

Morphological clines in reduced areas. The case of *Henrotius jordai* (Reitter), cave-dwelling beetle from Majorca Island

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SUMMARY

The present paper shows a statistically significant correlation between the geographical latitude and the morphological variation of the pronotum of *Henrotius jordai* (Reitter) (Col. Caraboidea), cave-dwelling beetle from Majorca island, after studying the linear and curvilinear regression between these two variables.

The existence of specimens situated at different heights of the regression lines leads to the conclusion that morphological variation is clinal.

The phenomenon of "semi-isolation" to which the studied populations are subjected, because of their cavernicolous character, allows to explain the existence of a cline in such a restricted area as that occupied by this beetle (ca. 500 Km²).

It is worth pointing out the interest in the study of these reduced clines of cavernicolous populations, because they can provide a restricted "observation field" -easier to deal with- to investigate these genetic phenomena and their evolutive implications.

In a preceding note (Bellés, 1976), I dealt with some aspects related to the systematics of *Henrotius jordai* (Reitter) (Col. Caraboidea), a cave-dwelling beetle spread over an area of ca. 500 Km², along Serra Nord, in the north-western portion of the Majorca island. In that paper I mentioned that in the caves of Ala-

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ro, further to the south, there is a predominance of specimens with the anterior margin of pronotum wider than the posterior one. In the area of Pollença, on the northern side, the ratio becomes even inverse.

This character was one of those used by Jeannel (1950) to differentiate two species. Later, with the discovery of intermediate locations, both species became united through transition stages (Bellés, l.c.).

These facts have prompted me to study the variation of this character, whether it is gradual and if it can be correlated with geographical factors.

The present work was carried out on a small number of specimens because, *Henrotius* are normally rare. The results obtained are thus limited as a consequence of the few data available.

STUDY OF THE CORRELATION BETWEEN THE GEOGRAPHICAL LATITUDE AND THE SHAPE OF THE PRONOTUM

Material and methods

As all the caves studied lie between 39 and 40° of North latitude, only the values of minutes and seconds, given in seconds, are reported ("reduced latitude" on Table 1). Most coordinates were obtained from the "Inventario espeleológico de Mallorca" (Encinas et al., 1974).

The change of anterior and posterior margin of the pronotum, was measured by the *IP* index, defined as the ratio of the length of those margins (Fig. 1):

$$IP = \frac{AP}{PP}$$

AP: Anterior margin length of pronotum
PP: Posterior margin length of pronotum

Most *IP* values on Table 1 are deduced from the corresponding *AP* and *PP* values previously reported (Bellés, l.c.). As there is no sexual dimorphism in the pronotum shape, the data include both males and females.

On the other hand, because of the variable number of specimens for each location, the corresponding *IP* values were averaged.

Definitive calculations were carried out with a Hewlett Packard 9830-A computer.

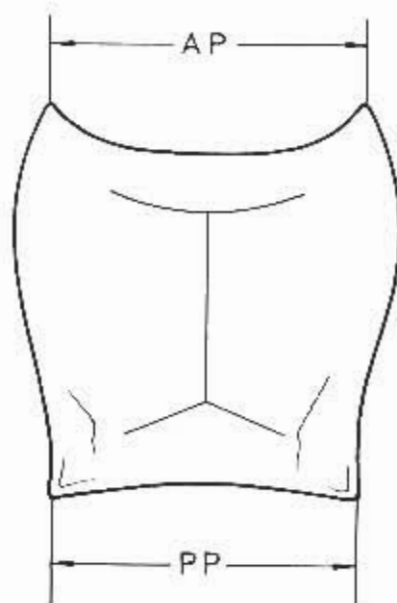


Figure 1 - Pronotum of *Henrotius jordai* (Reitter), with indication of the measured margins.

Table 1. Pronotum index (IP) and geographical data of the studied samples of *Henrotius jordai*.

N	CAVE	REDUCED LATITUDE (X)	SAMPLE SIZE	IP AVERAGE (Y)
1	Av. des Picarol Gros	2636*	1 ♀	1.100
2	Es Bufador de Solleiric	2699	5♂, 3♀	1.084
3	Cv. des Torrent de Cuber	2780**	1 ♀	1.096
4	Cv. de Campanet	2840	1 ♂	1.031
5	Cv. de Can Sion	2994	6♂, 3♀	1.030
6	Cv. de Sa campana	3044	1♂, 1♀	1.059
7	Cv. Argentera	3172	1 ♀	1.000
8	Cv. de Lienaire	3188	1 ♀	1.000
9	Av. de la Malé d'Ariant	3213	1 ♀	0.972
10	Cv. de Cornavaques	3285	6♂, 4♀	1.038
11	Cv. de Cal Pessó	3293	1 ♂	0.970
12	Cv. de les Rodes	3311	1♂, 1♀	1.000

* A. Ginés, personal communication

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Results and discussion

The coefficients of linear and curvilinear regression (parabola of second degree) were calculated, and the results are shown on Table 2 (values adjusted to four decimals by the computer itself).

