Let there be night, for wildlife's sake

DIETER TELEMANS/PANOS

Peter Aldhous, Edmonton

IT IS time to take back the night for wildlife. That was the rallying call from a landmark session on light pollution at the Society for Conservation Biology on 4 July in Edmonton, Canada.

The disruptive effects on animals of our penchant for bright lights has rarely impinged on public consciousness. Notable exceptions are when turtle hatchlings head inland to the bright lights of a beach resort instead of the safety of the moonlit sea, or birds collide en masse with brightly lit buildings.

"The glare of street lights diverts some pregnant bats from their usual commute to get food"

It is rapidly becoming clear, though, that light pollution subtly interferes with the growth, behaviour and survival of many nocturnal species – not just those that hit the headlines.

The threats posed by the humble street lamp do not rival the wholesale destruction of tropical forests and other habitats, or indeed the threat of climate change. But participants in the session at the Edmonton meeting agreed that planners should spare a thought for wildlife when installing lighting. "We've taken away the night," warns Travis Longcore of the University of Southern California in Los Angeles, who chaired the session.

For instance, Emma Stone of the University of Bristol, UK, has shown that high-pressure sodium street lights can divert lesser horseshoe bats from their usual routes between roosts and foraging grounds. Such diversion may be energetically costly – all the more of a worry as the bats in the study were pregnant.

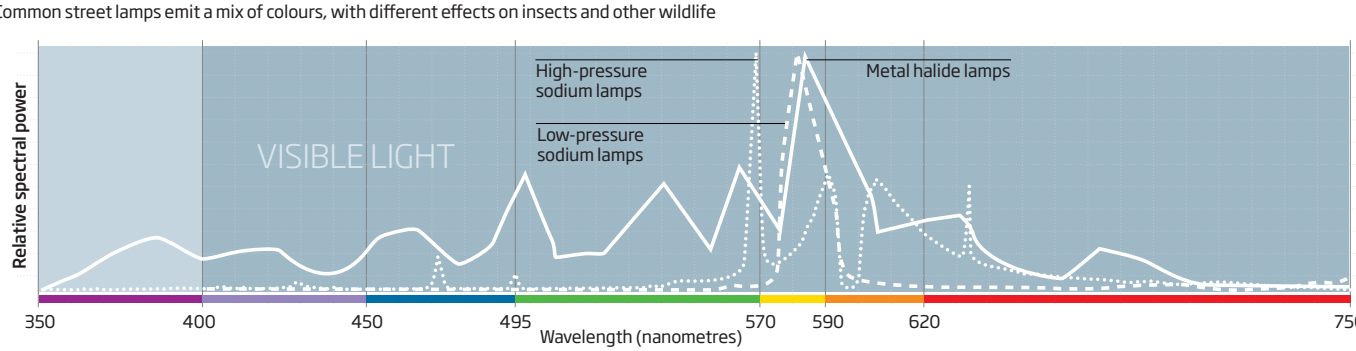
Many migratory birds also fly at night, and can be disoriented by brightly lit structures, circling them until they become exhausted, or collide with the buildings or each other. Surveys over 25 years at a single TV broadcasting tower in Florida recorded more than 42,000 casualties involving 189 species.

Alan Clark of Fordham University in New York City is now using microphones and radar to track birds through urban environments. He has found that more birds fly over darker and quieter sites like the Bronx Zoo and Central Park, and that those trying to navigate busy districts like Little Italy and East Harlem tend to call out much more, suggesting that they are disorientated.

Nor does it take New York City's bright lights to disrupt animals: recent studies on frogs have shown that lights barely brighter than a full moon can have profound effects. Bryant Buchanan of Utica College, New York, found that exposing the tadpoles of the South African clawed frog (*Xenopus laevis*) to 1 lux every night for 37 nights

Not all street lamps are the same

Common street lamps emit a mix of colours, with different effects on insects and other wildlife



Ultraviolet – Strongly attracts insects - many are killed by the lamp's heat

Blue – Blocks production of melatonin, disrupting daily biorhythms and possibly seasonal behaviour changes

Green – Attracts some amphibians, but less disruptive for bird orientation

Yellow – Less attractive to insects, but disrupts foraging in other species and leaves some amphibians disorientated

Red – Strongly disrupts bird orientation

SOURCE: T. LONGCORE, UCS, L.M. ROBERTS, INDULUX TECHNOLOGIES

Dim the lights

slowed their transformation into froglets. That's little brighter than a full moon, and typical of a light-polluted marsh in Utica. If native frogs are similarly affected, it could threaten their survival: delayed development can be fatal for frogs breeding in ponds that are susceptible to drying up.

