

Faraday Discussions

Electronic Supplementary Information (ESI)

Optical Costs and Benefits of Disorder in Biological Photonic Crystals

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Electronic supplementary information

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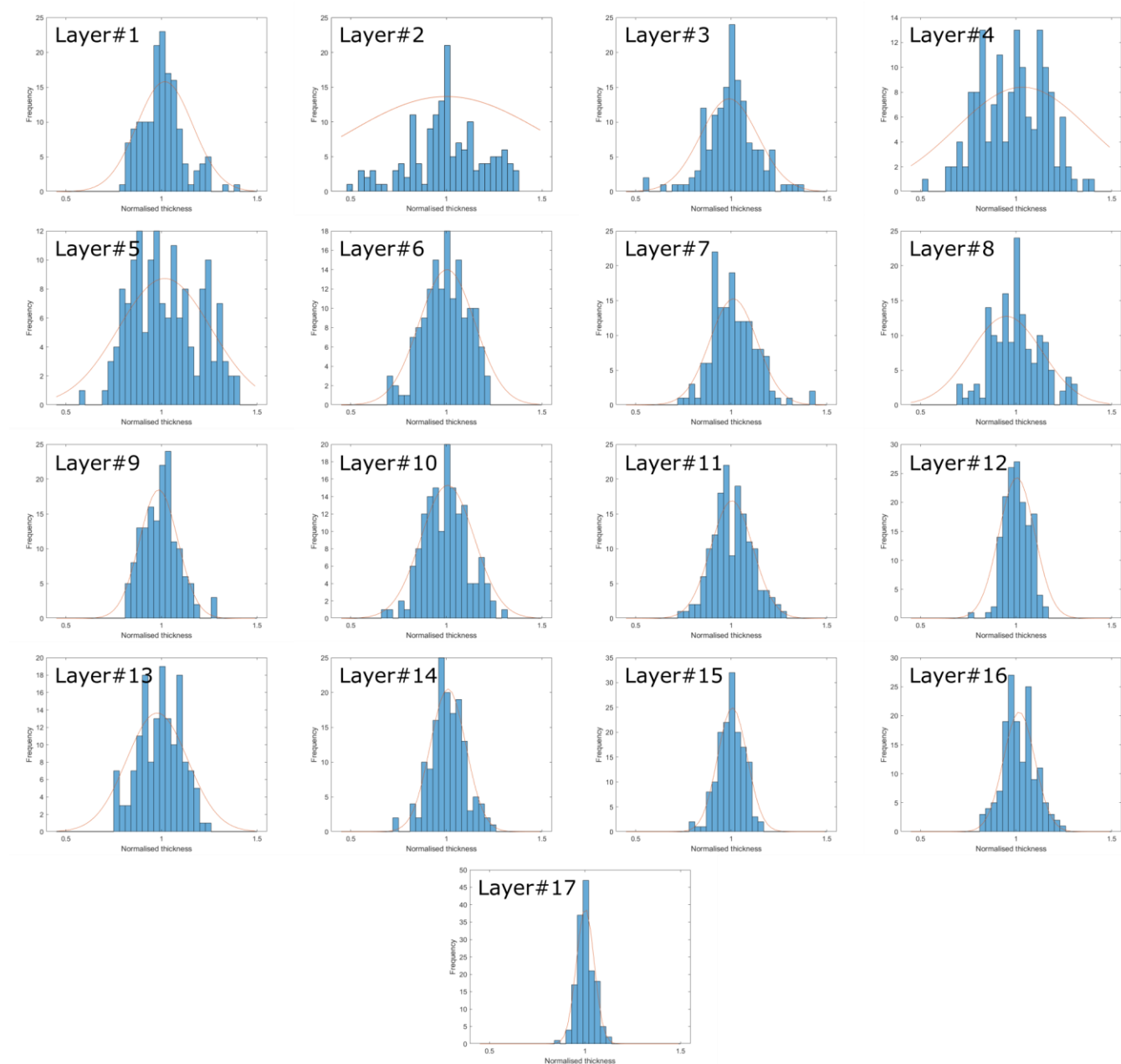


Fig. S1 – Distributions of normalised thicknesses of each layer in the green region of the elytra of *C. rajah* ($N = 152$) with Gaussian fits. Layer#1 corresponds to the top layer and #17 to the deepest layer.

