New perspectives in Amazonian bird vocal behavior


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**Abstract:** Neotropical region are known for its huge avian diversity and for the dominance of Suboscine or Tyranni passerines species. These species diversity are reflected in vocal communication and we will present here two examples of Brazilian Amazon forest of Tyranni species. Although the Tyranni
are known for presenting a stereotyped song compared to Oscine passerines, we have found a species with a complex calls repertoire and other with a distinguished individual variation. The study area is the Ecological Park of Gunma, Santa Bárbara, Pará, Brazil, 50 km north of Belém. We performed playback experiments to define the vocalizations of Rusty-margined flycatcher *Myiozetetes cayanensis*, species that presents a complex repertoire of 15 different vocalizations, including a complex duet song. We also studied *Lipaugus vociferans*, a lekking bird, in which males perform conspicuous vocalizations in aggregations. We have analysed songs of 19 individuals from six leks, considering the physical parameters (frequency bandwidth and temporal parameters) of the species-specific song. The results showed that it is possible to differentiate the individuals by song. These differences can represent an important function in individual recognition inside or between leks. These results show the necessity to investigate the high diversity of behavior in tropical habitats.

**Does vocal learning accelerate acoustic diversification? Evolution of contact calls in Neotropical parrots**


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**Abstract:** Learning has been traditionally though to accelerate the evolutionary change of behavioral traits. We evaluated the evolutionary rate of learned vocalizations and the interplay of morphology and ecology in the evolution of these signals. We examined contact calls of 51 species of Neotropical parrots of the tribe Arini from recordings obtained in Central and South America. Parrots are ideal subjects due to their wide range of body size and habitats and their open-ended vocal learning that allows them to modify their calls throughout life. We estimated the evolutionary rate of acoustic parameters of parrot contact calls and directly compared them to those of morphological traits and habitat. We also evaluated the effect of body mass, bill length and vegetation density on acoustic parameters of contact calls while controlling for phylogeny. Evolutionary rates of acoustic parameters did not differ from those of our predictor variables except for spectral entropy, which had a significantly slower rate of evolution. We found support for correlated evolution of call duration, and fundamental and peak frequencies with body mass; and of fundamental frequency with bill length. We demonstrate that parrot contact calls, which are learned acoustic signals, show similar evolutionary rates to morphological traits. This is the first study to our knowledge to provide evidence that change through cultural evolution does not necessarily accelerate the evolutionary rate of traits acquired through lifelong learning.

**Transmission properties of vocalizations in a year-round territorial bird**


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**Abstract:** Acoustic Adaptation Hypothesis (AAH) predicts that acoustic signals using in long-distance communication should be optimized for transmission through its’ natural environment. To test if White eared Ground-sparrows (*Melozone leucotis*) vocalizations are adapted to transmit long distances I
conducted two sound transmission experiments where I broadcast and re-recorded different calls, songs, and duets. This ground-sparrows use vocal communication year round for territory defense and mate attraction. I conducted the experiments inside ground-sparrows territories in Costa Rica, broadcasting natural vocalizations at different combination of distances, speaker and microphone heights to quantified the signal-to-noise ratio, tail-to-signal ratio, blur ratio, and excess attenuation. Songs and duets of White-eared Ground-sparrows showed similar patterns of degradation with distance and with proximity to the ground, suggesting that vocalizations facilitate communication with receivers at similar shorter distances (in less than a typical territory’s diameter). Chip calls showed higher degradation in comparison to tseet calls with the distance, suggesting that tseet calls are design for longer distance communication. To my surprise, chip calls, songs, and duets has not experienced strong selection for long distance communication, because results do not support the AHH, and probably these vocalization characteristics are under other selective forces as sexual selection or phylogenetic constrain.

