

Multiple Ornaments: Trade-offs and Redundancy in Signaling Functions in male and female varied tits (*Sittiparus varius*)

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Abstract: Signals conveyed by ornaments can be indicators in the process of sexual selection. Specifically, signals may superimpose each other to represent an individual's quality, convey different information, or offer redundant information. As much of the research has focused on relationships between males' diversified signals, those of females' have largely been overlooked. From 2022 to 2023, we tested whether the three traits, namely acoustic (song display) and visual ornaments (patch size and carotenoid-based plumage coloration), and morphology (wing and tail length), were interrelated in males and whether visual ornaments and morphology were interrelated in females on a wild population of varied tits (*Sittiparus varius*). We found that males with brighter and more reddish plumage sang at lower maximum and minimum frequencies, with narrower bandwidths and lower frequency peaks. Similarly, a negative correlation between tail length and carotenoid-based plumage coloration were observed in both sexes. Furthermore, a positive relationship was found between signals within traits. These results highlight the trade-offs of signals between different traits, as well as the consistency within the same traits.