

Primate camouflage as seen by felids, raptors, and conspecifics

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Anti-predator Coloration



Background matching

Primate Coloration



R G B



R G B U



R B

Introduction

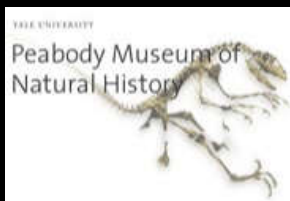
Methods

Results

Discussion

| Species | Specimen | Back | Belly | Cap | Tail |
|-------------------------------------|------------|----------------|-----------|-----------|-----------|
| <i>Eulemur fulvus collaris</i> | YPM 003344 | x | x | x | x |
| <i>Eulemur macaco</i> | YPM 003345 | x | x | x | x |
| <i>Eulemur mongoz</i> | YPM 001606 | x | x | x | x |
| <i>Haplemur griseus</i> | YPM 001601 | x | x | x | x |
| <i>Varecia variegata</i> | YPM 001605 | x ¹ | x | x | x |
| <i>Indri indri</i> | YPM 001608 | x ¹ | x | x | |
| <i>Propithecus diadema diadema</i> | YPM 001602 | x | x | x | x |
| <i>Propithecus verreauxi</i> | YPM 000313 | x | x | | x |
| <i>Callithrix jacchus</i> | YPM 000327 | x | x | x | x |
| <i>Cebus olivaceus</i> | YPM 000331 | x | x | x | x |
| <i>Saimiri sciureus</i> | YPM 015033 | x | x | x | x |
| <i>Alouatta caraya</i> | YPM 004858 | x | x | x | |
| <i>Alouatta palliata</i> | YPM 000322 | x | | x | x |
| <i>Alouatta seniculus</i> | YPM 000321 | x | x | x | x |
| <i>Ateles belzebuth</i> | YPM 004865 | x | x | x | x |
| <i>Lagothrix lagotricha</i> | YPM 000325 | x | x | x | x |
| <i>Cercopithecus ascanius</i> | YPM 015030 | x | x | x | x |
| <i>Cercopithecus mitis</i> | YPM 000714 | x | x | x | x |
| <i>Cercopithecus wolffi</i> | YPM 014273 | x | x | x | x |
| <i>Chlorocebus pygerythrus</i> | YPM 000334 | x | x | x | x |
| <i>Colobus guereza albyssinicus</i> | YPM 000340 | x | | x | x |
| <i>Erythrocebus patas</i> | YPM 000337 | x | x | x | |
| <i>Lophocebus alterrimus</i> | YPM 014199 | x | x | x | x |
| <i>Macaca arctoides</i> | YPM 000328 | x | x | x | |
| <i>Macaca fascicularis</i> | YPM 004870 | x | x | x | x |
| <i>Macaca mulatta</i> | YPM 000329 | x | x | x | x |
| <i>Papio</i> | YPM 000333 | x | x | | x |
| <i>Ptilocolobus foai</i> | FK110 | x ² | x | x | x |
| <i>Pygathrix nemaeus</i> | YPM 000339 | x | x | | |
| <i>Semnopithecus entellus</i> | YPM 000338 | x | x | x | x |
| Total | | 33 | 28 | 27 | 25 |

