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**LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF STRIPED PIGGY,
POMADASYS STRIDENS IN THE İSKENDERUN BAY**

ABSTRACT

In this study, the length-weight relationship (LWR) and condition factor of *Pomadasys stridens* (Forsskal, 1775) in İskenderun Bay, Türkiye were determined. The fish samples were monthly collected by nets from November 2014 to October 2015. The length-weight relationship was expressed as follows: Males $W=0.015*TL^{2.992}$ ($r=0.920$), females $W=0.028*TL^{2.749}$ ($r=0.893$) and all individuals $W=0.013*TL^{3.033}$ ($r=0.916$). Isometric growth was detected in all individuals, while negative allometric growth was detected in females. The average condition factor was found to be 1.422 ± 0.007 for males and 1.444 ± 0.008 for females.

Keywords: *Pomadasys stridens*, Length-Weight Relationship, Condition Factor, Non-Indigenous Species (NIS), İskenderun Bay

1. INTRODUCTION

The striped piggy, *Pomadasys stridens* is a species that belongs to the Haemulidae family. It is a non-indigenous species (NIS) that is distributed from the Indian Ocean, the Red Sea, the coasts of South Africa, Western India, and East Africa to Mozambique and the Arabian Gulf [1 and 2]. The species *P. stridens*, first reported from the Mediterranean Sea ecosystem in 1969, was first identified for the Turkish coast in 2009 from the İskenderun Bay [3 and 4]. Moreover, it has been documented that they entered the Mediterranean Sea from the Red Sea and the İskenderun Bay to Egypt via the Suez Canal [5]. Despite being regarded as an invasive species from an ecological standpoint, it possesses negligible economic value. Research on the length-weight relationship and condition factor of the *P. stridens* species has been conducted by [6, 7, 8, 9, 10, 11, and 12]. Research on reproductive characteristics has been conducted by [13 and 14] and otolith biometry by [15 and 16] biology and population dynamics parameters have been conducted in detail; one of these was carried out on the Egyptian coast and the other on the Turkish coast.

Length-weight relationships (LWR) and condition factor represent two of the most significant biological parameters in the study of fish species. The objective is to provide information regarding the growth level [17]. The evaluation of the length-weight relationship is of paramount importance in the fields of fisheries ecology and stock assessment. This evaluation results in the conversion of growth-in-length to growth-in-weight, a process which is of the utmost importance when estimating condition factor and conducting geographic

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comparisons of life histories [18, 19 and 20]. Moreover, this relationship facilitates the comparison of the between-region life histories of species [21].

The objective of the present study is to provide information on the length-weight relationship (LWR) and condition factor (K) of *P. stridens* in İskenderun Bay, Türkiye.

2. RESEARCH SIGNIFICANCE

The present study revealed the length-weight relationship and condition factor of *P. stridens* species in İskenderun Bay.

Highlights:

- The present study determines the relationship between total length and total weight of the *P. stridens* species caught in the İskenderun Bay.
- It provides the relationship between total, fork, and standard length of the *P. stridens* in İskenderun Bay.
- It shows the growth type of *P. stridens* species. The condition factor relationship of *P. stridens* species was examined in detail.

3. MATERIALS AND METHODS

This study collected samples of *P. stridens* from trawlers fishing in the İskenderun Bay between November 2014 and October 2015 (Figure 1). The samples obtained were examined at the Faculty of Marine Sciences and Technology Laboratory at İskenderun Technical University. The subjects' total length, standard length, and fork length were measured in centimetres with a precision of 0.1 cm. Weight measurements were obtained using an electronic scale with a precision of 0.01 gr. The length-weight equation was worked out through the least-squares method on logarithmic transformed data by means of the equation $W=a*L^b$, where W is the total weight, L is the total length, and a and b are parameters to be estimated [22]. This analysis was performed both on the whole sample and on the sample subdivided by sex. Standard error was calculated for the slope (b): the hypothesis of isometric growth was tested through Student's t -test, with values of $p<0.05$ considered significant. Fulton's condition factor (K) was calculated using the equation; $K=(W/L^3)*100$, where W is total weight (g), L is total length (cm) [23]. Furthermore, the minimum, maximum, and average length values measured in females, males, and all individuals, as well as their standard error values were calculated. Finally, all statistical analyses (t -test, χ^2 test, ANOVA, regressions, correlations, etc.) were performed at a 5% significance level ($p=0.05$) using the EXCEL computer software package [24].



