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New web-enabled technology records the presence of species by analyzing their sounds.

Identifying, and monitoring the fluctuations of thousands of species in tropical ecosystems is a difficult challenge, but newly developed technology now makes it much easier. Scientists report on new cyberinfrastructure which enables real-time acoustic recording and subsequent species identification in remote locations around the world. Thousands of audio recordings of tropical birds, frogs, monkeys, and insects in Puerto Rico and Costa Rica have been captured (using automated recording stations placed in their natural habitat) and analyzed to identify the species concerned.

Tropical deforestation and climate change are expected to have serious negative effects on most tropical species, but few species have been studied for more than a few years, and they are usually studied in a single site. This new technology (which combines both software and in-situ hardware) makes species monitoring easier, more extensive, and cheaper, and is able to deliver the results in real-time over the internet.

A group of scientists led by Dr. Mitchell Aide and Dr. Carlos Corrada-Bravo of the University of Puerto Rico have developed hardware and software to collect, process, and analyze audio recording in real-time. The hardware, which utilizes cheap and easily obtainable components such as iPods and car batteries, records 144 one-minute recordings per day in remote sites and sends them in real-time to a base station up to 40 km away. The recordings are then forwarded to the project server in Puerto Rico where they are processed and made available to the world through the internet in less than a minute. The system was tested in Puerto Rico and Costa Rica, and today, anyone with an internet connection can view and listen to more than 1 million recordings from these and many other sites such as Puerto Rico, Hawaii, Arizona, Costa Rica, Argentina, and Brazil (via http://arbimon.com). To automate species identification, the group developed a web application which provides users with tools to train the software to automate species identification, along with other tools for measuring the accuracy and precision of the model. Once the biologist has developed a reliable model, the computer can process more than 100,000 recordings in less than an hour, providing information on species presence and absence.

The system and its results are described in a paper published today in the open access journal PeerJ. By using the system to analyze a recently described species of endangered frog in Puerto Rico (*Eleutherodactylus juanariveroi*), the team was able to demonstrate the value of long-term data acquisition. This species showed a significant decline in calling activity over four years, but in the fifth year the calling rate recovered to the original level (a dynamic which is common in many species, but often difficult to measure).

“To understand the impacts of deforestation and climate change, we need reliable long-term data on the fauna from around the world,” explained Dr. Aide. “Traditional sampling methodology, sending biologists to the field, is expensive and often results in incomplete and limited data sets because it is impossible to maintain biologists in the field 24 hours a day throughout the year, and it is impossible to clone expert field biologists, so that they can monitor various sites simultaneously.”

“We are not trying to eliminate the biologist, however” explained Dr. Corrada-Bravo. “On the contrary, we are trying to provide the best data and tools possible, so that the biologists can use their time to convert these data into useful information for science, conservation, management, and education.”

At the same time, this methodology provides a verifiable permanent record. “Each recording is the equivalent of a museum sample, which can be analyzed with the knowledge and technologies we have today, but which will be permanently stored so that biologists 20 or 50 years from now, will be able to analyze these recordings with new technologies and ideas” said Dr. Corrada-Bravo.

“Conserving and managing the biodiversity in the world is a major challenge for society, particularly in the tropics. We hope that the tools we have developed will allow researchers, students, managers, and the public to better understand how these threats are impacting species, so that we can make informed conservation and management decisions” concluded Dr. Aide.

All recordings are available in real-time over the internet and the data are archived for future generations to analyze for new trends or insights.

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Additional Materials

Two images (reproduced below, with full resolution versions available at the links noted) and an MP3 Sound clip are available for press use.

