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The Use of the Macaulay Library of Natural Sounds to Supplement Labs and Field Studies

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Our students have been playing recordings from the Macaulay Library of Cornell University of natural sounds and videos (http:macaulaylibrary.org) while simultaneously recording with the sound recording program Audacity. In this way they can analyze number of vocalizations per a certain time period, the range of frequency of the sounds, as well as other parameters. This data has been used for compare/contrast scenarios in their own live recordings of vocalizations of sea lions from zoos and aquaria. The students have been able to hear recordings of animals (including sea lions) from places such as New Zealand and the Galapagos that are currently inaccessible to them in person.

Keywords: sound recordings, vocalizations, sound library

Link to Original Poster
http://www.ableweb.org/volumes/vol-37/poster?art=82

Introduction

The Macaulay Sound Library, (originally created in 1929 by the Cornell University Lab of Ornithology and called the Library of Natural Sound or LNS and renamed the Macaulay Sound Library (ML) in 2003) is a treasure-trove of both audio and video recordings from birds, mammals, amphibian, reptiles, arthropods, and fish (175,000 audio and 60,000 video recordings) (http://macaulaylibrary.org)., The ML website lists references of those that have used their website to discern meaning in vocalizations of animals ranging from birds to crickets (Frei et al., 2015; Symes et al., 2015). Students can a. simultaneously record for analysis sounds from this library using the free downloadable software Audacity or Raven Lite or b. add their own recordings to the website. These programs allow you to calculate maximum and minimum frequencies of vocalizations on a spectrogram as well as number and duration of each sound during a defined time period. Patterns emerge that can be recorded and analyzed.

What can vocalizations tell you about animals? Blumstein et al. (2011) suggest that we can learn much about the ecology of populations and species interactions through studying vocalizations. There might be seasonal and geographic differences, such as those recorded by Morano et al. (2012) in fin whales. Students could see if sea lion or other animal calls fit into categories such as these that are previously described, or even come up with their own descriptors. Ndez-Juricic (1999) discriminated several different vocalization of South American sea lions in a rookery off Argentina. They discerned four calls for adult males (high pitched call, bark,growl, and exhalation), two for adult females (mother primary call and grunt), one for juveniles (yearling primary call) and one for pups(pup primary call.) They correlated these calls with various types of behavior. For Parks and Tyack (2006) categorized whale sounds visualized on spectrograms as "scream, gunshot, blow, upcall, warble, and downcall". Students could compare vocalizations of their own pets that they record with wild animal recordings found in the ML. (See Nicastro (2004) for a comparison of vocalizations between domestic and wild cats.) I was in the Bronx Zoo and heard a loud roar that sounded like it was amplified—it was from a lion! (I wish I had had Audacity running on my computer—I had just finished a sea lion recording session and closed my computer) It would be an interesting and challenging exercise for students to try to capture vocalizations of animals such as these and compare them

to those in the ML. It is hoped that when students listen to these recordings they will be piqued to learn more about the animals they are recording. For example, Southern male elephant seals "settle" their differences (mostly) through vocalizations.

Several biology majors have been recording sea lion vocalizations using the free downloadable program Audacity in an attempt to discern interesting patterns (Nolan et al., 2015). This interest was initiated by Dr. Biolsi through a travel course that she taught in which she introduced the students to pinnipeds and explained that mothers and pups can recognize each other through vocalizations (Schusterman et al, 1992, Tripovich et al., 2006; Sorano et al., 2009, Pitcher et al., 2010) In the meantime, we discovered the Macaulay Library of Sounds (ML) organized and sponsored by Cornell University (Table 2). The ML has, in addition, added a Bioacoustics resource that records large mammals such as elephants and whales, and has creative visuals for the public to view these sounds. We will continue to take students on field trips to various zoos and aquaria in the New York City area and record sea lion vocalizations (sample data given here), as well as add information from these web sites to the curriculum. For example, we plan on using the websites to aid in common bird call recognition.

Table 1. ML Marine mammal collections.

Order	**Common name**	**Audio**	**Video**
Cetacea	Whales, dolphins, porpoises	2159	312
Sirenia	Manatees, dugongs, sea cows	12	-----
Carnivora			
Family			
Ursidae	Includes polar bears	-----	100
Phocidae	seals	1586	172
Otariidae	Sea lions, fur seals	83	294
Odoberiidae	walruses	17	-----
Mustelidae	Sea otters	3	26

Student Outline

1. Download the free program Audacity. Your computer must have an internally built microphone.
2. Open up the Macaulay Library of Natural Sounds http://macaulaylibrary.org
3. Go to the archive, search an animal you would like to listen, and press "play".
4. Once you have decided which animal you would like to record on Audacity, press the red record button on Audacity, (Audacity should now be open in a lower window on your screen) and the ML recording button immediately thereafter. When you are finished with the recording, press the yellow stop button on Audacity.
5. Save your recording. To listen to your record, press the green "play" button. The program saves the whole recording, and it also saves it as individual six-secon files for you to analyze.
6. Watch the YouTube video that shows you how to convert your sound tracing to a spectrogram. This is a very intriguing six and a half minute video that plays six seconds of sound and analyzes it. You will learn how to become a better listener after watching this video. https://www.youtube.com/watch?v=7WYw3qoTdU4
7. Convert the sound tracing you recorded to a spectrogram by clicking on the upper left hand side. The spectrogram view will give you maximum and minimum frequency for six seconds of sound at a time. Decibels are a bit harder to calculate accurately, because one needs to know the distance the microphone was front the subject---sound is attenuated with distance. Record your results.
8. Make a table in Excel similar to the one shown in Table 2., Sample student data…

Sample Results

Some very surprising findings were noted of walruses (not easily found except in captivity in New York City at the New York Aquarium). They have very unusual vocalizations that range from a sound like a jackhammer to a bell sound. One pup recording looked remarkably like the recording from an adult sea lion, and there were recordings of a pup that changed over a short time period (See Figures 1, 2, 3 and 4.)