The coefficient of determination (R^2) was in the both cases relatively high (it was higher in the case of curvilinear regression). In the case of linear regression, the correlation coefficient (r) was statistically significant at 1% level.

Figure 2 shows the graphs of the linear regression (dotted line) and curvilinear regression (continuous line), obtained directly from the plotter of the computer.

The present paper demonstrates that the correlation between geographical latitude and pronotum variation is significant (1%). The pronotum index increases gradually from the northern to the southern specimens. The existence of points in different heights of the regression lines, leads to the conclusion that the morphological variation is clinal, in the sense of Huxley and Haldane (*in* Margalef, 1974).

It might seem surprising to find a cline in such a reduced area as the present one, but it must be borne in mind that this species is cavernicolous, with all the biases this implies. It must be admitted that in a population of a given cave, possibilities of migration and genetic interchange with that of another cave—relatively close, at best—are obviously much more limited than in typical epigeal populations.

According to Mayr (1942), an important clue to understand the significance of these clines is that usually they are not found in isolated populations. Thus, the present results can be an indirect evidence that the hypogean populations studied are not complete isolated, in other words, not "strictly" cavernicolous.

In summary, this morphological cline could be explained by two important factors, *i.e.* reduced gene flow and weak environmental differentiation. These factors are those claimed by Endler (1977) as inducers of steep clines in reduced areas.

Finally, it is worth pointing out the interest in the study of these reduced clines of cavernicolous populations, because they provide a restricted "observation field"—easier to deal with—to investigate these genetic phenomena in depth.

Table 2 - Coefficients of linear and curvilinear regression between geographical latitude and the pronotum index among the studied samples of *Henrotius jordai*.

		Curvilinear Regression ($y=a+bx+cx^2$)	Linear Regression ($y=a+bx$)
Coefficients	a	2.5226	1.5098
	b	-0.0008	-0.0002
	c	0.0000	—
Coefficient of determination	R ²	0.7381	0.7278
Regression coefficient	r	—	0.8531

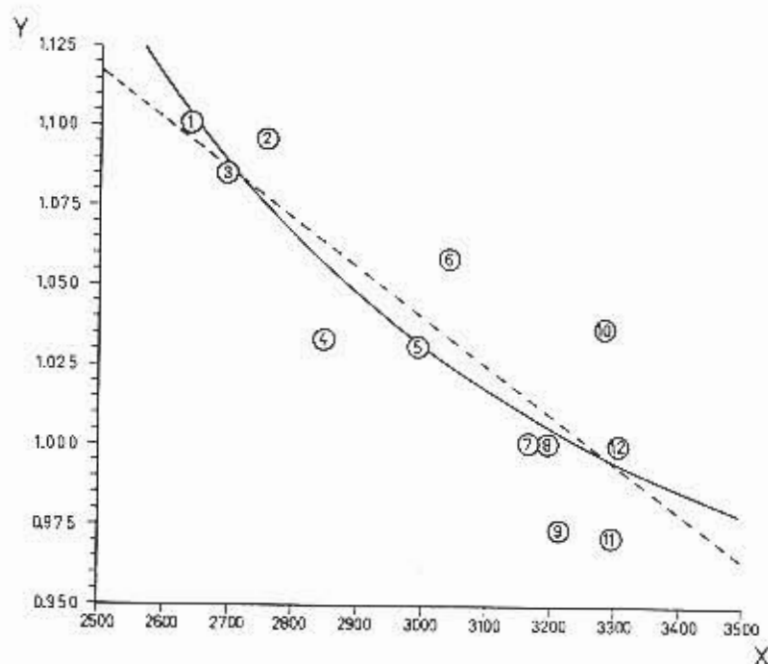


Figure 2 - Relationship between geographical latitude (X) and IP index of the pronotum of *Henrotius jordai* (Y), for linear (dotted line) and curvilinear (continuous line) regressions. Numbering of points refer to the corresponding population cave as depicted in Table 1.

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RESUMEN

En la presente nota se demuestra la correlación significativa entre la latitud geográfica y la variación morfológica del pronoto de *Henrotius jordan* (Reitter) (Col. Caraboidea), coleóptero cavernícola de la isla de Mallorca, estudiando la regresión curvilínea y lineal entre estas dos variables.

La existencia de ejemplares situados a diversas alturas de las líneas de regresión, hace pensar en una variación morfológica clinal.

El fenómeno de "semitaisamiento" a que se ven sometidas las poblaciones estudiadas por corresponder a una especie cavernícola, permite explicar el establecimiento de una clina en un área tan reducida como la que ocupa este coleóptero (aprox. 500 Km²).

Es interesante resaltar el interés del estudio de estas clinas reducidas que corresponden a poblaciones cavernícolas ya que pueden proporcionar un "campo de observación" restringido -y por ello más fácil de abordar- para la investigación de estos fenómenos genéticos y sus implicaciones evolutivas.

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