Figure 1. Map of the research area

4. RESULTS AND DISCUSSION

A total of 1,064 individuals of *P. stridens* were captured in the study area between November 2014 and October 2015. Of these, 37.97% (404) were female, 53.85% (573) were male and 8.18% (87) were juveniles (see Table 4.1). The male-to-female ratio (M:F) was calculated as 1:0.71. The chi-squared test revealed that the difference between the observed male:female ratio and the expected 1:1 ratio was significant (Table 1).

Table 1. Total length, weight and sex ratio distributions by month

Sampling Period	Number of Individuals (n)		M:F	Total Length	Total Weight
	Female	Male		(cm) $\pm$ SE	(g) $\pm$ SE
November 2014	4	12	01:00.3	13.72 $\pm$ 0.38	37.52 $\pm$ 2.83
December 2014	68	38	01:01.8	14.23 $\pm$ 0.08	41.81 $\pm$ 0.70
January 2015	87	128	01:00.7	12.74 $\pm$ 0.10	30.84 $\pm$ 0.89
February 2015	72	93	01:00.8	13.63 $\pm$ 0.09	37.12 $\pm$ 0.82
March 2015	36	50	01:00.7	15.06 $\pm$ 0.10	49.49 $\pm$ 1.04
April 2015	40	47	01:00.8	14.91 $\pm$ 0.12	48.91 $\pm$ 1.16
May 2015	19	28	01:00.7	14.94 $\pm$ 0.19	47.88 $\pm$ 1.80
June 2015	32	25	01:01.3	15.90 $\pm$ 0.12	56.16 $\pm$ 1.54
July 2015	7	22	01:00.3	15.15 $\pm$ 0.11	47.94 $\pm$ 1.18
August 2015	1	10	01:00.1	14.36 $\pm$ 0.22	46.61 $\pm$ 2.06
September 2015	8	34	01:00.2	13.29 $\pm$ 0.17	36.92 $\pm$ 1.50
October 2015	30	86	01:00.3	13.87 $\pm$ 0.15	38.46 $\pm$ 1.26
Total	404	573	01:00.7	13.96 $\pm$ 0.05	40.45 $\pm$ 0.42

As shown in Table 1, the average total length and body weight for all individuals were 13.96 $\pm$ 0.050 cm and 40.45 $\pm$ 0.424 g, respectively. Figure 2 shows the total length frequencies of *P. stridens* individuals obtained by month. Examining the length distribution graph by month reveals that the highest number of individuals were found in the 13.0-14.9 cm length range, while the lowest number were found in the 17.0-18.9 cm range. In terms of length

groups, the highest number of individuals was found in the 11.0-12.9 cm range in January, followed by the 13.0-14.9 cm range in February. Additionally, individuals were not obtained in the 9.0-10.9 cm, 11.0-12.9 cm and 17.0-18.9 cm length ranges in some months (Figure 2).

