

Echolocation Calls of Dominican Bats
By Holli Swick and Melissa Bennett
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Texas A&M University Dominica Study Abroad Class
Dr. Tom Lacher
Dr. Robert Wharton

Abstract

Echolocation calls were recorded and analyzed using ANABAT II software. *Tadarida brasiliensis* was recorded at Fort Shirley in Cabrits National Park and the Check Hall River at Springfield Plantation. *Natalis stramineus* was recorded at Stinking Hole in Middleham Falls. *T. brasiliensis* has a vertical call structure that ranges from 35 kHz to 50 kHz. *N. stramineus* has a horizontal structure that has a range from 55kHz to 70 kHz.

Introduction

Echolocation calls were recorded from *Natalis stramineus* and *Tadarida brasiliensis*. These bats vocalize at a frequency too high for the human ear, therefore, ANABAT II software was used to lower the calls to a level that humans could hear while keeping the integrity of the call. The software produces a log scale of the calls and allows the user to view the calls in a number of ways. *T. brasiliensis* and *N. stramineus* were chosen for research because their calls are best heard on the ANABAT II, yet some bat's calls are too low to be recognized. The goal of this study was to continue the library of the previous projects. The first study only included foraging calls, but this study also includes emergence and distress calls.

Methods

All echolocation calls were recorded using the ANABAT II echolocation system combined with a laptop computer or a tape recorder. A laptop computer was used whenever possible because it reduces the amount of extraneous background noise that is recorded. A state-of-the-art tape recorder was used when a laptop was unavailable or during rainy weather. Then all calls were transferred to the Analook software for analysis.

There were three recording dates, June 1st, 3rd, and 8th. On June 1st the first recordings of *T. brasiliensis* distress calls were taken at the Check Hall River, on the Springfield Estate. Then on June 3rd outside Fort Shirley at Cabrits National Park more *T. brasiliensis* distress and emergence calls were recorded. The last recordings were completed on June 8th at Stinking Hole located along the Middleham Falls trail. Distress calls for *N. stramineus* were also recorded there. Distress calls were recorded from bats entrapped in 6 meter mist nets or while being held. Emergence calls were recorded as the bats emerged from their roosting sites or as they were taking flight. To receive the most accurate readings, the microphone was placed in a close proximity to the bat.

Results

Refer to Figures 1 through 7.

Discussion

Bats use echolocation calls to detect objects in their path, to forage for food, and to communicate with each other. Echolocation calls were recorded for *T. brasiliensis* and *N. stramineus*. Two types of calls were recorded: emergence and distress calls. Distress and emergence calls were recorded for *T. brasiliensis*, but only distress calls were recorded for the *N. stramineus*. Distress calls for *T. brasiliensis* ranged from 33 to 55 kHz and these calls have a structure similar to a logarithmic curve. Emergence calls for *T. brasiliensis* range between 33 to 65 kHz and these calls have the structure of a logarithmic curve but are more vertical than the distress calls. *N. stramineus* distress calls had an overall range of 62 to 78 kHz. These calls were in a relatively straight horizontal line as opposed to the curve of the *T. brasiliensis* call.

During this report the biggest problem faced was with the software and the computer. Both had glitches due to age and use. Becoming familiar with the software before beginning recording would be beneficial. There are shortcuts that will cut down on time and commands that require basic knowledge of DOS. To aid further research a condensed form of the original instructions has been added to our report, ANABAT for Dummies, in hopes to ease further frustration and problems. Difficulties also arose in identifying what species of bat each call was while analyzing them. It would be beneficial to record fewer calls and to take more time to label each call as they are recorded. Analyzing the calls as soon as possible will allow for easier identification.

In the future, a possible study may include analyzing a single species of bat to observe how echolocation calls vary within the species. This would provide a good base of calls for comparison. Another future study could analyze more calls of the bat species already recorded to create an average range of calls for each species.

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ANABAT for Dummies

INTRODUCTION

The Anabat II is an ultrasonic bat detector that uses a broadband microphone to detect frequencies that cannot be heard by the human ear. It will record, save, and analyze readings. It will record sounds from 20 to 200 kHz. It is convenient because it can be used with either a computer or state-of-the-art tape recorder. This is a condensed form of the original instructions, simplified for convenience. If there are any questions or a need to go into further detail, the original version may need to be consulted.

