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Comparative study of Eyes in different species and its environmental adaptation

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Abstract

The shape and form of the pupils in animal eyes are directly related to how they eat, where they spend their time and, if a predator, how they hunt. Prey species will tend to prioritize peripheral vision over depth perception, and aquatic animals will have very different pupils to land-based animals. Pupil shapes of terrestrial animals related to ecological niche. Pupil comes in variety of shapes.

Introduction

The pupil is the gap in the eye's iris that allows light through to the retina. The muscles of the iris vary the pupil's size, altering the amount of light that can get through. The shape and form of the pupils in animal eyes are directly related to how they eat, where they spend their time and, if a predator, how they hunt. Prey animals tend to have horizontal slit pupils, providing a wider field of vision like peripheral vision over depth perception and giving them an advantage in spotting any predators approaching them and aquatic animals will have very different pupils to land-based animals. Animals that hunt or are hunted at night need large, sensitive eyes that would be overwhelmed in bright daylight, so they have evolved an extra set of muscles to pull the pupil into a narrow-slit shape during the day. Pupils come in variety of shape. Animals with vertically elongated pupils are very likely to ambush predators and active day and night. Animals with horizontally elongated pupils are very likely to be prey and to have laterally placed eyes. Some reptiles and amphibians like frogs and snakes also have horizontal slit pupils, particularly beneficial for them as they spend their time on the ground looking upwards for predators. The evolutionary path of an



animal, and the manner in which it hunts for food or defends itself from predators, has a huge impact on the pupil shape it evolved to have over the years.

Shape and size of pupils in different animals

Round pupils- Animals with these kinds of pupils tend to be active hunters who chase down prey mostly during the day (diurnal) and give even focus across entire depth of field during the day. Round pupils are present in humans, dog and cats. Daytime-hunting large predators tend to have round pupils. But large cats and dogs, such as lions or wolves, can and do also hunt at night. They are able to do this through a combination of retinal adaptations (*tapetum lucidum*) which give them increased stealth abilities in low-light levels.

Horizontal pupils- Optimize field of view to detect predators and belong to prey animals like sheep goat and horse. Horizontal slit pupils: are usually found in prey animals like horses and sheep.

Vertical pupils- Optimize depth perception of both day and night. Vertical slit pupils are typical of smaller hunting creatures like small cats, foxes and snakes and belong to ambush predators that hunt close to ground. The shape of the pupil allows for a greater expansion to let more light in when needed. This is an adaptation for predators that tend to hunt in a variety of light conditions, including at night-time. This pupil shape also aids in judging short distances very precisely.

W-shaped pupils- W-shaped pupils are modified form of the horizontal-split pupil. The shape enables light to enter the eye from many different directions, and is also thought to boost image contrast and distance vision. It is present in cuttlefish.

Crescent shaped pupils- Crescent-shaped pupils provide enhanced vision by decreasing the effects of light-distortion by water. It is found in sea life like stingrays, catfish, dolphins and flatfish.

Shape of pupils helps in adaptation of animals in their environment:

Goats, sheep, horses, domestic cats, and numerous other animals have pupils which vary from fully circular in faint light to narrow slits or rectangles in bright light. The elongated pupils allow greater control of the amount of light entering the eye. For instance, a domestic cat can change its pupil area by a factor of 135 from fully dilated to fully constricted, whereas humans, with a round pupil, can only change area by a factor of 15. This is particularly useful for animals that are active both day and night, allowing for much better vision in low light conditions. The animals with vertically elongated pupils are very likely to be ambush predators which hide until they strike their prey from relatively close distance. They also tend to have eyes on the front of their heads. Foxes and domestic cats are clear examples of this. The difference between foxes and



wolves is down to the fact wolves are not ambush predators instead they hunt in packs, chasing down their prey.

In contrast, horizontally elongated pupils are nearly always found in grazing animals, which have eyes on the sides of their head. They are also very likely to be prey animals such as sheep and goats. Grazing animals have different problems to deal with. They need to check all around for prey and they need to flee rapidly in case of attack. Having eyes towards the side of their head helps them to see nearly all around them. Having a horizontal pupil enhances the amount of light they can receive in front of and behind them while reducing the amount of light from above and below. This allows them panoramic vision along the ground to help detect potential predators as early as possible. The horizontal pupil also enhances the image quality of horizontal planes and this enhanced view at ground level is also an advantage when running at speed to escape.

So, vertically elongated pupils help ambush predators capture their prey and horizontally elongated pupils help prey animals avoid their predators. A slit pupil provides the required dynamic range.

References

- G. L. Walls, *The vertebrate Eye and Its Adaptive Radiation* (Hafner, New York, 1942).
- H. S. R. Detweller, the eye and its structural adaptations. *Proc. Am. Philos. Soc.* 99, 224-238 (1955).
- I. P. Hammond, G. S. V. Mouat, The relationship between feline pupil size and Illuminance. *Exp. Brain Res.* 59, 485-490 (1985).
- L. S. V. Roath, L. Lundstrom, A. Kelber, R. H. H. Kroger, P. Unsbo, The pupils and optical systems of gecko eyes. *J. Vis.* 9, 27.1 27.11 (2009).
- S. G. De Groot, J.W. Gebhard, Pupil size as determined by adapting luminance. *J. Opt. Soc. Am.* 42, 492-495 (1952).

