

Calibrated Digital UV Reflectance Photography for Lepidoptera



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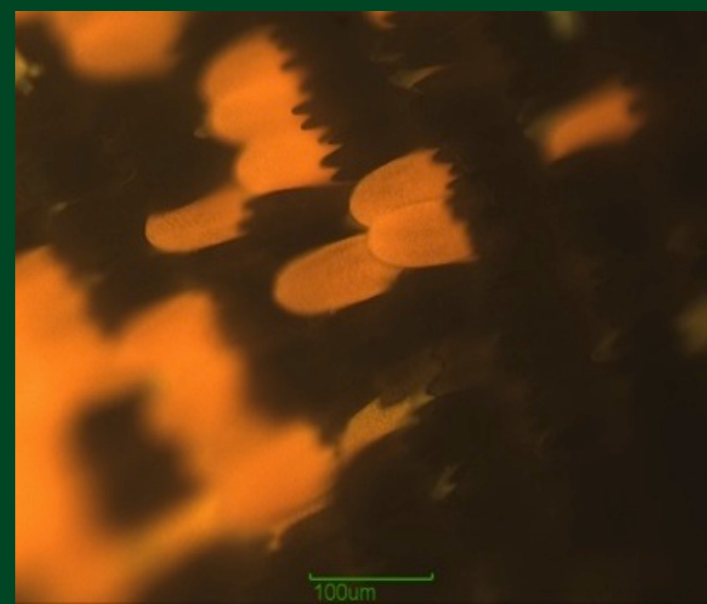


Introduction The conservation process for lepidoptera specimens is extremely challenging, particularly due to their large, fragile wings which become brittle and faded over time, following their natural tendency to decompose. Lepidoptera perceive UV light and some families (Papilionidae, Pieridae, Nymphalidae) bear UV visible markings, created by structural colours and pigments. UV reflectance photography can be used to allow humans to see these markings. Due to the inability of humans to perceive UV light, any photographs generated in the near UV spectrum could be misinterpreted. In this research, digital UV reflectance photography was used to record UV reflective patterns on butterfly wings. Handmade calibration standards developed for forensics were produced, to determine if they could be used to generate quantitative data from UV reflectance photography. This process is called UV optical densitometry. UV reflectance photography was compared with visible light photography, transmitted and reflected visible light microscopy, and scanning electron microscopy to characterise the deterioration of butterfly wing markings.

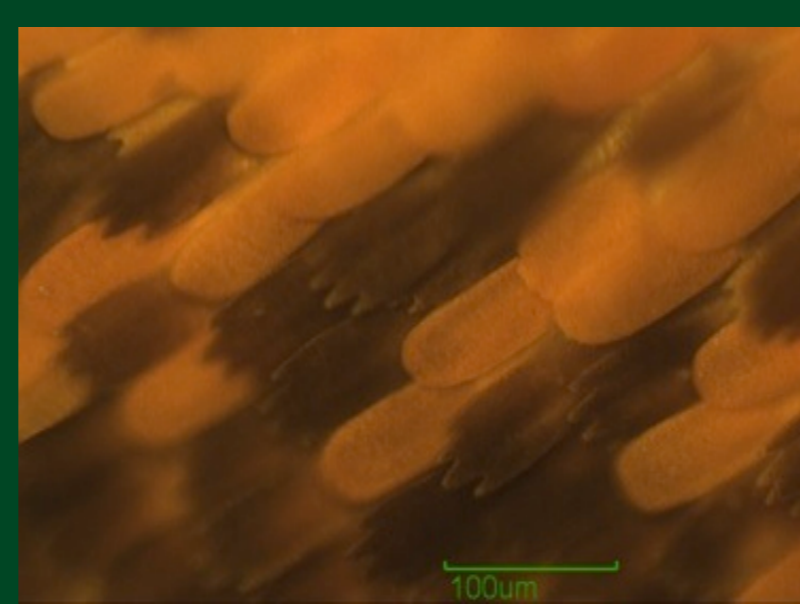
Experimental Fresh *Hebomoia glaucippe sulphurea* specimens, which exhibit UV-reflective markings on the upper wing tip of dorsal surface, were humidified and pinned. A UV-converted Nikon D200 fitted with Baader Ultraviolet Venus filter, and Xenon bulbs with UV blocking removed were used to photograph the specimens. Handmade reflectance standards made of magnesium oxide, plaster and carbon were placed in the frame. Two older specimens were photographed in the same manner. Using reflectance values determined by a Cary 3 UV-Vis Spectrophotometer, each calibration standard was used for optical densitometry in the UV, in other words, to generate quantified measurements of UV reflective wing markings. One fresh specimen and one older specimen were also compared with reflected and transmitted light microscopy, and scanning electron microscopy (SEM).

