

The Outside Story

Olfactory Superpowers

By Michael J. Caduto

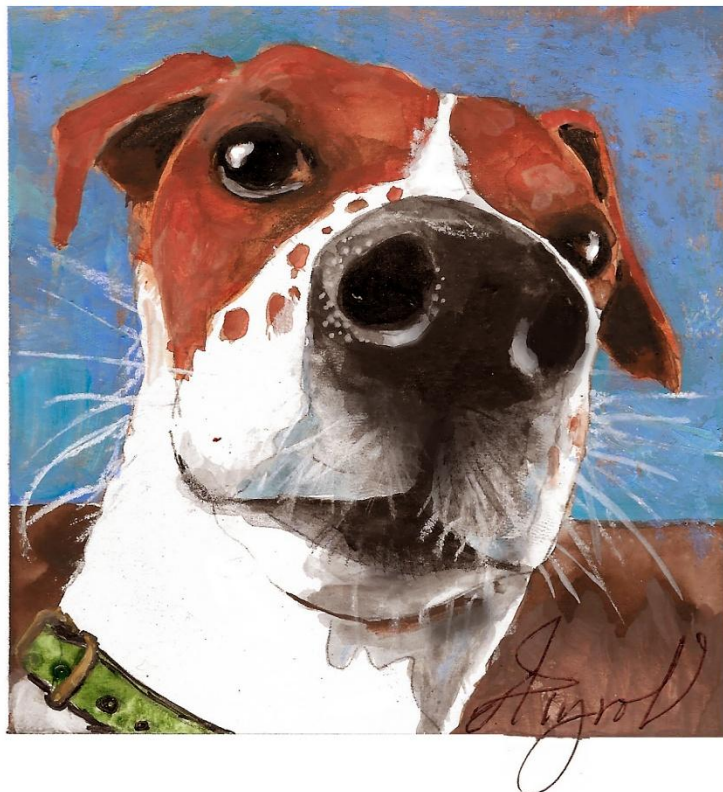
When my cat greets me with a headbutt, I affectionately return the gesture. To me, it's a sign of love and affection, but to my cat, it is much more. Rubbing me with the scent glands on her cheeks and forehead leaves an olfactory marker that identifies me as a member of her family. Cats have nine scent glands that span head to tail. These pheromones strengthen familial bonds, mark a cat's territory, and communicate an animal's emotions, state of health, reproductive status, and identity.

Cats aren't the only animals that exist in rich and highly informative olfactory realms. By both emitting and sensing odors, animals can locate sources of food, orient towards their homes, find a mate, detect danger in their surroundings and sense whether another animal is predator or prey.

The mass of neural tissue in a vertebrate animal's forebrain that processes the information detected in the nasal cavity is called the olfactory bulb. Humans have an acute sense of smell and possess an olfactory bulb significantly larger than that found in many mammalian brains. When compared to the overall volume of the brain, however, many animals devote relatively more brain matter to detecting and interpreting scent. For example, the olfactory bulb and related structures make up nearly 2 percent of the volume of a dog's brain, versus 0.03 percent in humans. The relative size of a mouse's olfactory bulb is 200 times that of a human.

Black bears have an olfactory bulb that is five times larger than that in the human brain and possess 100 times more sensory tissue lining their nasal cavity – both of which account for why a black bear's nose is some 2,000 times more powerful than our own.

Coyotes, foxes, and other canids also have an exceptional sense of smell, possessing more than 50 times the number of olfactory receptors as humans. Canids can also direct their nostrils independently in order to detect smells coming from different directions. They exhale through a slit on each side of the nose, enabling their nostrils to capture and accumulate scents, rather than blowing them away.



Fox and coyote mark their territory with scents in their urine and feces. These smells communicate information on their sex, breeding status, state of health, age, and diet. While foxes tend to leave skunk-like scent markings on an elevated perch, such as a log or stump, coyotes leave theirs on the ground and scratch to spread them around. But mammals aren't the only creatures dependent on their strong sense of smell for survival.

If you asked a snake to describe how it senses odor, its response would be literally tongue-in-cheek. A snake's olfactory superpower comes from its unique system for detecting scent. When a snake flicks its tongue, it picks up minute scent particles in the air. The tongue is then drawn back into its mouth and inserted into two slots in the palate (one tip of the tongue goes into each hole) that connect to a sensory structure called the Jacobson's organ (vomeronasal organ), that then sends signals to the brain, which identifies the scent.

Birds also rely on their olfactory sense in everyday life. Turkey vultures possess one of the keenest senses of smell of any bird; they can detect the scent of carrion hundreds of feet away, even when an animal's remains are hidden beneath tree crowns and other dense foliage. This survival advantage contributes to their abundance, versatility, and broad geographic range, which – spanning from southern Canada to the tip of South America – exceeds that of any other vulture. A turkey vulture's olfactory bulb is unusually large compared to that of other birds and is even quadruple the size of this neural structure in the brains of black vultures. Moreover, the tissue in a turkey vulture's olfactory bulb possesses twice the number of mitral cells as a black vulture, the cells that convey olfactory information to the brain. Granted, the odor of carrion is repulsive to humans, but it is a vulture's olfactory elixir.

Survival aside, the appeal of the various smells we encounter is clearly in the eye (or nose) of the beholder. While we primarily take in the landscape with our eyes and ears, many other animals absorb the world through their sense of smell.

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