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Length-Weight Relationships of Five Species of Demersal Fish from North of Persian Gulf, Iran

Seyed Ahmadreza Hashemi [1,*], Seyed Aminollah Taghavimotlagh [2], Gholamreza Eskandary [3], Aliakbar Hedayati [1]

[1]*Department of Fisheries, Gorgan University of Agricultural Sciences and Natural Resources. Gorgan – Iran.*
[2]*Iranian Fisheries Research Organization, Tehran, Iran.*
[3]*South of Iran Aquaculture Fishery Research Center, Ahvaz, Iran.*

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ABSTRACT

This study describes length-weight relationships of five species (*platycephalus indicus, Pseudorhombus elevates, Plicofollis tenuispinis, Grammoplites suppositus, Pomadays stridens*) collected from Persian Gulf (Khuzestan province, Iran) during December 2009 to November 2011. A total of 2065 specimen were examined for this study. The relationship between weight and total length were estimated: $W=0.000004L^{3.10}$ (n=470, $R^2=0.86$) for *p. indicus*, $W=0.000009L^{3.04}$ (n=363, $R^2=0.96$) for *p. elevates* ,$W=0.000005L^{3.10}$ (n=466, R^2 =0.82), for *p. tenuispinis*, , $W=0.000006L^{2.95}$ (n=486, R^2 =0.69), for *G. suppositus* and $W=0.00009L^{3.04}$ (n=201, R^2 =0.89) for *p. stridens*. Length-weight relationship indicated positive allometric growth for *p. stridens*, *p. tenuispinis* and *p. indicus* while negative allometric growth for *G. suppositus*. The expected aim of the present study was to provide basic information for fishery biologists in Iran.

1 INTRODUCTION

Length-weight relationship has an important role in fishery resource management. It is also useful for comparing life history, morphological aspects of populations inhabiting different regions, length and age structures and estimating condition factor (Goncalves *et al*., 1997; Kholer *et al*., 1995; Pauly, 1983; Froese and Pauly, 2010). Mathematically, length–weight relationship explains the correlation between fish length and its weight. Hence, it is useful for converting length observations into weight estimates to provide some measure of biomass (Froese, 1998). In fish studies, the length of a fish is often more rapidly and easily measured than is its mass; therefore, it is opportune to be able to determine mass where only the length is known (Harrison, 2001; Hashemi *et al*., 2011).

The information about the length-weight relationships of fish species in our study in the Persian Gulf is very scarce and incomplete. Data about previous investigations of LWRs for fish species from the South Africa, Kuwait, India and Philippine are presented in Table 1.

[*]*Corresponding author: seyedahmad83@yahoo.com*

Table 1
Some of the results on LWR parameters estimated in different localities for the similar fish species targeted in the present study

Species	A	b	Area	References
p. indicus	0.0102	2.950	South Africa	Naik, 1990
	0.0022	3.322	Kuwait	Bawazeer, 1989
P. tenuispinis	0.0184	2.886	India	Dan and Mojumder, 1978
P. stridens	0.0118	3.000	Philippines	Pauly et al, 1998

Thus, the aim of the present study was to investigate the length–weight relationships of five marine water fish species from the south coastal waters of Persian Gulf in Iran. However, no study so far has been made on some of species length-weight relationships (*Pseudorhombus elevates, Grammoplites suppositus*) in Khuzestan Coastal Waters (northwest of Persian Gulf). Because of low data and ecological pattern of these five species and in spite of their economic value, in the present study we investigate the length-weight relationships of *platycephalus indicus*, *Pseudorhombus elevates*, *Plicofollis tenuispinis*, *Grammoplites suppositus*, *Pomadays stridens*) collected from Persian Gulf.

