

# Length–weight relations for 14 fish species (Actinopterygii) from the coastal waters off Gwangyang Bay, South Korea

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## Abstract

Length–weight relations were estimated for 14 fish species sampled from the coastal waters off the Gwangyang Bay in South Korea. The following species were studied: *Okamejei kenojei* (Müller et Henle, 1841); *Muraenesox cinereus* (Forsskål, 1775); *Thryssa adalae* (Rutter, 1897); *Thryssa kammalensis* (Bleeker, 1849); *Tribolodon hakonensis* (Günther, 1877); *Inimicus japonicus* (Cuvier, 1829); *Chelidonichthys spinosus* (McClelland, 1844); *Jaydia lineata* (Temminck et Schlegel, 1842); *Sillago japonica* Temminck et Schlegel, 1843; *Pholis nebulosa* (Temminck et Schlegel, 1845); *Favonigobius gymnauchen* (Bleeker, 1860); *Pampus echinogaster* (Basilewsky, 1855); *Cynoglossus joyneri* Günther, 1878; *Takifugu niphobles* (Jordan et Snyder, 1901). The length–weight relation of *Thryssa adalae* (Rutter, 1897), (Engraulidae) has not been previously reported. The new maximum total length of *Thryssa kammalensis* (18.0 cm) is now provided. The values of coefficient *a* ranged from 0.0007 to 0.0218, and the values of exponent *b* ranged from 2.82 to 3.52.

## Keywords

length–weight relations, maximum total length, Gwangyang Bay

## Introduction

Length–weight relations (**LWRs**) are generally used to estimate the weight of an organism for a corresponding length, and this can then be applied to determine fish stocks and population assessments such as those involving information regarding the fish growth type and the determination of fish growth conditions (LeCren 1951; Ricker 1968). LWRs data are used for estimating the weight corresponding to a given length and can be affected by many factors including season, habitat area, gonad maturity, sex, diet, stomach fullness, and health (Bagenal and Tesch 1968). Thus, this contribution provides information concerning LWRs of 14 common fish species in

the coastal waters of Gwangyang Bay. LWRs data involving *Favonigobius gymnauchen* (Bleeker, 1860); *Pampus echinogaster* (Basilewsky, 1855); and *Thryssa adalae* (Rutter, 1897) have not been registered in FishBase (Froese and Pauly 2020).

## Material and methods

The fishes were collected at four sites from the coastal waters of Gwangyang Bay in South Korea (34°52′07″N, 127°47′50″E; 34°50′34″N, 127°46′56″E; 34°45′43″N, 127°49′31″E; 34°43′7″N, 127°47′41″E) between July 2018 and June 2019 (July, September in 2018; March,

**Table 1.** Descriptive statistics and estimated parameters of length–weight relations for 16 fish species in the coastal waters off the Gwangyang Bay, South Korea.

Family	Species	FB	n	TL [cm]	W [g]	a	95% CL of a	b	95% CL of b	r <sup>2</sup>
Rajidae	<i>Okamejei kenoei</i>	1	34	20.3–48.6	48.6–815.7	0.0036	0.0026–0.0048	3.18	3.09–3.27	0.994
Muraenesocidae	<i>Muraenesox cinereus</i>	2	32	35.5–61.7	50.1–276.9	0.0007	0.0003–0.0015	3.14	2.93–3.35	0.972
Engraulidae	<i>Thryssa adela</i>	—	17	8.0–13.6	2.0–11.4	0.0030	0.0014–0.0063	3.11	2.80–3.42	0.975
	<i>Thryssa kammalensis</i>	3	141	8.0– <b>18.0</b>	3.1–36.5	0.0068	0.0051–0.0092	3.04	2.91–3.16	0.955
Cyprinidae	<i>Tribolodon hakonensis</i>	2	10	13.0–38.4	16.5–478.0	0.0074	0.0043–0.0128	3.04	2.87–3.20	0.994
Scorpaenidae	<i>Inimicus japonicus</i>	2	16	4.0–27.5	0.8–420.5	0.0041	0.0022–0.0076	3.52	3.31–3.73	0.989
Triglidae	<i>Chelidonichthys spinosus</i>	2	37	11.3–29.1	11.7–204.5	0.0053	0.0040–0.0071	3.17	3.08–3.26	0.993
Apogonidae	<i>Jaydia lineata</i>	1	86	4.0–14.8	0.8–40.0	0.0218	0.0181–0.0261	2.82	2.73–2.91	0.985
Sillaginidae	<i>Sillago japonica</i>	1	38	10.0–18.3	7.5–49.3	0.0085	0.0062–0.0116	2.95	2.84–3.06	0.990
Pholidae	<i>Pholis nebulosa</i>	2	13	4.0–27.5	0.1–106.8	0.0013	0.0010–0.0015	3.42	3.31–3.53	0.998
Gobiidae	<i>Favonigobius gymnauchen</i>	1	26	3.5–7.4	0.4–3.5	0.0061	0.0037–0.0100	3.11	2.81–3.40	0.955
Stromateidae	<i>Pampus echinogaster</i>	—*	43	8.9–21.5	12.9–140.2	0.0175	0.0103–0.0299	3.12	2.91–3.38	0.951
Cynoglossidae	<i>Cynoglossus joyneri</i>	6	67	10.3–28.9	12.5–99.6	0.0053	0.0034–0.0084	2.98	2.82–3.13	0.964
Tetraodontidae	<i>Takifugu niphobles</i>	2	13	8.0–15.9	9.1–83.3	0.0131	0.0087–0.0200	3.19	3.02–3.36	0.992

