

Abstract

Puntius dorsalis and *Puntius vittatus* (Teleostei: Cyprinidae) are widely distributed indigenous species in Sri Lanka and adjacent countries. As no previous information exists on their intraspecific geographic variation and whether the Sri Lankan species are similar or different from Indian species, the present study aimed to describe the morphometric character variations of Sri Lankan populations, and to carry out a comparative analysis with some Indian specimens.

Specimens (n= 5-30) of *P. dorsalis* were collected from eight selected streams or tanks with hydrological connection to different major river systems in Sri Lanka (Kalu River, Nilwala River, Urubokka Oya, Menik River, Kirindi Oya, Mahaweli River, Malwathu Oya and Kelani River). Specimens (n=5) collected from a single location in Tamil Nadu (museum collection) were compared with Sri Lankan populations. Twenty two morphometric characters of individual *P. dorsalis* fish using pre-decided landmark points were obtained. Specimens (5-30) of *P. vittatus* from selected streams connected to different river systems were used to collect data on 15 morphometrics from digital images of individual fish (two locations of Gin river and one each from Kalu, Nilwala, Mee Oya, Kala Oya and Kelani River). Museum specimens from three locations in India (WHT collection: Kerala, Veliyanadu and Nedu Mudi- Alleppey) were included for *P. vittatus*. All the morphometric characters were standardized to remove size effect prior to data analysis, and differences among the populations were tested by univariate ANOVA and multivariate methods.

Caudal-Peduncle-Length (CPL) and Pre-Orbital-Length (PrOL) of *P. dorsalis* were significantly different ($p < 0.05$, n=30 from Nilwala River) between males and females

thus further data analysis for population comparison was done excluding CPL and PrOL. Univariate ANOVA revealed significant heterogeneity in seven shape characters among eleven samples, but no population-specific characters that can be used to identify individual populations of *P. dorsalis* were found. In the discriminant function analysis (DFA), Eye Diameter had the greatest power to discriminate *P. dorsalis* populations. In principal component analysis (PCA) plot, separation of two groups of populations was possible, where Canonical variate 1 (CV1) and CV2 explained 61.0% of the total variation in data. In the cluster analysis, Indian sample clustered with Nilwala River, Malwathu Oya, Menik River, Mahaweli River-Minneriya, Kalu River, Kirindi Oya and Pattiyapola populations (clade A) whereas, Mahaweli River-Polonnaruwa and Hasalaka populations made another clade in the same branch. It seems that Kelani River population was different from all others, however, no external morphometric differentiation was found in the ANOVA. Therefore, the findings suggest that Sri Lankan specimens represent the same species of *P. dorsalis* that was described from India, while considerable divergence may have occurred in the Kelani River population.

In *P. vittatus* analysis, only Head-pre-dorsal diagonal (HPdD) was significantly different between males and females (t-test, $p=0.04$, $n=30$ sample from Nilwala River), thus further data analysis for population comparison was carried out after excluding it. Univariate ANOVA showed no significant difference in any variables ($p<0.05$) among three studied Indian populations. Considering only Sri Lankan populations, except Pre-orbital L (PrOL), Dorsal fin base (FBD), Anal fin base (FBA), Maximum body depth (MBD) and pre-anal L (PAL), all the others showed significant heterogeneity among seven Sri Lankan populations, where Post orbital length (POL) had the greatest power

to discriminate them. In PCA, separation of two groups of populations was possible, where CV1 explained 72.5% of the total variation in data. In cluster analysis, Nilwala River, Mee Oya, Kala Oya, and Kelani River populations made a separate clade whereas Kalu and Gin River populations made another indicating considerable divergence between the two. Three Indian locations cluster with Nilwala River, Kelani River, Mee Oya and Kala Oya whereas Kalu River and two locations of Gin River made another diverging clade. The results concluded that Indian populations represent the characters of the first Sri Lankan clade, but the second Sri Lankan Clade ('Kalu+Gin' Clade) seems to be specific to Sri Lanka and can be considered as a diverging group. Hence, the measures should be taken to conserve any genetic diversity present among them. The findings are expected to be important in issues related to biodiversity and taxonomic assessment of Sri Lankan ichthyofauna.

Keywords: morphometric characters, phenotypic variation, cluster analysis, shape variation, *Puntius dorsalis*, *Puntius vittatus*, diverging group