

ACOUSTIC TECHNIQUES FOR BIOLOGICAL MONITORING AND LAW ENFORCEMENT



Fig 1. Elephants congregating in Langoué Bai in Ivindo National Park. The Langoué Bai Elephants have been monitored using direct observation and acoustic methods over several years

Botswana

Cameroon

Central African Republic

Congo Republic

Democratic Republic of Congo

Gabon

Ivory Coast

Kenya

Madagascar

Namibia

Nigeria

Rwanda

Tanzania

Uganda

Zambia

Acoustic monitoring - a novel tool for forest conservation

Acoustic recording units (ARUs) are a promising tool for biological monitoring and law enforcement. ARUs work automatically on battery power, recording sounds, including at frequencies too low for humans to hear, onto hard disks. They are light enough to be deployed in remote locations and once installed can run unattended (see Fig. 2). They have been used to monitor elephant activity and different measures of human presence in national parks in Gabon since 2007, in and around Batéké, Ivindo and Loango National Parks (see map). This work has been piloted by the Elephant Listening Project (ELP) at Cornell University, which has provided and deployed the acoustic units and carried out the data analysis, and reporting (e.g. Wrege *et al* 2010¹). WCS has supported this work with logistics and field assistants.

Applications of acoustic monitoring in Gabon

Monitoring in forest bays

Bais are important feeding sites for forest elephants (Fig. 1). The acoustic method has been used to assess elephant vocalisation patterns in bais, providing data on nocturnal activity of elephants which complements diurnal direct observations by field teams. As multiple bais across Ivindo and Batéké National Parks and their buffer zones have been monitored with ARUs, there is now data on seasonal use and their relative importance to elephants (Fig. 2). This seasonal data has value for: 1) planning active protection efforts and guiding tourism activity in parks, and 2) the planning of timber extraction around important sites for elephants in forestry concessions.

Surveillance

In forestry concessions in Ivindo National Park buffer zones, ARUs have been deployed near company road barriers. These barriers are intended to prevent unauthorised vehicle traffic, in particular towards the park boundaries. The acoustic units have been used to monitor the effectiveness of the barrier personnel, whereby the acoustic recordings of passing vehicles is checked against the notes taken at barriers, frequently demonstrating errors or negligence by the barrier guards.

Monitoring the impacts of oil exploration on elephant activity

At Loango National Park, the ELP studied how oil exploration affected forest elephant activity and whether illegal hunting increased. Elephants did not leave the area but shifted activity to the night time in response to exploration activity. Hunting activity was effectively controlled during exploration. On completion of the exploration, when conservation and oil-company personnel vacated the area, surprisingly high levels of hunting were detected. Continued surveillance and anti-poaching is therefore necessary to control hunting.

WCS capacity in country

WCS has trained field teams able to install and manage acoustic devices (Fig. 2). These teams can help researchers in the deployment and maintenance of ARUs, over the duration of a monitoring cycle.

Initial data preparation and analysis is currently carried out in Gabon, with detailed analysis completed by ELP at Cornell University.

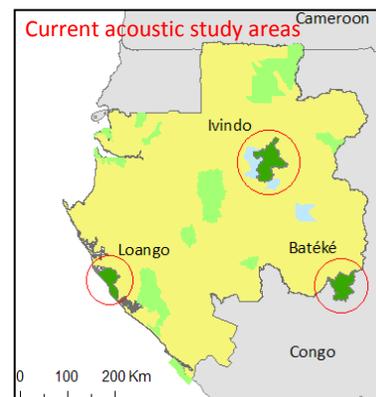
Technical development needs

Currently acoustic sound files are visually scanned for wildlife vocalisations and human signs.

Automatic detection software of wildlife and human signs will dramatically increase the speed at which acoustic data files can be analysed.

The immediate transmission of automatically detected human signs from remote devices has the potential to facilitate rapid deployment of law enforcement personnel.

WCS is seeking funding to address these technological developments.



