
ISSN: 0001-5113
AADRAY

ACTA ADRIAT.,
46 (1): 99 - 106, 2005

UDC: 597.5(262.3)
Original scientific paper

Biometry and distribution of snipefish, *Macroramphosus scolopax* (Linnaeus, 1758), in the Adriatic Sea

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*Specimens of the snipefish, *Macroramphosus scolopax* (Linnaeus, 1758), from the middle and southern Adriatic were biometrically analyzed during the demersal communities research project, MEDITS. The specimens (n = 103) were caught at depths deeper than 100 m. Total length ranged 4.8-16.0 cm, with a mean of 9.45 ± 2.796 cm. According to the length-weight relationship, positive allometric growth was established ($b = 3.23$).*

Key words: *Macroramphosus scolopax*, snipefish, biometry, Adriatic Sea

INTRODUCTION

The snipefish, *Macroramphosus scolopax* (Linnaeus, 1758), is a schooling demersal species. It is carnivorous, feeding on zooplankton and benthic invertebrates (MASUDA & ALLEN, 1993), and is usually found between the seabed and midwaters, on the lower continental shelf. The snipefish occurs mainly in temperate latitudes at 20-40°N, although it also occurs in the southern hemisphere to 43°S (BAUCHOT & PRAS, 1993). Reproduction takes place during January and February (EHRICH & JOHN, 1973). Several authors described the biometric characters and biology of snipefish from different localities: MORH (1937), EHRICH & JOHN (1976), BRÊTHES (1979) and BORGES (2000, 2001) for the Atlantic Ocean, ASSIS (1993) for the Mediterranean Sea, and CLARKE (1984) and MIYAZAKI *et al.* (2004) for the western Pacific Ocean.

Prior to the early 20th century, the snipefish was rarely caught in the Adriatic Sea since

trawl fishing was not well developed. However, snipefish was mentioned in fish identification keys (BINNI, 1968; ŠOLJAN, 1975; TORTONESE, 1975; JARDAS, 1996) and descriptions of Adriatic ichthyofauna (ŽUPANOVIĆ & JARDAS, 1989). Biometric analysis and the length-weight relationship of the Adriatic snipefish population remained to be studied. The present paper provides the first detailed description of the biometry and length-weight relationship of snipefish in the Adriatic Sea.

MATERIALS AND METHODS

Macroramphosus scolopax specimens were collected by bottom trawlers during the MEDITS research cruises in the spring and summer of 1997 and 1998 (Fig. 1). Tows were carried out over the continental shelf at depths of 40-800 m for 30-60 min, depending on the depth. The mean trawl speed was 3 knots. Overall, 103 specimens were caught in 18 of