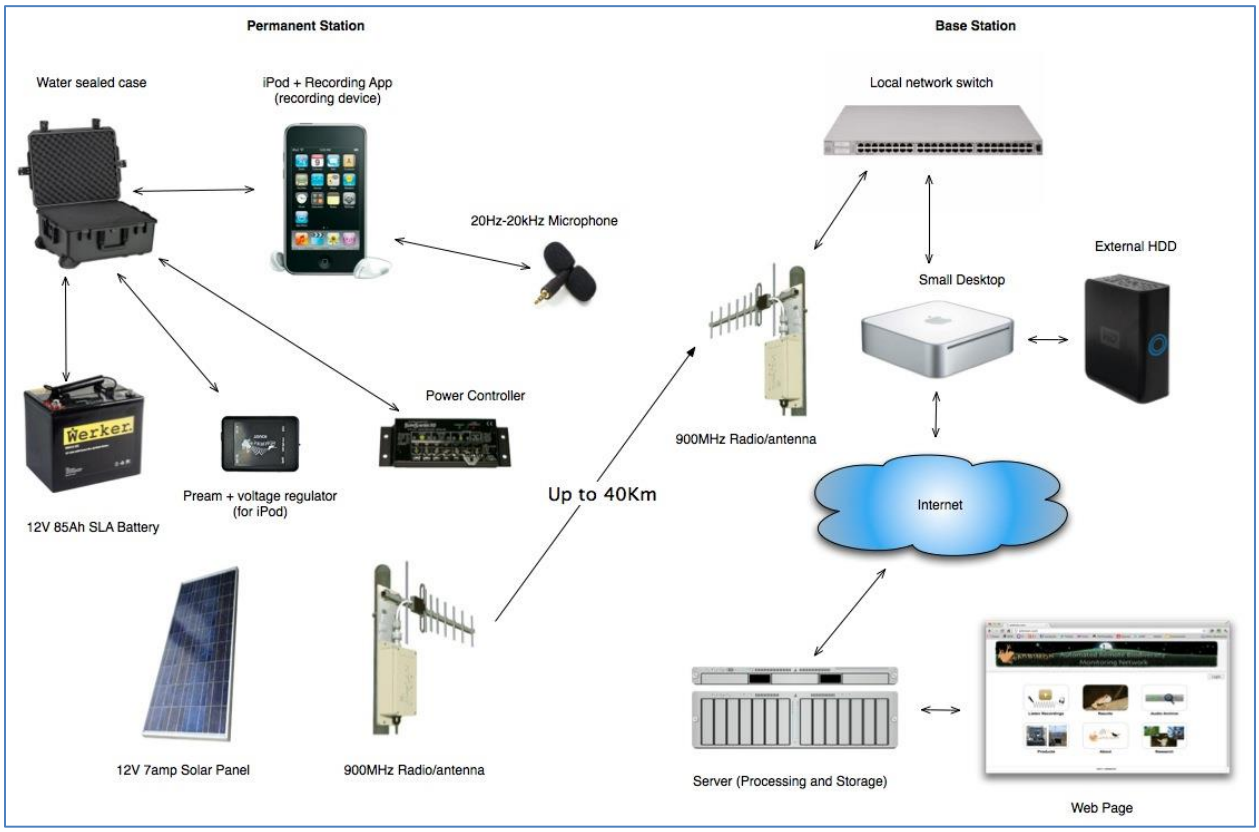
Image of the *Eleutherodactylus juanariveroi* frog

Image credit: http://coquipr.com/coquies-de-puerto-rico/coqui-llanero/
Download the full resolution version at: http://bit.ly/AidePeerJimage1

Audio File: A 1 minute audio file (MP3, 470 Kb) of *Eleutherodactylus juanariveroi* frogs calling at the Sabana Seca site may be downloaded at http://bit.ly/AidePeerJAudio (or email press@peerj.com to request a copy)

Schematic of the set-up from: http://arbimon.com/arbimon/index.php/products-acoustics
Download the full resolution version at: http://bit.ly/AidePeerJimage2

"ARBIMON components of the recording station"



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Link to the Published Version of the article (quote this link in your story – the link will ONLY work after the embargo lifts): https://peerj.com/articles/103 - your readers will be able to **freely** access this article at this URL.

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Abstract (from the article)

Traditionally, animal species diversity and abundance is assessed using a variety of methods that are generally costly, limited in space and time, and most importantly, they rarely include a permanent record. Given the urgency of climate change and the loss of habitat, it is vital that we use new technologies to improve and expand global biodiversity monitoring to thousands of sites around the world. In this article, we describe the acoustical component of the Automated Remote Biodiversity Monitoring Network (ARBIMON), a novel combination of hardware and software for automating data acquisition, data management, and species identification based on audio recordings. The major components of the cyberinfrastructure include: a solar powered remote monitoring station that sends 1-minute recordings every 10 minutes to a base station, which relays the recordings in real-time to the project server, where the recordings are processed and uploaded to the project website (arbimon.net). Along with a module for viewing, listening, and annotating recordings, the website includes a species identification interface to help users create machine learning algorithms to automate species identification. To demonstrate the system we present data on the vocal activity patterns of birds, frogs, insects, and mammals from Puerto Rico and Costa Rica.