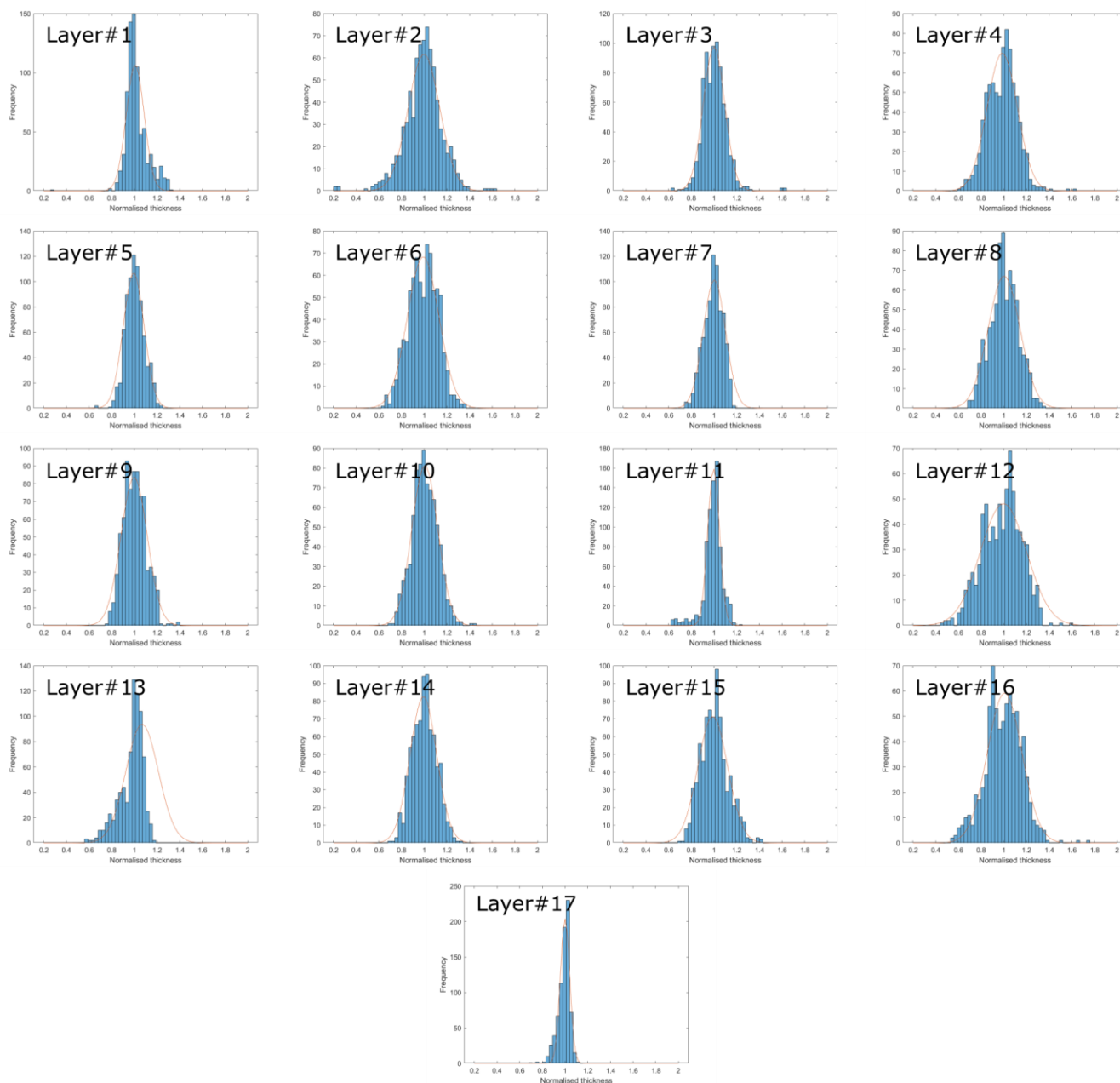


Fig. S2 – Distributions of normalised thicknesses of each layer in the orange region of the elytra of *C. rajah* ($N = 771$) with Gaussian fits. Layer#1 corresponds to the top layer and #17 to the deepest layer.