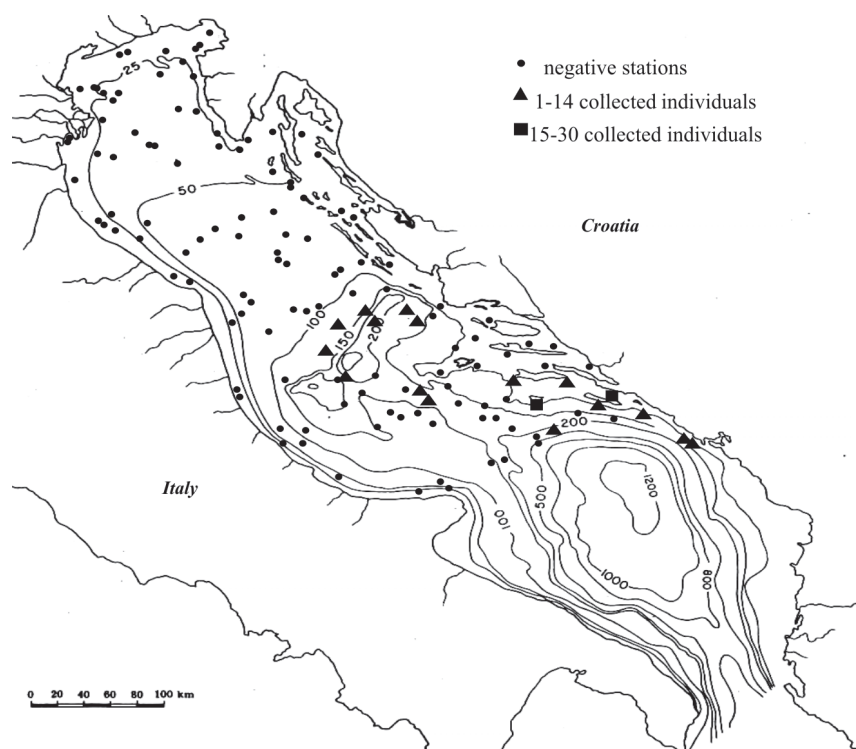


Fig. 1. Sampling stations of the MEDITS survey (1997-1998) in the Adriatic Sea. Squares and triangles indicate sampling stations according to the number of *Macroramphosus scolopax* collected

127 hauls. The specimens were preserved in a 4% formaldehyde solution prior to examination. Lengths were measured to the nearest 0.1 cm and total weights to the nearest 0.01 g. Eighteen morphometric characters (Fig. 2) were measured according to JARDAS (1996). In addition, six meristic characters were counted: number of rays in the first dorsal, second dorsal, pectoral, pelvic, anal, and caudal fins.

To ensure that any impact of the formaldehyde on the measurements was eliminated, morphometric characters were expressed as a percent of the total or head length. To compare growth, length-length relationships were established using linear regression analysis (BINOHLAN *et al.*, 1998). Sex was determined according to the shape and appearance of the gonads. Statistical differences between mean lengths of males and females were determined by Student's *t* test, and differences between their distributions by χ^2 test.

The length-weight relationship was calculated by the function $W = aL^b$ (RICKER, 1975),

where W is the total weight measured in g, L is total length measured in cm, and a and b are constants. The hypothetical isometric growth was tested by STUDENT's *t* test.

RESULTS AND DISCUSSION

According to the pattern of occurrence, this species is distributed along the continental shelf at depths deeper than 100 m. Depth appeared to be the main factor determining the spatial distribution of snipefish.

Total length ranged 4.8-16.0 cm with a mean of 9.45 ± 2.796 cm. Sex was determined for 33 specimens: 14 were male (42%) and 19 were female (58%). The ratio of males to females did not significantly differ from the expected 1:1 ratio ($\chi^2 = 0.758$; $p > 0.05$). As the length frequency distribution for both sexes resulted in a single mode, mean lengths represent the length frequencies for each sex. Total length ranged 9.7-16.0 cm in females ($\chi^2 = 13.12 \pm 1.743$ cm)

