

LISTENING TO AMPHIBIANS: SELF-CONTAINED RECORDING UNITS

TECHNICAL SHEET

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Learn more: www.life-croaa.eu

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LISTENING TO BULLFROG AND AFRICAN CLAWED FROG

Context

An invasive alien species is defined as a species introduced by humans outside its natural range (voluntarily or fortuitously) and whose establishment and spread threaten ecosystems, habitats or native species with ecological consequences. and/or economic and/or negative health (French Invasives alien resource center).

Several legal texts address the issue of invasive alien species at national, European and international levels. In France, the national strategy on invasive alien species was drafted in 2016. It aims to protect marine, freshwater and terrestrial ecosystems, as well as the animal and plant species they support, from the risks and effects associated with biological invasions. Its general objective is to strengthen and structure collective action concerning prevention and awareness, the establishment of surveillance and rapid reaction systems, long-term management means, including the restoration of ecosystems, and the improvement of knowledge.

Guided by these European and national strategies, study and control actions against African clawed frog (Xenopus laevis) and bullfrog (Lithobates catesbeianus), two invasive alien species of amphibians, have been tested by professionals from and environmental associations (the LIFE CROAA project). They aim to identify and contain these species, limit their dispersal, and if possible reduce their impact on the natural environment.

It is in this context that this sheet offers a few models of autonomous recording units for listening in the field, detecting and reporting these species in the wetlands of France. **The loggers listed below can also be used for other amphibians.**

Exotic amphibians monitored by LIFE CROAA



Two eavesdropping invasive alien amphibians

Sound characteristics of the Bullfrog (*Lithobates catesbeianus*)

The song of the Bullfrog is characteristic: it resembles the mooing of a cow, which earned it its name. Low and short, which can be repeated in short sequences, it is audible within a radius of several hundred meters.

Several types of songs can be commonly recorded in this species, referring to different behaviours (1):

- Song of call to reproduction;
- Territorial song (male, female, male and female specific song);
- Rejection song (when a female or male individual is hugged and is not receptive to the amplexus);
- Warning song in case of danger;
- Song of distress when an individual is attacked by a predator.



Figure 1. Representation of the bullfrog's song, a signal often emitted on the surface of the water and whose range is very long (several hundred meters). (A) Oscillogram representing 3 successive songs. (B) Sonagram representing these same songs (time on the abscissa, frequency on the ordinate and amplitude with the colour (the maximum energy is represented by the warm colours). Note that the sounds are emitted at a very low frequency below 0.5kHz. (c) Thierry Lengagne - CNRS, UMR 5023 - LEHNA, University of Lyon, Laboratory of Ecology of Natural and Anthropized Hydrosystems.

Listening conditions

Bullfrogs are audible during the breeding season from May to July. They sing both day and night.

Listen to a bullfrog song (see Metropolis tab)



(c) Matthieu Berroneau



Sound characteristics of African clawed frog (Xenopus laevis)

The song is emitted underwater and is therefore inaudible out of water. It evokes a too-tight bicycle bell used with vehemence and repetition (1). It is characterized in particular by episodic sound pulses (sound pulses separated by intervals), which vary according to the temporal characteristics of the species, the sex and the period of reproduction.



(c) Damien Troquereau

Several types of songs can be commonly recorded in this species (2):

- Breeding call song: produced by males, it takes the form of alternating modulated trills with slow (30 Hz) and fast (60 Hz) sound amplitude pulses when they are alone or in the presence of other frogs.
- Females that are sexually receptive and ready to spawn produce trains of 12 Hz sound pulses (raps) in response to males. Males modify their call-in response, which consists of a longer rapid trill, a shorter slow trill, and an increase in amplitude modulation.
- Song of Rejection: During mating, males sometimes produce short calls (~4 10 Hz) when hugging females. If the female is not receptive, she will tick (4 Hz sonic pulses) as a release call.



Figure 2. Representation of the song of the African clawed frog which is barely audible and emitted under water. (A) Oscillogram representing a succession of vibrato type sound units. (B) Sonagram representing these same songs (time on the abscissa, frequency on the ordinate and amplitude with the colour (the maximum energy is represented by the warm colours). Note that the energy is very concentrated on a frequency band around 2kHz. (c) Thierry Lengagne - CNRS, UMR 5023 - LEHNA, University of Lyon, Laboratory of Ecology of Natural and Anthropized Hydrosystems.

Listening conditions

Listening to the song of African clawed frog is much more complex, because it is a species with an essentially aquatic lifestyle. To detect their presence, only hydrophones are able to record their song. The recordings are to be made at night and during the breeding season from May to July.

(see Metropolis tab)

(1) ACEMAV coll., DUGUET R. & MELKI F. ed., 2003. The Amphibiens de France, Belgique et Luxembourg, Collection Parthénope, éditions Biotope, Mèze (France), 480p.
(2) Barkan Charlotte L. L., 2017, Evolution of Xenopus Vocal Patterns: retuning a hindbrain circuit during species divergence, Univiersity of Columbia, 142p.



