

Morphometric Analysis of Two Populations of *Eurygaster maura* (Het.: Scutelleridae) in Iran

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Abstract

Morphometric differentiations may explain biogeographic distinctions among populations of a given species. The possibility of morphometric distinctions between two populations of *Eurygaster maura* L. collected from the northeast (Golestan province) and the northwest (Azarbayegan province) of Iran was examined using principal component analysis over 25 body measurements (eight absolute and 17 proportional, separately). The northeast individuals were relatively larger and darker in colour than those of the northwest; total body lengths of the former were 13.56 ± 0.49 and 13.25 ± 0.38 mm (female and male, respectively), and the respective values for the latter were 12.74 ± 0.39 and 12.63 ± 0.49 mm. Generally, proportional indices including genital width had positively the highest contributions to population discrimination. Different habitats and climatic conditions may explain, in part, these morphological variations between the studied populations.

Key words: *Eurygaster maura*, Heteroptera, population differentiation, biogeography, morphometrics, Iran.

Introduction

In the genus *Eurygaster* Laporte, similar to the rest of the Heteroptera, the main diagnostic character is the male genitalia (1, 2, 9, 14, 15, 16). Within the species, morphological differences among populations may explain a bio-ecological distinction. In the well-known sunn pest, *Eurygaster integriceps* Puton, morphometric differences among populations have been investigated by Bryantseva (3), who demonstrated three different population-groups from five studied populations. Sarafrazi (13) also showed seven distinct clusters of sunn pest populations collected from 16 different localities in Iran, based on morphometric indices.

Distribution of *E. maura* in Iran has been reported by Safavi (12), Brown & Eralp (2), and Mohaghegh (8). There are two main distribution areas in the country: Azarbayegan

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(northwest) and Golestan provinces (northeast);p each of them represents its specific climate. To the best of my knowledge, there are, however, no publications dealing with the population differentiation of *E. maura*, at least from statistical point of view. Specimens of *E. maura* collected from these regions seemed differently in size and colour. The objectives of this study are first to examine whether a distinct morphological difference exists between the two populations, and secondly, if so, to identify characters contributing this differentiation using statistical approaches.

Materials and methods

Populations of *E. maura* collected from the northeast (Gorgan, Golestan province, 160 m.a.s.l.) and the northwest (Tabriz, East Azarbayejan province, 1362 m.a.s.l.) were subjected to a morphometric study. For each population, 50 adult specimens (25 ♀ and 25 ♂) were examined and continuous variables measured using an ocular micrometer (± 0.1 mm). Measurements used for statistical analyses are illustrated in fig.1. Up to eight absolute and to 17 proportional measurements were analysed using *t*-test and principal component analysis (PCA) from the SPSS software (6).

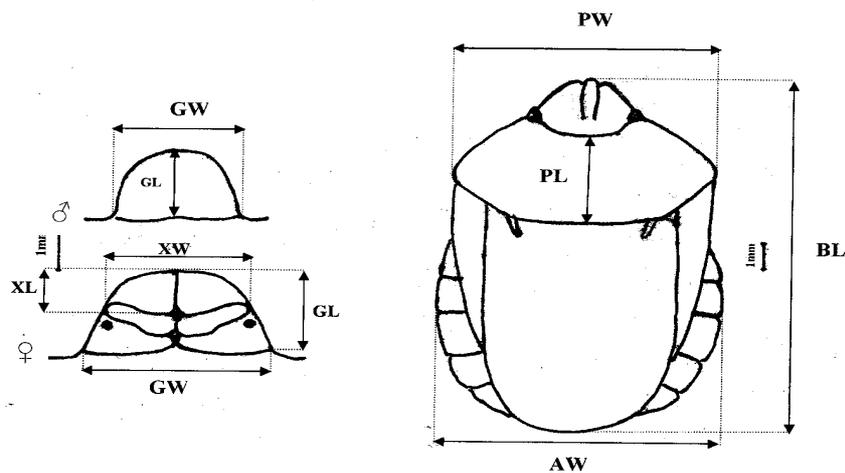


Figure 1. Measurements used for morphometric study of *E. maura*. (AW, abdominal width; BL, body length; PL, length of pronotum; PW, width of pronotum; GL, length of genital segment; GW, width of genital segment; XL, length of gonocoxite VIII; XW, width of gonocoxite VIII).

