ÉCOLE DOCTORALE GALILÉE
Université Sorbonne Paris Nord

Contrat Doctoral — ED Galilée

Titre du sujet : **Plastic sex allocation in hermaphrodites and beyond: oxytocin and social interactions across annelids' sexual systems**

- Unité de recherche : LEEC-Laboratoire d'Ethologie Expérimentale et Comparée
- Discipline : Ethologie
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- Domaine de recherche : Ethologie
- Mots-clés : Social interactions, modulatory mechanisms, oxytocin, invertebrates

Context: Our understanding of the adaptive value of social behaviour, here defined in the broad sense of interactions between conspecifics, has a solid theoretical background; yet research on the mechanisms of social behaviour - how it is caused, regulated and modulated at the proximate level - has proven challenging (Hofmann et al., 2014). Evidence has been accumulating in the last decades that Oxytocin (OT) or OT-like peptides play an important regulatory role in physiological and behavioural processes associated with social interactions, as these peptides have been involved in the regulation of cooperation, pair formation, parental care, etc. Typically, OT/OT-like peptides promote tolerance and bonding across vertebrate taxa, from mammals and birds to fish and amphibians (Donaldson & Young, 2008; Froemke & Young, 2021; Carter, 2022). Yet, OT-like peptides are evolutionarily well conserved - they appeared at least 700 million years ago – and have been detected in invertebrates (Donaldson & Young, 2008; Odekunle & Elphick 2020). Namely, there is evidence OT-like peptides play a role in rmating behaviour in Caenorhabditis elegans (Garrison et al., 2012) and in egg-release in the annelid Eisenia foetida (Oumi et al., 1996). Therefore, OT-like peptides are a candidate mechanism for investigating the hormonal control of social and reproductive behaviour in invertebrates.

Study models: Marine annelid worms of the genus Ophryotrocha include species which exhibit a striking diversity in sexual systems: some species are simultaneous hermaphrodites (each individual produces male and female gametes simultaneously), others are sequential hermaphrodites (individuals spend a part of their life as males and a part as females), yet others have separate sexes (that is, there are females and males). However, all species mate with a partner to reproduce (i.e., hermaphrodites cannot fertilise their eggs with their own sperm). The hermaphroditic species have a plastic sex allocation, that is, they adjust their investment into the two sexual functions depending on the social environment, or, more precisely, on mating opportunities: the larger the social group, the higher the mating opportunities, the higher the investment into the male function and the lower that on the female function (which reflects in the production of gametes and/or in the time spent as male or female). When they adjust their sex allocation to the social environment, the worms also change the quality of their social interactions, from pair bonding, reciprocity in egg exchange and parental care in isolated pairs (Picchi et al., 2018) to overt aggression and competition in larger groups (e.g., Lorenzi et al., 2006; Santi et al., 2018).

Research questions: Are OT/OT-like peptides involved in social and reproductive behaviour in Ophryotrocha worms? Do OT/OT-like peptides play a role in sex allocation adjustments to social environment in hermaphroditic species? How does the function of OT/OT-like peptides change between hermaphroditic and separate-sex species?
The candidate will investigate the role of OT/OT-like peptides on social interactions and reproductive outcomes in three species of Ophryotrocha worms with different sexual systems (O. diadema, O. puerilis and O. labronica, which are simultaneous hermaphrodites, sequential hermaphrodites and separate-sexes, respectively - all species are available at the LEEC in seawater cultures kept in thermostatic cabinets). The candidate will also quantify OT and OT-like peptides and other potential candidate hormones using state-of-the-art methods. These data will unveil the role(s) of OT-like peptides in mediating social interactions in invertebrates for the first time. In addition, by analysing the function of OT/OT-like peptides in closely related hermaphroditic and separate-sex species, the candidate will draw a scenario of the evolutionary trajectory of the function(s) of these peptides along an evolutionary gradient of increasing sexual specialisation.

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