Funded by the European Union

NATURE4NATURE

Doctoral Candidate (DC2): Tongue and beak filtration in dabbling ducks

Host Institution: Muséum National Histoire Naturelle, France
Secondments: Stellenbosch University, South Africa (SU; 6 months)
Technische Hochschule Deggendorf, Germany (THD; 2 months)
Impactvista, Belgium (2 months)

About Nature4Nature

Bioinspiration (including biomimetics and biomimicry) develops novel materials, devices, and applications inspired by biological structures and strategies. However, the main obstacle preventing this field from achieving its goals derives from differences in tools, practices and viewpoints of its practitioners. The EU-funded Nature4Nature project brings biologists, engineers, designers and manufacturers together to deliver early-stage researchers (ESRs) teaching in a learning environment that connects the inspiration, integration and implementation aspects of the bioinspiration process to undertake the conceptual, methodological and practical challenges. To do so, the project will collectively focus on biological filtration mechanisms to explore, test and design high-throughput, clog-resisting filtration systems, which could ultimately alleviate the current problems facing aquatic environments.

Muséum National Histoire Naturelle

Founded almost 400 years ago, the Muséum National Histoire Naturelle (MNHN) is one of the world's major natural history institutions and contributes to the knowledge and conservation of biodiversity. At the crossroad of natural and social sciences, its remit encompasses research, teaching, maintenance of collections, dissemination of knowledge and outreach, as well as consultancy in all areas pertaining to natural history. It is home to 2500 staff, including 500 researchers, and hosts 300 postgraduate students. The MNHN delivers MSc programs and is associated with the neighbouring Sorbonne Université in a joint graduate school. The MNHN has a solid track record in running awards by the EU and the ERC, and also participates in European or high-profile international infrastructure consortia such as the CETAF, GBIF and DiSSCo.
The **Mecadev** Adaptive Mechanisms and Evolution research unit, comprises 25 researchers, of which 8 in the FunEvol team work on the relationships between structure-function-phylogeny and potentialities
In addition, the MNHN launched "**Bioinspire-Muséum**" in 2019 to support and coordinate all bioinspired activities across its five remits (Research, Education, Expertise, Collections and Sharing Knowledge).

Project description

The PhD proposal focuses on the identification and description of a biological functional system, the transfer procedure of this system to technology and the study of the impact of taking evolutionary constraints into account in the process of transferring biological functional systems to technology in the context of sustainable development. The biological model studied is the tongue and beak filtration system of dabbling ducks.
The DC will study the morphology of the bucco-lungual system of a sample of species representative of the phylogenetic and ecological diversity of the Anatidae to determine anatomical characteristics linked to evolutionary history and those linked to the type of food filtered. He/she/they will identify the principles of filtration and propose procedures for technology transfer. The DC will investigate how providing practitioners with an evolutionary context can facilitate the development of technological frameworks based on form-function relationships in nature.
The DC will establish a solid 3D anatomical knowledge of the osteo-muscular system associated with filtration (beak and tongue) from the literature, classical anatomical dissections, and numerical segmentations of digital models (MNHN). To obtain appropriate 3D digital models, the DC will establish a method of anatomical preparation using contrast agents to access detailed soft and hard tissue anatomy by tomography. The 3D models acquired by micro-CT will be obtained using the latest generation of image analysis software (VGStudio Max) (SU). The DC will analyse the diversity of structures involved in the oral-lingual system and identify structures associated with filtration in a variety of *Anas* species from different ecologies. 3D geometric morphometry methods will be used to quantify shape and variation between species in an evolutionary and functional context (MNHN). The DC will extract the underlying conserved biological principles and evolutionary adaptations associated with the filtration mechanisms observed in dabbling ducks for the design of a technological system (THD). To do so, the DC will link the knowledge base they have created to existing tools in the Bioinspired design and development process, e.g., identification of biological trade-offs (E2BMO) or innovative design principles (BionIQuity, BioTRIZ) for the application (thesaurus, business canvas). In addition, they will identify areas of application of the identified principles and models that can inform the development of various applications. An analysis of

the approach, from evolutionary biology to industry application, will be carried out (Impactvista) in order to identify how this innovation can be useful in the context of sustainable development and more broadly how evolutionary biology concepts can participate in bioinspired innovation.
The main part of the thesis will take place at MNHN in Paris, France. The PhD student will have to stay at the SU for 6 months in the first year, at the TDH for two months in the second year and at Impactvista for two months in the third year.

Profile & requirements

- Applicants must hold a master's degree or equivalent
- Transcripts of the master's degree must be available by the date of the recruitment
- Applicants should have a strong affinity for research in functional morphology and evolution
- Applicants may be of any nationality but must comply with the Horizon Europe MSCA eligibility criteria*
- Applicants must be able to understand and express themselves in both written and spoken English to a level that is sufficient for the completion of a PhD
- All qualified applicants, including minorities and woman, are encouraged to apply

* *HORIZON MSCA Mobility Rule*: Applicants must not have resided or carried out their main activity (work, studies, etc.) in the country of the host organization (France) for more than 12 months in the past 3 years immediately before the recruitment date. Compulsory national service, short stays such as holidays, and time spent as part of a procedure for obtaining refugee status are not taken into account.

* *HORIZON MSCA eligibility criteria*: Applicants may not hold a doctoral degree or equivalent at the start date of the recruitment. Researchers who have successfully defended their doctoral thesis but who have not yet formally been awarded the doctoral degree will not be considered eligible.

Benefits

- The selected candidate will be employed by the host organisation for **36 months**
- **The start date will be as of September 1st, 2023**
- The opportunity to be part of an MSCA Doctoral Network: the selected candidate will benefit from the designed training programme offered by the host organisation and the Nature4Nature consortium.
- The selected candidate will participate in international secondments to other organisations within the Nature4Nature network.
- *Doctoral candidates are offered a competitive remuneration based on the MSCA allowances in line with the MSCA WP 2021-2022*. The gross monthly amount corresponds to the amount for doctoral scholarship holders. Moreover, funding is available for technical and personal skills training and participation in international research events. Minimum wages are governed by the French government (https://www.legifrance.gouv.fr/loda/id/JORFTEXT000033076467/).

Application

- Interested candidates are invited to apply for this position: https://www.adum.fr/as/ed/voirproposition.pl?langue=&site=ed227&matricule_prop=45248
- The closing date for applications is **January 31st, 2023**.
- The selection committee will review all the applications upon the application deadline.
- The recruitment process of Nature4Nature is in line with the principles set out in the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.
- Ukrainian researchers are eligible to benefit from the Science4Refugees initiative without the need of holding the refugee status.

Additional information

- For more information on the Nature4Nature consortium, please visit our website at https://www.nature4nature.net/
- Any additional questions can be directed to the project manager, Genevieve Diedericks, at Genevieve.Diedericks@uantwerpen.be

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