

PHOENICULUS DAMARENSIS - P. PURPUREUS LATITUDINAL GRADIENT IN MANTLE IRIDOSOME DIAMETERS

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Abstract

A latitudinal gradient was proposed in microscopic differences in green and violet woodhoopoe mantle iridosome diameters of mantle feathers. Outer iridophore diameters from Green Woodhoopoe *P. p. purpureus* barbules ($0.22 \pm 0.03 \mu\text{m}$, $n = 244$) recorded at Morgan Bay were smaller than those from violet barbules ($0.28 \pm 0.04 \mu\text{m}$, $n = 248$) recorded in Namibia. A latitudinal gradient demonstrated a strong correlation with outer diameters ($r=0.99$, $r^2=0.98$, $n=6$, $p<0.001$). When the outer diameters were divided by body mass the correlation with latitude was marginally significant ($r=0.70$, $Z \text{ score}=1.49$, $n=6$, $p=0.07$). This study examined woodhoopoes mantles which may have consequences for energy expenditures.

Keywords: mass; latitude, microscopy, woodhoopoe.

INTRODUCTION

There is an ecogeographical rule which states within a species of endotherms, more heavily pigmented forms are found in more humid environments near the equator [9]. It was first remarked upon this phenomenon in 1833 in a review of covariation of climate and avian plumage color.

The Namibian Violet Woodhoopoe *P. d. damarensis* is an arid near-endemic with a partially resolved taxonomic status [3,5,2,12]. It is closely related to the Green Woodhoopoe *Phoeniculus purpureus* yet differs in mass and mantle feather colouration [3,4,7,10]. Here I provide some resolution to the ecogeographical status of the Violet Woodhoopoe *P. damarensis* in comparison with the Green Woodhoopoe *P. purpureus*, using microscopic details of mantle feathers across latitude.

MATERIALS AND METHODS

Mantle feathers were sampled from netted live Violet (Namibia: Hobatere and Omaruru; $n = 9$) and a dead Green Woodhoopoe (Morgan Bay; $n = 1$) in 1999. Mantle feathers were soaked for 30 min in 0.25M NaOH, followed by 2 hours in formic acid: EtOH (2:3 v/v) and 3 days in 15% (v/v) Spurr's resin in propylene oxide. They were then embedded in Spurr's resin. Both transverse and longitudinal sections of the barbules were cut, revealing that the iridophores of both species were hollow prolate cylinders. Iridophore cylinder widths were measured and correlated with latitudes using the Pearson Correlation Coefficient Calculator (<http://www.socscistatistics.com/tests/pearson/default2.aspx>). Measurements of the outer iridosome diameter of Green feathers from the Morgan Bay bird were compared with those from a Hobatere bird and an Omaruru bird. Next I controlled for by mass and produced a correlation of mean outer iridosome diameters divided by body mass against latitude. Both localities had a Ultra Violet Index of 0, similar mean annual temperatures (22 °C). They differed in precipitation (Omaruru 316mm; Morgan's Bay not given).

RESULTS

Mantle feathers and iridophores from Namibian Violet Woodhoopoe *P. damarensis* and Green Woodhoopoe *P. p. purpureus* vary according to latitude (Figure 1). Birds identified as *P. d. damarensis* had predominantly violet mantles. The difference between woodhoopoe species is a strong correlation between outer diameter and latitude ($r=0.9892$, $r^2=0.9785$, $n=6$, $p=0.000174$). When the outer diameters were divided by body mass the correlation with latitude was marginally significant (Figure 2: $r=0.69636835$, Z score= 1.48993583 , $n=6$, $p=0.06812058$). Outer diameters did not correlate with mean body mass ($r=0.40144263$, Z score= 0.42536753 , $n=4$, $p=0.33528442$).

