



الهيئة الملكية لمحافظة العلا
Royal Commission for AlUla



Origins and diversity of the Date Palm in al-'Ulā Oasis, Saudi Arabia: a multidisciplinary approach combining Genomics, Ethnobotany and Archaeobiology

KEY INFORMATION

Affiliations Université de Montpellier (France)

Doctorate school ED584 GAIA – Montpellier

Speciality EERGP - Écologie, Évolution, Ressources Génétique, Paléobiologie

Research units Mostly at [Institut des Sciences de l'Évolution – Montpellier](#) (ISEM, UMR 5554 Université de Montpellier, CNRS, IRD, EPHE), and secondarily at the [lab. Éco-anthropologie – Paris](#) (UMR 7206 CNRS, MNHN, Univ. de Paris, at Musée de l'Homme).

Teams Dynamique de la Biodiversité, Anthro-écologie (DBA) + Ethnoécologie: savoirs, pratiques, pouvoirs

PhD advisors [Pr. Jean-Frédéric Terral](#) (ISEM), [Dr. Muriel Gros-Balthazard](#) (New York University Abu Dhabi, United Arab Emirates) & [Dr. Vincent Battesti](#) (CNRS)

Funding [CNRS](#) with [AFALULA](#) agency (see booklet attached)

Start February 1st 2020

Duration Three (3) years

Application deadline December 23rd 2019 (11:59 pm) - <http://bit.ly/2YbZm6b>

INFORMATIONS CLÉS

Affiliations Université de Montpellier

École doctorale ED584 GAIA – Montpellier

Spécialité EERGP - Écologie, Évolution, Ressources Génétique, Paléobiologie

Unités de recherche En grande majorité à l'Institut des Sciences de l'Évolution – Montpellier (ISEM, UMR 5554 Université de Montpellier, CNRS, IRD, EPHE) et secondairement au lab. Éco-anthropologie — Paris (UMR 7206 CNRS, MNHN, Univ. de Paris at Musée de l'Homme).

Encadrants de thèse Pr. Jean-Frédéric Terral (ISEM), Dr. Muriel Gros-Balthazard (New York University Abu Dhabi, Émirats arabes unis) & Dr. Vincent Battesti (CNRS)

Financement CNRS avec l'agence AFALULA (voir la brochure ci-jointe)

Début 1^{er} février 2020

Durée Trois (3) ans

Date limite de candidature 23 décembre 2019 (23h59) - <http://bit.ly/2YbZm6b>

Keywords

Date palm (*Phoenix dactylifera* L.), agrobiodiversity, population genomics, seed morphometrics, ethnobotany, oasis, Saudi Arabia

Project description

The oasis of al-'Ulā in the northwest of the Kingdom of Saudi Arabia, considered a remote and isolated territory, is at the center of an ambitious development project by the Saudi government. Al-'Ulā is mainly an agricultural terroir, with the date palm (*Phoenix dactylifera* L.) being the engineering plant of this complex man-made system, and even an essential part of the county's economy, beyond sustaining its communities. The touristic and economic development will have an impact on urban areas and agriculture and on the date palms in particular. A sustainable project hence requires an accurate assessment of the agrobiodiversity richness of the local date palms.

The goal of the PhD project is to provide a comprehensive estimation of date palm past and present diversity along with the understanding of its origins and evolution through time. Genomic and seed morphometric analyses of modern and ancient date palms will inform us on the agrobiodiversity: their diversity, origins, provenances and transformations from the beginning of date palm cultivation in al-'Ulā oasis till today. These results will be interpreted in light of the ethnobotanical survey performed in parallel.

Beyond the characterization of local germplasm, this project will provide the knowledge that is fundamental to the sustainable development of the oasis, conservation purposes and breeding programs.

Task I. Assessment of the diversity of date palms in al-'Ulā and its region

The objective is to describe the structure and extent of the present diversity of date palms in al-'Ulā and the surrounding region. The PhD student will participate to the collect of material

(seeds and leaflets) in the field, in Saudi Arabia. She/he will be trained in the lab in NYUAD (DNA extraction, library preparation for sequencing), and will generate a SNP dataset to be analyzed using population genomic methods. She/he will also generate a seed size/shape dataset (modern and ancient seeds) using morphometric methods and will analyze it. The results will be interpreted in light of the ethnobotanical survey.

Task 2. Origins and evolutionary history of *al-'Ulā* date palms

The goal is to infer the origins of the diversity in *al-'Ulā* Oasis and its evolution through time. Both genomic and seed morphometric datasets, generated in the Task 1, will be incorporated in the existing datasets of the current date palm diversity found worldwide. Population genomics/modeling methods will be employed to infer where *al-'Ulā* date palms originate from. The large seed morphometric dataset will allow to infer precisely the evolution of the phenotypic diversity through time.

Duration of the thesis

The PhD candidate will work under a three (3) years PhD contract with the CNRS and will have to complete her/his PhD thesis in these three years. Research schedule will be discussed with the PhD advisors.

