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RACES OF *HELICONIUS ERATO* (NYMPHALIDAE: HELICONIINAE) FOUND ON DIFFERENT SIDES OF THE ANDES SHOW WING SIZE DIFFERENCES

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Heliconius erato (Linnaeus, 1758) is a brightly colored, variably patterned butterfly that is distributed from Mexico to Central and South America. It is adapted to altitudes that range from sea level to 1,600 m. and is frequently found flying in open pastures in disturbed forest and secondary growth (DeVries 1987). Its geographical races have different coloration patterns that range from orange and black, to red, yellow, and black, and to iridescent blue and pink (this pattern of coloration is shared with the co-mimic *H. melpomene*, (Sheppard et al. 1985). There are approximately 30 parapatric races that mate randomly in narrow hybridization zones (Emsley 1964; Mallet 1986). Brower (1994) grouped *H. erato* races into 2 main clades. One clade includes races that are located on the eastern side of the Andes, while the second clade is found on the western side of the Andes. Here I report the presence of statistically significant differences in wing size between individuals representing the 2 clades. I show that individuals of *H. erato* from the eastern side of the Andes are larger than the races from the western side. Ecological studies were performed to understand whether these size differences are due to environmental, genetic, or maternal factors (Hay-Roe 1996, 2004)

The Lepidoptera collection of the McGuire Center for Lepidoptera and Biodiversity, FLMNH, was used to measure the size (forewing length) of different races of *H. erato*. The number (n) of individuals measured is shown in Table 1. Wing length was measured from the base of the wing to the apex. A Vernier caliper (Spi 2000) graduated to 0.1 mm was used to make the measurements.

Four geographical races, *H. e. colombina, H. e. hydara*, *H. e. cyrbia,* and *H. e. petiverana,* represent the *H. erato* population from the western side of the Andes. These races were compared with *H. e. phyllis*, *H. e. favorinus,* and *H. e. magnifica* found on the eastern side of the Andes. Systat program V 10 and ANOVA were used to analyze the results and a Tukey test was used for multiple comparisons when ANOVA gave significant F values.

Measurements taken from the museum specimens support the hypothesis that geographical races from the eastern side of the Andes tend to be larger than the geographical races from the western side of the Andes (Table 1). Geographical factors alone had a large effect on size ($F = 254$; $df = 1, 179$; $P < 0.001$), but the races of *erato* found on the western side of the Andes were also significantly different in size from each other ($F = 14$; $df = 5, 179$; $P < 0.001$) (Table 1).

The races from the eastern region are relatively constant with respect to their body size. In contrast, the races from the western side of the Andes show more variability in sizes. In the eastern region, stabilizing selection probably acts against extreme phenotypes and favors the more common variant. This mode of selection may reduce variation and maintains the larger sizes. The races of the western side of the Andes may be exposed to greater ecological pressures, such as competitive interactions, as discussed by Benson et al. (1976). According to Brower (1994) the vicariant separation of the races could have occurred during the Cenozoic era, specifically the Pleistocene, during the formation of large mountains (including the Andes) around the world.

TABLE 1. AVERAGE WING LENGTH (WL) AND STANDARD ERROR OF GEOGRAPHICAL RACES OF *HELICONIUS ERATO* FROM MUSEUM SPECIMENS IN DIFFERENT REGIONS.

Geographical races	Regions	N	WL (cm) $\bar{x}$ ± SE
H. e. magnifica	Eastern	15	3.85^{a*} ± 0.06
H. e. favorinus	Eastern	57	3.94^{a} ± 0.03
H. e. phyllis	Eastern	32	3.89^{a} ± 0.04
H. e. hydara	Western	15	3.30^{e} ± 0.06
H. e. petiverana	Western	25	3.01^{d} ± 0.08
H. e. cyrbia	Western	31	3.55^{b} ± 0.03
H. e. colombina	Western	15	3.24^{cd} ± 0.03

*Wing length not followed by the same letter are different ($P < 0.05$).

Differences in allometric ratios of wing and abdomen length have been reported to favor competing males of *H. hewitsonii* engaging in pupal mating (Deinert et al. 1994). In adult *H. erato*, which are also pupal maters, there are no significant differences between the wing length of the sexes, however abdomen length differ significantly between the sexes (Hay-Roe 1996). Results from ecological studies performed under laboratory conditions suggest that size differences are genetically based; size differences between races remain, regardless of maternal origin, or the host plant fed to the caterpillars (Hay-Roe 1996, 2004). These results suggest that the body plan, the shared ecology of the group, and a shared evolutionary history may contribute to the final variation of the wing sizes between races of *H. erato*.

Summary

Differences in wing size in geographical races of *Heliconius erato* distributed on the western and eastern side of the Andes are reported here. Individuals from the eastern side of the Andes are statistically larger in size than the ones on the western side of the Andes. Statistical difference is also found between individuals of different races on the western side of the Andes.

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