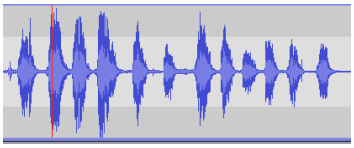

Figure 1. Walrus pup recording—note rhythmic-like pattern that is similar to sea lion bark. http://macaulaylibrary.org/audio/120370

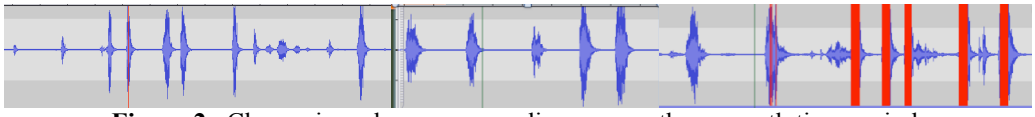

Figure 2. Change in walrus pup recordings over a three-month time period. http://macaulaylibrary.org/audio/120322

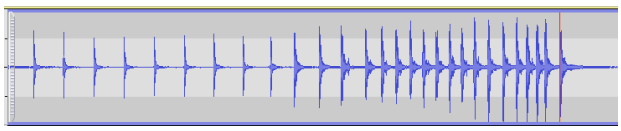

Figure 3. Walrus "hammering" http://macaulaylibrary.org/audio/129697

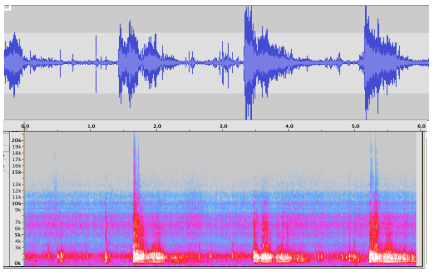

Figure 4. Walrus bell sound with concordant spectrogram below. http://macaulaylibrary.org/audio/129697

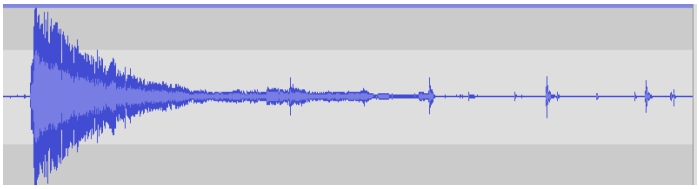

Figure 5. An Audacity tracing from a Weddell seal, Antarctica http://macaulaylibrary.org/audio/123436

An exciting recording to find was that of the "trumpet" like sound of the elephant seal. Nolan had the chance to hear them in person in California with Dr Biolsi's class Marine Mammal Cognition and found them to be truly astounding! See Figure 6 for the ML recording.

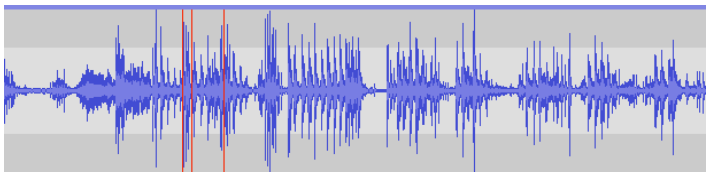

Figure 6. Trumpeting by elephant seal ML http://macaulaylibrary.org/audio/110965

Figure 7. Elephant seal

Student record vocalizations and then compare predominantly females assemblages (Bronx Zoo) with all males (Queens Zoo). The average number of barks/vocalization is 5.7 for the males vs. 2.04 for the females.

Table 2. Sample student data of a female California sea lion barking from a zoo recording at the Bronx Zoo.

Min Frequency	Max Frequency	Duration (s)	# of barks in succession
196	7374	1	1
255	7257	1.4	3
328	7367	2.2	2
208	7302	1.3	2
202	7403	1.2	2
228	7319	1.3	2
225	7315	1.5	2
206	7342	1.5	3
325	7383	1.8	3
250	7307	2.5	2
222	7295	0.6	1
212	7378	1	2
251	7299	1.5	3
252	7262	0.5	1
264	7324	1.8	2
327	7339	1.3	3
306	7376	2.3	4
193	7402	2.3	4
203	7338	1.8	3
254	7385	1.5	3
533	7378	0.8	1
230	7408	1	2
139	7294	0.7	1
186	7428	0.9	1
210	7250	0.6	1
221	7334	0.7	1
223	7344	0.7	1
229	7383	0.6	1
139 (min)	7428 (max)	2.04 (Average)	57 total (in 7 min) vocalizations

Notes for the Instructors

What is great about this exercise is that the students can do it on their own and/or at home. Since there are a large number of audio and video recordings (the latter sometimes with sound), the students can really collect limitless data. We suggest that you do take the students on a field trip to record animals---all they have to do is open their computer and run Audacity. We did try recording the sounds, but it means twice the amount of time, because the chip has to be played and recorded in Audactiy later.

Future Ideas for Students

With sea lions, are their substantial differences based on species, sex, age, seasonal, or whether or not the animals are captive or free? Can the vocalizations be typed to individuals and/or type of behavior? Do the animals vocalize differently based on whether people, such as trainers or children are present or not? How do vocalizations figure into their interactions with each other? Can we apply the same techniques to birds or other animals?

What other differences, especially in marine mammals, do we note as we search the library? Can we contribute our own sounds to the library? Would we be able to establish a service learning internship using the library with children and/or with blind people?

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