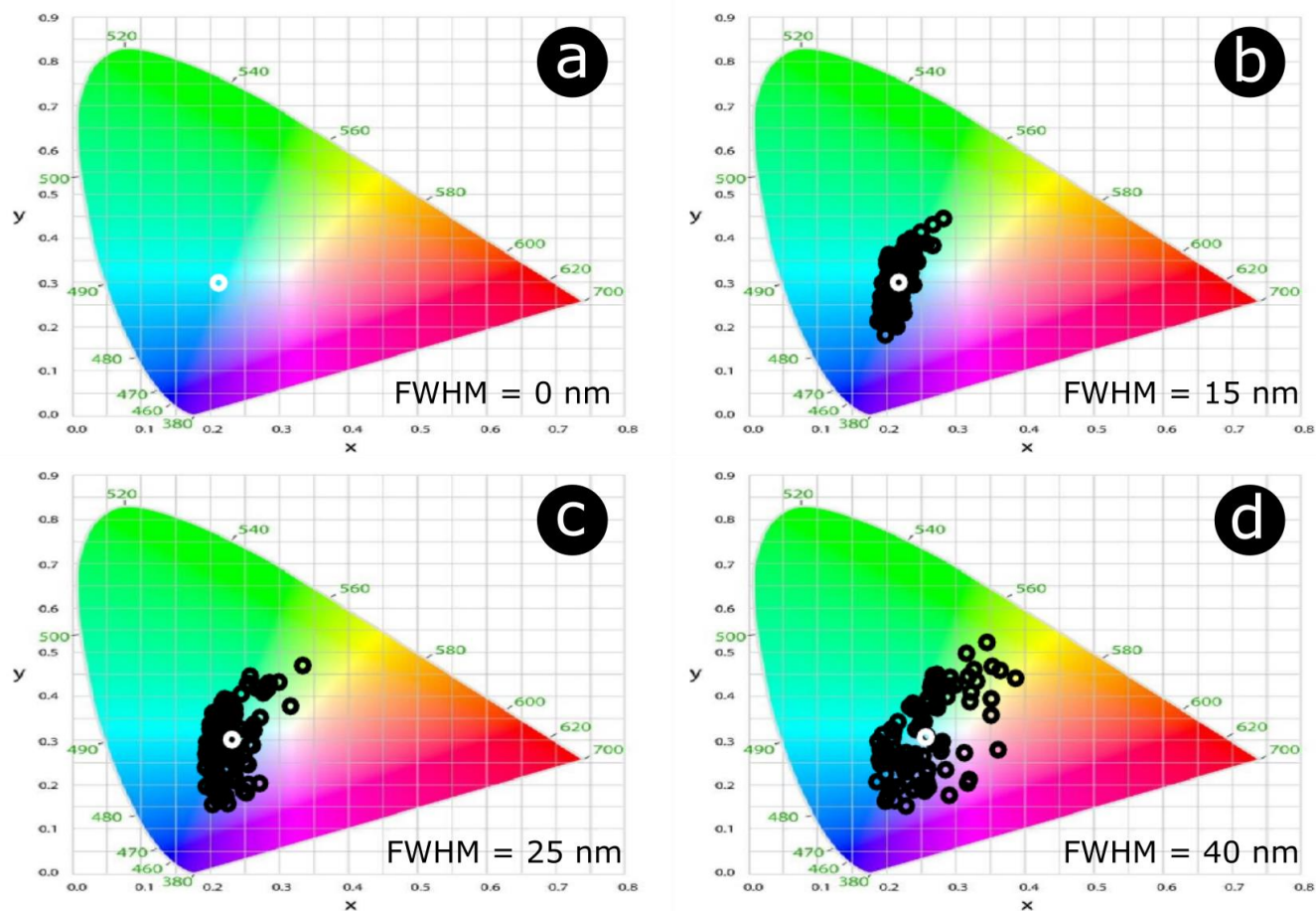


Fig. S3 – The apparent constant and stable optical response of natural photonic structures arises from their high tolerance and resilience to positional defects arises. Representation on a 1931 CIE diagram (assuming a D_{65} illuminant) of the reflectance spectra calculated at normal incidence from a typical multilayer model in which positional disorder is progressively added (Fig. 12). The multilayer model is made out of 9 bilayers¹, the high ($n = 1.68 + 0.03i$) and low ($n = 1.55 + 0.14i$) refractive index layers had thicknesses randomly selected following normal distributions with mean parameters equal to 92 nm and 60 nm, respectively. The FWHM of these normal distributions were varied from 0 nm to 40 nm (e,f). Fig. a-d correspond to FWHM = 0 nm, 15 nm, 25 nm and 40 nm, respectively.