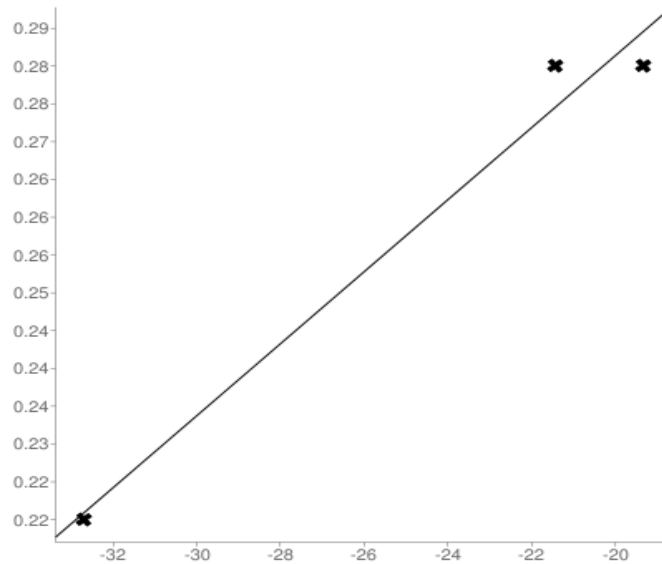
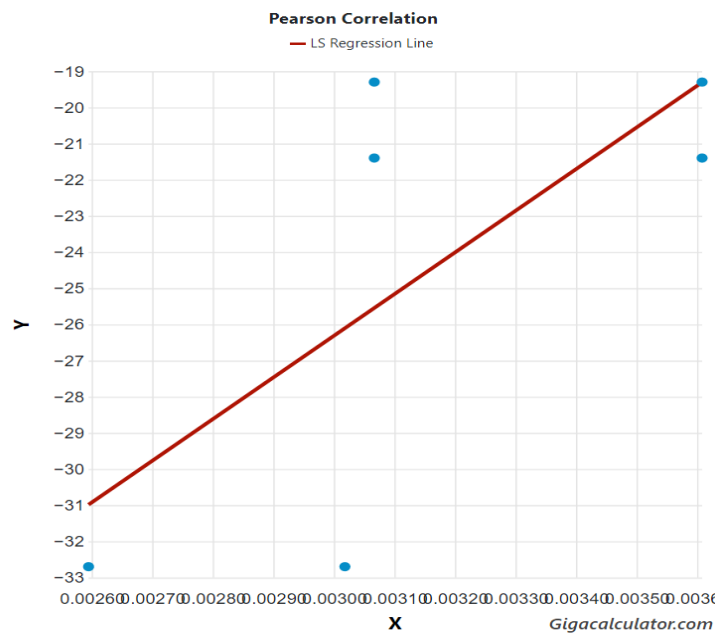


Figure 1. Correlation between iridosome outer diameter (0.22 versus 0.28) (y-axis) and latitude (x-axis) of woodhoopoe mantle feathers from Morgan Bay (-32.7S), Hobatere (-



19.3S), and Omaruru (-21.4S).

Figure 2. Correlation between iridosome outer diameter (0.22 versus 0.28) (y-axis) and latitude (x-axis) of woodhoopoe mantle feathers from Morgan Bay (-32.7S), Hobatere (-19.3S), and Omaruru (-21.4S) after controlling for body mass.

DISCUSSION

Examination of mantle feathers from woodhoopoes suggests a clinal variation [4]. A simple model of latitudinal gradients can account for differences between iridophore diameters, differences that are enough to distinguish green from violet woodhoopoes. This study reveals woodhoopoes mantles have consequences for energy expenditure [7]. The results support a complex version of the biological rule [9, 11]. This supports the results found in Australasian songbird clades [8]. It is also consistent with darker birds being larger than lighter birds [1, 4]. Closer examination of rainfall and temperature and a comparison among woodhoopoes from different latitudes helps to reconcile the complex and simple biological rules [4, 6]. A cursory examination showed mean annual temperatures to be nearly identical so perhaps differences in precipitation gradient as predicted in the original simple rule are causal [9].

CONCLUSION

Examination of mantle feathers from woodhoopoes suggests latitudinal variation of the outer iridosome diameters consistent with the biological rule.

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