n spp = 30

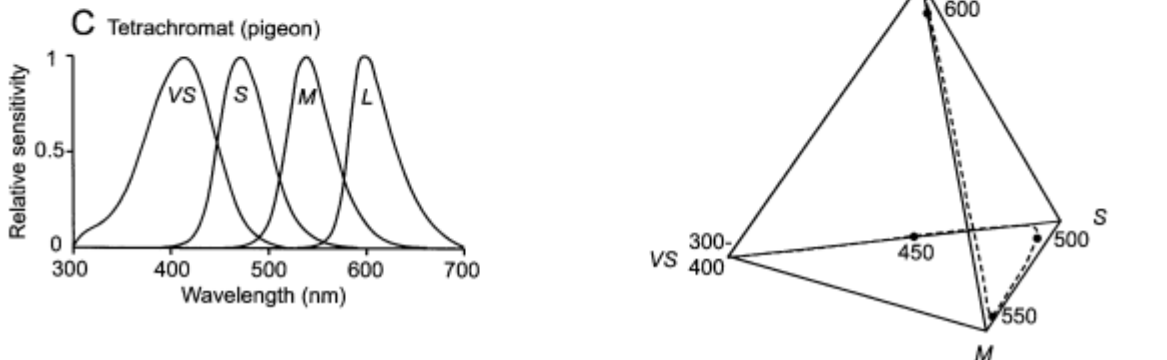
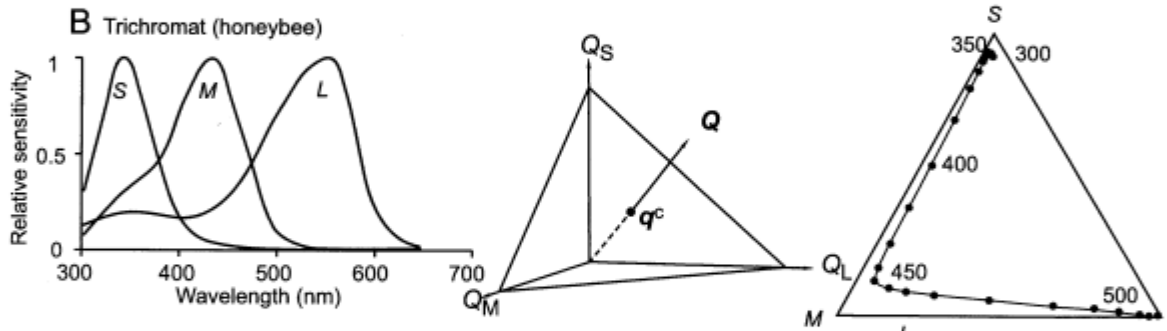
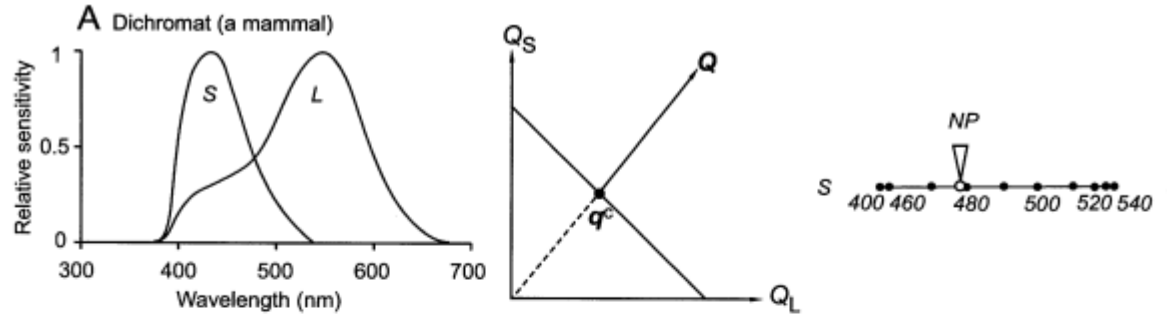