2 MATERIALS AND METHODS

2.1. Study area

The major fishing areas of *platycephalus indicus, Pseudorhombus elevates, Plicofollis tenuispinis, Grammoplites suppositus, Pomadays stridens* species, in the northwest of Persian Gulf are located in Liphe-Busafe and Bahrekan fishing areas between 29° 44' to 07 'N and 48° 45' to 49° 50' (Fig. 1). In total, each month 2065 individual fishes were directly collected from artisanal fishermen from December 2009 to November 2011. The fishes were captured by bottom trawl and gill net.

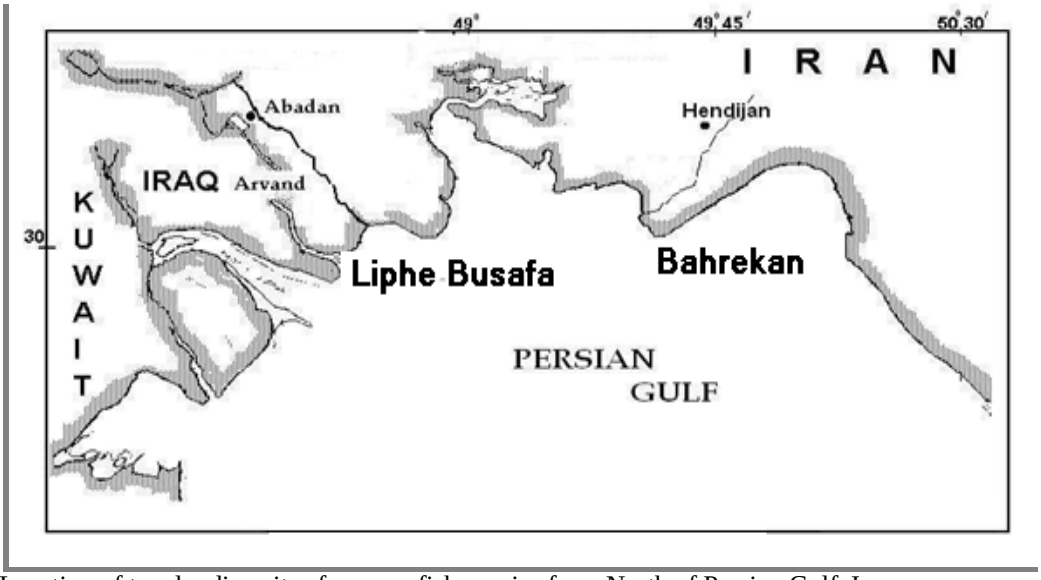

Fig. 1. Location of two landing sites for some fish species from North of Persian Gulf, Iran

2.2 Methods

In the laboratory, fork length (±1.0 mm), sex, and weight (±0.001 g wet weight) were recorded for each fish. Length-weight relations were calculated by $W= a L^b$ equation where W is weight (g), L is total length (cm), a is the regression constant (intercept) and b is the regression slope (i.e. fish growth rate).The parameters a and b were estimated by the least-square method from logarithmically transformed data and the correlation (r^2), that is the degree of association between the length and weight was computed from the linear regression analysis (Biswas, 1993). The parameters of the relationships were calculated using SPSS software. In order to verify if the calculated b was significantly different from 3, t-test was employed using the statistic: $t_s = (b-3) /Sb$, where Sb is the standard error of the slope (Zar, 1996).

When the b value in length-weight relationship was statistically equal to or did not show significant deviation from 3, the growth was considered isometric, whereas the positive or negative allometric growth occurred when the b value was significantly different from 3. In order to verify if the calculated b was significantly different from 3, the students t-test was employed (Zar, 1996).

2.3 Statistical analysis

Data were transferred to Microsoft Excel spreadsheet for analysis. SPSS 16.0 statistical software was also used for ANOVA and students t-test analysis. Differences were considered significant at values of $p<0.05$.

3 RESULTS AND DISCUSSION

In the present study, 2065 fishes covering the families (Platycephalidae, Paralichthyidae, Arridea and Haemulidae) which had a total length range of 111 mm to 600 mm and weight range of 14 to 1886 g were utilized. The mean, maximum, minimum and standard deviation (SD) of total lengths and weights are illustrated in Table 2. This may be explained by the selectivity of the sampling nets used and low fishing press on these species in the Persian Gulf.

