



Technical contribution

Length–weight and length–length relationships for cavedano chub *Squalius squalus* (Bonaparte, 1837) in Italy

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Summary

Data of 31496 specimens of cavedano chub *Squalius squalus* were collected in 89 different waterbodies distributed geographically throughout Italy and used to provide length–weight and length–length relationship for this species. The linear relationship between total length (TL) and standard length (SL) was described by the equation $TL\text{ (cm)} = 4.007 + 0.874\text{ SL (cm)}$. The resulting total length–weight equation for cavedano chub in Italy was: $\log_{10} W = -2.121 + 3.083 \log_{10} TL\text{ (cm)}$.

Introduction

Analyses of length–weight relationships can provide important insight into the ecology of a species and the assessment of its populations (Froese, 2006). For example, it allows between-region comparisons of life histories of a certain species (Moutopoulos and Stergiou, 2002), or the evaluation of biomass through length (Tsoumani et al., 2006).

Cavedano chub *Squalius squalus* (Bonaparte, 1837) is a cyprinid endemic in the Italian peninsula and the Balkans (Skadar and Ohrid basins) (Kottelat and Freyhof, 2007), inhabiting the intermediary stretches of the watercourses (Lorenzoni et al., 2006).

Although it is one of the most widespread freshwater fishes in Italy (Pompei et al., 2011), information on this species in Italian waterbodies is limited (Lorenzoni et al., 2011) also because it was assimilated with the congeneric European chub *S. cephalus* (Linnaeus, 1758) (Giannetto et al., 2012). It is only recently that studies based on morphological and molecular analysis confirmed the separation of cavedano chub and European chub into two different species (Kottelat and Freyhof, 2007; Gigliarelli et al., 2012), and no estimates on length–weight relationships for this species are available in FishBase (Froese and Pauly, 2012).

The main aim of this study was to provide length–weight and length–length relationship for cavedano chub *S. squalus* in Italy.

Materials and methods

Length and weight data on cavedano chub were collected by electrofishing in different waterbodies throughout Italy. For all fish caught in the field, total length (TL in cm) was measured to the nearest millimeter and weight (W in g) was determined with a digital balance to an accuracy of 0.1 g. After measurement, all fish were released at the site of capture.

Conversion of lengths measured in terms of standard length (SL) to total length (TL) was done using the linear regression model, developed by using all fish in the dataset for which SL and TL measurements were recorded:

$$TL\text{ (cm)} = 4.007 + 0.874SL\text{ (cm)} \\ (R^2 = 0.998; P < 0.001; n = 1087).$$

Weights and lengths were log transformed and the LWR for the total sample was determined by the equation $\log_{10} W = \log_{10} a + b \log_{10} TL\text{ (cm)}$, where a is the intercept on the Y-axis of the regression curve and b is the regression coefficient. The difference between the value of b of the LWR and the value of isometric growth ($b = 3$) were then compared by t -test. Finally, a LWR was determined for each population separately and a linear plot between the slopes (b) against all intercepts (a) of all populations was calculated.

Results and discussion

During the research 31496 specimens were analyzed from 89 waterbodies throughout Italy. Captured fish ranged in size from 2 to 49.4 cm (mean \pm SE = 147.973 cm \pm 80.042) and in weight from 0.1 to 1855 g (mean \pm SE = 66.9 g \pm 118.005). The LWR based on the total dataset was:

$$\log_{10} W = -2.121 + 3.083 \log_{10} TL\text{ (cm)} \\ (R^2 = 0.986; P < 0.001; TL\text{ range } 2\text{--}49.4\text{ cm}; n = 31496).$$

The value of b of the LWR (3.083) was higher than 3, indicating an isometric growth. This emphasized a positive

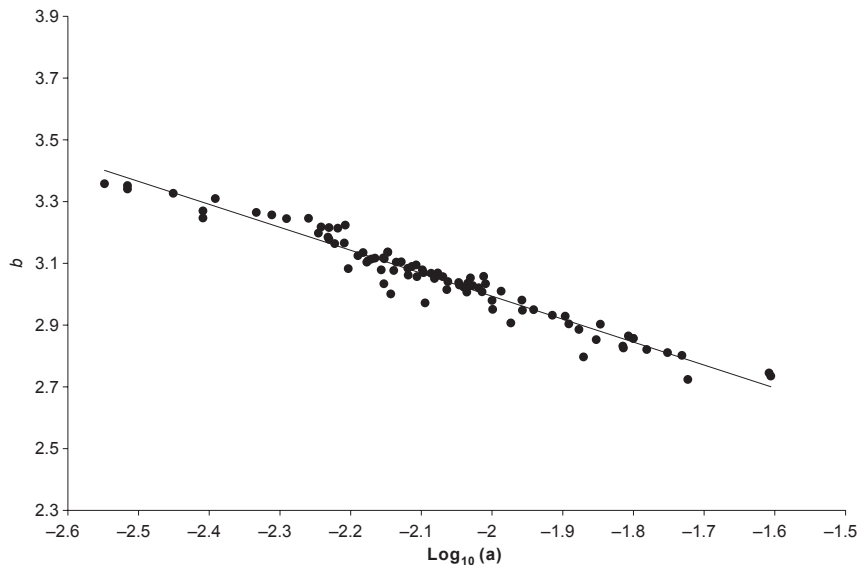


Fig. 1. Linear plot between slopes against all intercepts of all populations of cavedano chub, *Squalius squalus*, in Italy

allometric growth for cavedano chub; this value in a t -test was highly statistically different by 3 ($t = 1471.460$ $P < 0.001$).

The resulting linear equation between b against $\log_{10}(a)$ of all populations (Fig. 1) was:

$$b = -1.270 \log_{10}(a) + 1.797 (R^2 = 0.946; P < 0.001; n = 89)$$

and no populations were identified as outliers. The value of b for all populations ranged from 2.724 to 3.358, in accordance with Carlander (1969) and the assumption that b normally falls between 2.5 and 3.5. This study provides the length–weight relationship for cavedano chub, a native species widespread in Italy, by analyzing a dataset collected throughout its area of distribution. According to Froese (2006), only when weight–length estimates reasonably cover geographic, seasonal, and inter-annual variations, is it possible to discuss isometric versus allometric growth of the species as a whole, based on mean b . This supports the present study in which, by the analyses of b values of the LWRs obtained, a positive allometric growth for the cavedano chub resulted.

The results represent the first reference on length parameters for this species and add new information that could give useful insight for management and conservation of this native and endemic species.

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