Results and discussion

In general, bugs from the northeast were larger and darker in colour than those from the northwest of the country. Means of body measurements for females and males are shown in table 1. All absolute measurements were significantly different between two populations (t -test; $P < 0.001$), except for the width of the female genital segment which was borderly significant ($P = 0.053$). The darker colour of the northeast individuals can be a considerable remark to distinguish the populations. McQuillan and Ek (7) in their study on *Oreixenica ptunarra* Couchman (Lep.: Nymphalidae) stated that butterflies from warmer, less cloudy eastern Tasmania, were larger and less dark in colour than those from the west. The northeast population of *E. maura* occurs in a relatively-humid subtropical climate with mild winters, whereas the northwest population inhabits a relatively-humid temperate climate with cold winters (11). Annual average of mean daily temperature and annual total of sunshine were 17.9 °C and 1973.7 h for Gorgan, and 11.8 °C and 2757.3 h for Tabriz, respectively (data from the Meteorological Organization of Iran). Therefore, larger and darker individuals may reflect the warmer and cloudy climate of the northeast, compared with smaller and brighter bugs from the northwest representing temperate and less cloudy weather.

Table 1. Mean \pm SD body measurements of two *E. maura* populations from northeast (NE) and northwest of Iran (NW).

Measurement	Female		Male	
	NE ($n = 25$)	NW ($n = 25$)	NE ($n = 25$)	NW ($n = 25$)
BL ¹	13.56 \pm 0.49 a ²	12.74 \pm 0.39 b	13.25 \pm 0.38 a	12.63 \pm 0.49 b
AW	8.78 \pm 0.25 a	8.07 \pm 0.18 b	8.72 \pm 0.29 a	8.16 \pm 0.27 b
PW	8.25 \pm 0.24 a	7.67 \pm 0.23 b	8.13 \pm 0.28 a	7.65 \pm 0.27 b
PL	3.88 \pm 0.14 a	3.59 \pm 0.12 b	3.80 \pm 0.12 a	3.58 \pm 0.14 b
GW	2.85 \pm 0.11 a	2.79 \pm 0.11 a	2.04 \pm 0.08 a	1.92 \pm 0.06 b
GL	1.50 \pm 0.09 a	1.37 \pm 0.06 b	1.14 \pm 0.06 a	1.04 \pm 0.05 b
XW	1.82 \pm 0.08 a	1.77 \pm 0.09 b		
XL	0.73 \pm 0.06 a	0.63 \pm 0.07 b		

¹ See fig. 1 for abbreviations.

² For each sex, means followed by different letters in a row are significantly different (t -test, $P < 0.001$).

Results of PC Analyses are summarized in table 2, showing the coefficients of correlation of each index with each component. They, however, indicated the relationship between the original variables. In general, proportional indices including genital width (GW) had positively the highest contributions to PC-Is of both sexes. First two components together covered 58.13 and 62.39% of the overall variance in females and males, respectively.

After studying five different populations of *E. integriceps* based on 19 different morphometric characters, Bryantseva (3) showed that the Tajikistan population was the most autonomous having less body size and more divergence from four other populations. Likewise, Sarafrazi (13) illustrated seven clusters of geographic populations of *E. integriceps*, examining specimens collected from 16 localities in Iran. The author stated that the thoracic variables were the best discriminators.

Table 2. Eigenvalues, percent of variances and weights for first two principal components extracted based on proportional measurements for female and male populations of *E. maura* (- = inapplicable).

Variable	Principal components			
	Female		Male	
	I	II	I	II
Eigenvalue	7.2	2.7	3.9	2.4
% of variance	42.3	15.8	38.7	23.7
PW/BL ¹	0.248	- 0.772	- 0.147	0.947
AW/BL	0.281	- 0.732	- 0.247	0.657
PL/PW	- 0.040	0.372	0.081	- 0.794
PL/BL	0.182	- 0.344	- 0.066	0.070
PW/AW	- 0.079	0.025	0.108	0.397
GL/GW	0.786	0.303	0.569	0.155
BL/GW	0.818	0.427	0.963	- 0.167
AW/GW	0.936	- 0.009	0.907	0.199
PW/GW	0.938	0.017	0.913	0.372
PL/GW	0.812	0.191	0.926	- 0.129
XL/XW	0.777	0.068	-	-
XW/PW	- 0.783	0.453	-	-
XW/AW	- 0.790	0.450	-	-
XW/BL	- 0.709	0.056	-	-
XL/BL	0.553	0.101	-	-
XW/GW	0.211	0.702	-	-
XL/GW	0.787	0.259	-	-

¹ See fig. 1 for abbreviations.

