LIVING

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Night creatures

For many nocturnal hunters, sight is not the most important sense

For humans, the night is a world that both fascinates and frightens. It's no wonder. We're definitely at a distinct disadvantage when darkness falls. While we carry on our activities by artificial light, myriad animals become active and depend upon some of the most highly developed senses in nature to survive. However, because these animals are seldom seen or heard, it's almost as if they're not there. This week and next, I'd like to offer a window onto the fascinating world of nocturnal animals.

Drew Monkman
OUR CHANGING SEASONS

Most habitats, be they fields, woodlands, wetlands or even lakes and rivers, support both a dayshift and nightshift of animals. In other words, twice a day, animals essentially change places. The mixed forest where the goshawk hunts during the day becomes the domain of the great horned owl at night. Chimney swifts that feed in the urban core from early morning to dusk are replaced by nighthawks at night. Dividing up the resources of a given habitat between daytime and nighttime tenants is another way in which species avoid direct competition.

However, not all animals fall neatly into diurnal and nocturnal categories. A number of species are crepuscular, meaning they are usually most active during the twilight periods of dusk and dawn. Some well-known crepuscular species include skunks, deer, woodcock and owls such as the short-eared. Yet other animals divide their time into intervals of activity followed by periods of rest. These species may therefore be active both day and night. Voles have adopted this lifestyle.

There are definite advantages to a nocturnal lifestyle. The absence of daytime competitors for food resources is probably the most important benefit. However, living by night still has its downside. Predators abound and animals must always be ready to either take flight or defend themselves.

At least one or more of the five senses is highly developed in nocturnal animals. This attests to the amazing creativity of the evolutionary process as animals have adapted to a life in darkness. Being mostly visual animals ourselves, we might think that greatly enhanced eyesight would be the most common adaption. This is true with many nocturnal animals but probably not the majority. Hearing and smell tend to be even more important.

Still, it's hard not to be impressed by evolution's prowess in adapting the eye to the demands of a nocturnal lifestyle. A little eye anatomy is helpful at this point. An animal's eye has two kinds of light receptor cells on the retina, namely rods and cones. Cones have evolved to perceive colour and therefore function well in bright light. They also provide sharp visual acuity and are therefore most highly developed in diurnal, or daytime, animals. The denser the cone cells, the sharper the day vision. Rods, on the other hand, are more sensitive but do not detect colour as well. They are adapted for use in low light conditions and are therefore essential for night vision. Nocturnal animals have few, if any, cones, but they do have huge numbers of rods. This is certainly the case in owls, whose eyes are as much as 100 times more sensitive at night than a human's eyes. The number and ratio of rods to cones varies among species, depending on whether an animal is primarily diurnal or nocturnal. Diurnal birds may have no rods at all in their eyes and are essentially blind at night.

Although owls also have some cone cells in their eyes which provide a certain degree of daylight vision – and possibly the ability in some species to distinguish colour – it is believed that most owls inhabit a world of grays, both day and night. This may help to explain why owls have such drab plumage. There's no need for the male to invest in bright colours to attract a mate since she wouldn't be able to see the colours anyhow!

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This young, white-tailed deer buck (top) is a crepuscular feeder, most active at dawn and dusk. Its large ears move about like radar antennae. The great grey owl (left) uses its large facial disk to funnel sound to its ears, allowing it to hunt at night when prey can often be heard, but not seen.

An owl's eyes also have other interesting adaptations. They are front-facing which allows for binocular vision and provides excellent depth perception. They also have a large retinal surface, a large lens, a very wide pupil, and a tubular shape. In fact, an owl's eyes occupy fully half of the skull, which is as much room as the brain takes.