In fisheries biology, length–weight relationships are useful in determining weight and biomass when only length measurements are available, as indications of condition and to allow for comparisons of species growth between different regions (Williams, 2000). The relationship between body weight and length is simple but essential in fishery management (Chien-Chung, 1999). Length-weight relationships drastically help scientists to convert growth-in-length equations to growth-in-weight ones in stock assessment models (Bobori *et al*., 2010), to estimate growth rates and age structure, to obtain the condition of fish and comparative growth

Table 2
Minimum and maximum weight (reported to the nearest milligram) and length (measured to the nearest millimeter) measurements of species collected for the Length-Weight Study (2009-2011)

Species	Number of captured	Mean ± s.d total length (mm)	minimum and maximum(mm)	Mean ± s.d total weight	minimum and maximum(g)
platycephalus indicus	469	348±78	140-600	357±293	16-1886
Pseudorhombus elevates	362	264±57	115-415	238±150	14-827
Plicofollis tenuispinis	403	250±90	121-590	184±150	140-1358
Grammoplites suppositus	437	232±31	150-307	67±23	17-176
Pomadasys stridens	394	196±18	111-235	110±31	26-234

studies to estimate biomass from length frequency data (Goncalves et al., 1997).

The estimation of length-weight relationship of *p. indicus*, *P. elevates*, *P.tenuispinis*, *G. suppositus* and *P.stridens* for male and female are shown in Table 3. The logarithmic values of the observed lengths and the corresponding weights of the fishes in our study are plotted in Fig. 2. The relationships between weight and total length were found to be: $W=0.000004L^{3.10}$ (n=470, $R^2=0.86$) for *p. indicus* (Fig. 2a), $W=0.000009L^{3.04}$ (n=363, R2=0.96) for *p. elevates* (Fig. 2b), $W=0.000005L^{3.10}$ (n=466, R2 =0.82) for *p. tenuispinis* (Fig. 2c), $W=0.000006L^{2.95}$ (n=486, R2 =0.69) for *G. suppositus* (Fig. 2d),

Table 3
length-weight relationships of some species from north of Persian Gulf.

Family	Species	N	A	Min (mm)	Max (mm)	b	S.E (b)	R^2	P=0.05	Growth type
Platycephalidae	*p.indicus* (male)	248	0.000009	210	580	2.95	0.82	0.83	P< 0.05	A^-
	p.indicus (female)	198	0.000005	233	600	3.07	2.39	0.82	P< 0.05	A^+
	p.indicus (All fish)	470	0.000004	140	600	3.10	1.5	0.86	P< 0.05	A^+
Paralichthyidae	*P.elevatus* (male)	80	0.00002	210	314	2.90	0.49	0.94	P< 0.05	A^-
	P.elevatus (female)	200	0.000007	285	415	3.09	1.06	0.96	P< 0.05	A^+
	P.elevatus (All fish)	363	0.000009	115	415	3.04	1.02	0.96	P< 0.05	A^+
Arridea	*P. tenuispinis* (male)	248	0.00009	140	345	2.99	0.82	0.82	P< 0.05	A^-
	P. tenuispinis (female)	198	0.00004	130	470	3.07	2.39	0.83	P< 0.05	A^+
	P. tenuispinis (All fish)	446	0.00005	121	470	3.10	1.5	0.82	P< 0.05	A^+
Platycephalidae	*G. suppositus* (male)	80	0.029	165	275	2.90	0.001	0.79	P> 0.05	I
	G. suppositus (female)	409	0.000006	162	307	2.99	0.1	0.72	P> 0.05	I
	G. suppositus (All fish)	489	0.000006	150	307	2.95	0.10	0.69	P> 0.05	I
Haemulidae	*P. stridens* (male)	100	0.00008	160	229	2.66	0.34	0.80	P< 0.05	A^-
	P. stridens (female)	101	0.00003	130	235	2.88	0.27	0.90	P< 0.05	A^-
	P. stridens (All fish)	201	0.000009	111	235	3.04	0.33	0.89	P< 0.05	A^+

