Supplementary information

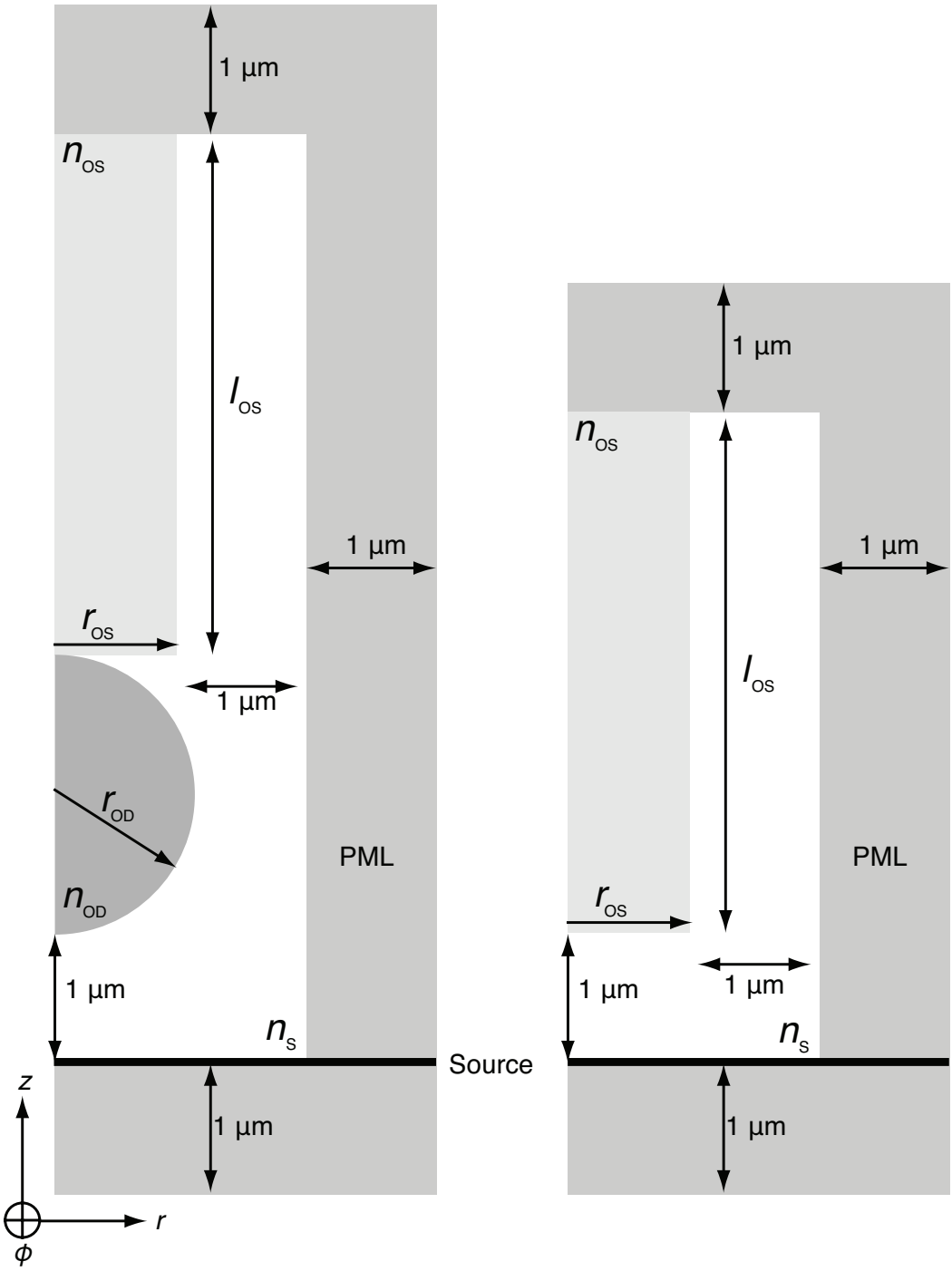

Fig S1: Example schematics of the simulation environment. Thick black line indicates the plane wave source. Calculations are performed in cylindrical polar coordinates (r, φ, z). φ-direction is normal to the plane of the page here. Simulation is surrounded on three sides with perfectly-matched layers (PML) which prevent numerical reflections from the sides of the simulation environment (Oskooi et al. 2010).