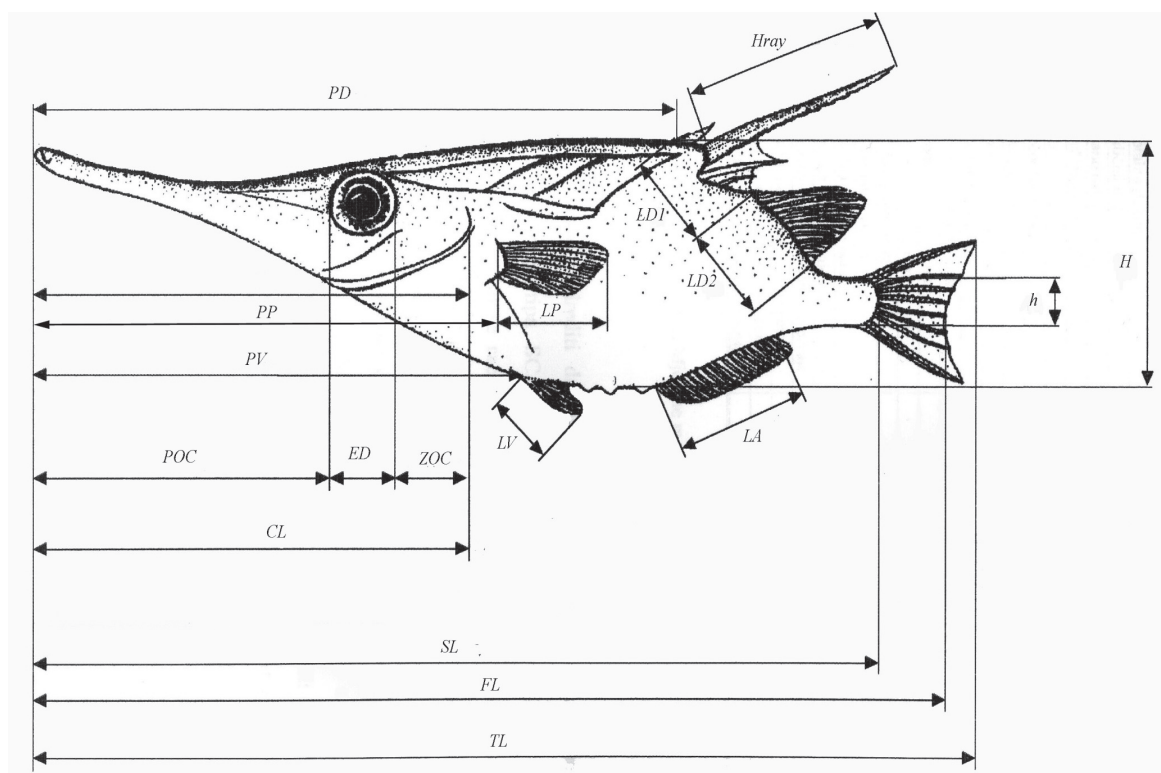


Fig. 2. Measured body proportions: CL = head length, ED = eye diameter, FL = fork length, h = minimum body height, H = maximum body height, Hray = length of the second spine in first dorsal fin, LA = length of anal fin base, LD1 = length of first dorsal fin base, LD2 = length of the second dorsal fin base, LP = length of pectoral fin, LV = length of pelvic fin, PD = predorsal distance, POC = preocular head length, PP = prepectoral distance, PV = prepelvic distance, SL = standard length, TL = total length, ZOC = postocular head length

and 9.1-13.8 cm in males ($\chi^2 = 11.74 \pm 1.334$ cm). Morphometric characters are displayed in Table 1. In general, there were no significant

differences ($p < 0.05$) between sexes except in mean postocular head length, but the coefficient of determination was very low ($r^2 = 0.4776$).

Table 1. Morphological characters of *Macroramphosus scolopax* ($n = 103$; males = 14, females = 19, undetermined sex = 70), from the Adriatic Sea in spring-summer, 1997 and 1998

Percent of total length	Sex	Range	$\chi^2 \pm SD$	t
Fork length (FL)	Males	94.90-98.90	97.19 \pm 1.040	0.821
	Females	96.64-97.74	97.42 \pm 0.607	
	Total	93.50-99.09	97.25 \pm 1.060	
Standard length (SL)	Males	87.50-91.10	88.33 \pm 1.220	0.867
	Females	85.37-91.04	88.75 \pm 1.520	
	Total	84.21-91.58	87.86 \pm 1.700	
Head length (CL)	Males	43.88-47.46	45.40 \pm 1.290	1.878
	Females	31.64-48.52	43.45 \pm 4.270	
	Total	31.64-48.53	44.95 \pm 2.350	
Predorsal distance (PD)	Males	66.30-70.00	67.90 \pm 1.320	0.394
	Females	65.04-70.30	68.09 \pm 1.440	
	Total	60.01-71.30	66.53 \pm 2.390	

