

WASIS User's Manual

21 December 2016



Contents

Chapter 1 - Introduction	1
How to Cite	1
WASIS Layout	2
<i>A - Menu bar.....</i>	<i>2</i>
<i>B - Toolbar.....</i>	<i>2</i>
<i>C - Library Panel.....</i>	<i>2</i>
<i>D – Audio Visualization Panel</i>	<i>2</i>
<i>E – Control Toolbar</i>	<i>2</i>
Creating a Library	3
Opening an Audio File	5
 Chapter 2 - Working with Audio Files	 7
Audio Selections	7
Save Audio File.....	8
Save Audio File - Data	9
 Chapter 3 - Audio Comparison	 11
Brute Force Comparison.....	11
Class Model Comparison.....	13

Chapter 1 - Introduction

WASIS (Wildlife Animal Sound Identification System) is a friendly software that aims to animal species identification based on their songs. In a nutshell, WASIS extracts meaningful information of audio signals, and uses a series of classification algorithms to compare this information with a collection of databases in order to return the identification of animal species.

WASIS was developed at the Fonoteca Neotropical Jacques Vielliard (FNJV) in partnership with the Amphibians Natural History Lab (LaHNAB) from the Institute of Biology and the Laboratory of Information Systems (LIS) from the Institute of Computing of the University of Campinas (UNICAMP).



Fonoteca Neotropical Jacques Vielliard



Grant and fellowship were provided by:

FAPESP / Microsoft Research Virtual Institute (NavScales Project)

Grant #2011/52070-7, São Paulo Research Foundation (FAPESP)

Grant #2013/02219-0, São Paulo Research Foundation (FAPESP)

The current version can be downloaded from the following homepage:

<http://www.naturalhistory.com.br/wasis.html>

How to cite

Tacioli, L., Medeiros, C. B. & Toledo, L. F. 2016. WASIS: Wildlife Animal Sound Identification System (Version 1.5.0). Fonoteca Neotropical Jacques Vielliard, Unicamp, Brazil. URL: <http://www.naturalhistory.com.br/wasis.html>

WASIS Layout

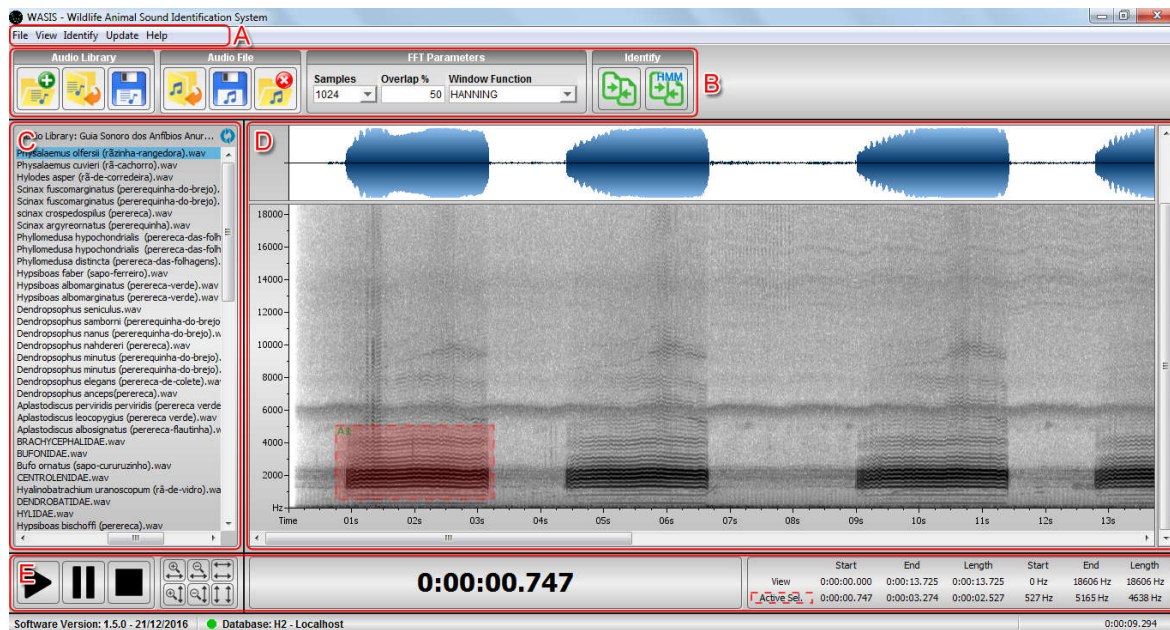


Figure 1.2.1 - WASIS window with the main components highlighted

A: Menu Bar

Located under the title bar where you can find all features for using WASIS.

