Proposition de stage M2 en Ecophysiologie Evolutive

ENCADREMENT

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LIEU DU STAGE

Université Montpellier, Place Eugène Bataillon, Bat. 24, Laboratoire MARBEC, MONTPELLIER

INTITULE DU STAGE / TITLE OF THE INTERNSHIP

Transitions évolutives et physiologiques chez le copépode *Eurytemora affinis* lors d'invasions en eau douce

Evolutionary physiological shifts during saline to freshwater invasions by the copepod *Eurytemora affinis* complex

BACKGROUND

Invasive species often impose catastrophic effects on the ecosystems, threatening native populations through predation, competition, disease transmission (Crowl et al. 2008), and food-web disruption (Sax et al. 2005). Organisms with short generation time tend to respond to environmental change through their capacity to evolve (evolutionary potential) (Lee and Gelembiuk 2008). The capacity to undergo rapid evolutionary change is essential when the extent environmental change exceeds the physiological tolerances or plasticity of the organism.
In the past century, there has been an increase in the rate of species invasions from saline into freshwater habitats, especially from brackish estuaries (Castille et al. 2016). The copepod, *Eurytemora affinis*, is an estuarine crustacean that has invaded freshwater habitats independently on three continents over the past 80 years (Lee 1999). Prior research has shown evolutionary shifts in ion transporter enzyme activity and body fluid regulation (Lee et al. 2012), indicating evolutionary shifts in the regulation of their internal ionic composition (adaptation) rather than broad salinity tolerances (acclimation).
Ion transporters have been shown to be under selection during these freshwater invasions. These studies have found that *E. affinis* harbors clusters ionocytes localized in their swimming legs and maxillary glands, possibly performing the function of ion uptake (Johnson et al. 2013; Gerber et al. 2016). Specifically, the ion transporters Na^+/H^+ antiporter (NHA), V-type H^+ ATPase (VHA), and Na^+/K^+ -

ATPase (NKA) are localized in the copepod legs (Gerber et al. 2016). The Na^+/H^+ antiporter (NHA) is hypothesized to be cooperating with VHA to import precious Na^+ ions from dilute environments, but this model remains debated. The role that NHA plays in ionic regulation in fresh water needs to be further explored. This project will provide insights into the actual physiological and evolutionary mechanisms of freshwater adaptation by a common invasive species. Evolutionary information is necessary to make predictive models of population responses to environmental change, because evolutionary responses can often greatly expand range limits and ecological niches. Moreover, this study is of utmost importance, given that species from saline habitat currently dominate as invaders of freshwater ecosystems (such as zebra mussels, quagga mussels, sea lamprey, etc.). The mechanisms revealed here are likely to be relevant for understanding invasions by other brackish water species.

OBJECTIVES

This internship is an opportunity to learn experimental design, live animal care, data collection, and quantitate analysis. The goal of this project is to quantify membrane ion transporter expression differences in invasive and native populations reared under similar conditions and then subject them to various salinities. The student will carry out a common garden study, localize ion transporters through immunohistochemistry and explore ion transporter expression.

METHODS

Common Garden design
The student will raise freshwater and saltwater populations of copepods in a common garden setting for one generation. Once the copepods reach adulthood, individuals from each population will be subjected to test salinities. After several days in the test salinities, the copepods will be preserved.

In situ *immunohistochemical staining of ion transporters*
The student will need to determine a preservation and staining technique that leads to the highest quality histological stain. Ideally, this will allow the student to quantify protein expression in a whole copepod (*in toto* immunohistochemistry) through confocal microscopy and 3D imaging.
The student will examine *in situ* localization (protein expression) of different ion transporters in the invasive copepod *Eurytemora affinis*. Depending on the quality of the staining, the expression of these membrane proteins will be compared across native and invasive populations.

Required Profile:
Master 2 student in research with an attraction for evolutionary ecophysiology and experimentation and work in laboratory. A good level of scientific English is necessary.
If you are interested by this internship, please send us a CV and motivation letter.

Profile recherché:
Etudiant M2 recherche avec une attirance pour l'écophysiologie évolutive et le travail au laboratoire (mise en place d'expériences en dispositif common garden, immunocytochimie, microscopie confocale). Un bon niveau d'anglais est nécessaire du fait d'une collaboration étroite avec la coencadrante et des réunions avec une équipe américaine.
Merci de nous envoyer un CV accompagné d'une lettre de motivation si ce stage vous intéresse.

REFERENCES

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