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Some nocturnal birds and mammals also have a layer of reflective tissue at the very back of the eye called the tapetum. Acting like a small mirror, its purpose is to increase the animal's night vision by reflecting back the light that has already passed through the retina. This gives the photoreceptor rods a second chance to capture the image. The tapetum produces the "eye shine" you see when you shine a flashlight into the eyes of a nocturnal bird or a mammal such as a dog. The same thing happens when you take these animals' picture with a flash. Not having a tapetum is another reason why humans don't see well in low light conditions. Despite these wonderful adaptations, night vision is short range and tends to be most important when predators are within striking distance of their prey.

As a general rule, a well-developed sense of hearing is even more important to nocturnal animals than vision. Even owls depend more on hearing than sight. Some species such as the barn owl have been shown to be able to hunt with pinpoint accuracy in 100 per cent darkness. Good hearing is characterized by a large outer ear to collect and funnel sounds. This is why rabbits have large, erect ears that can collect more sound waves and detect potential danger when it is still a fair distance away. A rabbit's ears can also be rotated and moved independently of each other. This, too, serves to maximize their hearing ability.

Instead of having large, erect, external ears like rabbits, owls have a facial ruff or "disk" of specialized feathers that surround the eyes. The facial disk acts almost like a radar dish antenna and guides sounds into the ear openings, which are located on the external edges of the facial disks. Once a sound is detected, the owl orients towards the sound and pinpoints its location with great accuracy in both horizontal and vertical planes. The high degree of accuracy is explained by the fact that an owl's ear openings are usually asymmetrical, meaning one ear is higher than the other. This means that there is a minute time difference as to when the sound is perceived in each ear. Owls can actually detect a left/right time difference of as little as three one-hundred thousandths (0.00003) of a second. Conscious of this difference, the owl then turns its head until the sound arrives at both ears simultaneously. This tells it that the prey is straight ahead. The owl then flies towards the sound but can make corrections in mid-flight should the prey move. At about two feet from the prey, the owls brings its feet forward, spreads its talons, and, at the last second before striking the hapless victim, thrust its legs out in front of its head for the kill.

When it comes to the range of audible sounds, an owl's hearing is not unlike a human's. However, the difference lies in the acuteness at certain frequencies. Owls are able to hear the slightest movement a prey makes, even when they are hidden under leaves or deep snow. Foxes, on the other hand, can hear extremely high frequencies – up to 40,000Hz (hertz). This is double what humans can hear. It is nothing, however, compared to a bat. Using echolocation, bats emit sounds in the 40,000 to 100,000Hz range. The sound bounces off flying insects and immediately returns to their large ears. When the bat's brain processes the echo, it gets a detailed "image" of the insect's shape, texture, distance away and direction. Having knowledge of the precise location, the bat can then scoop the insect up in its tail membrane for transfer it to its mouth.

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Smell, along with taste, is also of extreme importance to many nocturnal mammals. The degree of an animal's ability to smell depends on the number of specialized receptor cells located in two depressions above the air passages in each nostril. It is most highly developed in carnivores, but can also be an extremely important sense for salamanders and even fish. Compare, for example, the wolf's 250 million receptor cells to the human's five million! When a fox or wolf holds its head up high to sniff, more air is brought in and therefore more scent particles. In a split-second, smell provides information as to whether the source of the odour is a predator, a prey animal or even a potential mate. The importance of taste is less well understood, but it may be important in some reptiles and amphibians.

The sense of touch is not to be forgotten, either. It is especially important in the case of raccoons. When hunting, they rely on touch more than even eyesight or smell. Raccoons have ultra-sensitive front paws that become more pliable when wet. Biologists believe this may be one reason why they often wet their front feet; it makes the sense of touch more sensitive. Almost two-thirds of the area responsible for sensory perception in a raccoon's brain is specialized to interpret tactile nerve signals. This is more than in any other studied animal. Raccoons are even able to identify objects before even touching them with their paws , thanks to vibrissae located above their claws. Vibrissae are hairs that have become specialized for tactile sensation.

Next week, I'll discuss in more detail some of the highlights of nighttime nature observation right here in the Kawarthas.

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