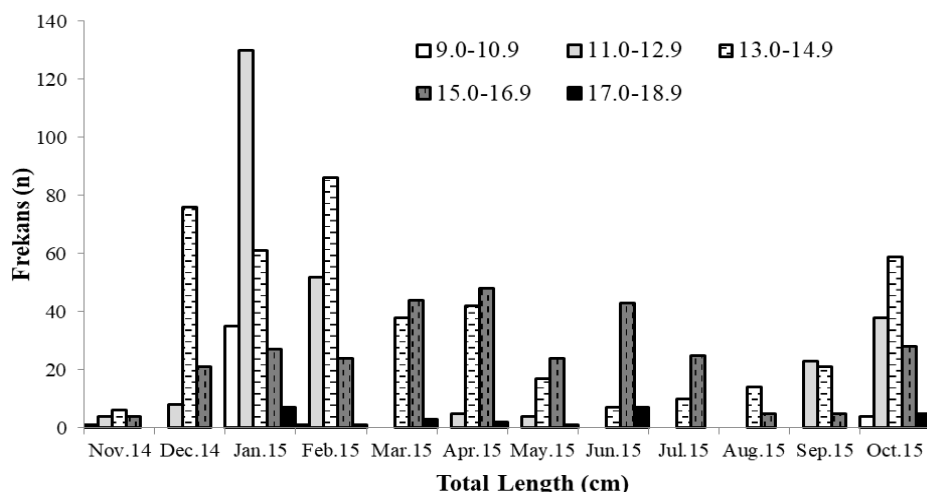


Figure 2. Total length distribution by months of *P. stridens*

The total length value was used for *P. stridens* individuals. To enable comparison with length values in other studies on the species, conversion to other length values was calculated. To enable evaluation of the results from different studies, total, fork and standard-length measurements were taken from 1,064 individuals and length-to-length conversions were performed using the linear regression equation $Y=a+bx$. The results of the length-to-length regression are presented in Table 2.

Table 2. Regressions of total (TL), fork (FL) and standard length (SL) of *P. stridens* for all individuals

Y	X	a	b	R2
TL	FL	0.554	0.917	0.989
TL	SL	-0.579	0.879	0.972
FL	SL	-1.568	0.991	0.981

The relationship between total length and total weight measured in *P. stridens* individuals yielded b parameter values of 2.992 (2.92-3.06) for males, 2.749 (2.66-2.84) for females, and 3.033 (2.98-3.09) for all individuals (Figures 3-5). The t-test performed on the difference between the b constants of the length-weight relationship of the striped piggy relative to 3, isometric growth ($t_{\text{calculated}} < t_{0.05(n-2)}$ not significant) was observed in males and all individuals, while negative allometric growth ($t_{\text{calculated}} > t_{0.05(n-2)}$ significant) was observed in females. Moreover, the confidence interval for the b value was calculated to be between 2.98 and 3.09 for all individuals.