Reflected light microscopy

The shimmery, erythropterin-pigmented orange scales are rounded, and the matte, melanin-pigmented black scales are jagged. The black scales of the older wing are very faded. The orange scales are less faded.



Fresh wing: orange and black scales 200x

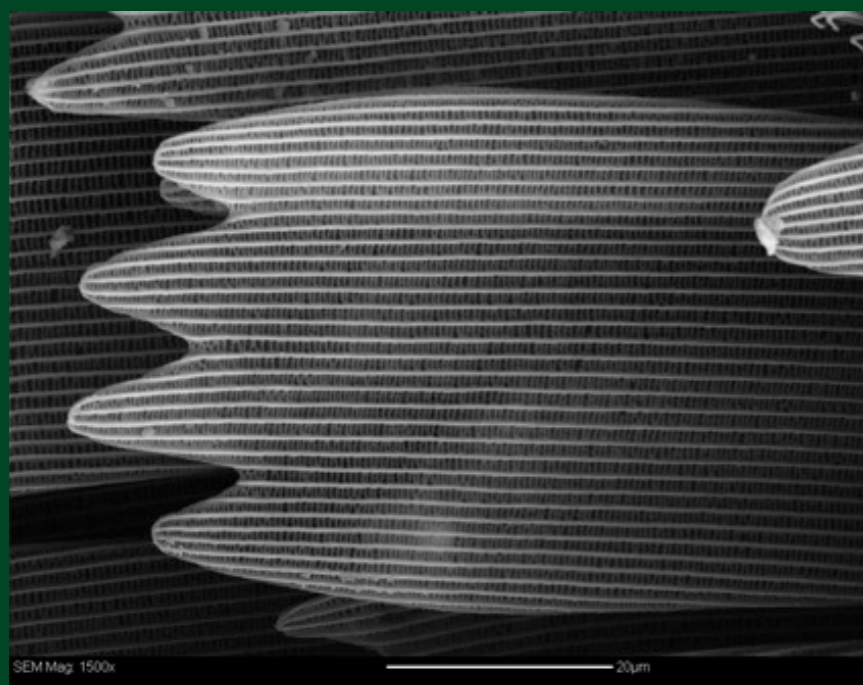


Older wing: orange and black scales 200x

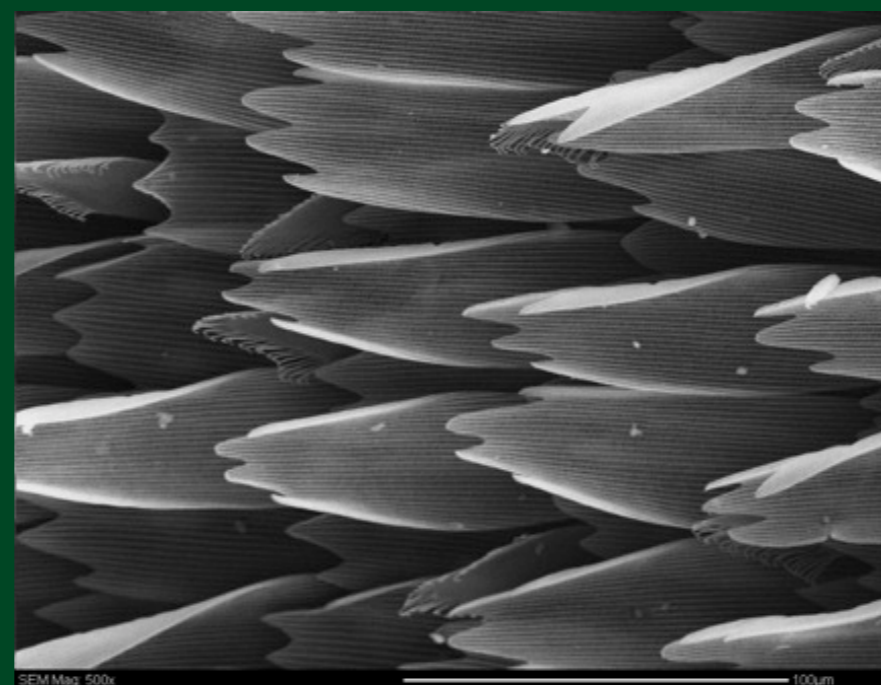
SEM

UV absorbent black scales:

Fresh scales lay flat. Older wing scales curl inward and lose melanin held in the structural interstices.