**Studying dolphin whistles in Mexico**

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**Abstract:** Dolphin whistles are emitted especially during social interactions and feeding activities involving group cohesion, individual recognition and recruitment. Here at the Faculty of Sciences of UNAM we are studying dolphin whistles, mainly those of wild and captive bottlenose dolphins, *Tursiops truncatus*, to learn about their social structure and how whistles may be used to study dolphin ecology. We have developed a new methodology to describe and compare the whistle repertoire, which consists of whistle contour extraction to classify whistles into whistle types (using Matlab BELUGA and ArtWARP), then classifying whistle types into four general categories (high complexity, low complexity, linear long, and linear short), and finally computing a complexity index and a proportional variability of the whistle repertoire. Results obtained showed that this very simple method is useful to describe the whistle repertoire and to compare it according to the general behavioral state of dolphins, and between species. It is necessary to implement new methodologies like this one to better understand how dolphins are using whistles, since acoustic communication is the most important sense in dolphin species. [work currently supported by PAPIIT-UNAM].

**Cetacean acoustic survey using towed array in the western South Atlantic shelf break**

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Abstract: Passive acoustic towed array during ship surveys has being applied to increase the knowledge about cetacean. From 2012 to 2015, towed arrays were used to investigate cetacean distribution along the western South Atlantic shelf break. Research cruises were performed between 26°S and 38°S over the continental shelf break and slope. Acoustic tracklines comprised an average of 780 nm of effort per survey. Hydrophone arrays (Auset®) were towed 150 and 300 meters behind the vessel. The system was configured to give a variable frequency response from 1,592 (High Pass Filter) to 100,000 Hz. Acoustic data was recorded as .wav files. Concurrent environmental and GPS data were logged automatically using WinCruz software. Visual positive identifications were associated to the acoustic recordings. The .wav files were analyzed using partially automated detections tools complemented with visual and acoustical searched for species confirmation whenever possible. A total of 9 cetacean species were acoustically detected. The most frequently species were Physeter acrocephalus, Delphinus delphis, Stenella longirostris, Orcinus orca, and Globicephala sp.. Additional studies are needed to describe acoustic parameters of the various species present in this region in order to improve automated detection systems. This study was supported by Instituto Aqualie and was funded by BG Group and Chevron Brasil Upstream Frade LTDA.

Enhanced feature extraction using the Morlet transform on 1 MHz recordings reveals the complex nature of Amazon River dolphin (Inia geoffrensis) clicks
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Abstract: The Amazon River dolphin lives exclusively in freshwater throughout the Amazon River watershed, a dynamic and acoustically complex habitat. Although generally considered a relatively non-vocal species, recent evidence suggests that these animals are acoustically active, producing tremendous quantities of high-frequency, pulsed signals. Moreover, these pulsed signals appear to be considerably more complex than previously believed. This study explored the high-frequency pulsed emanations produced by Amazon River dolphins in Peru. Audio recordings were made using a two hydrophone array, one of which sampled at 1 MHz, in August of 2015. Digitized recordings were analyzed using FFT and Morlet wavelets. Subsequently, unsupervised machine learning attempted to delineate various click categories based upon inter-click intervals, the frequency bandwidth of each click, and the formants contained within each click. Although the Morlet transform is much more robust and accurate for higher frequencies than the FFT, its performance was not constant for all frequencies. Thus, the Morlet transform and the FFT produced different click categories. Thus, formant results above 230 kHz most likely were skewed. These results are the first to clearly demonstrate the heterogeneity of the high-frequency pulsed emanations of the Amazon River dolphin.
Steps towards promoting bioacoustics research in Mexico
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Abstract: Bioacoustics has played a major role in animal research in the past decade. Unfortunately, in Mexico it is still seen as a novel approach, and few research groups incorporate it into their studies. To overcome this lag, work needs to be done in three major areas: Collaboration among experts, preparing young students, and providing specialized equipment. In Mexico, there are many institutions devoted to research in biology, but there are only a few researchers in acoustics because there are no graduate research programs in this area. Collaboration among acousticians interested in biology and biologists interested in acoustics becomes crucial, and future researchers, coming from both specialties, need to be prepared. Once this synergy is created, emerging research groups often see the cost and availability of specialized equipment as a limitation, so it is also necessary to focus on providing access to research-grade, low-cost hardware. In this talk, I will describe my efforts towards promoting bioacoustics research in Mexico through collaboration with other research centers, with examples of ongoing projects, graduate program support, and equipment presented in major peer-reviewed conferences that we have developed with low-cost, open source materials that are comparable with standard, high quality research equipment.