Research thematic

Agrobiodiversity, Evolution, Genetics and Populations Genomics, Ethnobotany, Ethnoecology, Archaeobiology.

Profile and skills required

The candidate must have a master's degree (or equivalent) in biology and an excellent expertise in population genomics and evolutionary biology. Skills in bioinformatics are desirable (*R* and *bash* languages) as bioinformatics approaches will be engaged for genomic data analysis. The candidate must have an interest in multidisciplinary, especially in archaeosciences/archaeobiology and ethnobotany.

The candidate should be mobile, as she/he will primarily be based in Montpellier (ISEM) but will spend several months each year abroad (in Abu Dhabi mostly and in the field in the Kingdom of Saudi Arabia). Several trips to Paris and conferences abroad are also planned.

Excellent knowledge of English is desirable. Yearly research progress reports will have to be written in English for the project.

Mentoring

The PhD student will be mentored by 3 researchers having a great experience in the date palm biology, evolution, history, archaeobotany, ethnoecology and ethnobotany: M. Gros-Balthazard (NYUAD: morphometrics and population genomics), Vincent Battesti (MNHN, Musée de l'Homme, Paris: ethnoecology and ethnobotany) and Jean-Frédéric Terral (ISEM, Montpellier: archaeobiology and paleoecology). He/she will be mentored in population genomics by Dr. Muriel Gros-Balthazard (New York University Abu Dhabi) during three months each year. She/he will also be mentored in ethnobotany by Dr. Vincent Battesti, CNRS, Paris.

The doctoral student will enroll at the GAIA doctoral school of the University of Montpellier (ED 584), city where he/she will reside for most of the year.

Material and scientific environment (specific safety conditions)

The human and technical resources required to complete the thesis are planned and budgeted for, the means to carry out field research (air tickets, *per diem*, etc.), and are present in the host laboratories/institutions:

- collections of biological material: ISEM and NYUAD
- Morphometrics: ISEM
- Genomics: NYUAD
- Ethnoecology and ethnobotany: CNRS-MNHN, Musée de l'Homme, Paris.

This unique opportunity to conduct a three-years multisite research opened on different disciplines will provide an opportunity for field research in Saudi Arabia in a secure region of the kingdom, in the northwest, a region that is opening up to tourism.

Objectives of valorization

- Publications,
- International meetings,
- Applied science for valorization and development projects of the oasis.

Collaborations

The PhD, interdisciplinary and carried out in 3 different laboratories, provides an unique framework for the establishment of a broad and solid collaboration network.

International openness

Essence of the PhD

How to apply?

Applications must be sent via the CNRS job website (<https://emploi.cnrs.fr>) before December 23rd 2019 (11:59 pm): <http://bit.ly/2YbZm6b> (ref.: UMR7206-VINBAT-002)

Any auditions will take place in Montpellier and/or videoconference within one or two weeks after the closing date for applications.



Photography 1: working with local people in al-'Ulā oasis (KSA), April 14th, 2019, by V. Battesti

Links

- RCU (Royal Commission for al-Ula): <https://rcu.gov.sa>
- AFALULA: <https://www.afalula.com/en>
- CNRS: <https://cnrs.fr/en>
- Université de Montpellier: <https://www.umontpellier.fr/en>
- ISEM: <http://www.isem.univ-montp2.fr/fr/equipes/dynamique-de-la-biodiversite-anthro-poecologie-index/>
- Lab. Éco-anthropologie (Musée de l'Homme): <https://www.ecoanthropologie.fr/en>
- Center for Genomics and Systems Biology (NYU Abu Dhabi): <https://cgsb.abudhabi.nyu.edu>

References

- Gros-Balthazard*, M., Battesti*, *et al.* Integration of ethnobotany and population genetics uncovers the agrobiodiversity of date palms of Siwa Oasis (Egypt) and their importance to the evolutionary history of the species. *bioRxiv*. <https://doi.org/10.1101/820407> (2019).
- Gros-Balthazard, M., Hazzouri, K. M. & Flowers, J. M. Genomic Insights into Date Palm Origins. *Genes (Basel)*. 9, 1–14 (2018).
- Battesti*, V., Gros-Balthazard*, M. *et al.* Date Palm Agrobiodiversity (*Phoenix dactylifera* L.) in Siwa Oasis, Egypt: Combining Ethnography, Morphometry, and Genetics. *Hum. Ecol.* 46, 1–18 (2018).
- Gros-Balthazard, M. *et al.* The Domestication Syndrome in *Phoenix dactylifera* Seeds: Toward the Identification of Wild Date Palm Populations. *PLoS One* 11, e0152394 (2016).
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- Gros-Balthazard, M. *et al.* The Discovery of Wild Date Palms in Oman Reveals a Complex Domestication History Involving Centers in the Middle East and Africa. *Curr. Biol.* 27, 2211–2218 (2017).