



CALL FOR STUDENT -

PhD scholarship available:

## **Multimodal perception of aerial sounds and aquatic vibrations in crocodiles**

PhD advisers: Nicolas Mathevon and Nicolas Grimault.

**Summary:** As top predators, crocodylians are very well equipped to probe their environment: excellent vision at least in air, highly developed smell, extraordinary abilities of mechano-reception, and an acute sense of hearing. We have recently studied how crocodiles locate the position of an airborne sound source, and how these animals identify airborne acoustic signals in their noisy environment thanks to their ability to categorize sounds along a sound continuum. During this PhD project, we will integrate a new perceptual dimension of crocodiles: aquatic vibrations. Crocodiles lead an amphibious life, at the interface between water and air. Their ears are mainly dedicated to the perception of airborne sound waves, while mechanoreceptors distributed on the body of the animal and especially all around the mouth are sensitive to aquatic vibrations. The objective of this project will be to understand how the crocodile integrates information from these two sensory channels. Through propagation measurements, we will evaluate the information transmitted to a swimming crocodile at the air-water interface by airborne sound waves and aquatic vibrations in naturalistic situations (e.g. when a prey approaches the water body and starts to drink). We will then test through playback experiments in the wild and in the laboratory (using loudspeakers and vibratory devices), how crocodiles integrate information from these two channels. We will test the following hypotheses: 1) do water vibrations produced by the prey add information to the airborne sound signals, and allow the crocodile to identify more precisely the cause of the sounds and vibrations (i.e. size of the prey; appropriate moment to approach it), 2) do water vibrations increase the reliability of the information provided by the airborne sound signals, by improving for example the crocodile's ability to localize the source. We will also evaluate the ability of crocodiles to combine the information provided by airborne sounds and waterborne vibrations spatially (co-located or separate signals) and temporally (signals arriving simultaneously or successively).

**Outcome of the project:** There is currently a great interest in understanding the evolution of the archosaurian lineage. Crocodylians diverged from birds more than 240 million years ago and they are of primary interest in the reconstruction of ancestral archosaurian biology. In this perspective, increasing our knowledge about crocodylian biology is a necessary step. This thesis will be the first of its kind to examine how an amphibious animal integrates information from airborne sounds and waterborne vibrations. More broadly, the research performed during this PhD project will bring new knowledge about multimodal sensory processing, a universal problem faced by all animal species living in complex environments.

**Logistics.** Experiments on captive individuals will be performed at the ENES lab (Saint-Etienne, France) and at Crocoparc Zoo (Agadir, Morocco). Field experiments will probably

be performed at Nhumirim field station (Pantanal, Brazil). The focal species will mainly be the Nile crocodile and the spectacled caiman.

**Supervision.** Prof. Nicolas Mathevon (University of St-Etienne, ENES Team, <https://www.eneslab.com/nicolas-mathevon>) and Dr. Nicolas Grimault (University Lyon 1, CAP Team).

**Administrative information:**

-3-years position; Starting around 1<sup>st</sup> October 2021.

-The PhD student will be part-time in Lyon (CAP team) and part-time in St-Etienne (ENES team).

**Skills:**

The applicants must be graduated at the MASTER level. Two profiles might fit:

A MASTER in acoustic with a particular interest in research with animals (ethology)

or

A MASTER in ethology with a particular interest toward acoustics and sound perception.

The candidates must be highly motivated to work with crocodiles. The candidate should also be aware that the PhD will include at least one field trip in a hostile (tropical) environment.

Knowledge/skills in the following will be appreciated:

-acoustics

-vibrations

-ethology

-programming environments: Matlab, Python, R-studio...

-statistics

**To apply, please send a CV (2 pages max) + 1 cover letter + the name of 2 referees to:**

[mathevon@univ-st-etienne.fr](mailto:mathevon@univ-st-etienne.fr) and [nicolas.grimault@cnrs.fr](mailto:nicolas.grimault@cnrs.fr).

**DEADLINE FOR APPLICATIONS: Friday 25<sup>th</sup>, June**

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