Arizona's Raptor Experience, LLC

September 2018

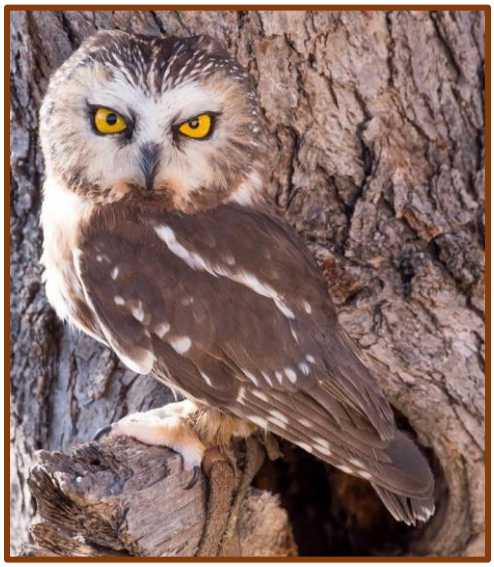
~Newsletter~

Greetings from Chino Valley!

We hope you are well and ready for autumn. Birds are showing signs of the changing season by starting to migrate – another big wave of hummingbirds passed through our yard, consuming massive amounts of sugar water, and the Swainson's Hawks have been gathering into large groups here in Chino Valley getting ready to make their way south. Paul's honey bees remain busy on the last of the flowering plants but will be settling in for winter in a little over a month. The cooler evenings will soon prompt rattlesnakes to seek shelter and we will begin hunting with the birds once again. At the end of October, we will visit Jay's Bird Barn (the birds will too!) at the Flagstaff and Prescott locations. Hope to "see" you there. In this issue, we focus on raptor vision – we hope you enjoy it!

The Eyes Have It!

Photo by Eric Gofreed, DVM



Northern Saw-whet Owl with beautiful yellow eyes.

Photo by Mark Elder

Raptor Vision

Birds of prey have the most highly evolved eyesight of all living organisms. Scientists estimate their visual acuity is somewhere between three and eight times better than ours. They see in color and can discern black and white. Some even see in the UV spectrum. Vision is the most important sense used by diurnal raptors, and, together with their hearing, is just as important to the nocturnal owls.

Cool Fact

If your night vision were equivalent to that of a Barn Owl, you could see a mouse from one mile away with just the light of a match!

Eyeball Basics

The eyes of all vertebrates have a cornea through which light initially enters the eye. It passes through the pupil, which is surrounded by the colored iris to finally reach the retina, which is like a screen at the back of the eye where the image seen is projected.

Once we get beyond this basic design, we start to find some differences. Bird's eyes in general are larger in proportion to their body size than the eyes of other vertebrates. In some species, the two eyes together can actually weigh more than the brain! If you have the chance to examine an owl skull, you will see that the eyes take up most of the room in the skull. In fact, the eyes are so large, that no room is left for muscles to move them. This is also true for hawks, falcons and eagles. To compensate, birds of prey have 14 cervical vertebrae, seven more than humans and most birds, which gives them tremendous flexibility and a 360-degree visual field when they rotate their head.

Although both owls and diurnal raptors share eye placement at the front of the head with overlapping binocular vision and good depth perception, there are differences in the make-up of their eyes, each favoring the lifestyle of the bird. Let's start with the retina. This part of the eye has a huge number of light sensitive cells called rods and cones. The rods work well in low light, are sensitive to black and grey tones and shape. The cones need more light to work

and are sensitive to bright light and colors. Also in the retina are fovea, or small pits. The cone cells are tightly packed in these pits. The fovea refract light, enlarge the image being seen and enhance focus.

The diurnal raptors are bi-foveate, meaning they have two foveae on each retina. One is deep and provides a forward line of sight, allowing them to focus on distant objects. To get the best image to fall on this fovea, the bird turns its head to the side when looking at things in the distance. The shallow fovea aids in three dimensional and binocular vision. When using this fovea, the bird faces forward.

Owls only have one fovea on each retina, and their eyes are placed a little more to the front of the head, giving them a greater binocular field of view. The fovea in owls contains primarily rods instead of cones, which is an adaptation to their nocturnal lifestyle.

The eyeball itself in owls is shaped differently than diurnal raptors. They are longer from front to back than they are from side to side. This allows them to function much like a pair of binoculars, giving them enhanced distance vision that is excellent despite only having one fovea.

Cool Facts

Humans have 200,000 rods cells per square millimeter of retina. Owls have 1 million rods in the same amount of space on their retina.

Primates are the only foveate mammals. Humans have one fovea. When looking straight at an image, we see it clearly, but have poor peripheral vision.

Eyelids and Pupils

Like many birds and some reptiles and mammals, raptors have three eyelids. The upper and lower eyelids only close when the bird is asleep, and the muscles that close these eyelids are involuntary. The third, usually translucent eyelid, called the nictitating membrane, moves across the eye to moisten and clean the eye surface. This eyelid is controlled by voluntary muscles. On

Barred Owl with "blue blink."

P. Schnell photo

occasion photographers capture the moment when the nictitating membrane is crossing the eyeball. The appearance is referred to as the "blue blink."

Muscles that control the pupil in birds are also voluntary, unlike in humans (ours are involuntary). Therefore, birds' eyes can adjust more quickly to changing light conditions. Hawks are particularly adept at adjusting quickly. Nocturnal owls open their pupils wide to admit the maximum amount of light for nighttime hunting. They can adjust the size of their pupils independently of one another – adjusting to the amount of light on each side of the head!

Cool Fact

The human eye takes 30 minutes or more to adjust to darkness to achieve our best nighttime vision. We cannot actively control our pupils – the muscles are involuntary.

Eye Color

The color of the iris in birds of prey varies as it does in other animals. Trying to explain the evolutionary reasons for differing and even changing eye color is a difficult task, although theories do exist. For example, it is believed that the eye color change from brown to yellow in Bald Eagles, together with their changing beak color and the addition of white head and tail feathers, is a sign of sexual maturity, reached at five years of age. (P. Schnell photos.)

Juvenile Bald Eagle

Mature Bald Eagle

In another group of birds, the *Accipiters* (Sharp-shinned Hawks, Cooper's Hawks and Goshawks), eye color changes as the birds age even beyond sexual maturity. One theory suggests that eye color can advertise the age of birds to prospective mates, the oldest having the greatest value as a mate because of their experience and hunting skills. In these species eye color changes from yellow, to orange to red as the bird ages. The change appears to occur more rapidly in males. A disadvantage to this change comes in the nest when feeding young. Young raptors are attracted to red objects when feeding and may strike at the adult's eyes just as readily as they would a piece of meat. More experience with feeding young probably reduces this risk. Young inexperienced females have yellow eyes thus reducing the risk of injury while they are still awkward with chicks.

Here is an example of eye color changes from yellow to orange in the Cooper's Hawk. Older birds have red eyes.

Red eyes in an older Sharp-shinned Hawk.

Many thanks to our dear friends up north at Braddock Bay Raptor Research for sharing these photos!

www.bbrr.org

In owls, only four North American species have dark brown eyes (Barn Owl (pictured on the right), Barred Owl, Spotted Owl and Flammulated Owl). All other species have yellowish eyes. Some have speculated that habitat preferences may dictate eye color, however Barn Owls are open country birds whereas Barred Owls prefer wooded areas. Other theories suggest eye color may play a role in communication. We still have much to learn!

Featured photo

Marlee – Barn Owl

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