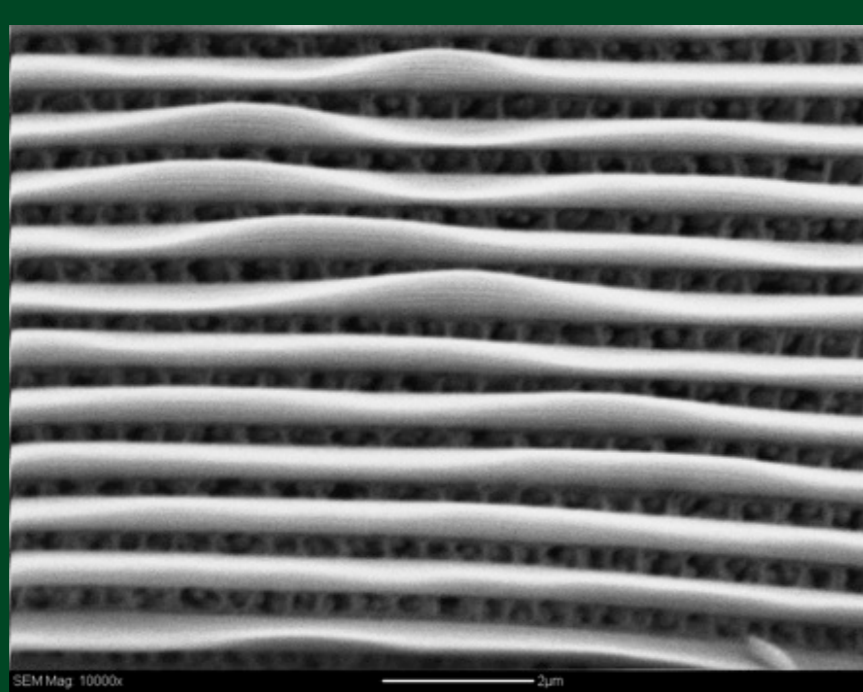
Fresh wing: black scale 1500x



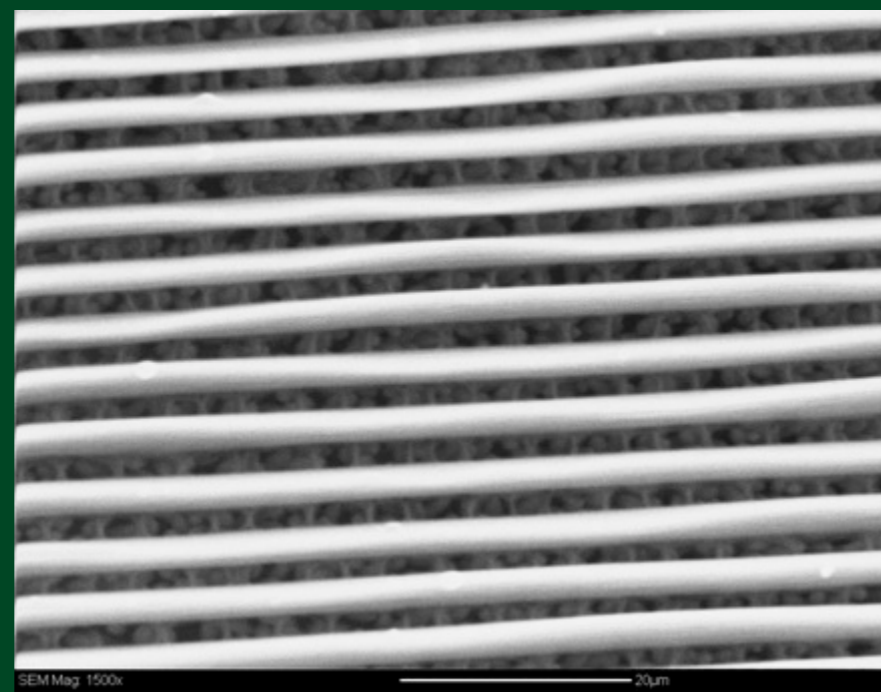
Older wing: black scales 500x

UV reflective orange scales:

Little observable difference between fresh and older wing structures.

