

SEXUAL DIMORPHISM IN *BOMBINA V. VARIEGATA*: A BIOMETRIC MULTIVARIATE APPROACH

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Sexual size dimorphism (SSD) in Yellow-bellied toad, *Bombina v. variegata*, (Linnaeus, 1758) has been not much investigated. This morphometrical study is based on a biometric multivariate approach.

Two sets of specimens were measured and analysed: one was composed by 68 (31F; 37M) live adults, captured in 4 localities situated in Lombard Prealps, while the second set was formed by 75 (28F; 47M) adults yellow-bellied toads, collected in some regions of northern Italy (Lombardy, Trentino – Alto Adige, Veneto) and alcohol-preserved in the Natural History Museums of Milan and Turin. The set of parameters recorded for each sample was body length (SVL), head length (HL), head width (HW), internarial distance (IND), interorbital distance (IOD), orbit-nostril distance (OND), eye diameter (ED), femur length (FEL), tibia length (TIL), foot length (FOL). The biometrical measures were taken using a 0.1 mm precision callipers. The statistical analysis were performed on log-transformed data, using the software SPSS ver. 12.0 (SPSS, 2004).

A preliminary discriminant analysis was performed to assess the homogeneity of the whole sample. The mean measures of our preserved yellow-bellied toads resulted significantly lower than those of live specimens (males: Wilks' lambda = 0.428; $\chi^2 = 67.877$; d.f. 4; $P < 0.001$; females: Wilks' lambda = 0.412; $\chi^2 = 49.176$; d.f. 3; $P < 0.001$). Therefore we decided to perform separate analysis on them.

Museum sample: A discriminant analysis was applied to the set of 10 variables. The stepwise method selected two variables: FOL and SVL; with an F-to-remove greater than 5.2. In the jackknifed classification matrix, 74.7% of the animals were classified correctly. The differences among the sexes were highly significant (Wilk's lambda = 0.804; $\chi^2 = 15.685$; d.f. 2; $P < 0.001$), with a canonical correlation value of 0.442. From the Canonical score of group means the group of females appears correlated to longer measures of body than males, while the males themselves are correlated to longer measures of the foot.

Live sample: The discriminant analysis was performed. The stepwise method run for four steps, selecting the following variables: SVL, TIL, IOD and HW. However, in this analysis, the percentage of cases correctly classified in the jackknifed matrix increased to 75.0%. Differences between males and females were, clearly, still highly significant (Wilk's lambda = 0.634; $\chi^2 = 29.203$; d.f. 4; $p < 0.001$) with a canonical correlation value of 0.605. The Canonical score of group means for females was still correlated to longer measures of the body, and for males showed an association to wider heads (higher measures of HW and IOD) and longer legs (TIL).

Morphological studies on *B. variegata* have mainly regarded secondary sexual characters (SSC). While minor evidences of SSD had been found (Caldonazzi et al., 2000, Atti I Congresso Nazionale S.H.I., Torino 1996, Mus. Reg. Sci. Nat. Torino: 373-375; Radojicic et al., 2002, Folia Zool. 51(2): 129-140). Through discriminant analysis, significant differences between sexes have been found in both samples; ratio between the body length and the foot length seems an important variable in sexual dimorphism of *B. Variegata*. The multivariate statistics, considering more variables at the same time, permit the best separation between males and females.

Key words: *Bombina variegata*, sexual size dimorphism, biometric multivariate analysis.