B: Toolbar

Contains controls for the most common operations. The name of the component appears when you place the mouse pointer over it.

C: Library Panel

The library is the list of audio files previously loaded.

D: Audio Visualization Panel

When an audio file is loaded, two visual representations of the sound are presented:

- The waveform (top panel) shows amplitude versus time.
- The spectrogram (bottom panel) shows time along the horizontal axis, frequency along the vertical axis, and the sound pressure level (Decibel scale) in a gray scale spectra, from the lowest (white) to the strongest (black) levels.

E: Control Toolbar

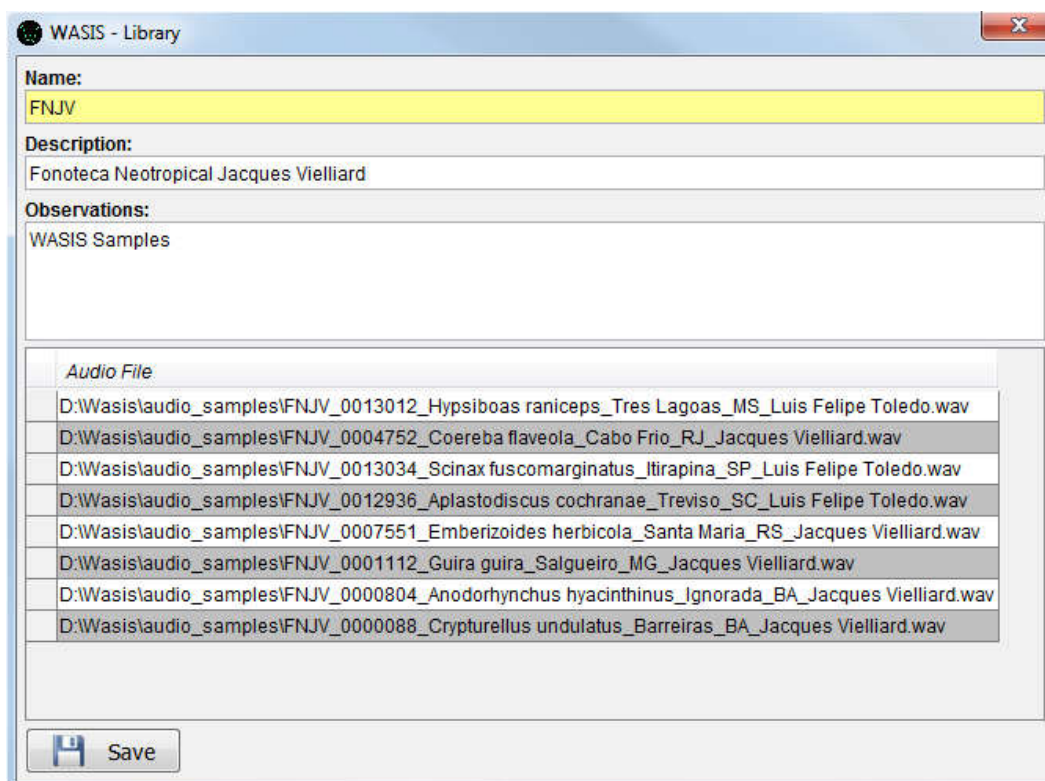
It has the following components:

- Audio Player
- Waveform and Spectrogram zooming tool
- Current time and frequency viewed/selected

Creating a Library

A library is a list of audio files. It is possible to create multiple libraries for different analyzes, but only one library can be opened at a time. For instance, if one wants to keep track of all the audio files from a specific location, he/she creates a new library and assigns all the audio files to the library.

