the difference of the morphometric characters in males and females of all species the ANOVA Tukey-one way variance test was used. And to test the in the meristic characters the Kolmogrov-Smirnov test was applied (Sokal and Rohlf, 1981).

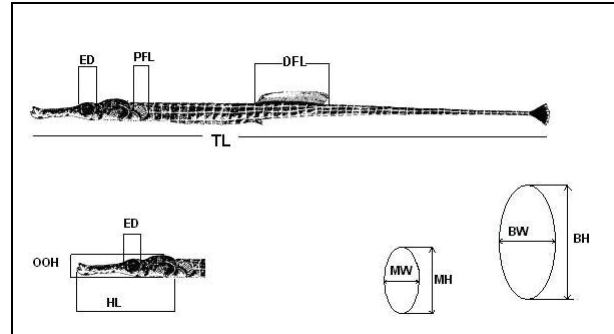


Figure 2. Biometric measurements obtained for pipefishes.

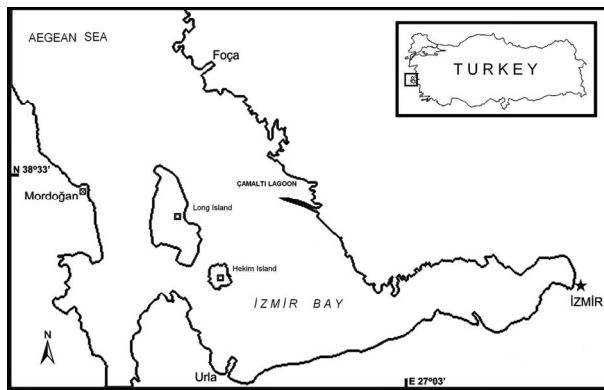


Figure 1. Map showing the location where sampling was carried out.

Results

The differences between the sexes are given statistically significant in the Table 1. The females and males of *S. acus* were found to differ only in the number of preanal (Pa.RN) and postanal rings (Po.RN) (Kolmogorov-Smirnov two way similarity test; Pr.RN DN: 0.894, K-S: 5.246 $p=0.00$; DN:0.614, K-S: 3.605, $p=0.00$). However, the Tukey one-way variance test did not reveal any statistically significant difference in the morphometric characters (Table 1).

The values of the 10 morphometric and 5 meristic characters of *S. typhle* are given in Table 2.

Kolmogrov-Smirnov test did not reveal any statistically significant difference between females and males in the meristic characters ($p>0.05$). The morphometric characters were found to be greater in females than in males in terms of the statistical significance (Tukey one-way variance test, $p=0.05$); the mouth width (df: 1-70, $F: 5.582, p=0.02$), mouth height (1-70 $F: 6.28, p=0.002$), eye dimension (df: 1-70, $F: 19.082, p=0.00$) and the length of the dorsal fin base (df: 1-70 $F: 13.49, p=0.00$).

The values of the morphometric and meristic characters of *N. ophidion* given in Table 3. Pectoral and caudal fins are absent in *N. ophidion*. So, nine morphometric and three meristic characters were determined.

The total length were significantly greater in females than males (df: 1-73 $F: 6.781, p:0.01$).

No statistically significant difference in the meristic characters in females and males of the *Nerophis ophidion* were found (Kolmogorov-Smirnov two way similarity test). The statistically significant differences between females and males of *N. ophidion* were revealed for the eye dimension in females (df 1-28, $F: 4.386, p= 0.048$) which was greater in males.

Table 1. The morphologic and meristic characters of *Syngnathus acus* (N: Number of individuals, M: Mode, SD: Standard deviation, SE: Standard error).

