PROPER LIGHTING TO SUPPORT AVIAN VISION

The Importance of Avian Lighting

Birds may be the most visually-oriented animals in nature. They have one of the most sophisticated visual systems, the largest eyes of any animal (relative to body size) and the highest proportion of brain power devoted to vision. They have often been described as "a pair of eyes with wings".

Birds' ability to see color far surpasses that of humans, as does their visual acuity and the speed with which they process images. In almost all aspects of the visual experience, birds see a world that we can scarcely imagine. Yet our companion birds often exist in an environment that is unable to support this spectacular visual machinery. Our human homes are lit for our comparatively unsophisticated eyes, and they often leave our feathered companions, if not "in the dark", then something relatively close to it.

Birds need proper light to find and analyze food; to identify flock mates; to detect predators and other dangers; to regulate daily cycles (sleep, feeding); and to regulate seasonal cycles (migration, reproduction). Yet standard home lighting is inadequate for several reasons. It is far too dim, has poor color spectrum, is often too red, has little-to-no ultraviolet, and is usually placed too low to effectively illuminate a bird's environment. These deficiencies can lead to health and behavior problems such as lethargy (inadequate brightness to fully trigger wakefulness), poor appetite (food may not "look right"), phobias (difficulty identifying objects and detecting dangers), and aggression (cannot recognizing flock mates), stress (from color imbalance), and reproductive behavior (too much red light indicating breeding season).

Moreover, birds actually have extraocular photoreception, meaning that they are affected by light in ways other than through their eyes (vision). Birds have two glands: the harderian gland and the pineal gland, which respond to light and are, thereby, thought to control things like migration/molting, reproduction, and sleep cycles. And, their visual acuity is superior; avian photoreceptors are 8 times denser than the human eye, allowing them to focus on the entire field of view, all at once.

To address the shortcomings of home lighting for birds, we need to consider the lighting equipment that our birds evolved under: the sun. While most of us can't realistically offer our birds full access to natural, unfiltered sunlight, many options exist to bring some of the key qualities of the sun into our living areas. We simply need to understand which characteristics of sunlight are most important to our birds' visual experience.

Brightness

The most important aspect of avian lighting is adequate brightness. The lighting that humans use in their homes is often hundreds—or thousands—of times dimmer than the tropical sun that our companion birds are used to. Recent studies have shown that birds require five-to-twenty times the light humans do in order to see in color. In general, this means that birds have severely limited color vision in lighting conditions dimmer than those of a clear sunrise or sunset.

Most human homes are not lit to nearly this brightness level. Standard living room lighting is about eight times dimmer than sunrise or sunset. Even the most brightly-lit rooms in our homes—the kitchen and bathroom—are rarely bright enough to fully support avian vision. To make matters worse, humans are generally poor at noticing differences in brightness. Our eyes quickly adjust to low light conditions, giving us the impression that our indoor lighting is much brighter than it actually is.

When buying bulbs, know that the brightness of a light source is measured in lumens and the brightness of light over an area, as perceived by humans, is measured in lux. To give you some perspective: the brightness of the sun at sunrise is 400 lux; the brightest room in your house, your kitchen, is about 300 lux; the brightness of the sun in the tropics at mid-day is about 130,000 lux.

Currently, fluorescent tubes offer the best solution for providing adequate brightness. They can greatly increase the brightness of a room with a minimum of cost or electricity use. They also provide a diffuse light source that mimics the general diffuse, bright lighting of a tropical forest.

Spectrum (CRI, Color Rendering Index)

Bird’s visual ability exceeds ours in many ways, and nowhere is this truer than in the area of color vision. Birds' eyes have four different color receptors compared to our three, giving them an extra dimension of color perception. Each color receptor is also much more precise than ours, and tests have shown that birds are able to distinguish between colors that look identical to humans.

These visual "superpowers" give birds the potential to see billions of colors, whereas human color perception maxes out at around seven million. This makes birds much more sensitive to differences in the

color spectrum of light. Lights that seem adequate for human purposes will likely be seen by our avian friends as quite different from natural sunlight.
The accuracy of a light's color spectrum is often expressed in Color Rendering Index (CRI). A perfect CRI is 100, reflecting the color of midday sunlight. Most indoor lighting has CRIs in the 60s and 70s. Even so-called full-spectrum lights can be rated as low as 85 CRI.

At first glance, large windows seem like a great solution to the problem of accurate spectrum. Windows certainly provide the high CRI of minimally-filtered sunlight, but they also present some problems. Large windows can leave birds feeling exposed, adding to their stress levels. Windows may also lead to overheating if a cage is left in direct sun for too long.

