# Visual Fields and Foraging Techniques in Blue Jays and Red-winged Blackbirds

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Blue-jay (BJ)

Red-winged Blackbird (RWBB)

## Introduction

- Birds rely heavily on vision to obtain information from the environment.
- There is evidence in non-Passeriformes that the configuration of the visual system is associated with foraging and anti-predator behaviors, but less is known about Passeriformes.
- Our goal was to characterize the visual fields of two species of Passeriformes with different foraging behaviors, Blue Jays (BJ) *Cyanocitta cristata,* and Red-winged Blackbirds (RWBB) *Agelaius phoeniceus.*
- RWBBs often forage with a 'gaping' technique, using the beak to pry apart a substrate in order to access prey, which may require a certain degree of binocular specialization.
- BJs have a wide range of foraging strategies (pecking, gleaning, scavenging, hawking, catching) that may be better suited for lateral vision.
- We compared the configuration of the visual fields (volume of space around the head from which visual information can be obtained) of these two species taking into account the degree of eye movement.

## Methods

VISUAL FIELD CONFIGURATION:

- We measured the configuration of the visual fields with an ophthalmoscopic reflex technique (Martin et al. 2007, Journal of Ornithology 148:547-562).
- Birds were restrained in a visual field apparatus.
- The head was held in its natural position (bill parallel with the ground) in the center of the apparatus.
- Measurements were recorded when the eyes were at rest (relaxed position), diverged (eyes towards the back of the head), and converged (eyes towards the bill) .
- Experimental procedures were approved by PACUC (09-018).

## Results

While at rest, there is a 20° difference in the width of the binocular field of the BJs (32°, Fig. 1a) and RWBBs (52°, Fig. 1b) in the horizontal plane. The blind area of the RWBB (49°, Fig. 1b) is much larger than that of the BJ (20°, Fig. 1a), limiting the size of the lateral field. Additionally, the bill intrudes into the binocular field of the RWBB while the eyes are at rest.

Upon divergence of the eyes, there is a 7° difference in the width of the binocular field of BJs (0°, Fig. 1c) and RWBBs (7°, Fig. 1d) in the horizontal plane. The blind area of BJs is nearly eliminated upon divergence of the eyes (5°, Fig. 1c). However, RWBBs still have a fairly large blind area (31°, Fig. 1d).

Upon convergence of the eyes, the binocular field was 44° for the BJ (Fig. 1e) and 54° for the RWBB (Fig. 1f). The blind area of the RWBB (74°, Fig. 1e) is 31° larger than that of the BJ (43°, Fig. 1f), limiting the size of the lateral field. Additionally, the bill intrudes into the binocular field of both species when they converge their eyes.

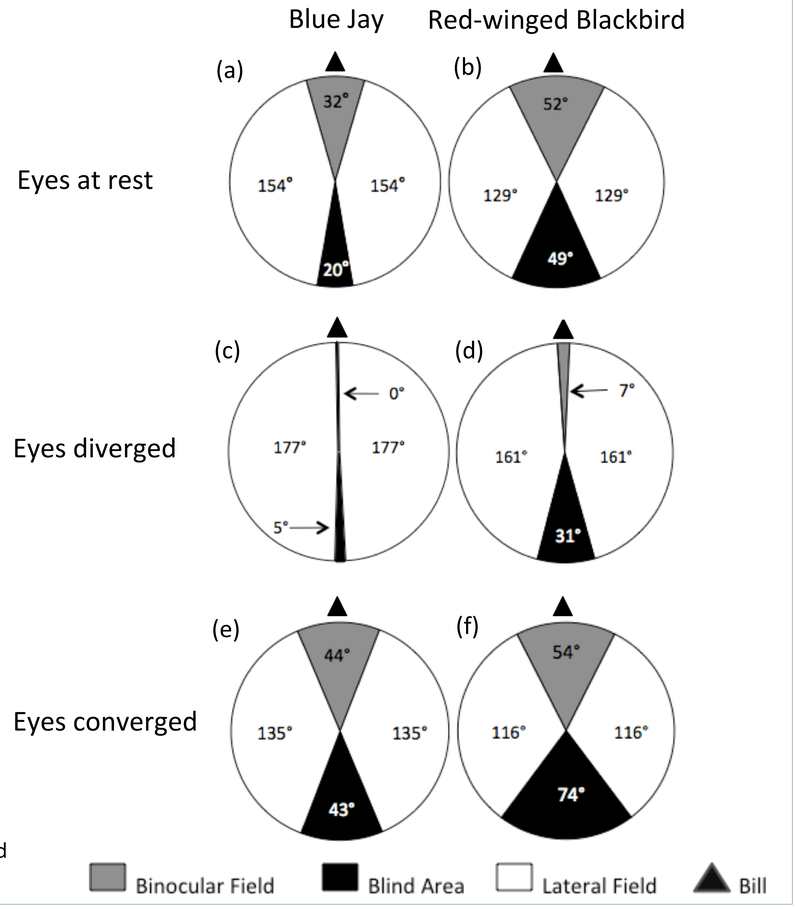


Fig. 1. A top-view representation of the visual field at the horizontal plane (bill parallel with the ground) when the eyes are at the resting (a,b), diverged (c,d), and converged (e,f) position for each species.