N: the sample size, min, max, mean total length, a: the intercept of relationship b: the slope of relationship, r: coefficient of correlation, P value (difference of b from 3) and growth type (isometric=I and allometric negative= A^- and allometric positive= A^+)

and $W=0.00009L^{3.04}$ (n=201, R2 =0.89) for *p. stridens* (Fig. 2e). These results show isometric growth in *Grammoplites suppositus* fish (Table 2). Length-weight relationships indicated positive allometric growth for *p. stridens*, *p. tenuispinis* and *p. indicus* while negative allometric growth for *G. suppositus*. The results also show isometric growth in *Grammoplites suppositus* fish.

The difference in the 'b' value of males and females indicated that the females were heavier than the males of the same length group. In the present study, the mean value of 'b' is 2.86 in males and 3.02 in females. It means the value of 'b' in females is more than the males. This shows that females are heavier than males at equal length.

According to Marthin (1994), the range of "b" could be from 2.5 to 4 and Tesch (1968) believed "b=3 in fish with isometric growth".

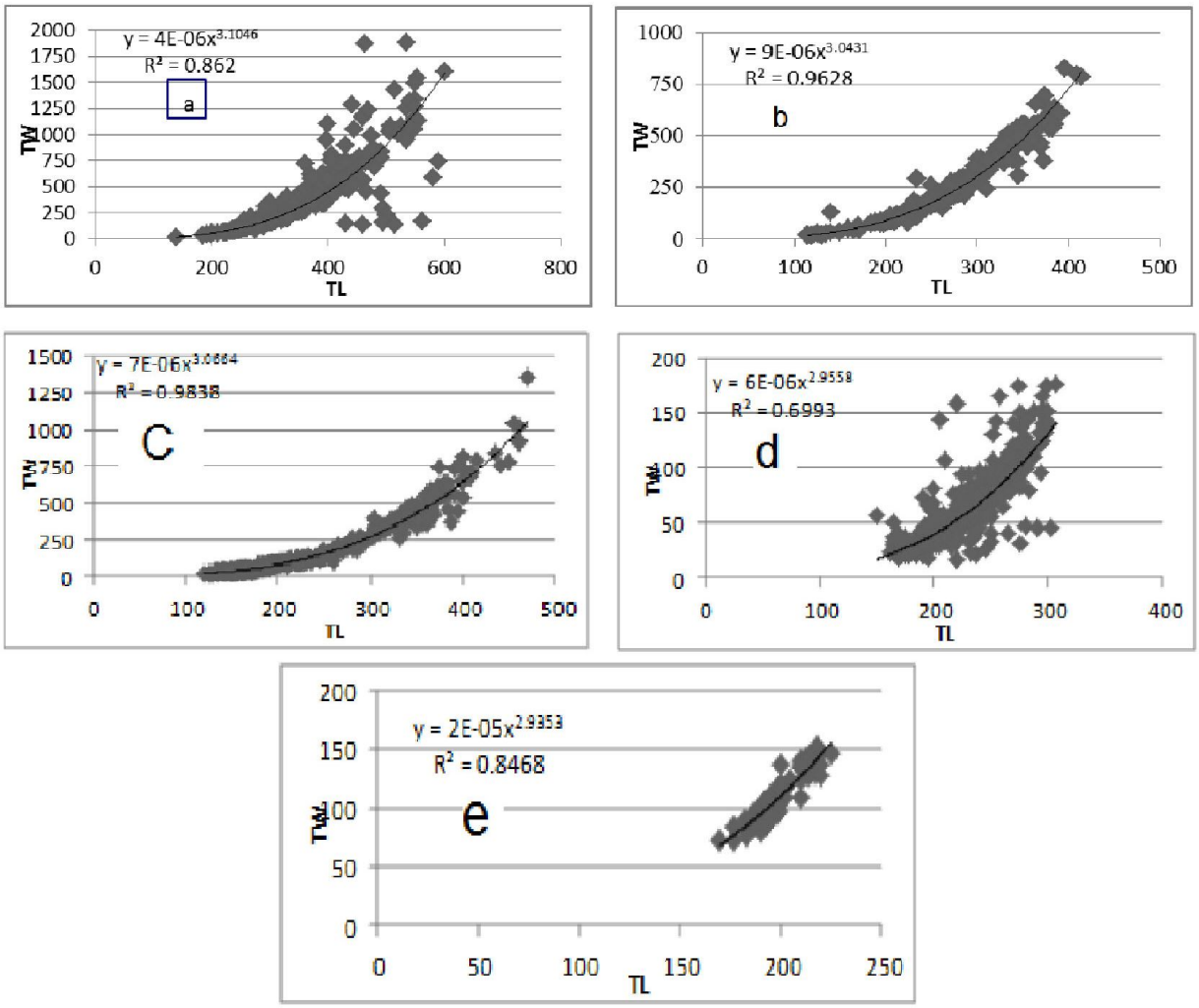

Fig. 2. The length-weight relationship curve for five fishes in Khuzestan Coastal Waters (Persian Gulf, 2009-11), a: bartail flathead (p.indicus), b: Deep flounder (*P.elevatus*), c: Thinspine seacatfish (*P. tenuispinis*), d: Spotfin flathead (G. suppositus) and e: Striped piggy (P. stridens)

Variation of b in the different regions could be due to seasonal fluctuations in environmental parameters, physiological conditions of the fish at the time of collection, sex, gonad development and nutritive conditions in the environment of fish (Biswas, 1993).

platycephalus indicus, P.elevatus, P. tenuispinis and *P. stridens* exhibited positive allometric growth. The findings reported in this study represent the first data on the LWRs of the above fishes in the southern waters of Persian Gulf in Iran. The growth was an isometric form of growth in weight for *G. suppositus* (Table 3). The LWR of these commercially important marine fishes helps to manage their stock in Persian Gulf.

