Newly discovered retinal structure may enhance vision for some birds

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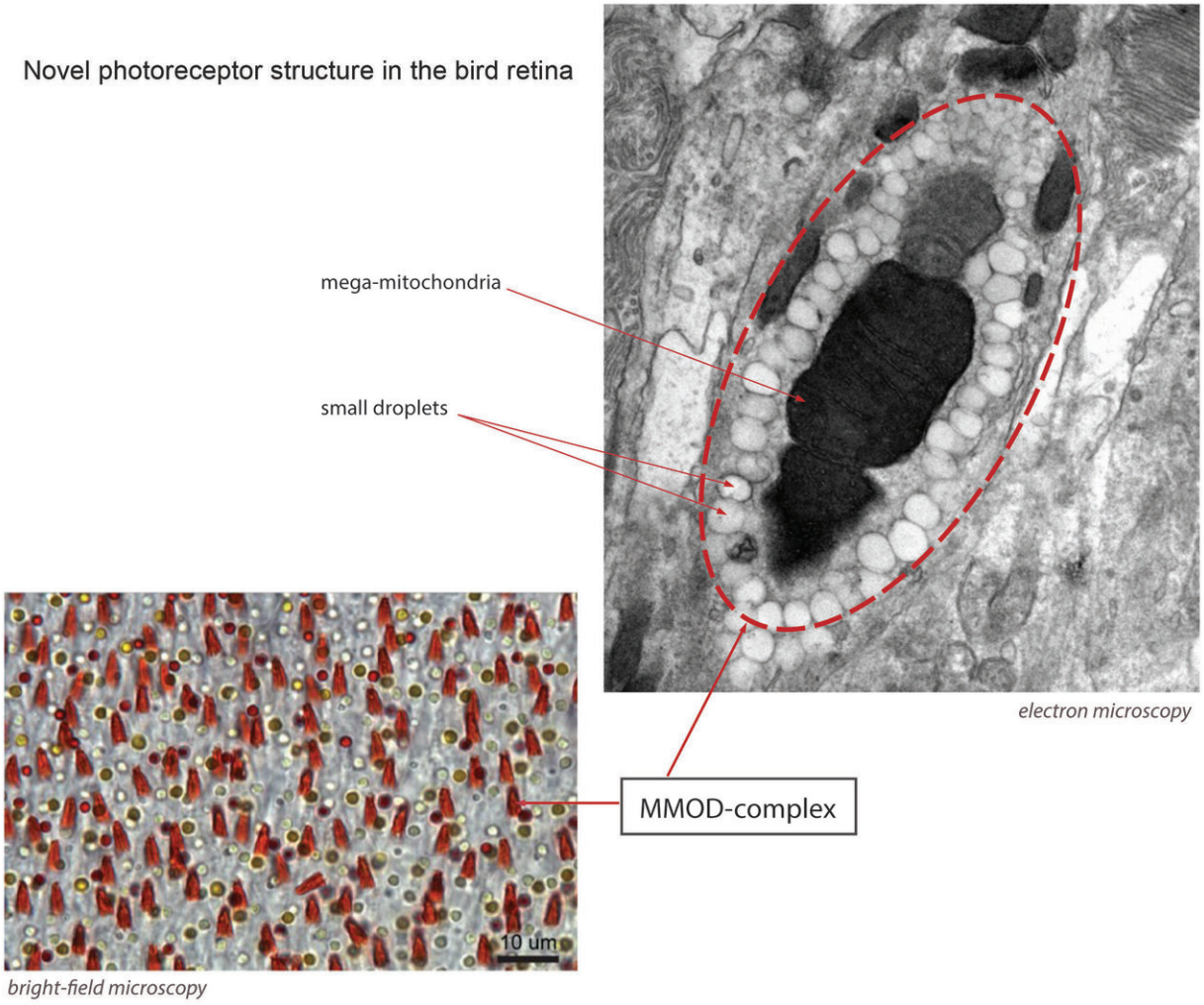

These microscopy images show a newly discovered retinal structure, called the MMOD-complex, in small sit-and-wait songbirds called flycatchers. Credit: Purdue University image/ Esteban Fernandez-Juricic and Luke Tyrrell

A newly discovered retinal structure in the eyes of certain kinds of songbirds might help the animals find and track insect prey more easily.

The foundation of avian vision rests on cells called cone and rod photoreceptors. Most birds have four cone photoreceptors for color vision, a fifth cone for non-color-related tasks, and a rod for night vision. Each cone photoreceptor cell contains a spherical structure called an "oil droplet," which filters light before it is converted to electrical signals by the visual pigments, enhancing color discrimination.

However, the researchers have discovered a never-before-seen type of cone structure in the retina of a group of small songbirds, called flycatchers. Instead of an oil droplet, it contains a high- energy-producing cellular structure called "megamitochondria" surrounded by hundreds of small, orange-colored droplets. The researchers named this novel cellular structure a megamitochondria-small oil droplet complex, or MMOD-complex.

The discovery, made at Purdue University, is detailed in a paper that appeared in the journal *Scientific Reports*, as part of a collaboration with the State University of New York at Plattsburgh, the University of Wisconsin-Madison, and the University of California, Davis.

The researchers studied this retinal structure using light microscopy, transmission electron microscopy and a technique called microspectrophotometry, which measures the wavelengths of light that these structures absorb the most. The MMOD-complex works as long-pass filters, letting light with wavelengths longer the 565 nanometers—or yellow, orange and red—pass through, and absorbing the shorter wavelengths of green, blue and violet.

Traditional cones were present throughout the retina of these flycatchers, and their density decreased moving away from the center toward the

periphery. However, the MMOD-complex photoreceptors were present only in the central region of the retina, an arrangement that could help birds detect flying insects, said Esteban Fernandez-Juricic, a professor of biological sciences at Purdue.

"The retina of flycatchers, which are sit-and-wait predatory birds, evolved a novel cellular structure in a photoreceptor that may allow them to detect, track and capture fast-moving prey, like insects," he said.

The paper's lead author was Luke Tyrrell, a former Purdue doctoral student and now an assistant professor of biological science at SUNY Plattsburgh.

"This new cone organelle has not been reported before in this form in any other vertebrate retina and may allow these birds to see their world in a different way from other animals," Tyrrell said.

More information: Luke P. Tyrrell et al. A novel cellular structure in the retina of insectivorous birds, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-51774-w

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