Autonomous recording units

The following recorders all have the advantage of reducing the time an agent is present in the field and limiting the impact of his presence during recordings made on the survey sites.

SM4 de Wildlife Acoustic



This device is capable of recording a large amount of bioacoustic data, such as the sound of frogs, birds and species of aquatic life. It has 2 built-in microphones, innovative planning tools, large data storage capacity, and very low power consumption (maximum autonomy of 450 hours). The SM4 also benefits from two other microphone outputs, so it is possible to add an optional hydrophone cable for listening to amphibians in the aquatic environment. The device, very robust, also has a polycarbonate shell to withstand multiple climatic conditions for several months.



Cost: about €900 to 1000 per unit.

The +: programming of recording sessions in advance; very good autonomy; quality recording with two omni-directional microphones; two further mic outputs available; solidity of the device.

The -: bulky device (218 mm x 186 mm x 78 mm) and heavy (1.2 kg with batteries); high cost; postprocessing time for identifying edges to be made by users (no automatic determination); long record processing times.

>> Find out more about the technical specificities of this model



This device is a small, low-cost, broad-spectrum, license-free acoustic recorder. The AudioMoth can listen at audible frequencies and ultrasonic frequencies. It is capable of recording uncompressed audio to a microSD card at rates of 8,000 to 384,000 samples per second.

Cost: around \in 50 to \in 60 per unit (\in 95 with protective shell).

The +: Light device (about 90 g with batteries) and compact (58 x





48 x 15 mm); low cost; possibility of attaching more or less sensitive microphones to the device; programming of possible recording sessions (it can notably be programmed to filter out relevant sounds so that only those of interest are recorded, thus reducing post-processing time); reduced energy consumption; easy deployment and use (dedicated application); long recording times possible.

The -: Device to be ordered abroad on pre-order (long order time); sensitive to bad weather (purchase of the protective capsule highly recommended); post-processing time for identifying edges to be made by users (no automatic determination); no anti-noise system.

>> Find out more about the technical specificities of this model



Passive device with high storage and energy saving capacity, ready to use, intended for listening to wildlife and its environment. More than 200 hours of recordings in audible frequencies for this first version (bandwidth from 0 to 22kHz). This device is being developed in France.

Cost: Around €160 per unit.

The +: Lightweight (approximately 40 g) and compact (71mm x 42mm x 28mm; reasonable cost; programming of recording sessions possible; easy to use with an ergonomic monitoring platform; good autonomy (several hundred hours); recording of files in .wav format or as compressed files for longer recordings; SD card compatible.

The -: The device is not yet on the market; no hindsight on its effectiveness; post-processing time for identification of edges to be made by users (no automatic determination); no anti-noise system.

>> Find out more about the technical specificities of this model

What's New From Research

The FrogPhone

A solar-powered listening deviceusing 3G and 4G networks, the FrogPhone can take acoustic readings remotely (by phone) and at the same time collect environmental data such as water and the air (transmitted by SMS).

Developed by scientists at University of New South Wales (UNSW) Canberra and the University of Canberra in Australia.

Cost: approximately \$1000 AUS for all the components needed to manufacture a unit.

The +: Remote listening to recordings in real time (avoids recurrent movements of installation and removal of equipment); programming of calls and recordings possible; automatic collection of air and water temperature environmental data (transmitted by SMS); long autonomy thanks to its solar panel; detection of edges up to 150 m; noise limiting system; quality sound recording.





The -: Bulky device; not commercialized at the present time (to be developed oneself); relatively high cost; assembly and programming to be carried out by the user; dependence on the 3G/4G mobile network (satellite communication module under study); dependence on sunlight; post-processing time for identifying edges to be produced by users (no automatic determination).

>> Learn more about this device

In France, research is currently underway to develop intelligent systems capable of automatically detecting the presence of a target amphibian species when recording its song.

Device Comparison

Criterias of comparison	SM4	AudioMoth	AudioLog	FrogPhone
Cost	1 11	++	++	-
Volume & weight	-	+++	+++	
Marketing in France	+++		forthcoming	1070
Direct availability	+++	++	-	12
Outdoor solidity	+++	++	++	+++
Energy consumption & autonomy	+++	+++	+++	++
Device long distance call	-	-	-	+++
Long duration of recordings	+++	+++	+++	+++
Scheduling of recordings	+++	+++	+++	+++
Recording quality	+++	++	++	+++
Automatic recognition of the songs	.=0	1)	11 1	31 1
Automatic collection of environmental data	++	-	-	+++
SD / micro SD card support	+++	+++	+++	-
Simple and ergonomic configuration interface	-0	+++	+++	8-
Easy installation of the device on site	++	+++	+++	1.

+++: ideal

++: to be improved

-: disappointing or unavailable





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