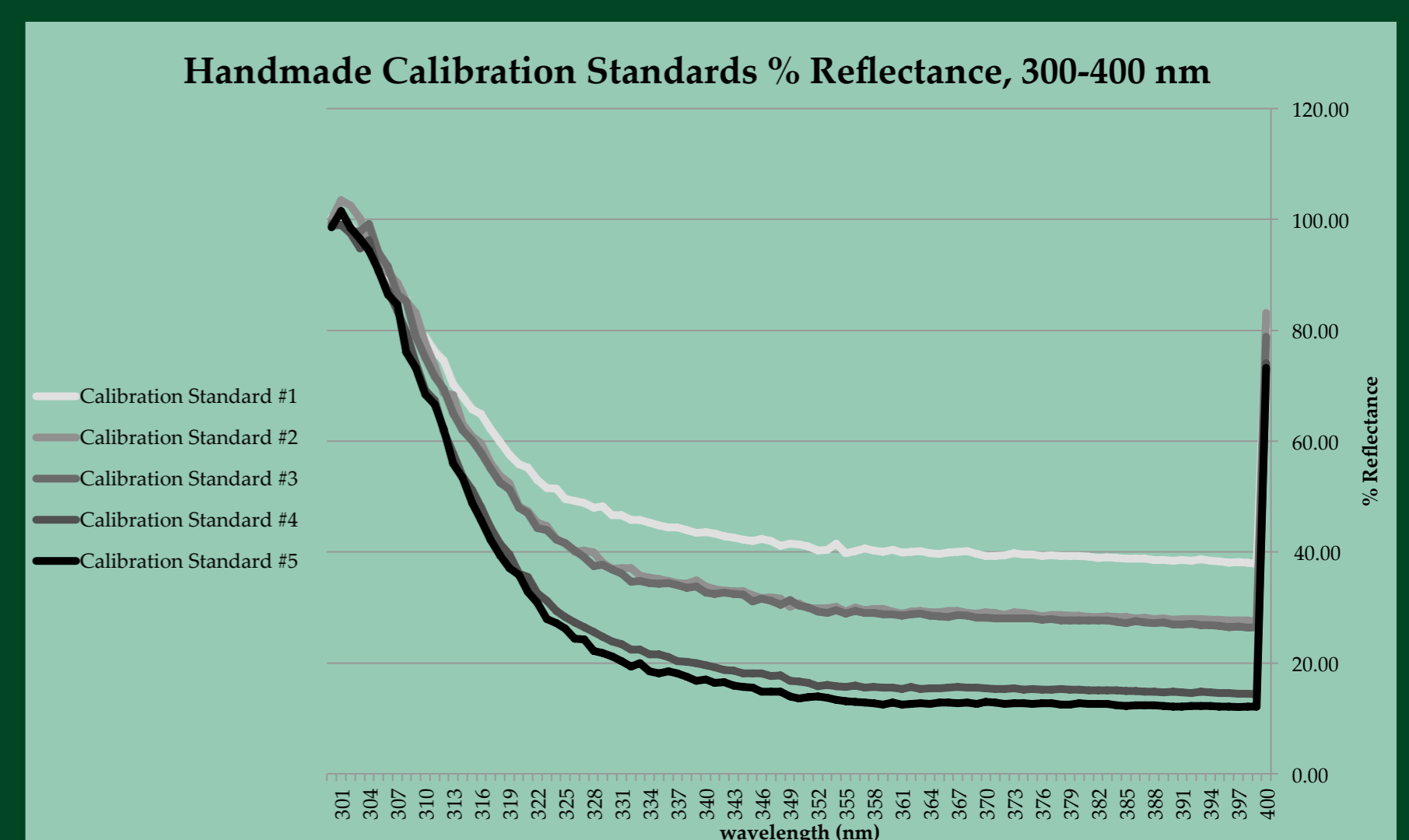


Fresh wing: orange upper lamina 10000x



Older wing: orange upper lamina 10000x

Calibrated Digital UV Reflectance Photography



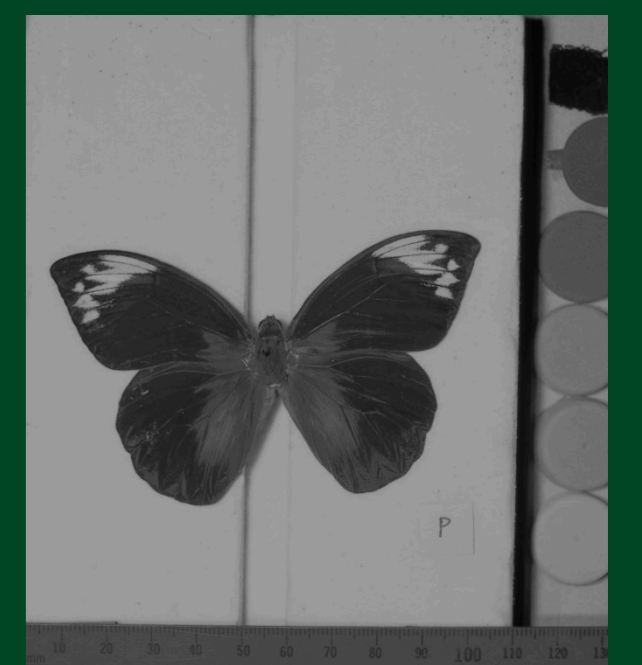
Spectral curves of the five handmade calibration standards were produced from data taken by a Cary 3 UV-Vis Spectrophotometer at the Canadian Conservation Institute. The graph above shows the spectra for the 300-400 nm range. In this study, the range between 320-390 nm, the wavelengths transmitted by the Venus U-filter, are most important. Image J was used for UV optical densitometry using reflectance measurements of the five calibration standards. Results of this analysis are forthcoming.



Visible reflected light



UV reflected light, fresh specimen



UV reflected light, older specimen

Conclusions

- Handmade standards can be used to generate quantitative data from UV reflectance photography.
- Black melanin-pigmented UV absorbent wing markings deteriorate more significantly than erythropterin-pigmented UV reflective wing markings.
- UV reflectance photography complements and supports information gleaned from visible light photography, transmitted and reflected visible light microscopy, and scanning electron microscopy.

Acknowledgements: Dr. George Bevan, Dr. Alison Murray, Prof. Krysia Spirydowicz, Adrienne Brewster and Cambridge Butterfly Conservatory, Ian Longo, Bernie Ziomkiewicz, Charles Cooney, Timothy Greening, Luci Cipera, Alex Gabov, Dr. Rob Waller, Dr. David Grattan, Mylene Choquette, Season Tse, fellow MAC students and my family.