Table 1. cont'd

Prepectoral distance (<i>PP</i>)	Males	43.88-47.64	45.38±1.270	
	Females	31.64-48.52	43.50±4.290	
	Total	31.64-48.52	44.99±2.360	1.808
Prepelvic distance (<i>PV</i>)	Males	54.60-65.60	57.50±3.150	
	Females	53.00-64.90	57.40±3.060	
	Total	41.60-65.60	56.42±4.970	0.093
Maximum height (<i>H</i>)	Males	23.26-26.98	25.45±1.180	
	Females	20.79-29.46	26.07±1.740	
	Total	18.18-30.83	24.74±2.260	1.170
Minimum height (<i>h</i>)	Males	3.20-5.70	4.17±0.751	
	Females	3.26-5.97	4.53±0.553	
	Total	3.20-5.97	4.37±0.659	1.589
Length of 1 st dorsal fin (<i>LD1</i>)	Males	7.69-10.10	8.86±0.693	
	Females	7.81-11.36	9.33±1.006	
	Total	7.69-11.36	9.13±0.907	1.511
Length of 2 nd dorsal fin (<i>LD2</i>)	Males	6.50-8.81	7.55±0.689	
	Females	6.64-9.70	7.85±0.795	
	Total	6.49-9.70	7.72±0.755	1.132
Length of anal fin (<i>LA</i>)	Males	13.56-17.62	15.39±1.167	
	Females	10.40-16.49	14.93±1.386	
	Total	10.39-17.62	15.124±1.299	1.018
Length of pectoral fin (<i>LP</i>)	Males	14.41-18.46	15.95±1.099	
	Females	12.42-16.83	15.09±1.280	
	Total	12.42-18.45	15.46±1.265	2.024
Length of pelvic fin (<i>LV</i>)	Males	5.98-9.34	7.39±1.029	
	Females	3.78-8.91	7.10±1.162	
	Total	3.76-9.35	7.22±1.100	0.671
Length of 2 nd spine in 1 st dorsal fin (<i>Hray</i>)	Males	24.35-35.70	28.70±3.310	
	Females	21.92-31.68	27.36±2.370	
	Total	21.92-36.47	29.50±2.950	1.381
<hr/> Percent of head length <hr/>				
Preocular head length (<i>POC</i>)	Males	65.79-73.17	69.46±2.420	
	Females	63.46-72.05	71.29±6.100	
	Total	54.16-73.17	67.20±5.190	1.188
Eye diamete (<i>ED</i>)r	Males	14.63-22.02	18.28±1.970	
	Females	16.79-26.19	20.00±2.900	
	Total	11.61-28.30	17.07±2.940	1.946
Postocular head length* (<i>ZOC</i>)	Males	16.00-19.50	17.90±1.060	
	Females	16.05-28.30	19.38±2.850	
	Total	12.12-28.30	18.13±2.740	2.085

* $p < 0.05$

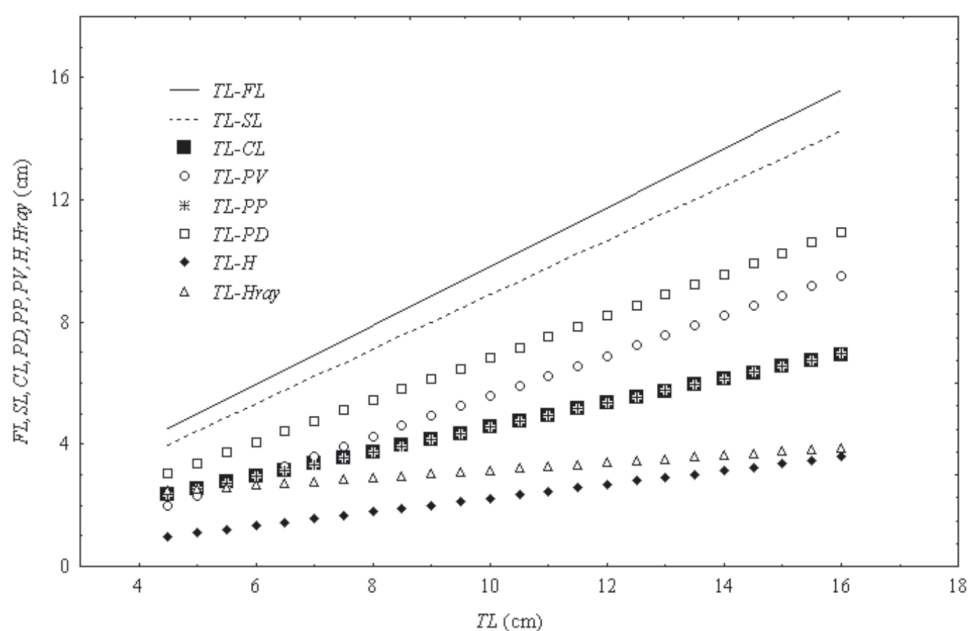


Fig. 3. Relationships of total length (TL) to head length (CL) fork length (FL), maximum body height (H), length of the second spine in first dorsal fin (Hray), predorsal distance (PD), prepectoral distance (PP), prepelvic distance (PV), and standard length (SL) of *Macroramphosus scolopax* ($n = 103$) from the Adriatic Sea

All length-length relationships were linear (Fig. 3). The estimated equations for the length-length relationships and coefficients of determination r^2 are presented in Table 2. Increase of the second spine length was slower than that of other lengths. There were no significant

differences between meristic characters of males and females (Table 3).

