

Seeing starfish: The missing link in eye evolution?

4 July 2013



This is a starfish in its habitat, the coral reef, at Akajima in Japan. Credit: Dr. Anders Garm, University of Copenhagen

A study has shown for the first time that starfish use primitive eyes at the tip of their arms to visually navigate their environment. Research headed by Dr. Anders Garm at the Marine Biological Section of the University of Copenhagen in Denmark, showed that starfish eyes are image-forming and could be an essential stage in eye evolution.

The researchers removed starfish with and without eyes from their food rich habitat, the coral reef, and placed them on the sand bottom one metre away, where they would starve. They monitored the starfishes' behaviour from the surface and found that while starfish with intact eyes head towards the direction of the reef, starfish without eyes walk randomly.

Dr Garm said: "The results show that the starfish nervous system must be able to process visual

information, which points to a clear underestimation of the capacity found in the circular and somewhat dispersed [central nervous system](#) of [echinoderms](#)."

Analysing the morphology of the [photoreceptors](#) in the starfish eyes the researchers further confirmed that they constitute an intermediate state between the two large known groups of rhabdomeric and ciliary photoreceptors, in that they have both microvilli and a modified [cilium](#).

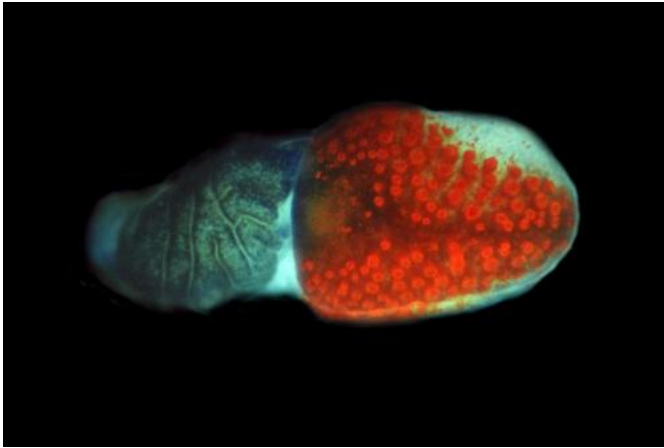


The starfish compound eye (red cups) is seen at the tip of the arm. Each red cup corresponds to a single optical unit, ommatidium, in an arthropod compound eye. Credit: Dan-Erik Nilsson, Lund University

Dr Garm added: "From an evolutionary point of view it is interesting because the morphology of the starfish eyes along with their optical quality (quality of the image) is close to the theoretical eye early in eye evolution when image formation first appeared. In this way it can help clarify what the first [visual tasks](#) were that drove this important step in eye evolution, namely navigation towards the preferred

habitat using large stationary objects (here the reef)."

Most known starfish species possess a compound eye at the tip of each arm, which, except for the lack of true optics, resembles arthropod compound eye. Despite being known for about two centuries, no visually guided behaviour has ever been documented before.



The starfish compound eye (red cups) sits at the base of a modified tube foot. Each red cup corresponds to a single optical unit, ommatidium, in an arthropod compound eye. Credit: Dan-Erik Nilsson, Lund University

The starfish species used in this study was *Linckia laevigata*.

More information: This work will be presented in a poster at 17:00-19:00 on Friday 5th July 2013.

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