

## PHD PROPOSAL FOR THE DOCTORAL SCHOOL « Ecologie, Géosciences, Agronomie, ALimentation »

### GENERAL INFORMATION

<b>Thesis title:</b> <b>Functional consequences of climate change and biodiversity redistribution on the ecological processes of communities and ecosystems</b>
<b>Acronym:</b> ASICS
<b>Disciplinary field 1:</b> Ecology <b>Disciplinary field 2:</b> Select an element
<b>Three keywords:</b> biological invasions, functional diversity, biostatistics
<b>Research unit :</b> UMR CNRS 6553 EcoBio
<b>Name of the thesis director:</b> David RENAULT <b>Email address of the thesis director :</b> <a href="mailto:david.renault@univ-rennes1.fr">david.renault@univ-rennes1.fr</a> <b>Name of the thesis co-supervisor 1 (if applicable):</b> Toke Thomas HOYE <b>Email address of the thesis co-supervisor 1 (if applicable):</b> <a href="mailto:tth@bios.au.dk">tth@bios.au.dk</a> <b>Name of the thesis co-supervisor 2 (if applicable):</b> Martin HOLMSTRUP <b>Email address of the thesis co-supervisor 2 (if applicable):</b> <a href="mailto:martin.holmstrup@bios.au.dk">martin.holmstrup@bios.au.dk</a>
<b>Thesis grant (funding origin and amount):</b> Contrat doctoral Politique d'Établissement
<b>Contact(s) (mailing address and E-mail):</b> David RENAULT, Université de Rennes 1, UMR CNRS 6553 EcoBio, 263 Avenue du Gal Leclerc, CS 74205, 35 042 Rennes cedex, France ; <a href="mailto:david.renault@univ-rennes1.fr">david.renault@univ-rennes1.fr</a>
<b>Recruitment process:</b> Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website <a href="#">here</a> . This information is needed for proposal publication. <input checked="" type="checkbox"/> <b>Doctoral school contest</b> <input type="checkbox"/> <b>Interview</b> <input type="checkbox"/> <b>Other (indicate) :</b>

**All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name\_Unit\_Subject Acronym\_EN.pdf**

ED EGAAL

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## SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

### **Socio-economic and scientific context : (10 lines)**

Global changes are a growing threat to biodiversity, and warming has already led to poleward, montane and alpine range shifts across many taxonomic groups. Cold environments (high elevation regions and polar zones, i.e. Arctic, Antarctic and sub-Antarctic islands), which host most of the world's last remnant wilderness ecosystems, including many plant and invertebrate communities that are close to their climatic limits, are disproportionately affected by climate change. In this context, biological invasions, the rapid rate of environmental changes, and their synergistic interactions, reduce the uniqueness of specialized cold environment biota through taxonomic homogenization and the loss of endemic species in these sentinel ecosystems. In this context, the Phd project will aim at assessing *what are the extent of changes in diversity of invaded ecosystems under climate change?*

### **Assumptions and questions (8 lines)**

We hypothesize that the ecophysiological plasticity of the species, and the plasticity of their functional traits, are important drivers for community assembly and long-term community dynamics.

(1) To what extent are thermal and desiccation tolerances setting the distribution limits and thermal niches of insects and plants? (2) Is physiological plasticity of native and non-native species sufficient to compensate for rapid changes in the environment? (3) By combining information of the current distribution of the species to the physiological parameters that are most likely at play during climate-induced phenological changes, we will make predictions of the distribution of the biota in the future, and assess what would be the importance of recent invasion events and environmental changes in driving community assembly?