Preliminary evidence for signature and copied whistles among spinner dolphins in the Southwest
Atlantic Ocean: beacon purpose?
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Abstract: In order to evaluate strategies of cohesion in a fission–fusion society, the occurrence of signature and copied whistles were investigated in free-ranging spinner dolphins, Stenella longirostris. Through an one-element hydrophone array towed over the Brazilian continental shelf break, a group of approximate 400 dolphins were recorded at 96 kHz/24 bits while navigating. The preliminary results demonstrated 218 similar signals that fit into previous definitions of signature or copied whistles. These whistles were produced in bouts with an inter-whistle interval of 0.066 – 11.56 s (mean ± SD: 2.66 ± 2.72) that varied from 2 to 32 repetitions comprising 6 different contour shapes. Thus, these data supports previous hypothesis that these signals are important units in the dolphin’s repertoire. It may also suggests a potential use on individual direction and localization, where repeated contours could be acting as a beacon to direct and locate the animals within the group. Additional research to ascertain the natural function of these vocalizations may clarify the basis for acoustic badges of membership and group organization of this cosmopolitan species.

Geographic variation assessment of Bryde’s whale (balaenoptera edeni) Be4 call in the Gulf of California
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Abstract: Mysticeti whales modify their calls in response to an increase in noise level within their environment. This is particularly important since environmental noise has been increasing continuously in the last decades. In the case of Bryde’s whale (Balaenoptera edeni), previous studies of it predominant call, Be4, have expose differences in the duration of its main component (f0) for northern and southern areas of the Gulf of California (GC). The objective of this research is to determine if the differences found amongst Be4 calls (f0, duration, energy distribution) are influenced by the noise levels in those areas. Results based on the characterization of Be4 Call and noise show that northern noise level is intense in the octave frequency band centered around 30Hz, and could mask the 30Hz component. This kind of noise is rare in the south (5%) and when it was present, the 30Hz component was not registered, which might be an adaptation to noise. Predominant moderate noise in the south within the band 20 to70 Hz overlaps the signals and higher components are present, specially the 165 Hz component. Results suggest that the difference between call from north and south areas might also be related to the noise present.
An underwater acoustic camera for marine mammal vocalization interaction studies
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**Abstract:** Acoustic Cams, promoted as “a way to listening with your eyes”, are widely used in the industry to visually pinpoint particular sound sources in a clouded sound environment. A video camera and complex multiple microphone array configurations are used to find the direction of arrival of sound and the results are color coded and superimposed in the video image. This technique has a great potential to be used in marine mammal studies where underwater vocal interactions among a close group needs to be determined. This is particularly important for *Otariids* and *Pinnipeds* for which the function of in-water calls involving no bubble emission needs to be studied. A prototype of an underwater acoustic camera built around a low cost open source linear array of hydrophones and a fishing underwater camera is presented. Results of the prototype test, first under controlled conditions, and then recording vocal interactions during normal swimming behavior of a colony sea lions (*Zalophus californianus*) in the Gulf of California, are presented.

Bioacoustic characterization of a coastal marine soundscape in Quintana Roo, Mexico
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1. 
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Abstract: Wild dolphins are exposed to a variety of biological and other natural and anthropogenic sounds. Several species of dolphins, including bottlenose dolphins (*Tursiops truncatus*), have been documented in the MesoAmerican Reef (MAR) region; however, there is little to no scientific monitoring of these populations. Characterizing the soundscape of wild dolphins on a section of the MAR would facilitate understanding the acoustic nature of this dolphin habitat. Passive Acoustic Monitoring using an Ecological Acoustic Recorder was conducted for one year off the coast of Quintana Roo, Mexico just north of Isla Mujeres, a site where dolphins are known to frequent. The soundscape was typified by natural sounds, however there was important periodic contribution by anthropogenic sources. Boat motor noise contributed to higher SPL rms during the day than in the night and contributed to noise between 500 Hz – 25 kHz, which is consistent with small vessels. While boat motor noise was not as frequent as fish sounds nor as pervasive as snapping shrimp sounds, when present it potentially overwhelms the natural soundscape. Anthropogenic characteristics of this soundscape have implications for dolphin welfare and regulations in the nearby marine protected areas.

