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# Length-weight relationships of five fish species from the inland waters of Oman

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**Abstract:** Length weight relationships (LWRs) were estimated for five endemic/native fish species collected from five localities in the inland waters of Oman in 2020 including *Aphaniops kruppi* and *A. stoliczkanus* (Aphaniidae), *Cyprinion muscatense* (Cyprinidae: Barbinae), and *Garra barreimiae* and *G. longipinnis* (Cyprinidae: Labeoninae) using foldable shrimp and crab fishing traps (mesh size of 3*3mm) and scoop nets (mesh size of 3*3mm). The parameter of *b* for all five species was within the expected range of 2.5–3.5. as proposed for different fishes (except for female *A. stoliczkanus*), and there were high and significant correlation coefficients for all species (0.931-0.972). Bailey's 't' test in the five studied species showed that *b* value significantly deviated from 3.

**Keywords:** Endemic fishes, Middle East, Oman, LWR.

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## Introduction

Length-weight relationships (LWRs) of fishes are an important tool in fisheries science (Esmaeili & Ebrahimi 2006; Esmaeili et al. 2014; Hossain & Sultana 2014; Sadeghi & Esmaeili 2018) and can be used to convert length into weight, since during field studies the weight cannot always be determined accurately. Also, in conjunction with several other parameters (e.g. sex ratio, age at first maturity, longevity and fecundity), population dynamics can be investigated. Length and weight are biometric data easily taken and available in most datasets from monitoring studies (Zuchi et al. 2020).

However, no information is available on the length-weight relationships of *Aphaniops kruppi*, *A. stoliczkanus*, *Cyprinion muscatense*, *Garra barreimiae* and *G. longipinnis* from Oman, and therefore in this study, the parameters of LWRs were determined for these species.

## Materials and Methods

The fish specimens were collected from five localities from the inland waters of Oman including Ibra (22°40′N, 58°32′E), Surur (23°22′N, 58°06′E), Wadi Faidh (24°42′N, 56°20′E), Tanuf (23°03′N, 57°28′E) and Nizwa (22°55′N, 57°32′E) using mostly foldable shrimp and crab fishing traps (mesh size of 3*3mm, 3 nets for overnight) and scoop nets (mesh size 1*1mm for *Aphaniops*). The sampling was conducted twice in winter 2020.

The collected specimens were fixed in 70% alcohol for a week at room temperature. Total length (TL), Fork length (FL) (except *Aphaniops*) and Standard length (SL) of the specimens were measured to the nearest 0.1 mm using digital calipers attached to computer. The specimens were weighed to the nearest 0.01 g (total weight, TW) using a digital electronic balance.

**Table 1.** Descriptive statistics and parameters of LWRs for five fish species from Oman.

| Species | Sex | N | TL/SL range (cm) | W range (g) | *a* | 95% CI of *a* | *b* | 95% CI of *b* | $r^2$ |
|---|---|---|---|---|---|---|---|---|---|
| *Aphaniops kruppi* (Freyhof, Weissenbacher & Geiger, 2017) | TL.M | 31 | 3.4-5.3 | 0.4-1.8 | 0.016911 | 0.01122-0.025516 | 2.811 | 2.529-3.093 | 0.935 |
| | SL.M | 31 | 2.7-4.3 | 0.4-1.8 | 0.032584 | 0.022803-0.046559 | 2.800 | 2.510-3.091 | 0.931 |
| | TL.F | 21 | 3.4-5.6 | 0.5-2.3 | 0.014093 | 0.008831-0.022542 | 2.985 | 2.672-3.299 | 0.954 |
| | SL.F | 21 | 2.7-4.5 | 0.5-2.3 | 0.030832 | 0.019588-0.048417 | 2.881 | 2.528-3.234 | 0.939 |
| *Aphaniops stoliczkanus* (Day, 1872) | TL.M | 43 | 3.0-4.9 | 0.4-1.5 | 0.016255 | 0.012677-0.020893 | 2.882 | 2.691-3.073 | 0.958 |
| | SL.M | 43 | 2.5-3.9 | 0.4-1.9 | 0.023714 | 0.01875-0.030061 | 3.084 | 2.869-3.300 | 0.953 |
| | TL.F | 12 | 3.5-5.4 | 0.5-3.3 | 0.003334 | 0.0013-0.008551 | 4.150 | 3.507-4.792 | 0.954 |
| | SL.F | 12 | 2.7-4.4 | 0.5-3.3 | 0.010209 | 0.005662-0.018365 | 3.978 | 3.506-4.450 | 0.972 |
| *Cyprinion muscatense* (Boulenger, 1888) | TL | 42 | 4.3-7.4 | 0.8-3.9 | 0.010691 | 0.007943- 0.014421 | 2.974 | 2.803- 3.145 | 0.969 |
| | FL | 42 | 3.9- 6.5 | 0.8-3.9 | 0.013996 | 0.010471- 0.018664 | 3.041 | 2.862- 3.220 | 0.967 |
| | SL | 42 | 3.4- 5.6 | 0.8-3.9 | 0.021232 | 0.016218- 0.027797 | 3.030 | 2.848- 3.211 | 0.966 |
| *Garra barreimiae* Fowler & Steinitz, 1956 | TL | 50 | 3.0-6.5 | 0.2-2.6 | 0.004875 | 0.003622-0.006561 | 3.441 | 3.216-3.667 | 0.952 |
| | FL | 50 | 2.7-5.9 | 0.2-2.6 | 0.006902 | 0.005236-0.009078 | 3.440 | 3.214-3.665 | 0951 |
| | SL | 50 | 2.3-5.3 | 0.2-2.6 | 0.015171 | 0.01205-0.019055 | 3.269 | 3.049-3.490 | 0.949 |
| *Garra longipinnis* Banister & Clarke, 1977 | TL | 36 | 3.8-7.4 | 0.51-3.9 | 0.008222 | 0.006053-0.011169 | 3.104 | 2.895-3.313 | 0.964 |
| | FL | 36 | 3.5-6.8 | 0.51-3.9 | 0.011092 | 0.008222-0.014962 | 3.098 | 2.880-3.316 | 0.960 |
| | SL | 36 | 2.9-5.7 | 0.5-3.9 | 0.014454 | 0.010666-0.019634 | 3.253 | 3.003-3.503 | 0.954 |