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Analook Commands

1) ANABAT II

- a) Power/Volume knob will increase the level of volume, allowing the user to hear better but does not increase the effectiveness of the recording. It records according to the sensitivity, and the volume is only for the user's ears.
- b) Division Ratio knob reduces the frequency of the echolocation to a level that can be heard by humans. The setting needs to be the same on the ANABAT II as on the computer for it to work (suggested level is 16). The frequency of the sound of the bat is divided by the division ratio number and that is the level that humans hear. The example given in the original manual was if a bat produced a sound at 48 kHz and the division ratio knob was set at 16 then humans would hear the sound at 3 kHz. ($48/16 = 3$)
- c) Sensitivity knob is similar to a microphone setting. The setting depends on several factors. It needs to be low enough to not detect background noises, yet strong enough to detect the bat. Before going into the field one needs to consider the species of bats, the number of bats, and the amount of background noises that will be encountered.
- d) Calibration Button will record a tone on the tape recorder. It is useful for separating calls.
- e) Low Battery indicator tells when the batteries are low, however there are still several more hours left after this light first comes on. (one 9 volt battery)
- f) Microphone button allows you to speak into the ANABAT II. This is useful when using the tape recorder because it allows you to be able to identify the calls on tape. However, when transferring the calls onto the laptop the calls cannot be heard.
- g) Tape Switch needs to be on when recording through the tape recorder.
- h) Timer on/off switch is to be used with the universal timer, but our setup lacks this feature.
- i) 12 Volt Jack cable was not included with the equipment. In the field it is easy to work off batteries.

2) ZCAIM (Zero Crossing Analysis Interface Module)

- a) Sensitivity knob has to be set at a minimum of 10 to register on the computer. It has relatively the function as the Sensitivity knob on the ANABAT II. The sensitivity light blinks whenever it receives an echolocation call.
- b) Input Jack is how the ANABAT II is connected to a computer through the ZCAIM. This is the ANABAT II / ZCAIM cable and it is composed of three wires, the taped one is not used at all.
- c) Low Battery Light is the same as the ANABAT II detector and once it is lit the ZCAIM can still function for a few hours.