Morfometric characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
TL	235	111.47±1.60	69-256	24.54		141	112.65 ±1.85	61-235	21.97		$p>0.05$
BH	83	3.14±0.09	1.99-6.73	0.87		46	3.00±0.12	1.97-5.45	0.79		$p>0.05$
BW	83	2.98±0.11	1.35-7.78	1.03		46	3.03±0.10	1.67-4.26	0.70		$p>0.05$
OOH	83	2.91±0.16	1.43-9.98	1.45		46	2.74±0.08	1.74-3.81	0.53		$p>0.05$
HL	82	12.48±0.40	0.43-32.31	3.63		46	12.07±0.26	9.21-16.87	1.73		$p>0.05$
MH	83	0.90±0.05	0.36-2.25	0.42		46	0.91±0.05	0.41-0.91	0.36		$p>0.05$
MW	83	1.04±0.03	0.56-2.07	0.28		45	0.98±0.03	0.51-1.48	0.22		$p>0.05$
ED	83	1.23±0.05	0.37-3.18	0.45		45	1.26±0.06	0.72-2.26	0.37		$p>0.05$
DFL	83	10.86±0.35	0.94-25.72	3.22		45	11.17±0.25	8.63-17.66	1.69		$p>0.05$
PFL	70	1.56±0.05	0.44-3.45	0.46		37	1.61±0.07	1.12-2.81	0.43		$p>0.05$
Morfometric characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
DfRN	13	29.92±0.53	25-33	1.93	30	4	30±0.82	28-32	1.63	39	$p>0.05$
PfRN	5	10±0.45	10	-	10	2	9.50±0.50	9-10	0.71	0	$p>0.05$
CfRN	13	7.77±0.72	4-10	2.59	10	4	7.50±1.45	5-10	2.89	5	$p>0.05$
Pr.RN	106	16.83±0.07	14-19	0.70	17	51	16.92±0.07	15-18	0.52	17	$p<0.05^*$
Po.RN	106	38.72±0.13	35-42	1.37	37	51	39.22±0.19	26-45	1.39	39	$p<0.05^*$

* significantly different at $p<0.05$

Table 2. Morphologic and meristic characters of *Syngnathus typhle*.

Morfometric characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
TL	70	171.24±5.11	19-302	42.66	-	42	158.90±5.15	97-304	33.78	-	p>0.05
BH	47	3.69±0.16	2.1-6.48	1.16	-	24	3.25±1.02	1.70-5.65	1.01	-	p>0.05
BW	47	3.95±0.19	2.27-7.33	1.32	-	24	3.36±0.20	1.45-5.52	0.98	-	p>0.05
OOH	47	4.12±0.17	2.7-7.46	1.20	-	24	3.66±0.16	2.14-5.32	0.76	-	p>0.05
HL	47	29.51±1.01	17.01-46.71	6.93	-	24	26.52±0.98	17.97-36.51	4.80	-	p>0.05
MH	47	1.74±0.09	0.68-2.82	0.58	-	24	1.42±0.08	0.69-2.10	0.39	-	p<0.05*
MW	47	1.21±0.05	0.71-2.16	0.35	-	24	1.03±0.05	0.61-1.74	0.25	-	p<0.05*
ED	47	1.74±0.05	1.15-2.63	0.35	-	24	1.55±0.05	1.16-2.35	0.27	-	p<0.05*
DFL	47	17.70±0.55	10.91-26.32	3.77	-	24	15.83±0.66	10.26-23.35	3.20	-	p<0.05*
PFL	33	1.73±0.05	1.22-2.35	0.30	-	15	1.63±0.09	1.10-2.53	0.36	-	p>0.05
Meristic characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
DfRN	2	31±1.0	30-32	1.41	-	4	31±1.0	28-32	2.00	32	p>0.05
PfRN	1	9	-	-	-	3	14±0.26	-	-	14	-
CfRN	2	9±1.0	8-10	1.41	-	4	8±0.70	7-10	1.41	7	p>0.05
Pr.RN	10	18.40±0.31	17-20	0.97	19	4	18.50±0.96	17-21	1.91	17	p>0.05
Po.RN	10	34.80±0.83	30-38	2.62	35	4	31.75±1.03	30-34	2.06	30	p>0.05

* significantly different at p<0.05

Table 3. Morphologic and meristic characters of *Nerophis ophidian*.