### **The main steps of the thesis and scientific procedure (10-12 lines)**

To address the above-mentioned objectives, the Phd student will first collect reliable descriptors (physiological, morphological, ecological) of potential ecological niches of plants and invertebrates in order to determine which species are most likely to respond *in situ*, and which ones will be threatened and displaced by climate change. Then, the Phd student will develop approaches able to tease apart the effects of different anthropogenic drivers, including human traffic pathways as a source of species' dissemination. In particular, functional diversity indices incorporating the different dimensions of biodiversity (phylogenetic, taxonomic, functional) will be implemented to provide insights into the past and current effects of climate change and biological invasions in a superior way to simple species diversity metrics. Based on functional trait data in combination with past, current, and future species abundance and distribution data, we will estimate the magnitude and direction of shifts in functional diversity with climate change.

### **Methodological and technical approaches considered (4-6 lines)**

The sensitivity of the Polar biota to climate change will be assessed through measurements a range of life history and stress related traits will be measured (thermal limits, reproductive [number of eggs, duration of development] and physiological [bioenergetics, omics techniques] costs will be measured. The multifaceted representation of community and ecosystem functions and their spatio-temporal dynamics, functional diversity metrics as well as community-weighted mean traits will be

calculated. To advance beyond simple statistical analyses of functional diversity, we will include functional diversity into (macro)ecological models.

### Scientific and technical skills required by the candidate

Applicants to the PhD position should have a strong expertise in population and community ecology and excellent programming experience in R is required. The applicant must have excellent writing skills, be independent, and should be enthusiastic about working in an interdisciplinary academic environment (H2020 BiodivERSa project ASICS: <https://www.coldregioninvasives.com/>). The candidate may have to perform fieldwork under demanding environmental conditions sub-Antarctic regions

## THESIS SUPERVISION<sup>1</sup>

<b>Unit name:</b> EcoBio - UMR CNRS 6553 - University of Rennes 1	<b>Team name:</b> EcoStress-EcoTox
<b>Unit director name:</b> Joan VAN BAAREN	<b>Team director name:</b> David RENAULT
<b>Mailing address of the unit director:</b> joan.van-baaren@univ-rennes1.fr	<b>Mailing address of the team director:</b> david.renault@univ-rennes1.fr
<b>Thesis director</b> Surname, first name: RENAULT David Position: Professor Obtained date of the HDR (Habilitation thesis to supervise research): July 18 <sup>th</sup> , 2008 Employer: University of Rennes 1 Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 40 Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0 Number of current thesis supervisions/co-supervisions: 0	
<b>Thesis co-supervisor 1 (if applicable)</b> Surname, first name: Toke Thomas HOYE Position: Senior scientist Habilitation thesis to supervise research <input type="checkbox"/> yes <input type="checkbox"/> no If yes, date diploma received: Not applicable (NA)	

<sup>1</sup> In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Employer: Aarhus University, Denmark

Doctoral school affiliation: NA

Rate of thesis supervision in the present project (%): 30

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50

Number of current thesis supervisions/co-supervisions: 1

**Thesis co-supervisor 2 (if applicable)**

Surname, first name: HOLMSTRUP Martin

Position: Professor

Habilitation thesis to supervise research  yes  no If yes, date diploma received: NA

Employer: Aarhus University, Denmark

Doctoral school affiliation: NA

Rate of thesis supervision in the present project (%): 30

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50

Number of current thesis supervisions/co-supervisions: 1

**Private partner (if CIFRE funding, private funding,...)**

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

**International partner (if Cotutelle thesis)**

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

**Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)**

*Please provide the following information for each PhD students supervised*

Surname, first name: ENGELL DAHL (BJORGE) Julie

Date of PhD beginning and PhD defence: 01/10/2017 (Phd delayed by 10 months after maternity leave)

Thesis supervision: David RENAULT, Martin HOLMSTRUP

Professional status and location: currently finishing her Phd.

Contract profile (post-doc, fixed-term, permanent): Phd defence scheduled in summer 2021

List of publications from the thesis work:

Engell Dahl J., Marti S-L., Colinet H., Wiegand C., Holmstrup M., **Renault D.** Thermal plasticity and sensitivity to insecticides in populations of an invasive beetle: Cyfluthrin increases vulnerability to extreme temperature. In press *Chemosphere*.