Yet in some circumstances it may be possible to design wildlife-friendly lighting. Hanneke Poot of the Max Planck Institute for Ornithology in Seewiesen, Germany, has come up with a way of reducing the number of birds killed at offshore oil and gas rigs. Working on the Dutch island of Ameland in the North Sea, she shone lights of different colours at migrating birds flying south from Scandinavia.

White lights, generally used on rigs, caused more than 80 per cent of birds to change direction on overcast nights. Red lights were only a little less disorienting, but with green lights just 27 per cent shifted course when the skies were overcast, and only 5 per cent were swayed by blue light. Although humans don't see well in blue light, in tests on a Dutch gas rig, workers were happy with green light, finding that it gave good contrast. Preliminary results indicate that only half the normal number of migratory birds circled the green-lit rig.

Most commonly used lights have different effects on wildlife depending on their precise spectra (see diagram). Gerhard Eisenbeis of the University of Mainz, Germany, has found that different street lights attract and kill vastly varying numbers of insects. The least disruptive, he found, were those using LEDs, especially the "warm" variety that emit less blue light.

Still, Longcore warns that what's good for one species may be bad for another. "I don't think we're going to find a perfect light that will have a low effect on all wildlife," he admits. Ultimately, there is only one simple way to reclaim the night for wildlife: dim the lights. ■

Quantum entanglement shapes life's blueprint

THE most celebrated molecule in biology – the DNA double helix – might owe its shape to a mysterious quantum property called entanglement.

In recent years, animals have been shown to use quantum processes to their advantage. For example, some birds' eyes use quantum trickery to "see" the Earth's magnetic field, and light-harvesting molecules in algae and bacteria rely on quantum processes to transfer energy efficiently. Now it seems the blueprint of life could also owe its functioning to such phenomena.

DNA consists of two strands, each made of a chain of nucleotides, or bases. The bases in each strand link up like the rungs of a ladder, with each rung called a base pair, and the whole thing is twisted into a double helix. The helical shape is vital to DNA's stability, as it prevents it from disintegrating inside a cell.

To see if quantum processes play a role in determining the shape of DNA, Elisabeth Rieper of the National University of Singapore and colleagues modelled each base pair as a cloud of electrons that oscillates around a positively charged nucleus. The team found that

"If you didn't have entanglement you would not get the twist that is vital to DNA's functioning"

quantum entanglement between these clouds helped DNA to maintain its helical structure.

Entanglement is a quantum property where two or more objects are linked and in "superposition" – existing in many possible states at once. When this happens, it is impossible to describe the state of each object individually – the entangled objects must be considered as a whole.

In their model, electrostatic forces caused the electron clouds of adjacent base pairs to interact with each other, an essential prerequisite for entanglement to occur. Each cloud has the largest effect on its neighbours, with its influence dropping with distance.

When the researchers analysed the DNA without its helical structure, they found that the electron clouds were not entangled. But when they incorporated DNA's helical structure into the model, they saw that the electron clouds of each base pair became entangled with those of its neighbours (arxiv.org/abs/1006.4053v1). "If you didn't have entanglement, then DNA would have a simple flat structure, and you would never get the twist that seems to be important to the functioning of DNA," says team member Vlatko Vedral of the University of Oxford.

"It's a very nice step forward, a new way of looking at DNA," says Sandu Popescu, who studies entanglement in biological systems at the University of Bristol, UK. But whether the entanglement has any biological relevance remains to be proven, he adds.

However, Aleksei Aksimentiev of the University of Illinois at Urbana-Champaign is sceptical that quantum effects are the sole reason for the helical structure. He points out that the way the helical structure shields the hydrophobic bases from water inside a cell is already considered a viable explanation for DNA's shape.

To better understand the significance of entanglement to DNA's stability, the quantum effect "should be compared to other factors that are known to stabilise DNA structure and give the molecule its functionality", Aksimentiev says.

It's also unclear whether entanglement affects the information content of DNA. Could it hinder how information is read or lead to faster information processing, as has been demonstrated in quantum computing? "At this stage I don't think we can answer either of these questions," Vedral says. Anil Ananthaswamy ■