Again, fluorescent tube lighting comes to our rescue. Many manufacturers produce specialty fluorescent bulbs that have a rating of 95 CRI or above. These bulbs tend to produce the most accurate and longest-lived color output.

Color Temperature

The temperature rating follows the color progression that hot objects exhibit as they start to glow from heat. As an object heats up, it first gives off dull red and then orange. These are examples of lower-temperature colors (note that this is the opposite of the cool/warm ratings that artists use). As an object grows hotter, its light becomes orange, then yellow and finally white and blue. (The flame on a gas stove is a great example of a very hot color spectrum.) Thus, “cooler” light is red (long wavelength), “hotter” light is blue (short wavelength).

For lighting, color temperature is measured on the Kelvin (K) temperature scale. You'll find ratings of "4700 K" or "6000 K", where the "K" stands for "Kelvin." This does NOT mean that the bulb gives off 6000 K of heat! It is simply a convenient way to refer to the hot/cold balance of colors in a light's spectrum.

Our companion birds do best under the color temperature of the sun (as experienced on earth), which is 5000 K in the tropical latitudes. Color temperatures lower than this (more red) can lead to breeding behavior, while higher color temperatures (more blue) have been shown to produce more stress and feather destruction. For tropical birds, look for a light that has a temperature of at least 5000 K and not more than 5700 K.

Specialty fluorescent tubes, like the Philips TL-950, give the best color temperature (5000 K) and have a of 98 CRI rating, offering a great option for basic supplemental lighting for your birds.

Ultraviolet Support

In addition to seeing more color detail, birds are also capable of seeing ultraviolet light. Birds likely perceive UV as an additional set of colors, which combine with the other colors in their visual spectrum. These extra color combinations are what allow birds to see around 200 times the number of colors that humans perceive.

Human vision stops around wavelengths of 380 nm, or just below ultraviolet. Birds can see wavelengths as low as 315 nm, thus into the near UV-A. UV-A is the closest to human visible light, and occurs in wavelengths of 315 to 400 nm, or approximately the limit of bird vision at the low end of the spectrum. UV-A is further divided into:

- Near UV-A (345-400 nm), which enhances bird vision of food, feathers, and so on.
- Far UV-A (315-345 nm), which produces suntan and vitamin D production in humans.

Birds' ultraviolet vision is likely useful in recognizing their flock mates. Most parrots have feathers that reflect UV light, meaning that parrot eyes are likely tuned to notice those reflections. Some parrots may even display sexual dimorphism in their UV coloration.

Birds can also use their UV vision to see the nutrients in their food. Flowers, berries, and fruits reflect UV light, as do many key nutrients and toxins. This is not unlike humans' ability to detect sugar content simply by looking at the amount of green or yellow in a banana's skin. For birds, their UV-sensitive eyes allow them to see oils, sugars, vitamins, minerals and amino acids that are invisible to us. Without UV light, birds cannot identify whether food looks nutritious and enticing, or rancid, moldy, and toxic. Thus, food may simply not "look right" to birds and may lead to problems with appetite.
Most of our household lighting is well-shielded against UV output. In addition, modern window glass blocks practically all UV. Mix in UV-absorbing interior paint and our living rooms are very UV-poor environments indeed.

Luckily, birds do not need much UV light to support their full vision. Natural sunlight has no more than 5% total UV content, of which only .1%—that is, 1/10 of 1 percent—is UV-B. Also, birds are not capable of seeing the powerful ultraviolet-B light, which is a high-energy, short wavelength of 280-315 nm. This light produces sunburn, skin cancer, and cataracts in humans and animals. Fortunately, in nature we are shielded from most UV-B, which is largely absorbed by the atmosphere. Thus, the UV-B that most reptile bulbs put out—and which have been repackaged as Avian lights—are not necessary to support your bird's vision and, in fact, can be dangerous.

(There's also little evidence that UV-B is useful for generating vitamin D, but that's a topic for another day.) A small fluorescent tube labeled "black light" should provide enough UV to support your birds' vision. Make sure that it only outputs the lower-energy ultraviolet-A, and try to find a bulb that also puts out some visible light. The Philips 13036 model is a good choices for UV supplementation.

While humans and other land vertebrates require some ultraviolet to produce vitamin D in the skin, birds produce vitamin D in oils secreted onto their feathers while preening. Birds can manufacture vitamin D with UV-A. UV-B is not required for birds and should only be used under explicit directions from your avian vet.

