Unité d'accueil : EthoS, Ethologie Animale et Humaine, CNRS, Université Rennes 1, Université Caen Normandie)

Equipe d'accueil : NECC, Neuro-Ethologie Cognitive des Céphalopodes, Caen

Encadrant : L. DICKEL, Professeur en Biologie des Comportements

Visual ecology of the cuttlefish: effect of water turbidity on survival, development and reproduction.

Finances : ANR-13-BSV7-0002 (→2020)-PRC/CNRS (→2021) –UMR CNRS 6552 EthoS (→2021)

Infrastuctures et compétences : CREC Plateforme éthologie des animaux marins (EAM, RIN-CPER 2020)-SMEL-Ben Gurion University, Eilat campus.

Among marine animals, the cuttlefish possesses probably one of the more developed and sophisticated visual system. Indeed, two thirds of its brain is devoted to the perception and the processing of visual inputs. Cephalopods' visual system is, then, crucial for their survival and their reproduction.

Cuttlefish visual acuity is equivalent to that of human. However, with only one retinal pigment, they are color blind, but they are sensitive to linear light polarization. They are able to perceive very small (<1°) variation of light polarization. They are also able, with some structures of their skin (between their eyes and along their arms), to polarize the light. Polarization sensitivity (PS) probably allows them to detect prey (*Shashar et al. 2000*), predators (*Cartron et al. 2013*), but also to navigate (*Cartron et al. 2012*) and to communicate with each other, especially for mating (*Boal et al. 2004*).

However, PS differs between two closely related species, probably under different environmental pressures:

PS is very high in the European *S. officinalis*, this species is living in very turbid waters (English Channel), while PS is low in *S. gibba* or *S. prashadi*, the latter living in clearer waters (Red Sea, *Darmaillacq & Shashar 2008*, *Cartron et al. 2013*). We demonstrated in *S. officinalis* that PS facilitates perception of potential predators in turbid water (*Cartron et al. 2013*).

A comparative study of PS will be led in *S. officinalis* and *S. prashadi* in the English Channel and the Red Sea, respectively:

□-a- *in situ* measurement of the light properties on natural spawning sites of both species will be made.

□-b- PS will be assessed on both species in different contexts (predation, defense, navigation).

□-c- The use of PS by individuals *in situ* and/or in laboratory conditions will be assessed during reproduction (communication with conspecifics and spawning).

□-c- Behavioural consequences of water turbidity during egg incubation will be assessed in newly-hatched cuttlefish of both species.

Darmaillacq AS, Shashar N (2008). Lack of polarization optomotor response in the cuttlefish *Sepia elongata* (d'Orbigny, 1845). *Physiol. Behav.* **94(4):**616-620

Cartron L., Josef N., Lerner A., McCusker S.D, Darmaillacq A-S., Dickel L. and Shashar N. (2013). Polarization vision can improve object detection in turbid waters by cuttlefish. *J. Exp. Mar. Biol. Ecol.* **447:**80-85.

Cartron L, Darmaillacq AS, Jozet-Alves C, Shashar N, Dickel L (2012). Cuttlefish rely on both polarized light and landmarks for orientation. *Anim. Cogn.* **15(4):** 591-596.

Shashar, Hagan, Boal, Hanlon (2000). Cuttlefish use polarization sensitivity in predation of silvery fish. *Vis. Res.* **40:**71-75

Boal JG, Shashar N, Grable MM, Vaughan KH, Loew ER, Hanlon RT (2004). Behavioral Evidence for Intraspecific Signaling with Achromatic and Polarized Light by Cuttlefish. *Behaviour* **141(7)**: 837-861.

Romagny S. Darmaillacq AS, Guibé M., Bellanger C., Dickel L. Feel, smell and see in an egg: Emergence of perception and learning in an immature invertebrate, the cuttlefish embryo. *J. Exp. Biol.* **215** : 4125-4130

O'Brien CE, Mezrai N, Darmaillacq AS, Dickel L (2017) Behavioral development in embryonic and early juvenile cuttlefish (*Sepia officinalis*), *Dev. Psychobiol.* **59(2)** : 145-160