M, male; F, female; N, number of specimens; TL, Total length; W, weight; *a*, intercept; *b*, regression slope; $r^2$, coefficient of determination.

The parameters of the length–weight relationships $W = aL^b$ were expressed by linear regression of the log-transformed weight and length which gives the linear equation (Koutrakis & Tsikliras 2003). LogW = Loga + b LogL where W= total weight in grams, L= length in cm, a = a constant being the initial growth index, and b= growth coefficient. Prior to regression analysis, log–log plots of length and weight values were performed for visual inspection of outliers (Froese 2006). The significance of the regression was tested by ANOVA. The regression coefficients for male and female *Aphaniops* specimens (with external sexual dimorphism) were compared using Students 't' test to study the variations in the *b* values between sexes (Zar 1974). Bailey's t-test was used to find out whether 'b' value significantly deviated from the expected cube value of 3. Covariance analysis was used to compare the significant difference of the b value between two genders of *Aphaniops* species (Zar 1974). For scientific fish name, Fricke et al. (2021) was followed.

## Results

The length-weight parameters are given in Table 1 including the length range and weight ranges, as well as the equation parameters a and b together with their 95% confidence intervals and the coefficient of determination. LWRs were significant for all species ($P<0.001$) with high correlation coefficients with $r^2 \geq 0.931$.

Covariance analysis using Students 't' test revealed the significant difference between *b* values of males and females of *Aphaniops* species (t= -30.059, $P<0.0001$ for *A. kruppi* and t=5.554, $P<0.0001$ for *A. stoliczkanus*). Bailey's 't' test in the five studied species showed that *b* value significantly deviated from 3.

## Discussion

The b value of length-weight relationships based on TL for all five species varies from 2.8 for *A. kruppi* to 4.15 for *A. stoliczkanus* being within the expected range of 2.5-3.5 (Froese 2006) for all species except female *A. stoliczkanus*, which might be due to low number of available specimens (see Froese 2006). Based on the obtained results, in *Aphaniops* species, the b value was higher in females than males indicating that females are heavier than males of the same length which might be due to difference in fatness, gonadal development and less metabolic activity as stated by Hossain & Sultana (2014). It has been already reported that variation in *b* value in fishes might be due to several factors including season, species, habitat, sex, gonad maturity, diet, stomach fullness, health, preservation techniques and locality (Le Cren 1951; Esmaeili 2001; Sadeghi & Esmaeili 2018). Differences in the LWRs could be due to the combination of one or more of the above factors. In conclusion, this study provides basic information on LWRs of five native/endemic fishes including two *Aphaniops*, one *Cyprinion* and two *Garra* species from Oman which will be useful in their fisheries and conservation management.

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# رابطه طول-وزن پنج گونه ماهی از آب‌های داخلی عمان

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**چکیده:** روابط طول-وزن برای پنج گونه ماهی بومی از جمله *Aphaniops kruppi*، *A. stoliczkanus*، *Cyprinion muscatense*، *Garra barreimiae* و *G. longipinnis* از پنج منطقه در آب‌های داخلی عمان در سال ۲۰۲۰ جمع‌آوری شده با استفاده از تله‌های صید میگو و خرچنگ (اندازه چشمه توری ۳*۳ میلی‌متر) و تور ساچوکی (اندازه چشمه توری ۳*۳ میلی‌متر) تخمین زده شد. مقدار پارامتر $b$ برای هر پنج گونه در دامنه مورد انتظار برای ماهیان ۳/۵-۲/۵ (به جز در گونه *A. stoliczkanus*) و مقادیر ضریب همبستگی برای همه گونه‌ها بالا و معنی‌دار بود (۰/۹۷۲-۰/۹۳۱). نتایج آزمون تی بیلی نشان داد که مقادیر $b$ برای هر پنج گونه مورد مطالعه به طور قابل توجهی با ۳ ($b$=۳) اختلاف دارند.

**کلمات‌کلیدی:** ماهیان بومی، خاورمیانه، عمان، رابطه طول-وزن.