Assessing the structure of a Neotropical bat community using acoustic monitoring techniques


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Abstract: Determining the structure and composition of tropical communities is challenging because some species are rare or hard to detect. Within Neotropical bats, aerial insectivores have been systematically undersampled because they avoid mist nets, the traditional sampling tool. Advances in bioacoustic monitoring techniques have allowed the study aerial insectivorous bat (AIB) communities across various spatial scales and habitats. We present two studies that assessed the underlying mechanisms that structure an AIB community across the Isthmus of Panama. First, we evaluated how habitat fragmentation affected two guilds of AIBs and found higher species richness in islands than in continuous forests. Background clutter aerial insectivores showed compositional differences due to effects of isolation, area and forest complexity, whereas open space bats were not affected by fragmentation. Second, we determined how climate and forest complexity affected AIB community structure at different spatial scales. We found that most of the variation in bat richness, abundance, and feeding activity occurred at the smallest spatial scale (10X10m) and was explained by habitat structure. In contrast, at large scales, climatic differences explained most of the variation in individual species’ abundances. Interestingly, species richness peaked at intermediate levels of precipitation, while total abundance was very similar across sites.

Acoustic description and synchronization of the duetting species Pezopetes capitalis, Costa Rica

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**Abstract:** Duetting has been widely studied, and its function vary across species, though in all cases temporal synchrony of the elements sang by each sex in the duet seems to play an important role. My goals in this study were to describe the structure of the duet of *Pezopetes capitalis*, and the degree of temporal synchronization of each individual of the pair during duetting. Duets of *P. capitalis* consist of overlapping elements between both members of a mated pair and can be initiated by either sex. Synchronization was similar between both individuals. For 11 pairs, both, females and males, reduce their silence intervals before singing a new element as a response to an increase in the duration of its partner's elements. Furthermore, both mates lower the high frequency of their elements of the second section, as the duet continues. Birds showed this pattern even in those cases where the female joins the male after he had began to sing its duet's part. This suggests a temporal coordination in frequencies (high frequency decreases with time). Indirect evidence suggest that duets in *P. capitalis* serve as a joint defense of territory and as a way to recognized mates when a pair reunited.

**Scaled mining of environmental acoustic data from temperate to tropical forests, from ocean to tropical rivers : A convolutional feature learning approach**


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**Abstract:** Scaled passive acoustic monitoring has recently been developed to assess changes in biodiversity. It is applied to monitor changes in fauna composition associated with anthropogenic impacts and to improve the management of species and habitat conservation. Under the auspices of the “Scaled Acoustic BIODiversity” SABIOD project (CNRS MI / GDR MADICS / JASON UTLN), interdisciplinary teams collaborate to develop new joint machine learning and signal processing bioacoustic analyses. Currently, terabytes of sounds are recorded monthly using the innovative open SABIOD autonomous sensor arrays, positioned within forests or deep in the ocean. The challenges associated with tropical biodiversity as the variety of sound sources and the complexity of acoustic paths are being addressed by optimizing strategies that couple features learning, Convolutional Neural Net and advanced passive acoustic localization / filtering. Applications are many, including the classification of one thousand Amazon bird species, whale song classification, automatic indexing forest soundscapes, passive acoustic 3D tracking of bats and cetaceans with our patented system, and offshore cetacean monitoring. We discuss the main difficulties encountered and summarize the promising steps and strategies that we intend to pursue in the future coupling scaled CNN with Deep Scattering Spectrum. Demo / details: [http://sabiod.univ-tln.fr](http://sabiod.univ-tln.fr).