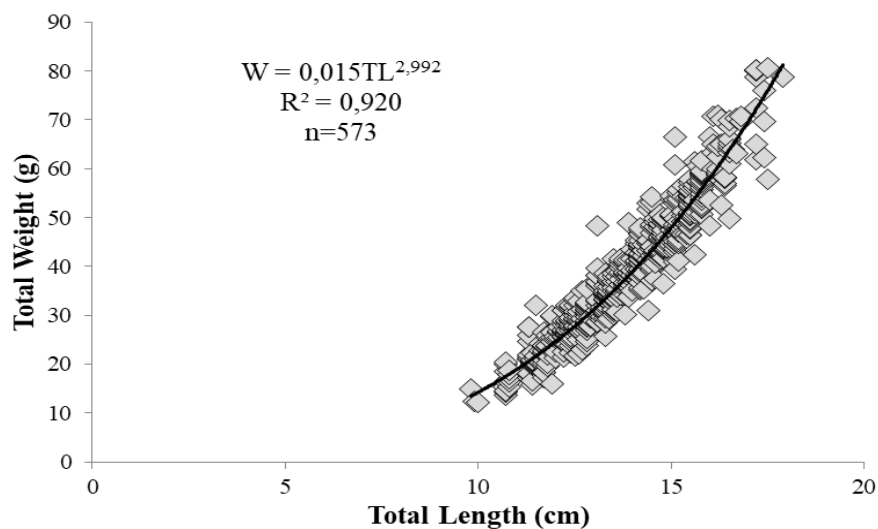


Figure 3. Total length-weight relationship of *P. stridens* for males

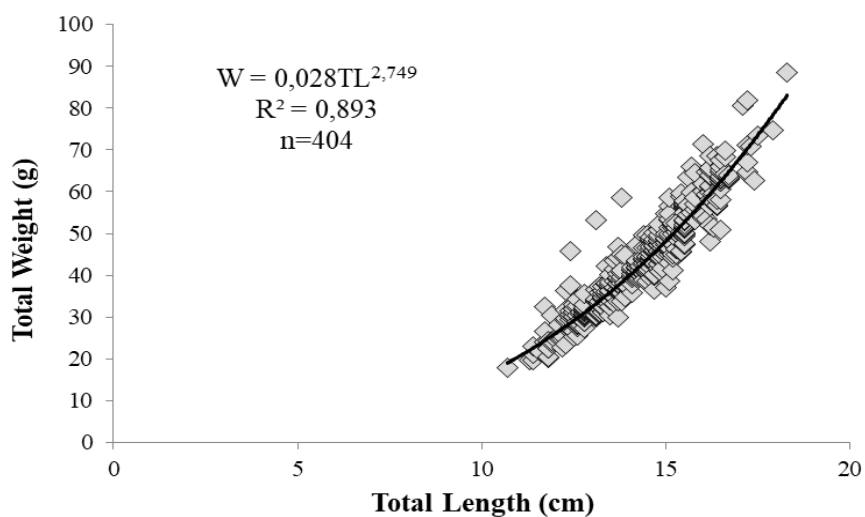


Figure 4. Total length-weight relationship of *P. stridens* for females

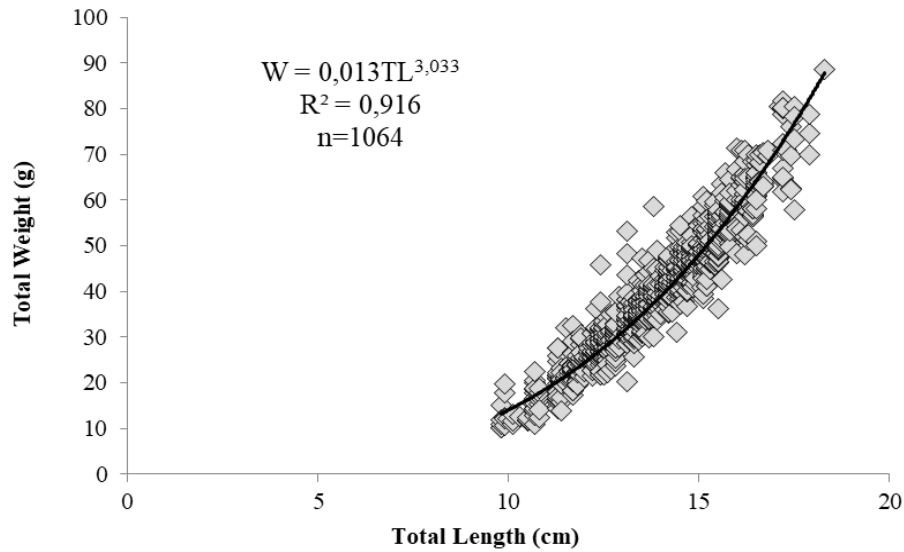


Figure 5. Total length-weight relationship of *P. stridens* for all individuals

When we compared male and female *P. stridens* by month, the condition factor was highest in August (female: 1.712 and male: 1.594) and lowest in July (female: 1.374 and male: 1.369) (Figure 6). The condition factor ranged from 0.498 to 2.148 in males and from 0.699 to 2.402 in females. On average, males had a condition factor of 1.422, with a standard error of plus or minus 0.007, and females had a condition factor of 1.444, with a standard error of plus or minus 0.008. We tested whether there was a difference in the condition factor between males and females using statistics. The t-test showed that there was no statistically significant difference between the sexes ($p > 0.05$).

