DOCTORAT ECOLOGIE
BRETAGNE GEOSCIENCES
LOIRE AGRONOMIE ALIMENTATION

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

## GENERAL INFORMATION

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| **Thesis title: (Epi)genetic responses of the aquatic invasive species, Ludwigia grandiflora subsp. hexapetala, to environmental change** |
| **Acronym:** Invagenome |
| **Disciplinary field 1:** Ecology<br>**Disciplinary field 2:** Agronomy |
| **Three keywords**: Biological invasion, (Epi)genetic, Bioinformatic |
| **Research unit : UMR DECOD** |
| **Name of the thesis director HDR (Habilitation thesis to supervise research) required:**<br>Barloy Dominique<br>**Email address of the thesis director:** dominique.barloy@agrocampus-ouest.fr<br>**Name of the thesis co-director (if applicable): HDR (Habilitation thesis to supervise research) required:** Barloy-Hubler Frédérique<br>**Email address of the thesis co-director (if applicable):** fhubler@univ-rennes1.fr |
| **Thesis grant (funding origin and amount):** ½ grant INRAE (département ECODIV) and ½ grant Institut Agro (108 K€) |
| **Contact(s) (mailing address and E-mail):** Dominique BARLOY – UMR DECOD – 65 rue de Saint Brieuc – 35042 Rennes Cedex |
| **Recruitment process:** Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here. This information is needed for proposal publication.<br>☐ **Doctoral school contest** ☒ **Interview** ☐ **Other (indicate) :** |

**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**

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# SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

**Socio-economic and scientific context:**

The development of invasive species, considered internationally as the third cause of biodiversity decreasing, represents a threat to agro-ecocosystems with important ecological consequences. The fight against invasive species is at the heart of French environmental policy, particularly for water primrose, including the species Ludwigia grandiflora subsp. hexapetala (Lgh). Water primrose is one of the most dangerous invasive species, given the serious ecological and socio-economic damage it causes in France. Thus, the decree of 2 May 2007 prohibits their marketing, transport, horticultural use and introduction into the natural environment. Lgh, an invasive aquatic plant, has demonstrated its ability to move from the aquatic environment to the terrestrial environment and to survive there. Genetic versus epigenetic adaptation is considered a potential factor in the rapid adaptation of invasive species. Understanding the molecular mechanisms of phenotypic variation of an invasive species in its area of introduction, and thus disentangling the effects of genetic variation and epigenetic regulation, is crucial for predicting the deployment of invasive species outside their native range and for providing management recommendations for invaded ecosystems and agrosystems.

**Assumptions and questions:**

The main objective of the thesis is to study the (epi)genetic responses of the water primrose to changes in the aquatic versus terrestrial environment using genomic resources generated from available genomic data from various sources in a non-model decaploid species. It will be broken down into two questions: (Q1) What strategies should be put in place to optimise the creation of genomic resources in a non-model decaploid species? (Q2) How do sources of flexibility such as genetic and epigenetic factors contribute to the acclimatisation of Lgh to the terrestrial environment, associated with the following hypotheses: (H1) Lgh's ability to change environments involves both genetic and epigenetic responses, both contributing to the expression of its phenotypic plasticity; (H2) 3rd generation sequencing provides sufficient genomic data to identify (epi)genetic factors in the acclimatisation of primrose willow to environmental changes.

**The main steps of the thesis and scientific procedure**

**1st year** (Work on Q1; 1st draft genome of Lgh and 1st publication): (1) Appropriation of the "omics" data available on the project (quality control, coverage rate, ...) and of the pipeline(s) defined on the chloroplastic and mitochondrial genomes in Lgh; (2) Bibliographical work on the methodologies/strategies for the construction of genomes of non-model species and polyploid species; (3) 1st thesis monitoring committee. (4) Realization of the 1st draft of the Lgh genome (assembly, scaffolding, annotation and exploitation of Lpm data) ; (5) Drafting of the genome publication.

**2nd Year** (Work questions 1 and 2; 1st transcriptome draft, functional analysis; 2nd publication): (1) De novo transcriptome assembly of Lgh; (2) Drafting of the transcriptome; (3) Differential analysis of the transcriptome expressed in the 2 terrestrial and aquatic morphotypes of Lgh cultivated under aquatic and terrestrial conditions; (4) 2nd thesis committee.

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| **3rd Year** (Draft methylome, differential analysis - 3rd publication - Writing thesis manuscript): (1) Analysis of euchromatin data; (2) Realization of a draft methylome of Lgh and differential analysis (Realizations in Orléans); (3) Writing publication 3; (4) Writing thesis manuscript. |
| **Methodological and technical approaches considered**<br>We have a wide variety of "omics" sequences, (1) short and long fragment DNA sequences (short reads, long reads); (2) RNA sequences (RNA-Seq) corresponding to differential expression of genes in the aquatic and terrestrial morphotypes of Lgh; (3) euchromatin sequences (methylome, euchromatin DNAse I). The methods used will call upon the fields of bioinformatics, computer science and functional genomics (see listing in the 'skills' item). |
| **Scientific and technical skills required by the candidate**<br>**Bioinformatics skills**: Use and understanding of different genome and transcriptome assembly and annotation software; **Computer skills**: Python programming, Bash, R - Collaborative science (GitLab, GitHub, MarkDown); **Functional genomics skills**: Gene biocuration, Ontology tools (GO, ...), Analyses in R (descriptive analyses, Machine learning, ...). |

