

# Comparative 3D-microanatomy of the visual system of cephalopod hatchlings

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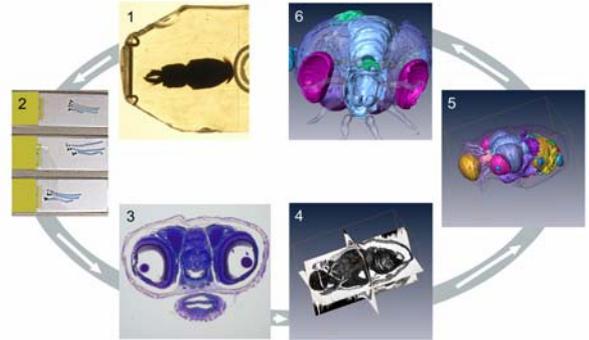
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## Introduction

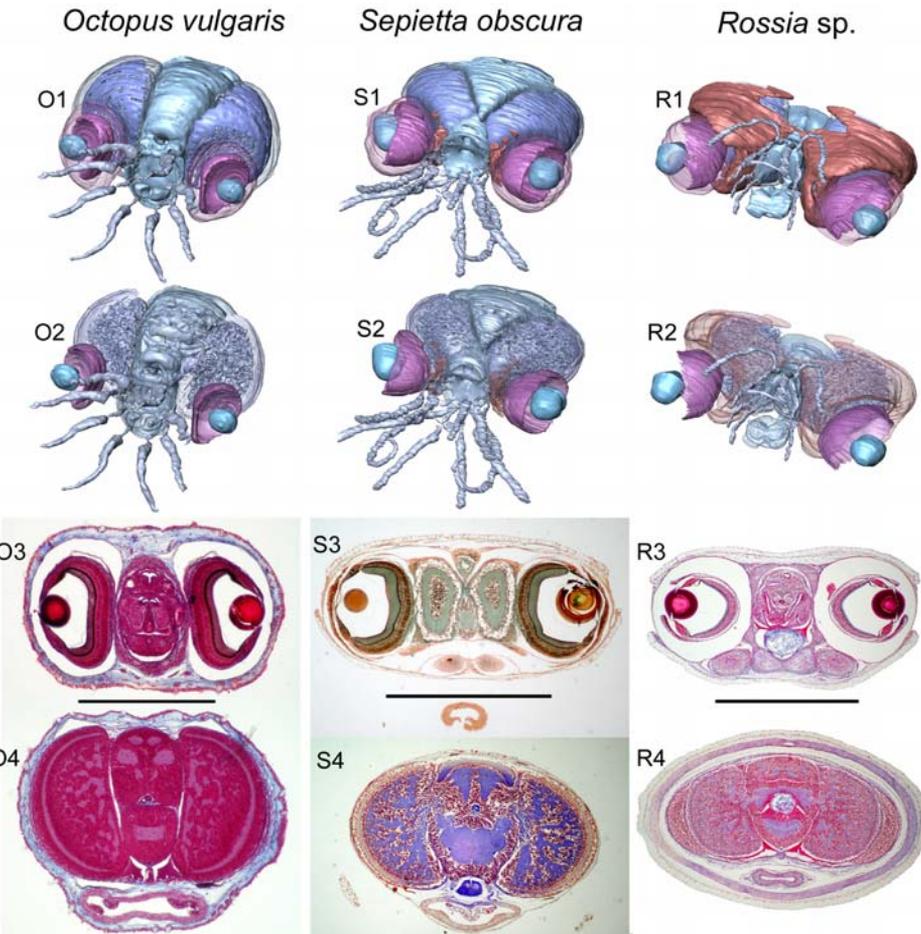
Leaving the egg-shell coleoid cephalopods are equipped with a structurally well developed visual system. Depending on the remaining yolk reservoir, total body size and locomotion efficiency the importance of visual orientation should differ between species, this in turn should be reflected in morphological differences within the visual system.

## Material & Methods

Based on histological paraffin section series we generated digital 3d-reconstructions (using Amira®) of the eyes and parts of the central nervous system of the hatchlings of six cephalopod species: *Octopus vulgaris*, *Sepietta obscura*, *Rossia* sp., *Eledone cirrhosa*, *Loligo vulgaris* and *Sepia officinalis* (the first three species shown here). The method allows the display of any segmented organ in free combination, perspective, color and transparency as well as morphometric operations.



1) Cephalopod hatchling embedded in epoxy resin. 2) Stained histological section series mounted on glass slides. 3) Digital light micrograph of a transverse section. 4) 3D raw data (grayscale) after alignment. 5) Surface rendering after manual segmentation of inner organs. 6) Close up after rotation and changed transparency settings.



## Results

The slices together with the Amira-renderings allow a detailed morphological description of eye geometry, retina topography and the internal complexity of the optical lobes, as well as the determination of absolute volumes and volume ratios. Interspecific differences prevailingly pertain to the dimensions of the dioptric apparatus (upon similar total head size) and to the relative size of optic lobes.

Volumes [mm <sup>3</sup> ]	<i>O. vulgaris</i>	<i>S. obscura</i>	<i>Rossia</i> sp.
Eyes	0.298	0.390	0.682
Lenses	0.031	0.052	0.045
Retinae	0.014	0.034	0.053
opt. Lobes*	0.553	0.729	1.053
*plex. Layers	0.036	0.071	0.061
*Neuropils	0.067	0.164	0.148
Brain	0.438	0.334	0.362

O) *Octopus vulgaris*. S) *Sepietta obscura*. R) *Rossia* sp.  
1+2) Surface renderings of the visual system + tentacle nerves: eyes, lenses, retinae, optic lobes with neuropiles, brain, opt. ganglia  
3+4) Tangential paraffin sections through eyes / optic lobes  
Bars: 500 µm.

## Discussion

Interspecific differences in the morphology of the visual system and its parts reflect differences in collecting ambient light and in processing visual information. The decapods e.g. have bigger eyes and optic lobes but smaller brains compared to *Octopus*. Concerning visual ecology obviously somewhat higher demands are made to the visual system of the carnivorous decapods, whereas the planktonic, yolk-feeding *Octopus* hatchling depends on visual orientation to a lesser degree yet.