n spp = 399



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Visual Modeling

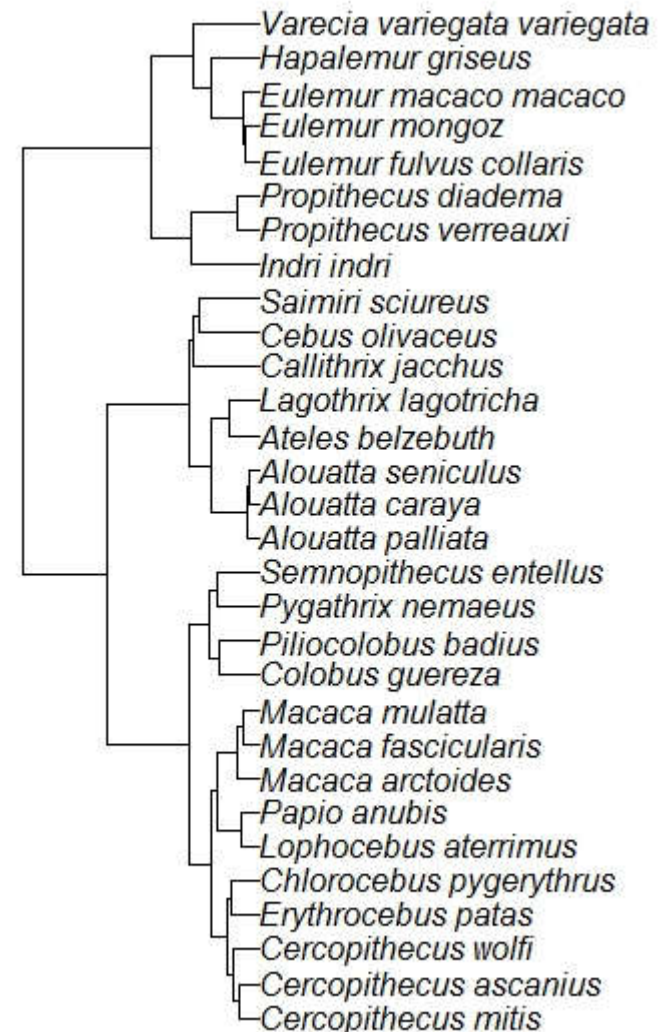


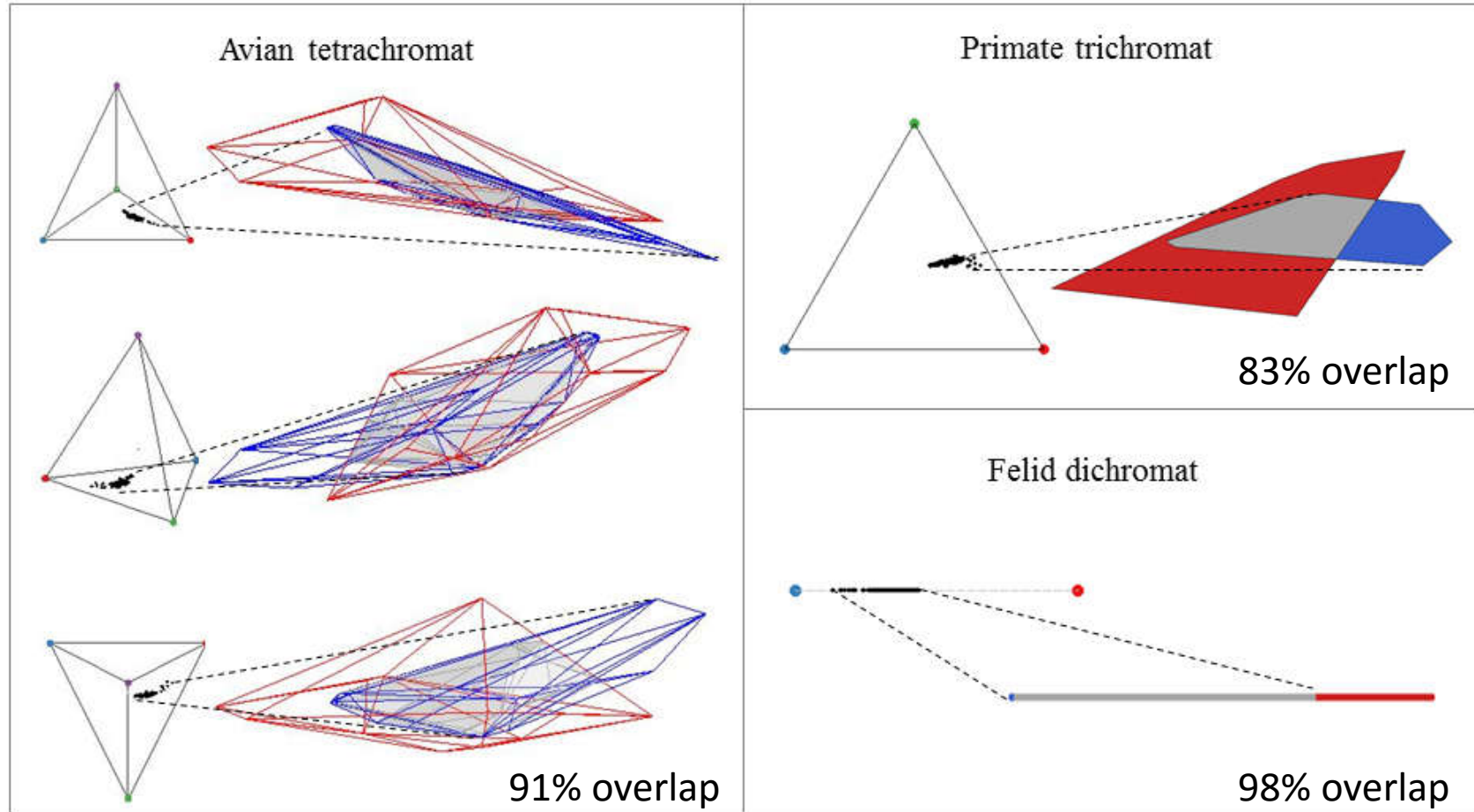
Analyses

Phylogenetically-controlled
generalized linear mixed models
(MCMCglmm)