## THESIS SUPERVISION[1]

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| **Unit name:**<br>UMR DECOD | **Team name:**<br>/ |
| **Unit director name:**<br>Eric Petit | **Team director name:**<br>/ |
| **Mailing address of the unit director:**<br>UMR DECOD – 65 rue de Saint Brieuc – 35042 Rennes Cedex | **Mailing address of the team director:**<br>/ |
| **Thesis director**<br>Surname, first name: BARLOY Dominique<br>Position: MC HC<br>Obtained date of the HDR (Habilitation thesis to supervise research): 2009<br>Employer: L'institut Agro Rennes Angers<br>Doctoral school affiliation: L'institut Agro Rennes Angers<br>Rate of thesis supervision in the present project (%): 50 %<br>Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0%<br>Number of current thesis supervisions/co-supervisions: 0 | |

[1] **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.**

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**Thesis co-director**

Surname, first name: Hubler Frédérique

Position: Chargée de Recherche

Obtained date of the HDR (Habilitation thesis to supervise research): 2002

Employer: CNRS

Doctoral school affiliation: ED EGAAL

Rate of thesis supervision in the present project (%):50%

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):30%

Number of current thesis supervisions/co-supervisions: 1

**Thesis co-supervisor 1 (if applicable)**

Surname, first name:

Position:

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

Employer:

Doctoral school affiliation:

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:

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

Surname, first name:

Position:

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

Employer:

Doctoral school affiliation:

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:

**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) (%):

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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: Genitoni Julien

Date of PhD beginning and PhD defence: 2016-2019

Thesis supervision: Barloy Dominique

Professional status and location: Reception and scientific mediation - Médiathèque d'Angers

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

List of publications from the thesis work:

Genitoni, J., Vassaux, D., Delaunay, A., Citerne, S., Portillo Lemus, L., O., Etienne, M.-P., Renault, D., Stoeckel, S., **Barloy, D.,** Maury, S. 2020. Hypomethylation of the aquatic invasive plant, *Ludwigia grandiflora* subsp. *hexapetala* mimics the adaptive transition into the terrestrial morphotype. Physiologia Plantarum, 2020 Oct;170(2):280-298. doi: 10.1111/ppl.13162. Epub 2020 Aug 16. PMID: 32623739.

Marin, P., Genitoni, J., **Barloy, D.,** Maury, S., Gibert, P., Ghalambor, C., K., Vieira, C. 2019. Biological invasion: The influence of the hidden side of the (epi)genome. Functional Ecology, (34), 385-400

Billet, K., Genitoni, J, Bozec, M., Renault, D., **Barloy, D**., 2017 - Aquatic and terrestrial morphotypes of the aquatic invasive plant, *Ludwigia grandiflora* show distinct morphological and metabolomic responses. Ecology and Evolution, DOI: 10.1002/ece3.3848.

Surname, first name: Portillo-Lemus Luis

Date of PhD beginning and PhD defence: 2017-2021

Thesis supervision: Barloy Dominique

Professional status and location: ATER, Université Pharmacie Montpellier

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

List of publications from the thesis work:

Portillo Lemus, L. O., Harang, M., Bozec, M., Haury, J., Stoeckel, S., **Barloy, D.** 2021 - Late-acting self-incompatible system, preferential allogamy and delayed selfing in the heterostylous invasive populations of *Ludwigia grandiflora* subsp. *hexapetala* – PCI Ecology bioRxiv- doi: https://doi.org/10.1101/2021.07.15.452457..

Portillo Lemus, L.O., Bozec, M., Harang, M., Coudreuse, J., Haury, J., Stoeckel, S. and **Barloy, D.** (2021), Self-incompatibility limits sexual reproduction rather than environmental conditions in an invasive water primrose. Plant-Environment Interactions, 2: 74-86. https://doi.org/10.1002/pei3.10042

Surname, first name: Luis ACUNA-AMADOR

Date of PhD beginning and PhD defence: 2014-2017

Thesis supervision: Frédérique HUBLER

Professional status and location: Maitre de conférences, Universitad de Costa Rica – San Jose. Costa Rica

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

List of publications from the thesis work:
Acuña-Amador L, **Barloy-Hubler F**. 2020 - Porphyromonas spp. have an extensive host range in ill and healthy individuals and an unexpected environmental distribution: A systematic review and meta-analysis.2020 Dec;66:102280. doi: 10.1016/j.anaerobe.2020.102280. Epub 2020 Oct 1.PMID: 33011277

Acuña-Amador L, Primot A, Cadieu E, Roulet A, **Barloy-Hubler F**. 2018 - Genomic repeats, misassembly and reannotation: a case study with long-read resequencing of Porphyromonas gingivalis reference strains. BMC Genomics. 2018 Jan 16;19(1):54. doi: 10.1186/s12864-017-4429-4. PMID: 29338683

Meuric V, Le Gall-David S, Boyer E, Acuña-Amador L, Martin B, Fong SB, **Barloy-Hubler F**, Bonnaure-Mallet M. 2017 - Signature of Microbial Dysbiosis in Periodontitis. Appl Environ Microbiol. 2017 Jun 30;83(14):e00462-17. doi: 10.1128/AEM.00462-17. Print 2017 Jul 15. PMID: 28476771

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

see list of publications above

## THESIS FUNDING

**Origin(s) of the thesis funding:** ½ INRAE grant (ECODIV department) + ½ grant on own funds Institut Agro

**Gross monthly salary:** 1 975 €

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| **Thesis funding state : Acquired** |
| **Funding beginning date/Funding ending date: 01.09.2022 / 36 months** |

**Date: 07/06/2022**

**Name, signature of unit director:**

**Name, signature of team director:**

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