In above-mentioned studies on *E. integriceps*, genital variables were not participated in population differentiation. Nevertheless, this study may suggest the genital measurements of *E. maura*, and probably other congeneric species, as reliable parameters in population discrimination. Contribution of genital characters towards population separation has been reported in other insects (e.g., 5).

Both raw and proportional data analyses via PCA demonstrated a tendency towards segregation between two female populations (fig. 2). Nevertheless, such a separation could not be established for males (fig. 3). Since genetic variation of both sexes in a population is

expected to reveal similar patterns, molecular analysis may clarify these morphological findings. However, *t*-test analyses of absolute measurements clearly differentiated the two populations in both sexes (table 1). Moreover, the darker colour of Gorgan population, compared with the relatively brighter colour of Tabriz population, should be also considered as a distinctive character.

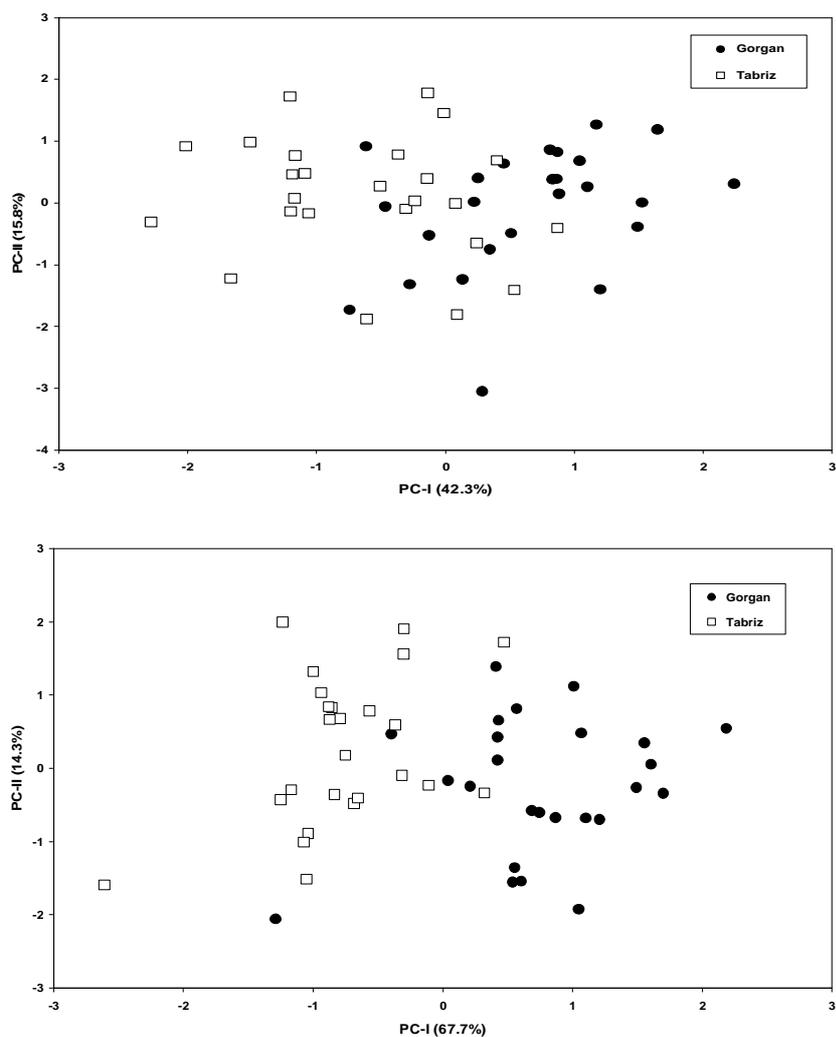


Figure 2. Scatter plots of two first principal components from the analyses of proportional (up) and raw (down) data for two female populations of *E. maura*.