## Conclusions

- Our results suggest that the visual fields of both species appear to be associated with their foraging strategies.

- First, Red-winged Blackbirds have more frontally placed eyes than Blue Jays (Fig. 2a,b). More frontally placed eyes generally result in wider binocular fields, as found in this study.

- Second, the area of highest acuity on the retina (fovea) is positioned in the same centro-temporal position in both species (Moore & Fernandez-Juricic, unpubl. data, Fig. 3). Given the different positions of the eyes in the skull (Fig. 2), we expect that the projection of the spot with high acuity vision in the visual field will differ between species (Fig. 2c,d). Therefore, high acuity vision will be more frontally placed in the Red-winged Blackbird, and more laterally placed in the Blue Jay (Fig. 2c,d).

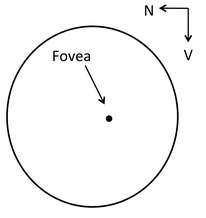


Fig. 3. Schematic representation depicting the orientation of the retinal specialization (fovea) in both BJs and RWBBs. N, nasal; V, ventral.

- Frontally placed eyes, placement of the fovea around the bill-tip, and a large degree of binocular vision may enable Red-winged Blackbirds to examine objects visually with high acuity within the binocular field (Fig. 4 a,b). These visual traits can be beneficial for a species that frequently uses a gaping technique to secure food. On the other hand, laterally placed eyes, wide lateral areas, and a laterally placed fovea may provide Blue Jays with greater flexibility to examine objects with their lateral visual fields in various ways (Fig. 4 c,d), which may be associated with more diverse foraging techniques.

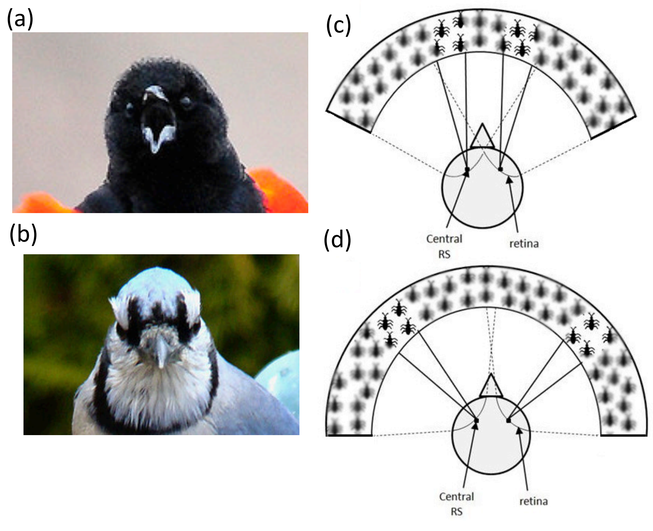


Fig. 2. Eye position of (a) RWBBs and (b) BJs. (c, d) Schematic representation of the projection of the retinal specialization (RS, fovea) for species with eyes placed more frontally (c) and more laterally (d).

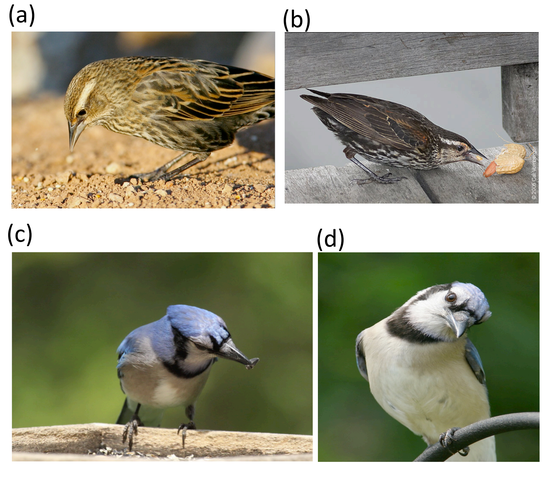


Fig. 4. RWBBs often examine objects with their binocular field (a,b). BJs often inspect items laterally (c,d).