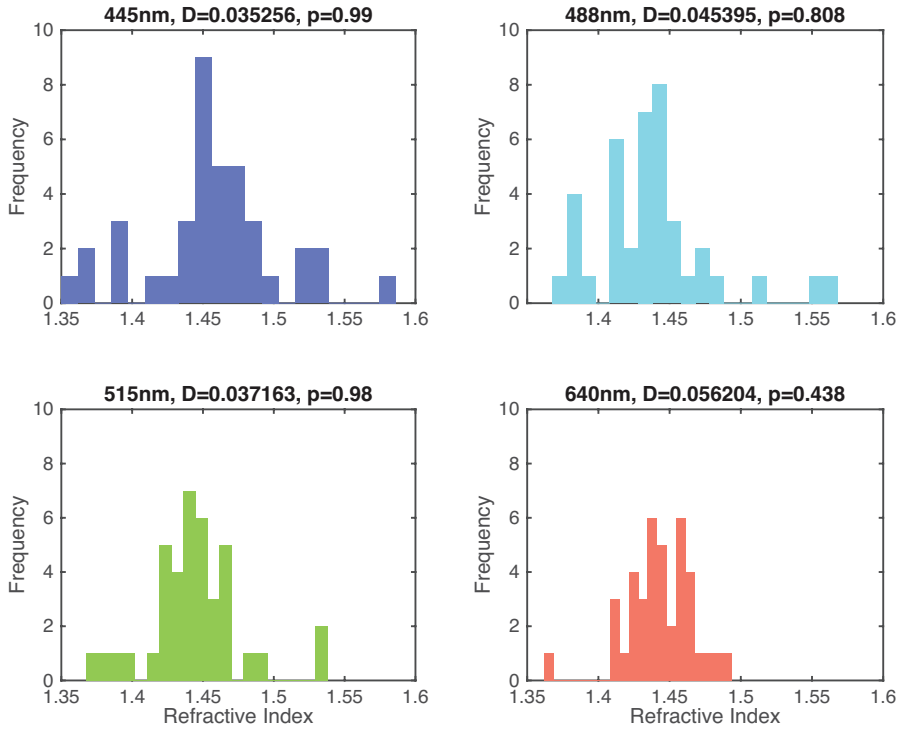

Fig S2: Histograms of the refractive indices of *Xenopus* oil droplets as measured at four wavelengths. *D* values show the result of Hartigans' dip test, which tests for multimodality in a distribution. None of these distributions demonstrate significant multimodality, indicating that in terms of refractive index, all *Xenopus* oil droplets measured are from the same population (ie there is not more than one type of oil droplet with respect to refractive index).