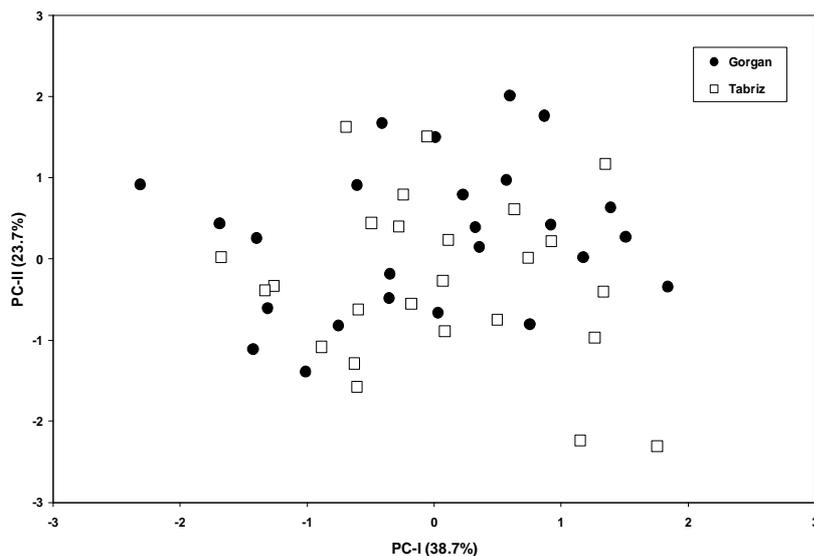


Figure 3. Scatter plots of two first principal components from the analysis of proportional data for two male populations of *E. maura*.

Different habitats and climatic conditions may partly explain these morphometric variations. Likewise, a high correlation was detected between morphological characters and ecological factors in *O. ptunarra* populations (7). Also, Caro-Riaó *et al.* (4) found that populations of *Rhodnius pallescens* Barber (Het.: Reduviidae) originating from different climates showed a light tendency towards separation.

The findings may also suggest more investigation on geographic origin of the two populations. Radjabi (10) stated that the northwest population of *E. maura* should be originated beyond the northwest borders of Iran, and may originally differ from that of the northeast. Likewise, Bryantseva (3) after studying five different populations of *E. integriceps* from the former Soviet Union considered that the Tajikistan population, with a distinct divergence index, would belong to the Asian reservation-centers of the bug, whereas the four other populations, with relatively closed divergence indices, could be addressed to the European reservation-centers of the species.

Briefly, this study indicated morphological differences between the two populations, based on their body size and complexion. Female genital measurements illustrated better contribution in the populations' distinction. However, further studies are required to elucidate

the geographic origin complexity of the populations; geometric morphometric and molecular analysis may be helpful in this relation.

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بررسی مرفومتريک دو جمعیت سن *Eurygaster maura* (Het.: Scutelleridae) در ایران

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تفاوت‌های مرفومتريک در بین جمعیت‌هایی از یک گونه ممکن است بیانگر اختلافات بین زیست-بوم آن جمعیت‌ها باشد. دو جمعیت از گونه سن *Eurygaster maura* L. مربوط به شمال‌شرق (استان گلستان) و شمال‌غرب (استان آذربایجان شرقی) کشور، به‌لحاظ امکان وجود تفاوت‌های مرفومتريک به‌کمک روش تجزیه به مؤلفه‌های اصلی (PCA) و روی ۲۵ شاخص (۸ اندازه‌گیری مطلق از قسمت‌های مختلف بدن و ۱۷ شاخص نسبی) مورد بررسی قرار گرفت. افراد جمعیت شمال‌شرق از نظر اندازه بزرگتر و از نظر رنگ تیره‌تر بودند؛ طول بدن برای جمعیت شمال‌شرق به ترتیب (انحراف معیار ± میانگین) $0.49 \pm 13/56$ م.م. در ماده‌ها و $0.38 \pm 13/25$ م.م. در نرها و در جمعیت شمال‌غرب $0.39 \pm 12/74$ م.م. در ماده‌ها و $0.49 \pm 12/63$ م.م. در نرها به‌دست آمد. بیشترین مشارکت در جداسازی افراد جمعیت‌های دوگانه‌ی فوق مربوط به شاخص‌هایی است که عرض صفحه‌ی تناسلی (GW) در آن‌ها لحاظ شده بود. شرایط متفاوت اقلیمی این مناطق می‌تواند بیانگر تفاوت‌های مرفولژیکی بین دو جمعیت باشد.

واژگان کلیدی: *Eurygaster maura*, Heteroptera، تفاوت جمعیت‌ها، جغرافیای زیستی، مرفومتريک، ایران

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