Fixed effects: visual system, body
part

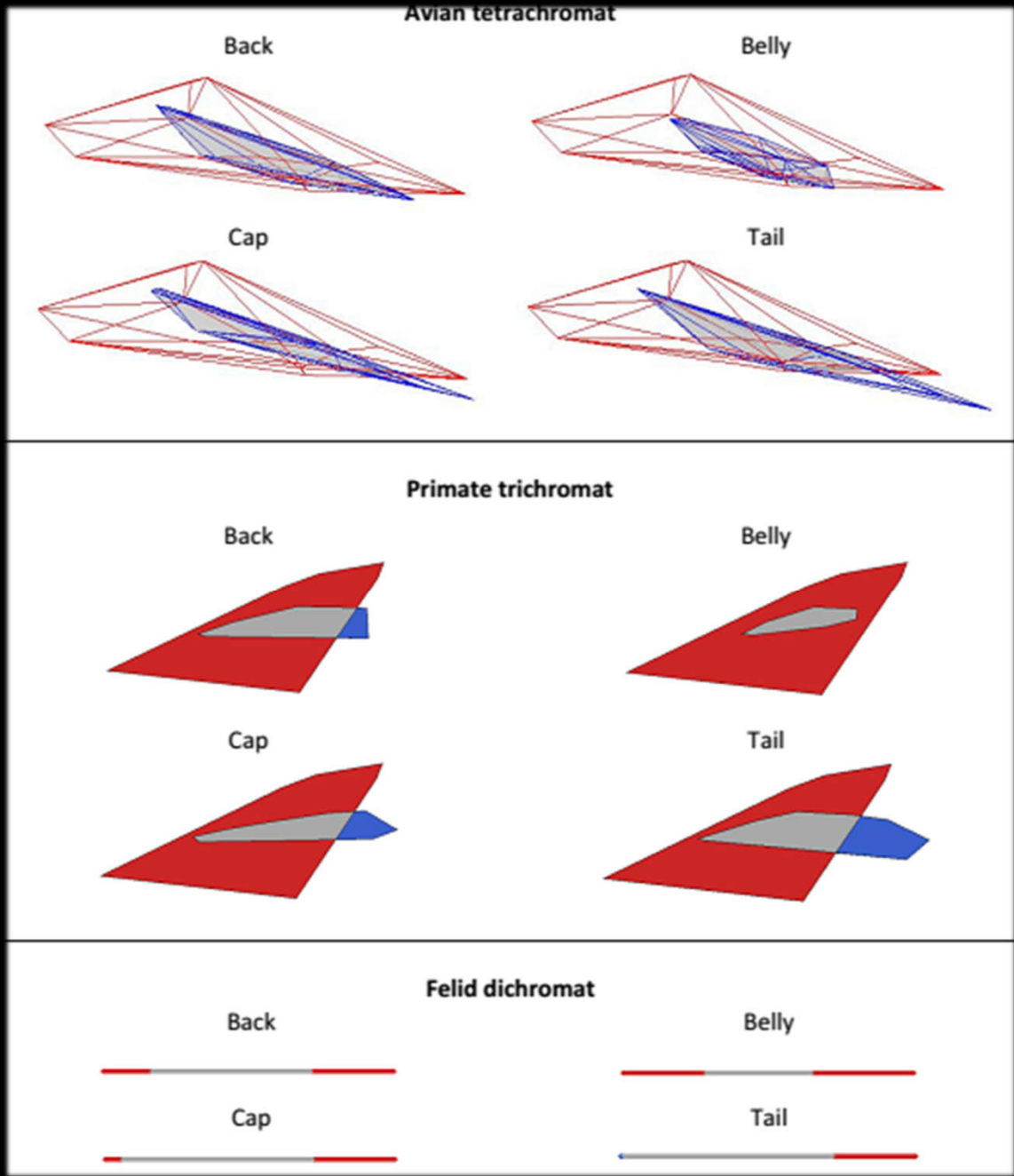
Model comparison using DIC
comparison & Wald tests





| Tetrachromat | Trichromat | Dichromat |
|-------------------------|-----------------------|-----------------------|
| • $\lambda_{max} = 371$ | | |
| • $\lambda_{max} = 448$ | $\lambda_{max} = 437$ | $\lambda_{max} = 454$ |
| • $\lambda_{max} = 502$ | $\lambda_{max} = 533$ | |
| • $\lambda_{max} = 563$ | $\lambda_{max} = 564$ | $\lambda_{max} = 561$ |