n = number of individuals, TL = total length, W = weight, a = intercept, 95% CI of a = 95% confidence intervals of a, 95% CI of b = 95% confidence intervals of b; r<sup>2</sup> = correlation coefficient; FB = the number of LWR data in FishBase (Froese and Pauly 2020); Bold prints denotes the newly recorded maximum total length (In reference to FishBase accessed on 26 June 2020); \*published (Wu et al. 2018) but not yet registered in FishBase.

June in 2019; 4 times in total). The specimens were caught with small-bottom trawl nets (length 8 m, width 8 m, mesh wing and body 3 cm, mesh liner 1 cm) at the four study sites. The fishes were identified at the species level based on Kim et al. (2005), classified based on Nelson (2006), and validated according to FishBase (Froese and Pauly 2020). Then, they were anesthetized using 0.1 g L<sup>-1</sup> ethyl 3-aminobenzoate methanesulfonate salt (Sigma-Aldrich, Munich, Germany) before weight determination. Total length and body weight values were measured on site to the nearest 0.1 cm and 0.1 g, respectively. After measurement, fishes were kept in a recovery tank (100 × 100 × 80 cm) for recovery, and subsequently released. LWRs for each species were estimated using the equation:

$$\log W = \log a + b \log L$$

where a is the regression intercept and b is the regression slope for the species (Ricker 1973; Anderson and Gutreuter 1983; Jobling 2002). Prior to regression, obvious outliers were removed by the linear regression analysis of the log-transformed data (Froese 2006; Froese et al. 2011). Scientific names and family assignments were assigned based on FishBase designations. All analyses were performed using Sigma Plot 10.0 software (Systat Software, Inc., San Jose, U.S.A.).

## Results

LWRs for a total of 573 individuals representing 14 fish species were calculated (Table 1). The following species were studied: *Okamejei kenoei* (Müller et Henle, 1841); *Muraenesox cinereus* (Forsskål, 1775); *Thryssa adela*; *Thryssa kammalensis* (Bleeker, 1849); *Tribolodon hakonensis* (Günther, 1877); *Inimicus japonicus* (Cuvier, 1829); *Chelidonichthys spinosus* (McClelland, 1844); *Jaydia lineata* (Temminck et Schlegel, 1842); *Sillago japonica* Temminck et Schlegel, 1843; *Pholis nebulosa* (Temminck et Schlegel, 1845); *Favonigobius gymnauchen*;

*Pampus echinogaster*; *Cynoglossus joyneri* Günther, 1878; *Takifugu niphobles* (Jordan et Snyder, 1901). The number of individuals sampled for a given species ranged from 10 in cases of *Tribolodon hakonensis* to 141 in the case of *Thryssa kammalensis*. All species exhibited high correlation coefficients for LWRs, with r<sup>2</sup> values > 0.950. The values for parameter b ranged from 2.82 to 3.52, and a ranged from 0.0007 to 0.0218. A new maximum total length value of 18.0 cm for *Thryssa kammalensis* is provided herewith as a result of the presently reported study.

## Discussion

Our data provided LWR parameters for 14 fish species from the coastal waters of Gwangyang Bay in South Korea. The b values ranged from 2.82 for *Jaydia lineata* to 3.52 for *Inimicus japonicus*. Our study provided the first LWR records for *Thryssa adela*. The values identified for the LWR parameters may be explained by other factors, including gender, gonadal maturity, abiotic variables (e.g., temperature, hydrodynamics), or food availability (Araújo and Vicentini 2001; Froese 2006). The value of parameter a is indicative of the body shape of fish (Froese 2006); in this study, the fish exhibited a mixture of two morphological forms: *Okamejei kenoei* was eel-like and elongated; *Inimicus japonicus* was elongated and fusiform; and *Takifugu niphobles* was short and deep. Values of parameter a for *Pampus echinogaster* ranged from 0.0103 to 0.0299, which is a newly reported finding in this study. It is anticipated that our LWR results will contribute to fisheries management through future research.

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