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Is there adaptation of *Melanargia galathea* to high altitude conditions ?

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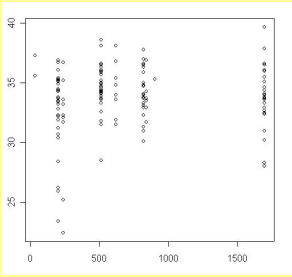
Introduction

Ectotherms living in a wide range of habitat conditions generally display adaptations to local climatic conditions. In which way the different components of this adaptation may be present in a single species ?
To answer this question, it should first be asked which adaptations are shown by the studied species *Melanargia galathea* (Lepidoptera, Nymphalidae, Satyrinae).

Hypotheses

High altitude butterflies may have allozymes which are active at lower temperature than lower elevation individuals, as shown by Watt *et al*. (2003) for several *Colias* butterflies.
In this case one would expect
•a lower temperature necessary for take-off in high altitude individuals.
•a genetic difference between low and high elevation individuals

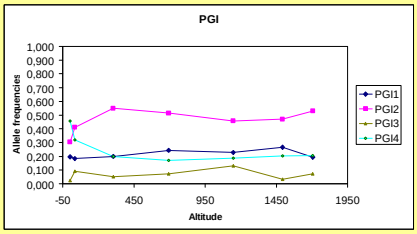
Take-off temperatures (°C)



Altitude (m)

Take off temperature was measured in laboratory conditions for 151 individual butterflies from various locations in France and Italy. No correlation was observed between take-off temperature and altitude.

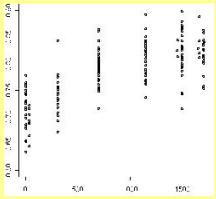
Genetic data



Four highly polymorphic loci were studied (PGM, PGI, AK, GOT), and none of these shows any correlation with altitude (*contra* Watt's results who got association of some PGI alleles with altitude). Only PGI alleles are shown here.

Phenotype

Proportion of black in forewings

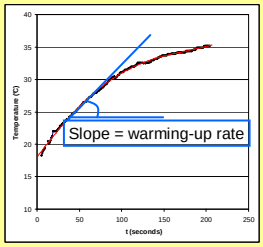


Altitude (m)

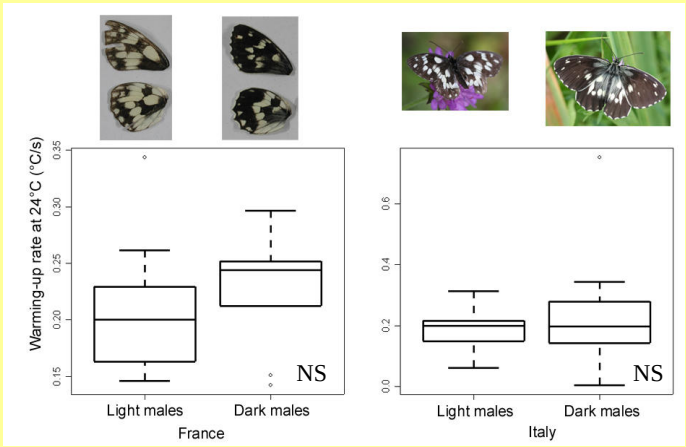
Darkness indices for 176 *M. galathea* males from south France. High altitude individuals tend to be darker than low altitude ones.

This suggests that dark individuals are so coloured in order to warm up more quickly than light individuals.

Lab experimental set up : individuals from a 11°C fridge are placed under a 150 W neodymium daylight lamp in a 25°C environment. Their thorax temperature was monitored continuously with a TESTO845® infrared thermometer, inputting 1 data point per second. Here a *Colias* butterfly is being tested.



The warming-up curve of every individual was modelled using a four degree polynomial, and the warming-up rate (expressed in °C/s) was taken as the tangent to the warming-up curve at different temperatures (here 24°C).



Contrary to expectation, warming-up rates did not vary between low altitude populations showing a light phenotype and high altitude ones showing a dark phenotype, neither in France (2 populations from Provence) nor in Italy (2 dark and 2 light coloured populations).

The question then remains as to why individuals get darker at high altitudes...

References

Descimon, H. & Renon, C. 1975. Mélanisme et facteurs climatiques. Archives de Zoologie expérimentale et générale **116** : 255-292, 437-468.

Watt, W.B., Wheat, C.W., Meyer, E.H. & Martin, J.-F. 2003. Adaptation at specific loci. VII. Natural selection, dispersal and the diversity of molecular-functional variation patterns among butterfly species complexes (*Colias* : Lepidoptera, Pieridae). Molecular Ecology **12** : 1265-1275.

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