■ Primate
■ Background



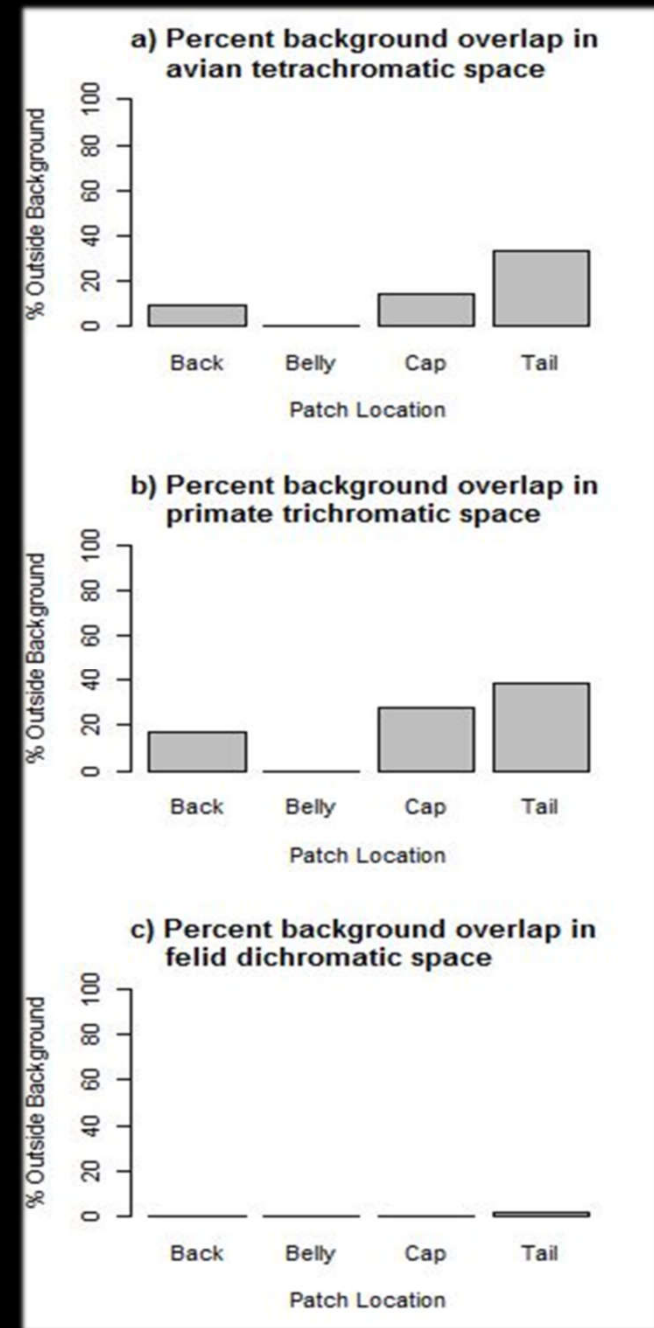
Full model fit data better than those excluding body part (DIC difference = 5.38) or visual system (DIC difference = 10.6)

Significant influence of **body part** (Wald chi-square = 8, $p = 0.018$)

- Cap & tail more likely to be outside background than belly (pMCMC = 0.001, 0.012, respectively)
- Back non-significant trend in same direction (pMCMC = 0.070)

Near-significant influence of **visual system** (Wald chi-square = 7.6, pMCMC = 0.054)

- Greater overlap in dichromatic v. trichromatic (pMCMC = 0.004) & tetrachromatic (pMCMC < 0.001) space
- No significant difference in trichromatic v. tetrachromatic space (pMCMC = 0.492)



Major Findings

Primate colors overlap greatly with background foliage colors – background matching

Differences between visual systems

- Primates less conspicuous to dichromatic felids compared to trichromatic conspecifics and tetrachromatic raptors
- Tetrachromacy does not provide improved detection over trichromacy

Differences across body parts

- Caps and tails most contrasting to background
- Bellies most background matched

Conclusions

Trade-offs between selective pressures

Red colors as a semi-private channel?

More colorful regions restricted to body parts used in conspecific signaling

Primate appearance has been influenced by the need to match backgrounds to reduce predation while communicating with conspecifics

Acknowledgements

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Questions?