Appendix 2. Red Chromaticity and Methods

To account for the fact that carotenoid-based coloration leads to elaborate plumage ornamentation through different physiological mechanisms, we calculated chromaticity values using the red and blue color scores extracted from the RGB values provided by Dale et al. (2015). Chromaticity values provide an estimate of the relative contribution of short and long wavelengths to the expressed color and can act as a reliable metric for measuring variation in carotenoid and structural plumage coloration separately (Dey et al. 2015). To calculate red chromaticity we used the equation: R/(R+G+B), where R is the red value, G is the green value, and B is the blue value (Dey et al. 2015). Many Tyrannidae taxa exhibit carotenoid plumage (Fig. 1 main text) and few express structural, so we focused on red chromaticity here (Gray 1996). We previously used chromaticity values to test biogeographic macroevolutionary processes of passeriform color evolution (Oud et al. *in revision*). In that work, we provided evidence from Thraupidae that distributions of female (n=346) and male (n=346) red and blue chromaticity values from 10 plumage patches do not overlap, indicating the values captured separate aspects of the color signal. We also showed the values are consistent with visual color estimates determined by a single, independent observer (Oud et al. *in revision*, Fig. S1). We then used PGLS models following methods in the main text to test the effect of climatic and ecological variables on female and male red chromaticity.

Red Chromaticity Results

Female and male red chromaticity were significantly predicted by forest cover (females: X^2=8.22, p=0.004, ϕ=0.14 [95% CI: 0-0.24]; males: X^2=4.25, p=0.04, ϕ=0.09 [95% CI: 0-0.20]; Appendix 2, Table 1).

Appendix 2, Table 1.

	Variable	df	X^2	p	Estimate
Female red chromaticity (λ=0.82)	Latitude	1,392	0.07	0.795	0.001
	Diet breadth	1,392	0.21	0.648	0.001
	Forest cover	**1,392**	**8.22**	**0.004**	**0.007**
	Annual precipitation	1,392	0.61	0.434	-0.002
	Max. Temperature	1,392	0.32	0.571	-0.001

	Migration behavior	1,392	2.52	0.113	-0.004
Male red chromaticity (λ=0.83)	Latitude	1,392	0.00	0.96	0.000
	Diet breadth	1,392	0.17	0.68	0.001
	Forest cover	**1,392**	**4.25**	**0.04**	**0.005**
	Annual precipitation	1,392	0.01	0.91	0.000
	Max. Temperature	1,392	0.89	0.35	-0.002
	Migration behavior	1,392	0.84	0.36	-0.002

Literature Cited

Dale, J., C. J. Dey, K. Delhey, B. Kampenaers, and M. Valcu. 2015. The effects of life history and sexual selection on male and female plumage coloration. Nature 527:367-370. https://doi.org/10.1038/nature15509

Dey, C. J., M. Valcu, B. Kempenaers, and J. Dale. 2014. Carotenoid-based bill coloration functions as a social, not sexual, signal in songbirds (Aves: Passeriformes). Journal of Evolutionary Biology 28:250-258. https://doi.org/10.1111/jeb.12560

Oud, M. D., S. M. Mahoney, C. Pageau, M. A. de Menezes, N. Smith, J. V. Briskie, and M. W. Reudink. Global patterns of plumage colour evolution in island-living passeriform birds. *In revision*.