We are looking for a bioinformatic Master 2-Student to develop clustering algorithms for bird vocalizations.

We are working on the sociality and the communication of a colonial cooperatively breeding birds endemic to southern Africa. We used on-board miniature devices (backpack microphones, Fig. 1, Gill et al. 2016) to record a highly social songbird, the Sociable weavers (*Philetarius socius*) (Covas et al. 2006).

Thanks to these devices we can record a high volume of high-quality individual vocalizations. This library is quite unique compared to classic bird audio recordings because within each file only a single focal bird is recorded. Moreover, all the recordings, are synchronized, meaning that we can reconstruct the vocal network of who is answering to whom.

We aim at understanding the meaning of each vocalizations type and how they are used. To do so we need to be able to individually select each vocalization in a recording and assign it to a "type" (i.e., cluster it). This process is pivotal to answer some initial descriptive biological questions: What is the species repertoire? Is sex coded into calls? Is individuality coded into calls? Is kinship coded into calls? Is social group coded into calls?
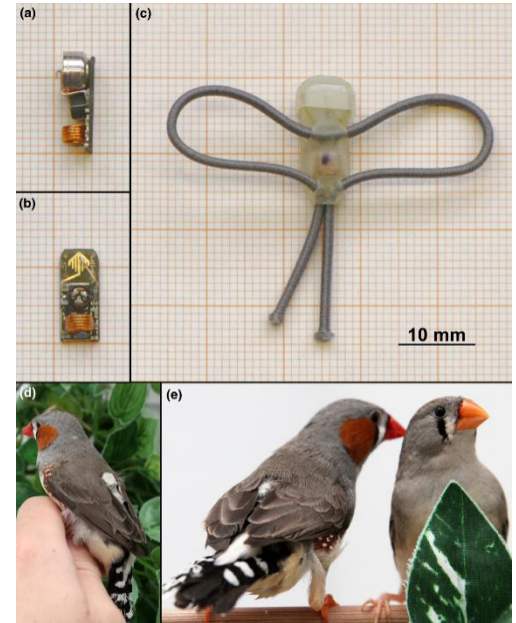

Fig. 1. Transmitter and leg-loop harness. Close-up pictures of microphone transmitter (a) lateral view, including battery; (b) top view, without battery; (c) silicon casing and leg-loop harness; (d) male with backpack exposed; (e) male in normal posture (backpack covered by feathers).

Content of the internship:

The student will need to be used to code using Python language. He/She will have to: 1) create a part of the database by extracting pictures (spectrograms) from audio files (already collected); 2) annotate the different categories of sounds; 3 develop a method to cluster the different sounds obtained previously (Sainburg et al. 2020, Demartsev et al. 2022); and 4) join all the steps in a user-friendly pipeline. The method will be a Deep Learning based method using either 2D CNN (Convolutional Neural Network) or Triplet Loss approach. Thus, students with knowledge of deep leaning methods will be preferred.

Fig. 2. Sociable weavers wearing backpack microphones. On the bottom, sonogram of the song of sociable weavers.

Localization of the internship: Centre d'Ecologie Fonctionnelle et Evolutive (CEFE at CNRS), Montpellier (France)

Supervision. The master will look under the close supervision of Pietro D'Amelio and Nicolas Silva and with F. Rybak, C. Doutrelant, R. Covas.

If you are interested in this project, please send an email to pie.damelio@googlemail.com with a CV and few lines about your motivation for this internship.

Selected readings:

Gill, L. F., D'Amelio, P. B., Adreani, N. M., Sagunsky, H., Gahr, M. C., & ter Maat, A. (2016). A minimum-impact, flexible tool to study vocal communication of small animals with precise individual-level resolution. Methods in Ecology and Evolution, 7(11), 1349–1358. doi: 10.1111/2041-210X.12610

Covas, R., Dalecky, A., Caizergues, A., & Doutrelant, C. (2006). Kin associations and direct vs indirect fitness benefits in colonial cooperatively breeding sociable weavers Philetairus socius. Behavioral Ecology and Sociobiology, 60(3), 323–331. doi: 10.1007/s00265-006-0168-2

Ferreira, A. C., Silva, L. R., Renna, F., Brandl, H. B., Renoult, J. P., Farine, D. R., … Doutrelant, C. (2020). Deep learning-based methods for individual recognition in small birds. Methods in Ecology and Evolution, 11(9), 1072–1085. doi: 10.1111/2041-210X.13436

Demartsev, V., Gersick, A. S., Jensen, F. H., Thomas, M., Roch, M. A., Manser, M. B., & Strandburg-Peshkin, A. (2022). Signalling in groups: New tools for the integration of animal communication and collective movement. Methods in Ecology and Evolution, 00, 1–12. doi: 10.1111/2041-210X.13939

Sainburg, T., Thielk, M., & Gentner, T. Q. (2020). Finding, visualizing, and quantifying latent structure across diverse animal vocal repertoires. PLOS Computational Biology, 16(10), e1008228. doi: 10.1371/JOURNAL.PCBI.1008228