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Population variation of the red stripe weevils, *Rhynchophorus vulneratus* (Coleoptera: Curculionidae) isolated by geographical limit

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Abstract. Morphological variation of the red stripe weevils, *Rhynchophorus vulneratus* (Coleoptera: Curculionidae) was investigated using three different populations from Kota Samarahan (Sarawak), Mukah (Sarawak), and central of Peninsular Malaysia. A total of 145 individuals were morphologically examined in which 23 morphological characters of head, body and legs were linearly measured. All data were analysed using Principal Component Analysis in Minitab Version 17.1. The first three principal components explained 82.5% of variance with eigenvalues greater than 1.0 and the principal component plot of PC1 against PC2 showed the clustering of the three populations, in which Mukah population forms its own cluster whereas Kota Samarahan and Peninsular Malaysia populations show overlapping clusters. The morphometric findings indicated that the pronotum and elytra were the most diagnostic characters for discriminating the three examined populations. This suggests that the populations of *R. vulneratus* might have undergone adaptive changes on its morphological characters possibly due to different environmental factors including the availability of food resources, habitat types,and human activities and this requires further testing.

Key words. variation, morphometrics, *Rhynchophorus vulneratus*, Principal Component Analysis (PCA)

INTRODUCTION

Variations can be observed through differences among individuals within a population and also between members of different species that involved alteration and displacement of some morphological key characters. According to Ferreira & McKinlay (1999), variation is a necessity in biology and is the most important feature of evolutionary theory. Divergences occurring within a population is considered as a vital point for speciation (Balon, 1993; Margurran, 1998), crucial for understanding the basis of biodiversity processes (Alibert et al., 2001) as well as microevolution (Garnier et al., 2005). In some studies of the ground beetles (Carabidae), morphology seems to be more informative than genetics, where significant morphological divergences may be detected despite little differences in molecular markers (Palestrini et al., 2012).

Variations described from morphological characters are associated with many factors including geographical areas, resource availability, nutrition quality, competition and temperature (Angilletta & Dunham, 2003; Sota et al., 2007; Chown & Gaston, 2010; Laparie et al., 2010). These factors however may vary across different habitats due to different surroundings and environmental conditions for particular insects (Laparie et al., 2010). As a consequence, polymorphism and phenotypic plasticity are evident in insects, in response to environmental change and surroundings. These alterations and variations subsequently increase survivability, fecundity, fitness, population density and species range (West-Eberhard, 2003; DeWitt & Scheiner, 2004; Whitman & Ananthakrishnan, 2009).

Many population studies had been conducted in insects to show morphological variations based on different geographical areas, habitat types and food availability (see Laparie et al., 2010; El-Mergawy et al. 2011a, 2011b; Tambe et al., 2013; Rugman-Jones et al., 2013; Hassan et al., 2017). Studying a particular group within a small geographical area may also indicate the ability of this population to utilise different resources at the same time (Selander, 1966; Daly & Wilson, 1983; Kalaisekar et al., 2012). The outcomes are beneficial to understand the adaptation shown by this local population, which promotes diversity in insect morphology and thus possibly lead to speciation (Sota et al., 2007). As a result, recognition of diagnostic morphological character(s) at the population level is essential to give better insights into the study population.

In this study, the morphological variation among different populations of the red stripe weevil, *Rhynchophorus vulneratus* is investigated. The adults are large-sized insects ranging from about 30 to 45 mm in body length. The overall body coloration is black with a visible red stripe in the middle of its pronotum. The sexual dimorphism in *R. vulneratus* is

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