

## Zoological Lighting Institute PhotoSciences Research Grants

### Plumage and behaviour in wild parrots of the New World Tropics (genus *Amazona*)

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#### Introduction

No facet of biodiversity is more striking than the colours of the natural world. Thus, understanding the mechanisms and functions underlying this variety is pivotal to understanding biodiversity itself. My thesis focuses on the ecology and evolution of plumage colouration in parrots, arguably the most social, vocal, intelligent and colourful birds.

#### Background:

Birds are the most colourful vertebrates, and both scientists and the public have been fascinated by plumage colouration for centuries. The study of avian colouration has contributed to our understanding of evolution, signal theory and animal behaviour<sup>1</sup> and has even led to the development of biomimetic materials<sup>2</sup> and novel lasers<sup>3</sup>. By studying the use of plumage in behaviour, we can understand the selective pressures acting on avian colouration and gain valuable insights into the evolutionary processes that shape colour diversity.



Figure 1: A red-tailed Amazon parrot fanning its tail. From *A Guide to Parrots of the World* by Juniper and Parr (1998)

The genus *Amazona* consists of 34 species of parrots, endemic to the neotropics. My initial observations and spectrometry measurements of *Amazona* specimens show that tail feathers change in hue and brightness, depending on the angle of observation. This phenomenon is a result of the interaction between light and the nanostructure of the feather rather than the feather pigments. Feathers that show changes in colour are often important in visual signalling, as famously noted in hummingbirds and peacocks<sup>4</sup>. Amazon parrots are known to ‘fan’ their tails – spread out and wave tail feathers from side to side – during courtship and aggressive displays<sup>5</sup> (Fig. 1). Consequently, it is likely that the dynamic colour of *Amazona* feathers is involved in social signalling. Dynamic displays in the animal world are understudied and we may be missing important components of the complex signals that influence animal behaviour. I am highly motivated to study Amazon parrot behaviour in their natural habitat and this will inform one chapter of my thesis which focuses on the interaction between behaviour and dynamic colouration. I believe that this field research project will enhance our understanding of these fascinating birds and, more broadly, dynamic colour communication in a natural setting.

Hypothesis: I predict that parrots should orient displays toward the sun because this can enhance signal efficacy by altering the brightness and hue of the feathers. Peacocks, for example, maintain an average angle of 45° relative to the sun when displaying their iridescent train<sup>6</sup>.

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Methods: I aim to observe several species (including the mealy, vinaceous-breasted, red-browed, red-spectacled, red-tailed, orange-winged and turquoise-fronted Amazon parrots) at roosting sites in the wild in São Paulo state, Brazil. Field sites are easily accessible from São Paulo city and include Ilhabela Island, Cardoso State Park and the *cerrado* west of São Paulo city. The display angle can be measured using a field compass and compared to the angle of the sun using a solar angle calculator<sup>6</sup>. I will also collect spectrophotometer measurements of tail colouration using museum specimens of *Amazona* parrots, to quantify the degree to which hue and brightness change with viewing angle. Colour data will be collected at the American Museum of Natural History (New York City) and the Academy of Natural Sciences of Drexel University (Philadelphia).

Combining spectrometry data and the angle of a displaying parrot, relative to an observer and the sun, I will model what a tail-fanning display looks like to an avian viewer. This requires converting absolute measures of reflectance to bird colour-space, by determining how a particular stimulus activates the four types of avian retinal cone cells<sup>7-9</sup>.

### Anticipated Analyses and Findings

I aim to produce a rich description of tail-fanning behaviour in wild Amazon parrots, as well as the most robust quantitative description of angle-dependent colouration in Amazon parrots. My observations will also contribute to our understanding of the natural history of these important social displays – what is the lighting and social context in which these displays are performed? Furthermore, I hope to determine whether displays tend to be oriented towards the sun, more than randomly expected, similar to the analysis of Dakin and Montgomerie<sup>6</sup>.

### Ethical Statement of Animal Research

No animals will be harmed or otherwise disturbed during this research. Field research will be observational and done from a distance, using binoculars, so as to avoid disturbing the animals. I have also applied to my university's animal care and use committee for field research approval, and anticipate that my application will be approved.

### References:

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