Morphometric characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
TL	50	155.58±3.87	103-214	27.33	-	24	140.08±4.21	106-179	20.63	-	p<0.05*
BH	25	1.55±0.06	1.02-2.61	0.35	-	5	1.49±0.14	1.11-1.82	0.31	-	p>0.05
BW	25	0.35±0.07	1.16-2.33	0.35	-	5	1.67±0.20	1.04-2.11	0.43	-	p>0.05
OOH	23	2.06±0.43	1.47-3.01	0.33	-	5	2.09±0.16	1.71-2.47	0.35	-	p>0.05
HL	25	9.52±0.27	7.69-12.94	0.26	-	5	8.90±0.68	7.08-10.87	1.50	-	p>0.05
MH	23	0.83±0.06	0.30-1.28	0.27	-	5	0.87±0.14	0.59-1.28	0.32	-	p>0.05
MW	25	0.89±0.05	0.60-1.36	0.24	-	5	0.77±0.07	0.57-0.94	0.16	-	p>0.05
ED	24	0.20±0.04	0.64-1.37	0.20	-	5	1.27±0.11	0.93-1.58	0.23	-	p<0.05*
DFL	18	14.98±0.48	12.01-20.19	2.04	-	5	12.77±1.09	8.70-14.75	2.42	-	p>0.05
Meristic characters	Females					Males					P
	N	Mean ±SE	Min-Max	SD	M	N	Mean ±SE	Min-Max	SD	M	
DfRN	2	37.50±0.50	37-38	0.71	-	-	-	-	-	-	-
Pr.RN	6	28.33±0.96	25-31	2.34	28	7	30.57±0.2	30-31	0.53	31	p>0.05
Po.RN	6	56±4.70	42-70	11.52	42	7	60.27±1.52	56-68	4.53	56	p>0.05

* significantly different at p<0.05

Discussion

In this preliminary study, data presented indicate that specimens of three pipefish have diverged in morphology. Differences in meristic and morphometric variations by sexes could be related to the procedures for sampling, sample size. The researchs of pipefish morphometry focused on head features, except Cakić et al. (2002) who studied morphometric characteristics mainly relation to head and mouth features. Syngnathids in general exhibit a high degree of trophic specialization compared to many other epibenthic or demersal marine teleosts (Hydnes et al., 1997). The trophic specialization occurs between different syngnathid species and especially their snout morphologies and feeding behaviour (Kendrick & Hydnes, 2005).

In this study demonstrates the existence of morphometric variations between species and sexes in three pipefishes. The mean mouth width and mouth height values of *S. acus* (mean MW:0.89, mean MH:0.76) and *N. ophidian* (mean MW:0.78, mean MH: 0.85) were determined to be shorter in *S. typhle* while *S. typhle*'s had a greater

measurement (mean MW: 1.08, mean MH: 1.51 MW; df: 1-70, F:5.582 p=0.02 and MH; df: 1-70, F: 6.28, p=0.002) than these mean values. Besides, no morphological variation was found in sexes of *S. acus* (Table 1). The eye dimension and the dorsal fin length values are observed to be shorter in females indicating a sexual dimorphism between sexes in *S. typhle*. (Table 2). In meristic characters, however, the preanal and postanal ring numbers differentiated in sexes of *S. acus* (PrRN, DN: 0.894, K-S: 5.246, Pr.RN: 0.614, K-S: 3.605, p<0.05, Kolmogorov-Simironov test) whereas in *S. typhle* and *N. ophidian* these meristic characters revealed a similar distribution (p>0.05). The differences in the morphological and meristic characters of specimens is supposed to be in association with aquatic ecosystems from which they originated (Cakić et al., 2002; Franičević et al., 2005). Also, Movčan (1988) indicated that significant differences in the number of rays in the dorsal in and number of preanal ve postanal rings between *S.abaster* populations of the Black and Azov Seas (Cakić et al., 2002). The number of vertebrae is genetically fixed within narrow limits are due to influences of environmental actors especially tempetarutes (Franičević et

al., 2005). The fact that our results for *S. acus* are unlike Bozkurt (1955) may be due to the lower water temperatures affecting embryonic stage of the populations in our area. Few researchers have described of morphometric and meristic characters of pipefish species (Margonski 1990; Kendrick & Hydnes 2005). Snout morphology is the important character that differed between this and other studies.

The results showed that the three pipefish species significantly differentiated in some morphometric characters (snout features, the dorsal fin length, eye dimension etc.) and meristic characters (preanal and postanal ring number etc.) in sexes. The biometric results in this paper are preliminary and provide an insight into distinguishing among pipefish species that might be use and further and more complex research combining morphological and genetic research are required. So, the need for detailed genetic research in order to provide evidence about the relationships among different populations of pipefish.

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