

INSIDE JEB

Falcons' vision up to speed for fast lifestyle



A Harris's hawk (*Parabuteo unicinctus*). Photo credit: Simon Potier.

Few people are lucky enough to transform their passion from a hobby into a career, but Simon Potier from Lund University has done exactly that. 'Falconry flows in my veins', says Potier, who was immersed in the ancient sport from an early age. 'My father is the main falconer at the Les Ailes de l'Urga falconry park', says Potier adding that his dad owns more than 60 birds. Working with some of the fastest animals on the planet, it was inevitable that Potier would become fascinated by the birds' vision. 'Some of them have the highest spatial resolving power known in the animal kingdom', he says, allowing the swift hunters to target prey with meticulous precision. However, Potier, Michael Pfaff and Almut Kelber realised that the raptors' high-definition vision was only part of the equation. Closing in on fleeing victims at speeds in excess of 320 km h⁻¹, raptors must be able to see events that are so fast that we would be oblivious to them. The question that Potier and colleagues wanted to ask was how fast could the birds see?

Returning home to Normandy, where the birds of prey are based, with experienced falconer Margaux Lieuvain, Potier set up a room equipped with two LED lamps mounted on the wall. One lamp appeared to be on constantly [flashing 1000 Hz (times per second)], while the flashing rate of the second could be adjusted from 10 Hz until the bird could no longer distinguish the flicker. Positioning a perch in front of each lamp and setting the adjustable lamp to flash at the slowest rate, Potier and Lieuvain trained three Harris's hawks (*Parabuteo unicinctus*), two peregrine falcons (*Falco peregrinus*) and a saker falcon (*Falco cherrug*) to fly and land on the perch in front of the constantly on lamp, rewarding the birds with a morsel of tasty chicken when they chose correctly. 'We were quite surprised how fast the falcons learned to fly to one perch ... [but] this is the advantage of using birds from falconry; they are trained to fly every day with humans', says Potier. Then, the duo began gradually increasing the flicker rate of the adjustable lamp until the birds could no longer distinguish

between the two lamps and began choosing their resting perch randomly.

After months of patiently working with the animals, it was clear that the record-breaking peregrine falcon has the fastest visual response of the three species; they were able to distinguish lights flashing up to 129 Hz, more than twice as fast as humans. In contrast, the saker falcon was able to see flickers up to 102 Hz and the Harris's hawks could only distinguish lights flashing at 81 Hz.

Potier also realised that the birds' high-speed vision fits with their different hunting strategies. Peregrine falcons need high-speed vision to pursue agile aviators on the wing, while Harris's hawks, which specialise in dive-bombing slower rodents on the ground, can make do with slightly slower vision. However, he points out that chickens can detect flashing lights as well as Harris's hawks can, and the vision of pied flycatchers – which respond to lights flashing up to 146 Hz – is even faster than that of peregrine falcons. It seems that birds that could be on the menu might need to see as well as the hunters that prey on them. In addition, Potier warns that lights that appear to be on continuously for us could be distressing for birds of prey that are sensitive to flickering. 'Our study provides evidence that bright artificial illumination flickering at 100 Hz (common in Europe) or 120 Hz (in the USA) may not be suitable in enclosures for raptors, specifically falcons', he says.

10.1242/jeb.219493

Potier, S., Lieuvain, M., Pfaff, M. and Kelber, A. (2020). How fast can raptors see? *J. Exp. Biol.* **223**, jeb209031. doi:10.1242/jeb.209031

Kathryn Knight
kathryn.knight@biologists.com