Placement

Proper positioning of a light source is often an afterthought, but it is a critical consideration when setting up your bird's lights. Placing a light directly over the cage (or on the cage) can lead to stress as a bird adjusts to a large new object looming over them. Also, placing a light too close to the cage can lead to big differences in light levels in different parts of the cage. That's because brightness is the measure of the amount of light at a certain location; and drops off as the square of the distance from the light source. Thus, if you move your light 2 feet further away from your bird cage, the brightness decreases 4 times. Conversely, if you move the light 3 feet closer, the brightness increases 9 times! So, do not place the light too close or too far from the cage.

Placing a light too low will also negate many benefits of proper lighting. Food dishes will still be in shadow, as will many toys and cage mates. Also, light coming from below or from the side may defeat a bird's natural eye shading, reducing visual acuity and causing stress. For best results, place your bird's lights well above the cage and offset from the top. This will give good, consistent illumination without adding a potential new stressor to your bird's environment.

Summary

As with most parrot-related topics, there is more to learn and new information constantly being discovered. But, at present, you can give your birds a decent indoor visual experience using a combination of windows and fluorescent tubes with the proper specifications, installed in electronic ballast fixtures, and supplemented with blacklights for near UV-A visual support. For additional focused light, you can use carefully placed halogen bulbs.

If mounting or hanging fluorescent tubes is not an option, using compact fluorescents is still better than using standard incandescents found in most homes.

Mickaboo offers a free class that covers these topics in detail. You'll learn about light, avian vision, the properties of sunlight, and how to select and set up proper lighting for your bird. Check our website under Advanced Classes for the next time this class will be offered.

LIGHTING REFERENCE

What do birds need to best simulate their natural experience in nature under the sun?

ADEQUATE BRIGHTNESS

Try to provide 400 lux as a minimum, 1000 lux or more is preferable. It is highly unlikely that your setup will be too bright. 10,000 lux, which would be nearly impossible to simulate, is acceptable. However, also provide an area that is shielded from light, by hanging a towel over a corner of the cage or placing a large (bird-safe) floor-plant behind it.

PROPER COLOR SPECTRUM

The ideal CRI (Color Rendering Index) is 100, which is the spectrum of the midday sun. Since humans cannot detect CRI over about 85, bulbs labeled full-spectrum are often no better than 85 CRI. For birds, the CRI should ideally be 93 or above, if possible.

APPROPRIATE COLOR TEMPERATURE

5000 K (Kelvin) is perfect, up to 5700 K is acceptable. Avoid bulbs that are 5900 K! The temperature will be too actinic and could lead to molting problems and feather destructive behavior. Avoid temperature below 5000 K, which is too red and can lead to egg laying and aggression.

MOUNTING LOCATION AND DISTANCE

To mimic sunlight, place the brightest lights above the cage and to the side, not directly overhead. Placement is critical to proper lighting. Mount or hang lights several feet from the cage, preferably mounted on the ceiling, wall, or at the juncture of the ceiling and wall.

Compact fluorescents should be installed a little closer to the cage, since they have a much lower output than fluorescent tubes. Remember the inverse square law.

PROPER FLICKER RATE

Flicker perception is the speed at which a flickering light appears continuous. Human flicker rate maxes out at about 50 flashes per second. So, for humans, a light with more than 50 flashes per second looks continuous. However, birds can detect flicker rates exceeding 100 flashes per second. A light with a low flicker rate, in which your bird can see the flashes, will be annoying, if not seriously stressful. To avoid this, use proper fixtures with electronic ballasts and **NEVER** put fluorescent lights of any kind on a dimmer. They dim by changing the flicker rate!

CONCENTRATION

Use mostly diffuse light, accented by a few brightly-lit areas. Create variable lighted areas. In nature, birds fly in and out of direct sunlight and spend much of their day in the filtered light of trees. Provide areas (in or out of the cage) where your bird can get away from light.

ULTRAVIOLET SUPPORT

Provide UV-A only, supplemental light (not UV-B) and remember, you don't need much. Our atmosphere filters most of the UV from the sun.

SPECIFIC RECOMMENDATIONS

WINDOWS

Use natural windows to raise illumination (brightness) and improve CRI (color spectrum). Windows, however, will block UV light. Also, DO NOT leave your bird in front of a window in direct sun!

BULBS

Make sure that ALL bulbs are placed in open fixtures! Glass or plastic enclosures for tube lights, or lampshades on floor lamps for compact fluorescents, will ruin the full-spectrum and UV output.

Avoid Avian specialty bulbs for now. These are largely repackaged, reptile bulbs with a dangerously high UV-B content for birds. The CRI is far too low, the temperature is far too blue, they degrade quickly, and the placement instructions are ridiculous and dangerous. Some brands to **avoid** are the Avian Sun compacts and the ReptiSun tubes. **NEVER USE THESE!**

Our specific recommendations for which bulbs to buy is a separate document since new products are coming out on the market all the time. We will keep that updated as products change.