SEASONAL DYNAMICS OF PLUMAGE COLORATION IN CAPTIVE GREATER FLAMINGOS (*Phoenicopterus roseus*)

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INTRODUCTION

Plumage coloration in the Greater Flamingo is determined by the accumulation of carotenoids, lipid-soluble pigments that not only confer the typical pink hue but also perform important antioxidant and physiological functions. Color intensity acts as an **indicator of individual condition and represents a high-quality visual signal** closely related to health status and reproductive success.
The species exhibits reversed sexual dichromatism, with females generally more intensely pigmented than males, and displays cosmetic coloration, consisting of the topical application of carotenoid-rich uropygial secretions to enhance feather brightness. Even in captivity, and under a constant diet, plumage color may still vary throughout the year.

Aim of the study

Analyze the **seasonal variation of plumage coloration** in a captive colony, assessing sexual differences and possible correlations with reproductive phases.

MATERIALS AND METHODS

- Study period: 2018–2019
- Location: zoo facility, Northern Italy
- Sample: approximately 100 ringed adults with a balanced sex ratio
- Duration and frequency: March-November (5 sessions in 2018; 7 sessions in 2019)
- Observation time: 10:00–12:30 (to ensure the best morning light)
- Feather coloration was assessed at the dorsal base of the neck.
- Each individual was assigned a score according to a three-level color scale:

1) Very pale pink
2) Pale pink
3) Intense pink

- Observations were independently carried out by three operators to minimize subjectivity; the final score assigned to each bird corresponded to the value agreed upon by at least two observers.

RESULTS

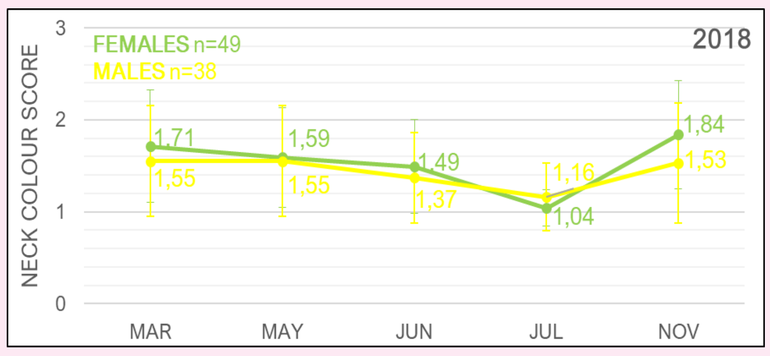
The analysis revealed a **seasonal pattern in plumage coloration** across both years of study. During the breeding season, the majority of individuals exhibited pale plumage tones, with a marked decrease in color intensity from spring to mid-summer. This period coincides with egg incubation and chick rearing, when energetic investment is primarily directed toward reproduction rather than self-maintenance.
As the season progressed, plumage coloration gradually increased in intensity, reaching its peak in late autumn. Both sexes showed this trend, although females consistently maintained higher color scores than males throughout the study period, confirming the presence of **reversed sexual dichromatism** typical of the species. These findings indicate that **plumage coloration in flamingos is a dynamic and reversible trait**, responsive to physiological and behavioral changes over time (Fig. 1, Fig. 2)

DISCUSSION

The observed seasonal variation supports the hypothesis that flamingo **plumage color reflects a balance between physiological demands and ornamental signaling**. During reproduction, carotenoids are temporarily redirected toward essential physiological functions such as antioxidant defense, yolk pigmentation, and crop-milk production. After breeding, these resources are reinvested in cosmetic coloration through uropygial secretions, enhancing plumage brightness in preparation for social and reproductive displays.
The results demonstrate that diet alone cannot account for the observed changes, as the feeding regime remained constant throughout the study period, with no addition or removal of pigment sources that could have affected plumage coloration. This highlights the role of hormonal regulation, photoperiod, and preening and **make-up behavior**, in which individuals apply carotenoid-rich uropygial secretions to enhance feather coloration. The persistence of higher coloration in females across both years further supports the **adaptive significance of reversed sexual dichromatism**, possibly linked to female choice and parental investment.

CONCLUSION

Plumage coloration in *Phoenicopterus roseus* is a **dynamic and seasonally modulated signal**, even under captive conditions. Carotenoids are redistributed between physiological and ornamental functions depending on the time of year. Females maintain higher color scores, confirming reversed sexual dichromatism.



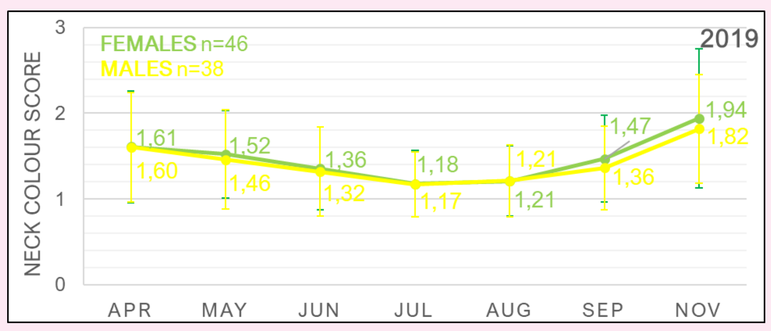
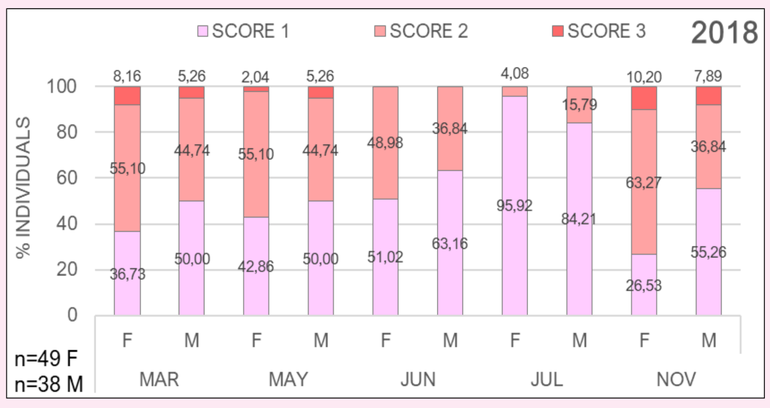


Fig. 1



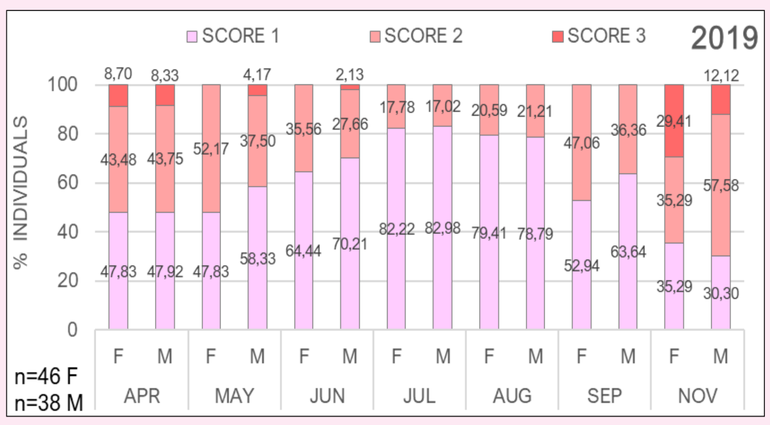


Fig. 2

4th International Flamingo Symposium
Venice, Italy
2025 November 10-15

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