- d) Parallel Port is where the printer cable attaches from the ZCAIM to the computer.
 - e) 6 Volt Jack cable was not included with the equipment and in the field it is easy to work off batteries.
- 3) Recording Devices
- a) Two recording devices work for the ANABAT II: a laptop and a tape recorder. If a computer is used the ANABAT II is connected to the ZCAIM and the ZCAIM is connected to the computer. However, if the tape recorder is used to record, only the ANABAT II and the tape recorder need to be used in the field. To transfer the files from the tape recorder to the computer, the tape recorder must be connected to the ZCAIM and the ZCAIM is connected to the computer.
 - b) It is best to use the laptop when possible because the calls do not have to be transferred from the tape recorder and the calls may be instantly reviewed using the ANABAT software. The disadvantages of using a laptop include a lack of battery supply, and one should not be used in bad weather.
 - c) A tape recorder can be used in any weather conditions. It has disadvantages, but these can be overcome. First a good quality tape recorder is needed to get consistent results. If the batteries run low then the echolocation call will be distorted. Also, the tape recorder will pick up more extraneous sounds than the laptop.
- 4) Setup (see diagram)
- a) Using the computer to record you need the ANABAT II, the ZCAIM, the laptop, the ANABAT microphone cable, and the printer cable.
 - b) Using the tape recorder to record you need the ANABAT II, the tape recorder, and the tape recorder interface cable.
 - i) When you transfer the recordings from the tape player to the laptop you need the tape recorder, the ZCAIM, the tape recorder interface cable, and the printer cable.
- 5) Software
- a) Anabat is the first software program and it is just used to record the calls. They are recorded onto a graph, the time is on the X-axis and the frequency of the call is on the Y-axis.
 - b) The Analook takes the calls from the Anabat and changes the calls into log scale. You can also edit out the extraneous sounds you recorded.
- 6) Anabat
- a) This program is in DOS, and the following is a list of commands to get into Anabat and then a few key commands that will be helpful once in Anabat. For a more complete guide, the original manual (C. Corben) may be referred to, but it is should be well noted that some of the original commands do not work.
 - b) If the initial prompt is C:\windows\>


```
C:\windows\>cd..
C:\
```
 - c) If you initial prompt is C:\


```
C:\>cd anabat
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 - d) C:\ANABAT>anabat5
 - e) This should take you to the title screen. Pressing any key will bring up the X, Y graph.
 - f) [Backspace] will bring up the Main Menu. While in the Main Menu, pressing the capitalized letter of each command will execute that command.
- 7) Anabat Commands
- g) Text Headers allow a label to be added to the file describing information for that particular recording.
 - i) [T] brings up the text header screen
 - ii) Arrow keys will move from field to field on the text header screen
 - iii) [Enter] will leave the text header screen
 - h) Configuration Menu (located under the Main Menu)
 - i) Divn ratio allows the computer to be set at the same ratio as the bat detector. (ANABAT II).

- i) File Menu (located under the Main Menu, too)
 - i) Save sequence file allows the text header to be edited and then saves the file
 - ii) Load sequence file will pull an already saved file onto the Anabat graph.
 - iii) The files are named according to the date and time. The first number indicates the last number of the year (this may also be a letter, instead of a number), the second number indicates the month (after September it also will become a letter), the third and fourth are the date, the fifth through eighth are the time (military), then a period and the seconds, followed by the pound sign. The time and date are the same as the one set on the computer.
 - j) Display Commands (used while looking at the graph)
 - i) Spacebar toggles between the true and compressed time.
 - ii) Esc returns the screen to its original 16 second display (this is the maximum length that a recording can be).
 - iii) F(1-10) change the amount of time represented on the screen, from 16 sec to 16 ms. This helps spread out the calls and makes them more visible.
 - iv) 1-9 and A-F will show a specific time on the left hand side of the x-axis, scrolling left allows the rest of the graph to be viewed.
 - v) +/- increases and decreases the frequency range on the y-axis.
 - vi) [Ctrl- [] returns the graph to the original 16 sec display, used as an "undo" button.
 - k) File Management Commands (used while looking at the graph, too)
 - i) [Shift L] will list all the files.
 - ii) [Alt -D] will delete the file currently open and the user will be asked for confirmation.
 - iii) [Ctrl -D] will delete the file from the file list.
 - iv) [Shift -{] and [Shift- }] will allow all the user to scan from file to file.
 - v) [Ctrl- X] will exit the Anabat program.
 - vi) [S] will save the file while recording.
- 8) Analook
- l) This program is in DOS, too, and the following is a list of commands to get into Analook and then a few key commands that will be helpful once in Analook. For a more complete guide, the original manual (C. Corben) may be referred to, but it is should be well noted that some of the original commands to not work.
 - m) First, exit out of Anabat. [Ctrl-X]
 - n) If you initial prompt is C:\
 - C:\cd anabat
 - o) C:\ANABAT>analook
 - p) This should take you to the title screen. Pressing any key will bring up the main screen.
 - q) The bottom of the Analook screen has the following abbreviations.
 - i) TOT indicates the total amount of time shown on the screen.
 - ii) TK indicates the time value of each tick mark on the x-axis.
 - iii) COMP/TRUE indicates the time displayed between compressed and true time, it can be toggled with the space bar. (Compressed time allows more calls to be shown on the screen at one time).
- 9) Analook Commands
- r) Spacebar toggles between the true and compressed time.
 - s) Esc returns the screen to its original 16 second display (this is the maximum length that a recording can be).
 - t) Backspace will open the Help menu.
 - u) Display Commands (used while looking at the graph).
 - i) F(1-10) change the amount of time represented on the screen, from 16 sec to 16 ms. This helps display a clear line.
 - ii) 1-9 and A-F will show a specific time on the left hand side of the x-axis, scrolling left allows the rest of the graph to be viewed.
 - iii) +/- increases and decreases the frequency range on the y-axis.
 - iv) [Alt-O] will change the color of the graph
 - v) [Ctrl-B] will change the pixel size.

- v) The text header can be edited the same as in Anabat, but it will also transfer from Anabat to Analook.
- w) File Management Commands (used while looking at the graph, also)
 - i) [Shift L] will list all the files.
 - ii) [Ctrl -D] will delete the file from the file list.
 - iii) [Shift -{] and [Shift- }] will allow all the user to scan from file to file.
 - iv) [Ctrl- X] will exit the Anabat program.
 - v) [Alt - M] will mark the file, but the file only remains marked until you exit the program
 - (1) [Alt-C] will copy all marked files to another directory. This way you can keep certain marked files separate.
- x) Editing Commands
 - i) [Q] will give calculated parameter values for the call that is on the screen.
 - ii) [V] will split the screen. The left side shows original screen. The right side will either show a slope of the entire calls [Ctrl-F1] or a bar graph of the time between the calls [Ctrl-F2]. Both can be used to help identify the calling species.