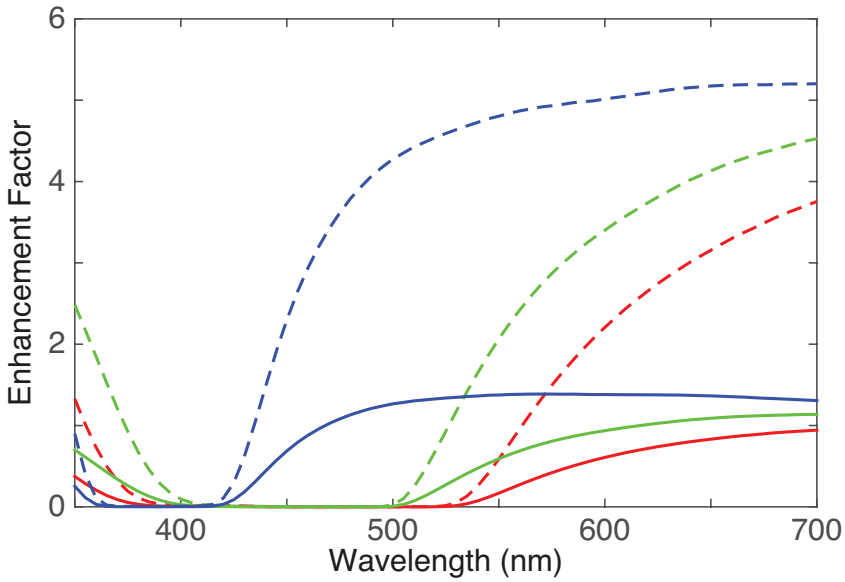

Fig S3: Calculations of enhancement with and without outer segments as a comparison to the Mie scattering calculations of Ives et al. (1983) for the receptor geometry, refractive indices and oil droplet absorption spectra of the turtle *Trachemys scripta elegans*. Solid lines show enhancement factors including the outer segment and dashed lines show calculations without. When the outer segment is not present we recover greater enhancement factors that approach those calculated by Ives et al. (1983). This is due to the waveguiding effect of the outer segment, which allows it to confine light to its volume even without the presence of the oil droplet. Red lines – LWS cone. Green lines – MWS cone. Blue lines – SWS cone.

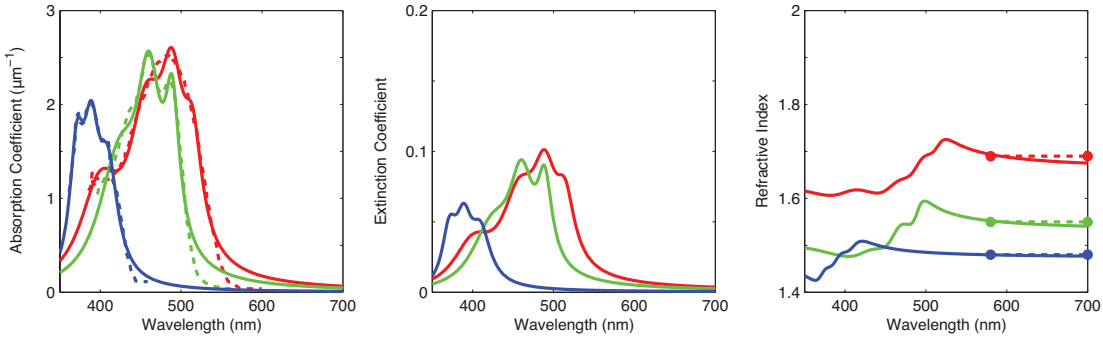

Fig. S4: Absorption coefficients and optical properties of the oil droplets of *T. scripta elegans*. Absorption coefficient modelled using the methods of Wilby et al. (2015). Solid lines show model spectra. Dotted lines show spectra from Strother (1963) and Liebman & Granda (1971). Calculated extinction coefficient and real refractive index. Circles show refractive index values from Ives et al. (1983) and the spectral range over which these were measured. Red lines – LWS cone. Green lines – MWS cone. Blue lines – SWS cone.

Table S1 can be found in a separate excel file.

Click here to Download Table S1

Table S2: Dimensions and refractive indices used in simulations of chicken, turtle and *Xenopus* photoreceptors.

Chicken	**Value**	**Source**
Oil droplet diameter	3.0 µm	Wilby et al. (2015)
Oil droplet refractive index	See Wilby et al. (2015) for details	
Ellipsoid length	3.5 µm	Wilby et al. (2015)
Ellipsoid diameter	3.0 µm	Wilby et al. (2015)
Ellipsoid refractive index	1.43	Wilby et al. (2015)
Outer segment diameter	1.5 µm	Wilby et al. (2015)
Outer segment length	30 µm	Wilby et al. (2015)
Outer segment refractive index	1.45	Wilby et al. (2015)

Turtle	**Value**	**Source**
Oil droplet diameter	5.0 µm	Ives et al. (1983)
Oil droplet refractive index	Refractive index from Ives et al. (1983). Pigment absorption from Strother (1963); Liebman & Granda (1971). See fig. S4.	
Outer segment base diameter	3.0 µm	Ives et al. (1983)
Outer segment end diameter	0.5 µm	Ives et al. (1983)
Outer segment length	10 µm	Ives et al. (1983)
Outer segment refractive index	1.45	Wilby et al. (2015)

Xenopus	**Value**	**Source**
Oil droplet diameter	6.2 µm	Röhlich & Szél (2000)
Oil droplet refractive index	See fig. 4 (main text)	Present study
Outer segment base diameter	4.5 µm	Röhlich & Szél (2000)
Outer segment end diameter	0 µm	Röhlich & Szél (2000)
Outer segment length	12 µm	Röhlich & Szél (2000)
Outer segment refractive index	1.45	Wilby et al. (2015)

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