¹ Wrege, P. *et al.*, 2010. Use of acoustic tools to reveal otherwise cryptic responses of forest elephants to oil exploration. Conservation Biology DOI: 10.1111/j.1523-1739

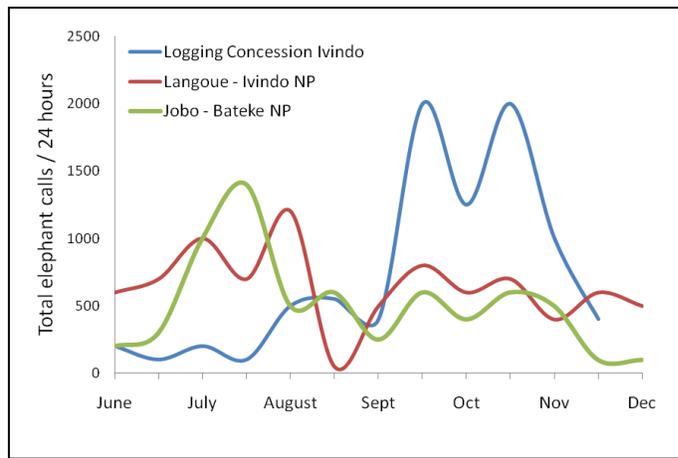


Fig 2. DEPLOYMENT: The ARU is suspended 7 to 15m up in the forest canopy. **RESULTS:** Patterns of elephant calls from bais within two national parks and one bai in an adjacent forestry concession during 2007. Calls fluctuate wildly and do not necessarily correspond with diurnal observations of elephants, and here the forestry concession bai had particularly high activity during the wet season (mid-Sept – Nov).

Future plans

Monitoring and law enforcement in forestry concessions

All forestry concession holders in Gabon are required to control access and illegal hunting in their forest permits. Companies interested in FSC certification are required to demonstrate reduced impact on populations of threatened species. Acoustics have already been shown to be a cost effective tool for monitoring elephant activity, gun shots and vehicle activity. The future deployment of ARUs in forestry concessions will provide a long term measure of hunting pressures and wildlife abundances, both before and after logging.

Roll out of acoustic monitoring in national parks

Monitoring elephant populations at bais in and around national parks is a way of following population size, demographic structure and seasonality. Most of our understanding on elephant use of bais is restricted to these diurnal observations. As ARUs record continuously, the 24 hour activity data is a valuable addition to improving our knowledge on resource use by elephants.

There is frequent disturbance and encroachment into national parks, either illegally such as poaching, or legally such as the oil exploration project in Loango National Park. Acoustic monitoring can effectively measure wildlife and human activity in strategically placed areas within the park. Although ELP has focused on elephants, many other species of wildlife including apes can also be monitored acoustically. This provides valuable information for monitoring impacts and directing law enforcement efforts. It therefore has the potential to be an important component of the national biomonitoring program across Gabon's network of national parks proposed by WCS.

The number of eco-guards available to protect national parks is insufficient to ensure that there is no illegal encroachment into parks and their buffer zones. Given further technical developments, arrays of ARU's distributed along the park limits could act as an early detection tool of illegal encroachment.

Important next steps

Automatic detection software

Software can be developed to facilitate the automatic detection of the acoustic signal of gun-shots, car traffic and different species of wildlife (namely elephants and apes). This will drastically decrease time spent on data scanning, and hence turn-around of information. This software can screen downloaded data from ARUs and select sounds that fit a pre-defined signal.

Instantaneous transmission of data

In some sites it is not logistically possible to have continuous protection by government agents or WCS teams. In these cases, the detection of gun-shots and immediate transmission of the data to a central base can then be used to deploy government agents out to the area where poachers are currently active. The Cornell Bioacoustics Research Program, where the ELP is based, are well positioned to develop the technical systems necessary to detect gun-shots in real time as the sounds are recorded, and then transmit these alerts to a central base nearly instantaneously, while WCS can test and implement this system in a network of appropriate sites in Gabon.

ARUs record animal vocalisations in the forest

Software that can automatically detect acoustic signatures for different species in sound files is being developed

Analytical techniques are being developed that will enable the use of ARUs for long term biological monitoring

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Mission

Save wildlife and wild places worldwide. We do so through science, global conservation, education and the management of the world's largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together these activities change attitudes towards nature and help people imagine wildlife and humans living in harmony. WCS is committed to this mission because it is essential to the integrity of life on Earth.

Wildlife Conservation Society

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The **Cornell** Lab
of Ornithology

Elephant Listening Project

<http://www.birds.cornell.edu/brp/elephant/index.html>