In India and South Africa, the *b* value for the *p. indicus* species denoted negative allometric growth (Naik, 1990) and for *P. tenuispinis* negative allometric growth was also represented in India (Dan and Mojumder, 1978). According to Ricker (1973), such differences in the *b* values could be ascribed to differences in the number of specimens examined, as well as to the area and seasonal effects.

P. stridens exhibited negative allometric growth (Table 1). Pauly *et al*. (1998) found that the *P. stridens* functional regression was equal to 3 in Philippines. This discrepancy may be due to the specific habitat conditions and morphological differences (Biswas, 1993).

Furthermore, the r^2 value of length-weight relationship of *P.elevatus* was relatively high. High correlation r^2 proved a strong relationship between the length and weight in these species.

Observed differences in parameters a and b calculated from Khuzestan waters in Persian Gulf when compared with those obtained by other authors (Table 3) are likely due to differences in the number of specimens examined, differences in the utilized length ranges or differing study seasons (Moutopoulos and Stergiou, 2002). WLRs are not constant over the entire year and vary according to factors such as food availability, feeding rate, gonad development and spawning period (Bagenal and Tesch, 1978). According to Weatherley and Gill (1987), the annual length-weight relationships could differ between seasons and years and many factors namely, maturity, temperature, salinity, food availability and size could contribute to these differences. Length-weight relationship may vary seasonally according to the degree of sexual maturity sex, diet, stomach fullness, and sample preservation techniques, number of specimens examined, area/season effects and sampling duration (Wootton, 1992).

In conclusion, length-weight relationships of these fish species in the Persian Gulf are very incomplete and no previous reports of length-weight relationships on *Pseudorhombus elevates, Grammoplites suppositus* species are available from the Persian Gulf. Further, results of the present study provide useful inputs for fisheries scientists stock assessment models and also spatial- temporal comparisons in the future.

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