The length-weight relationship was $W = 0.2 \times 10^{-5}L^{3.23}$ ($r^2 = 0.975$, $n = 103$) and allometric growth was positive. According to results of the STUDENT'S t test ($p < 0.05$), the hypothesized

Table 2. Estimated coefficients for relationship between total length (TL) and other lengths for *Macroramphosus scolopax* ($n = 103$) from the Adriatic Sea

Equation	r^2
Fork length (FL) = $0.9639TL + 0.1714$	0.9653
Standard length (SL) = $0.8925TL - 0.0302$	0.9498
Head length (CL) = $0.3990TL + 0.5619$	0.6805
Predorsal distance (PD) = $0.6869TL - 0.0405$	0.9337
Prepectoral distance (PP) = $0.4015TL + 0.5347$	0.6826
Prepelvic distance (PV) = $0.6575TL - 0.9879$	0.8753
Maximum body height (H) = $0.2618TL - 0.0292$	0.8267
Height of 2 nd spine in 1 st dorsal fin (Hray) = $0.1241TL + 1.9157$	0.4776

Table 3. Meristic characters of *Macroramphosus scolopax* ($n = 103$, males = 14, females = 19, undetermined sex = 70) from the Adriatic Sea in the 1997 and 1998 spring-summer period

Meristical character	Sex	Range (no.)	$\bar{X} \pm SD$	t
First dorsal fin rays (<i>D1</i>)	Males	V-VI	5.14±0.36	0.155
	Females	V-VI	5.16±0.38	
	Total	IV-VII	5.14±0.40	
Second dorsal fin rays (<i>D2</i>)	Males	I+(10-14)	11.4±1.08	0.000
	Females	I+(10-13)	11.4±0.68	
	Total	I+(10-14)	11.3±0.74	
Pectoral fin rays (<i>P</i>)	Males	14-17	15.4±0.85	0.952
	Females	14-17	15.7±0.95	
	Total	13-18	15.3±0.93	
Pelvic fin rays (<i>V</i>)	Males	I+(5-6)	5.2±0.43	0.654
	Females	I+(5-6)	5.3±0.45	
	Total	I+(4-6)	15.3±0.93	
Anal fin rays (<i>A</i>)	Males	17-19	18.4±0.65	0.465
	Females	17-19	18.6±0.60	
	Total	17-20	18.4±0.64	
Caudal fin rays (<i>C</i>)	Males	14-17	15.1±0.83	0.562
	Females	12-17	15.3±1.15	
	Total	12-17	14.9±0.91	

isometric growth for this species was rejected. The b -value was generally in agreement with results found by other authors. In the western Mediterranean, the length-weight relationship for this species was $W = 0.004L^{3.15}$ (MERELLA *et al.*, 1997) while in Portuguese continental waters it was $W = 0.004L^{3.127}$ (BORGES, 2000).

The biometry findings for snipefish habituating this part of the Adriatic Sea are

presented here for the first time and therefore significant. The biology of snipefish should be further studied, especially of older specimens.

ACKNOWLEDGMENTS

The authors are grateful to Dr. sc G. SINOVČIĆ and two anonymous reviewers for their critical and useful comments on the manuscript.

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Received: 27 October 2003

Accepted: 30 March 2005

**Biometrija i rasprostranjenost šljuke,
Macroramphosus scolopax (Linnaeus, 1758), u Jadranskom moru**

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SAŽETAK

U radu je prikazana rasprostranjenost i biometrija 103 primjerka šljuke, *Macroramphosus scolopax* (Linnaeus, 1758), koji su prikupljeni tijekom istraživanja pridnenih naselja Jadranskog mora, na dubinama većim od 100 m, a u sklopu projekta MEDITS, tijekom proljetno-ljetnog razdoblja 1997. i 1998. godine. Analizirano je 18 morfometrijskih i 6 merističkih obilježja ove vrste. Nisu nađene morfološke i merističke razlike između mužjaka i ženki. Analizom dužinsko – masenog odnosa je utvrđena pozitivna alometrija ($b=3,23$); šljuka je pokazala proporcionalno brži maseni nego dužinski rast.

Ključne riječi: *Macroramphosus scolopax*, šljuka, biometrija, Jadransko more