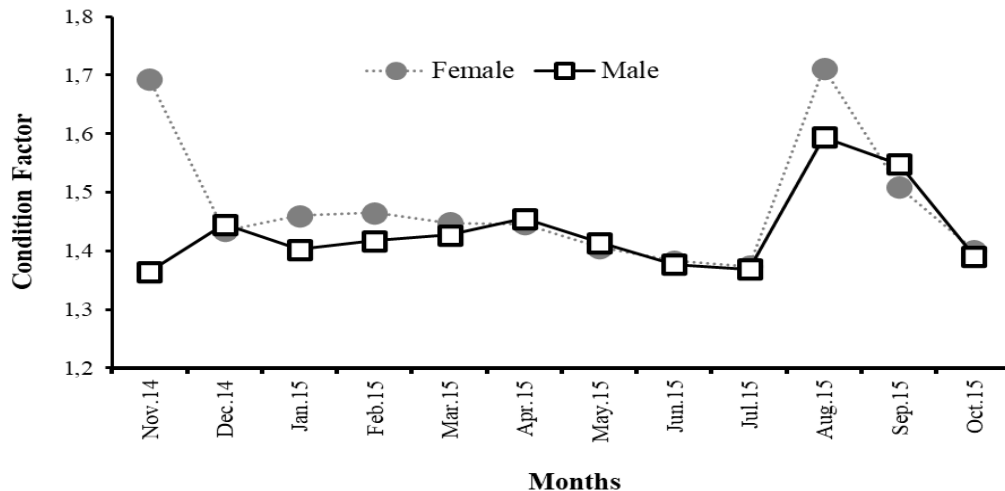


Figure 6. Condition factor by month of *P. stridens*

In this study, the 'b' value calculated for the length-weight relationship for all individuals is similar to the data of Hashemi et al. [6] and El-Drawany et al. [25], but differs from values obtained by other researchers (Table 3). This may be due to factors such as fish weight, season of capture, stomach contents and spawning conditions [26]. It may also vary within the same population in different years depending on feeding conditions.

Table 3. Comparison of the height-weight relationship with other researchers

Researcher	N	L _{min-max} (mm)	a	b	r	Growth
Ahmed et al. [27]	2013:O:96	14.0-20.8		1.07	0.974	A ⁻
	2014:O:96	13.8-20.8		1.01	0.972	A ⁻
Hashemi et al. [6]	O:201	11.1-23.5	9E-06	3.04	0.89	A ⁺
	M:100	16-22.9	0.00008	2.66	0.8	A ⁻
	F:101	13-23.5	0.00003	2.88	0.9	A ⁻
	M:155	5.6-19.8	0.1011	2.73	0.96	A ⁻
Safi et al. [8]	F:236	9.9-21.0	0.1023	2.82	0.94	A ⁻
Erguden et al. [9]	O:335	7.6-17.7	0.0049	3.41	0.96	A ⁺
Hoveizavi et al. [7]	O: 218	7.5-24.0	0.0372	2.62	0.78	A ⁻
Osman et al. [10]	O:409	6.6-19.0	0.0074	3.245	0.956	A ⁺
Avşar et al. [11]	M:445	9.1-18.6	0.0116	3.087	0.967	A ⁺
	F:471	7.8-18.9	0.0123	3.064	0.941	I
	O:1131	7.3-18.9	0.0113	3.096	0.958	A ⁺
El-Drawany et al. [25]	O:650	8-17.8	0.0112	3.0496	0.985	I
	M:313	8-17.6	0.012	3.021	0.985	I
	F:337	8.3-17.8	0.011	3.0406	0.984	I
Present study	O:1064	9.8-18,3	0.013	3.03	0.92	I
	M:573	9.8-17.9	0.0145	2.99	0.92	I
	F:404	10.7-18.3	0.0282	2.75	0.89	A ⁻

In this study, the maximum total length of the striped pigmy goby, *P. stridens*, was measured at 18.3 cm. The maximum lengths reported in different regions ranged from 24.0 cm [7] to 17.7 cm [9] (Table 3). Therefore, the maximum total length in this study falls within the average range. This variation in maximum length may be due to the fishing gear used, food availability, feeding conditions, and fishing pressure.

The present results highlight the importance of knowing the basic biological parameters of the species for the effective management of striped piggy stocks in the Iskenderun Bay. This study determined the length-weight relationship and condition factor of striped piggies caught in the Iskenderun Bay. These findings are expected to contribute significantly to future research on this species.

NOTICE

This article is based on the part of MSc. thesis of Berna Funda Özbek, entitled "Some Bio-Ecological Aspects of *Pomadasys stridens* (Forsskal, 1775) in Iskenderun Bay", a thesis which was carried out under the supervision of Assoc. Prof.Dr. Gülnaz Özcan at Iskenderun Technical University, Iskenderun, Türkiye. Also, this study was presented as a oral presentation at the International Iskenderun Bay Symposium held in Iskenderun-Hatay on 11-13 October 2017.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

FINANCIAL DISCLOSURE

The authors received no financial support for the research.

DECLARATION OF ETHICAL STANDARDS

The authors of the article declare that the materials and methods used in this study do not require ethics committee approval and/or legal special permission.

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