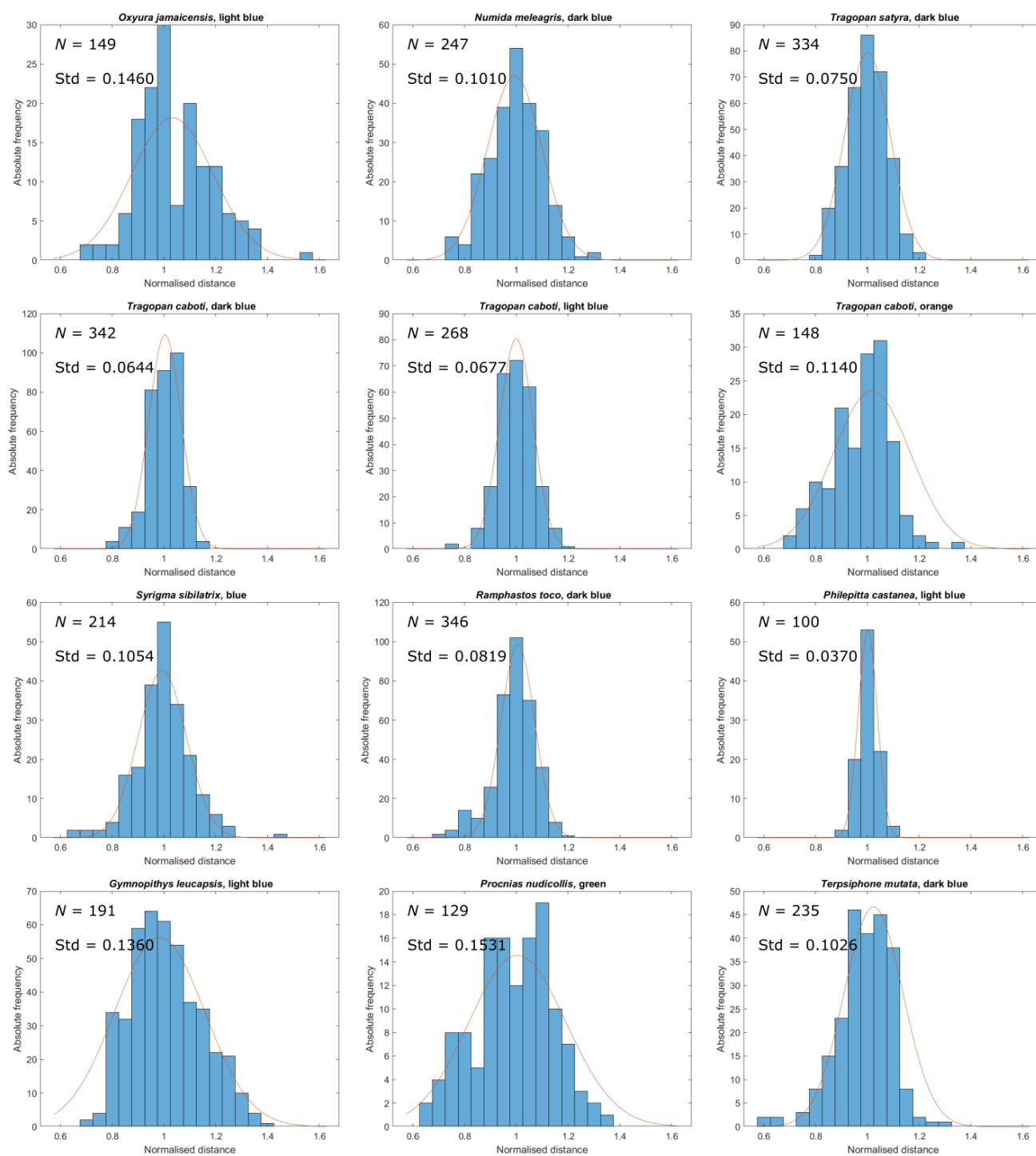


Fig. S4 – Statistical analysis (histograms and Gaussian fits) of TEM images of cross-sections of parallel collagen fibres surrounded by mucopolysaccharide in a selection of avian dermides² (Fig. 13). The distributions of normalised distances to nearest neighbour allow to assess the extent of disorder in the photonic systems related to *Oxyura jamaicensis*, light blue; *Numida meleagris*, dark blue; *Tragopan satyra*, dark blue; *Tragopan caboti*, dark blue; *Tragopan caboti*, light blue; *Tragopan caboti*, orange; *Syrigma sibilatrix*, blue; *Ramphastos toco*, dark blue; *Philepitta castanea*, light blue; *Gymnophaps leucapsis*, light blue; *Procnias nudicollis*, green and *Terpsiphone mutata*, dark blue.

Reference

- 1 J. A. Noyes, P. Vukusic, I. R. Hooper, *Opt. Express*, 2007, **15**, 4351-4358.
- 2 R. O. Prum, R. Torres, *J. Exp. Biol.*, 2003, **206**, 2409-2429.