FAVOURABLE RESULT OF A COMPLEX MODEL TO ACCOUNT FOR THE IRIDESCENT COLOURS IN WOODHOOPOE FEATHERS THROUGH GRADIENTS WITH CLIMATE II. ALTITUDE AND AIR PRESSURE

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ABSTRACT: Two gradients were predicted with microscopic differences in green and violet woodhoopoe iridosome diameters of mantle feathers. Here these two factors are added to the model i.e. altitude and air pressure. Iridophore diameters from Green Woodhoopoe *P. p. purpureus* barbules (0.22±0.03µm, n=244) recorded at Morgan Bay were smaller than those from violet barbules (0.28±0.04µm, n=248) recorded in Namibia (Hobatere and Omaruru). Altitude was correlated with outer diameter (Pearson's r=0.99244067, n=6, Z score=4.82751370, p=0.00000069). Air pressure was correlated with outer diameter (Pearson's r=-0.99314172, n=6, Z score=-4.91210603, p=0.00000045).

I. INTRODUCTION

There is an ecogeographical rule that states within a species of endotherms, more heavily pigmented forms are found in more humid environments near the equator [8]. It was first remarked upon this phenomenon in 1833 in a review of covariation of climate and avian plumage color. The Namibian Violet Woodhoopoe *Phoeniculus d. damarensis* is an arid near-endemic with a somewhat resolved status [2, 3, 4, 11]. It is closely related to the Green Woodhoopoe *P. purpureus* and differs in mass and mantle feather coloration [1, 2, 6, 9]. Here I provide further 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 altitude and air pressure.

II. 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 altitude and air pressure gradients using the Pearson Correlation Coefficient Calculator (http://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php). 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 to produce a correlation of mean outer iridosome diameters against the 2 climatic or weather factors (https://en.climate-data.org). Localities inputted were Kamanjab in for Hobatere, Omaruru, and Kei Road in for Mogan's Bay. Air pressure (Appendix 2) was generated at https://www.mide.com/air-pressure-at-altitude-calculator inputting temperature and altitude (Appendix 1) for the three localities.

III. RESULTS

Altitude was correlated with outer diameter (Fig. 1: Pearson's r=0.99244067, n=6, Z score=4.82751370, p=0.00000069). Air pressure was correlated with outer diameter (Fig. 2: Pearson's r=-0.99314172, n=6, Z score=-4.91210603, p=0.00000045).

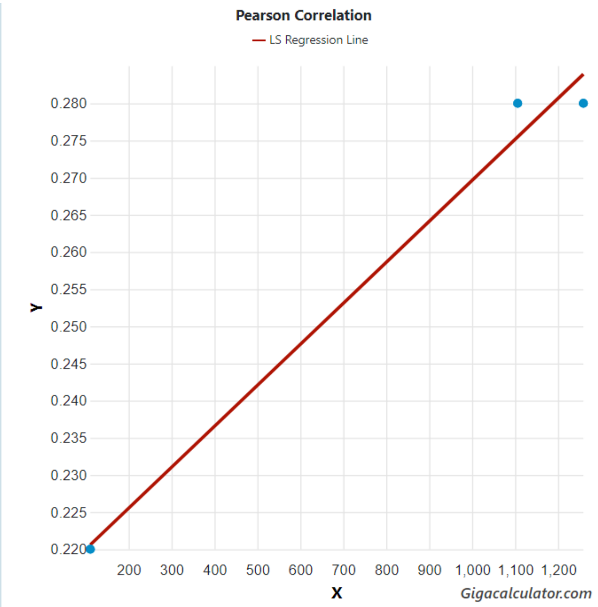

Fig. 1: Correlation between altitude and iridosome outer diameter.

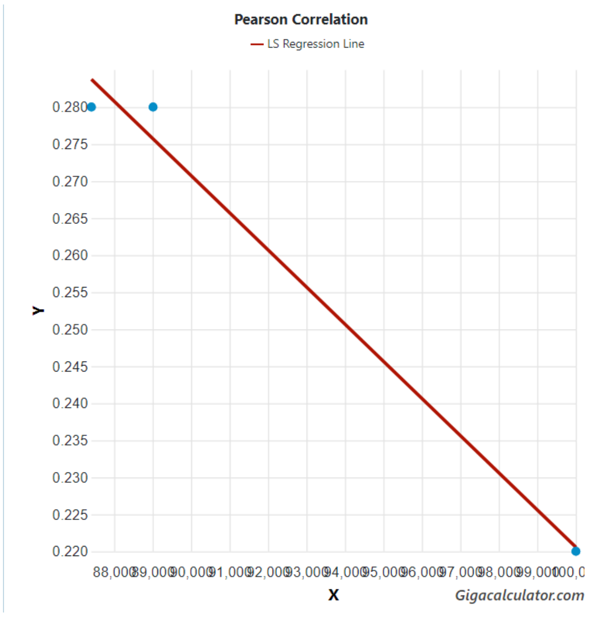

Fig. 2: Correlation between air pressure and iridosome outer diameter.

IV. DISCUSSION

Examination of mantle feathers from woodhoopoes predict a clinal variation with the two climatic or weather factors [1]. A complex model of climatic and weather gradients may account for differences between iridophore diameters, differences that are enough to discern green from violet woodhoopoes [12]. This study reveals how wood hoopoes mantles may have consequences on energy expenditure [6]. The results support a complex version of the biological rule [8, 10]. This is similar to the results found in Australasian songbird clades [7]. Closer examination of rainfall and temperature and comparison among woodhoopoes from different climates under different weather help to reconcile the complex and simple biological rules [1, 5, 10]. A critical examination showed two more factors differ with outer iridosome diameter as predicted in this rule [8].

V. CONCLUSION

Examination of mantle feathers from woodhoopoes suggests a clinal variation of the outer iridosome diameters consistent with the biological rule are complex; correlated and figured.

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APPENDIX 1: ALTITUDE (M) FOR THREE LOCALITIES WHERE WOODHOOPOES WERE NETTED IN SOUTHERN AFRICA; FOLLOWED WITH IRIDOSOME OUTER DIAMETERS (µm).

1259, 0.28
111, 0.22
1106, 0.28
1259, 0.28
111, 0.22
1106, 0.28

APPENDIX 2: AIR PRESSURE (PA) FOR THREE LOCALITIES WHERE WOODHOOPOES WERE NETTED IN SOUTHERN AFRICA; FOLLOWED WITH IRIDOSOME OUTER DIAMETERS (µm).

87408.98, 0.28
100005.46, 0.22
89012.32, 0.28
87408.98, 0.28
100005.46, 0.22
89012.32, 0.28