Engell Dahl J., Bertrand M., Pierre A., Curtit B., Pillard C., Tasiemski A., Convey P., **Renault D.** 2019. Thermal tolerance patterns of a carabid beetle sampled along invasion and altitudinal gradients at a sub-Antarctic island. *Journal of Thermal Biology* **86**, 102447.

**Surname, first name: HENRY Youn**

Date of PhD beginning and PhD defence: 01/10/2015 – 01/12/2018

Thesis supervision: David Renault & Hervé COLINET

Professional status and location: Postdoc (3 years) in Evolutionary Ecology Group, Vorburger Lab, Zürich (Switzerland)

Contract profile (post-doc, fixed-term, permanent): post-doctoral position

List of publications from the thesis work:

Henry, Y., Piscart, C., Charles, S., Colinet, H. 2017. Combined effect of temperature and ammonia on survival and molecular response of the freshwater crustacean *Gammarus pulex*/ *Ecotoxicology and Environmental Safety*. 137: 42-48.

Henry, Y., Renault, D., Colinet, H. 2018. Hormesis-like effect of mild larval crowding on thermotolerance in *Drosophila* flies. *Journal of Experimental Biology*. doi: 10.1242/jeb.169342.

Henry, Y. & Colinet, H. 2018. Microbiota disruption leads to reduced cold tolerance in *Drosophila* flies. *Science of Nature*. 105:59.

Henry Y., Overggard, J. Colinet, H. 2020. Dietary nutrient balance shapes phenotypic traits of *Drosophila melanogaster* in interaction with gut microbiota. *Comparative Biochemistry and Physiology, Part A*. 241:110626.

Henry, Y., Tarapacki, P. Colinet, H. 2020. Larval density affects phenotype and surrounding bacterial community without altering gut microbiota in *Drosophila melanogaster*. *FEMS Microbiology Ecology*. 96: fiae055.

**Five main recent publications of the supervisors on thesis subject:**

Renault D., Leroy B., Manfrini E., Diagne C., Ballesteros-Mejia L., Angulo E., Courchamp F. Biological invasions in France: Alarming costs and even more alarming knowledge gaps. *Sous presse, Neobiota*.

Ouisse T., Day E., Laville L. Hendrickx F., Convey P., Renault D. 2020. Does climate change facilitate the expansion of the invasive carabid beetle *Merizodus soledadinus* in the sub-Antarctic Kerguelen Islands? *Scientific Reports* 10, 1234.

Lebouvier M., Lambret P., Garnier A, Frenot Y, Vernon P, Renault D. 2020. Spotlight on the monitoring of the invasion of a carabid beetle on an oceanic island over a 100 year period. *Scientific Reports* 10, 17103.

Engell Dahl J., Bertrand M., Pierre A., Curtit B., Pillard C., Tasiemski A., Convey P., **Renault D.** 2019. Thermal tolerance patterns of a carabid beetle sampled along invasion and altitudinal gradients at a sub-Antarctic island. *Journal of Thermal Biology* **86**, 102447.

Renault D., Laparie M. McCauley S.J., Bonte D. 2018. Environmental adaptations, ecological filtering and dispersal, central to insect invasions. *Annual Review of Entomology* 63, 345-368.

## THESIS FUNDING

<b>Origin(s) of the thesis funding: Contrat doctoral politique d'établissement</b>
<b>Gross monthly salary: 1769 euros</b>
<b>Thesis funding state : Acquired</b>
<b>Funding beginning date/Funding ending date: 01/10/2021</b>

**Date:** 26/03/2021

**Name, signature of unit director:**

**Joan VAN BAAREN**  
Directrice de l'UMR Ecobio



**Name, signature of team director:**

Claudia WIEGAND



**Name, signature of thesis project director:**

David RENAULT