Firstly, the user can go either the menu “File/New Library...” or its respective button on the toolbar, and the following screen shows up:



WASIS - Library

Name:
FNJV

Description:
Fonoteca Neotropical Jacques Vielliard

Observations:
WASIS Samples

Audio File

D:\Wasis\audio_samples\FNJV_0013012_Hypsiboas raniceps_Tres Lagoas_MS_Luis Felipe Toledo.wav
D:\Wasis\audio_samples\FNJV_0004752_Coereba flaveola_Cabo Frio_RJ_Jacques Vielliard.wav
D:\Wasis\audio_samples\FNJV_0013034_Scinax fuscomarginatus_Itirapina_SP_Luis Felipe Toledo.wav
D:\Wasis\audio_samples\FNJV_0012936_Aplastodiscus cochranæ_Treviso_SC_Luis Felipe Toledo.wav
D:\Wasis\audio_samples\FNJV_0007551_EMBERIZOIDES herbicola_Santa Maria_RS_Jacques Vielliard.wav
D:\Wasis\audio_samples\FNJV_0001112_Guira guira_Salgueiro_MG_Jacques Vielliard.wav
D:\Wasis\audio_samples\FNJV_0000804_Anodorhynchus hyacinthinus_Ignorada_BA_Jacques Vielliard.wav
D:\Wasis\audio_samples\FNJV_0000088_Crypturellus undulatus_Barreiras_BA_Jacques Vielliard.wav

Save

Figure 1.3.1 – “Library” screen with data already inserted

It is also possible to open a saved library in the menu “File/Open Library...” or its respective button on the toolbar.



Open Library

Name	Description
Cebidae - Callithrix	
FNJV	Fonoteca Neotropical Jacques Vielliard
Frogs of Boracéia	
Hylidae - Scinax	

Open Library

Figure 1.3.2 - “Open Library” screen with saved libraries listed

Select the desired library from the list and all audio files linked to the library will be automatically loaded to the library on the “Library Panel”.

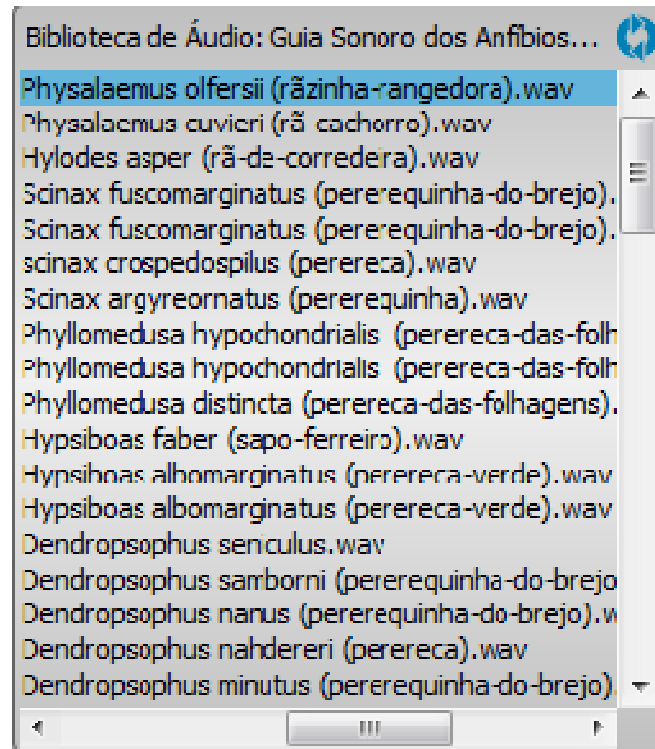


Figure 1.3.3 - “Library Panel”

If you wish to update the library, it is necessary to open the library, select the menu option “File/Save Library...” or its respective button on the toolbar, change the necessary data, and SAVE.

Notes:

A library is not a mandatory feature, but it will help to organize your audio files. Moreover, a same audio file can be included in different libraries.

Opening an Audio File

To open an audio file, choose “*File/Open Audio File...*”, or right-click inside the “Library Panel” and choose the respective option.

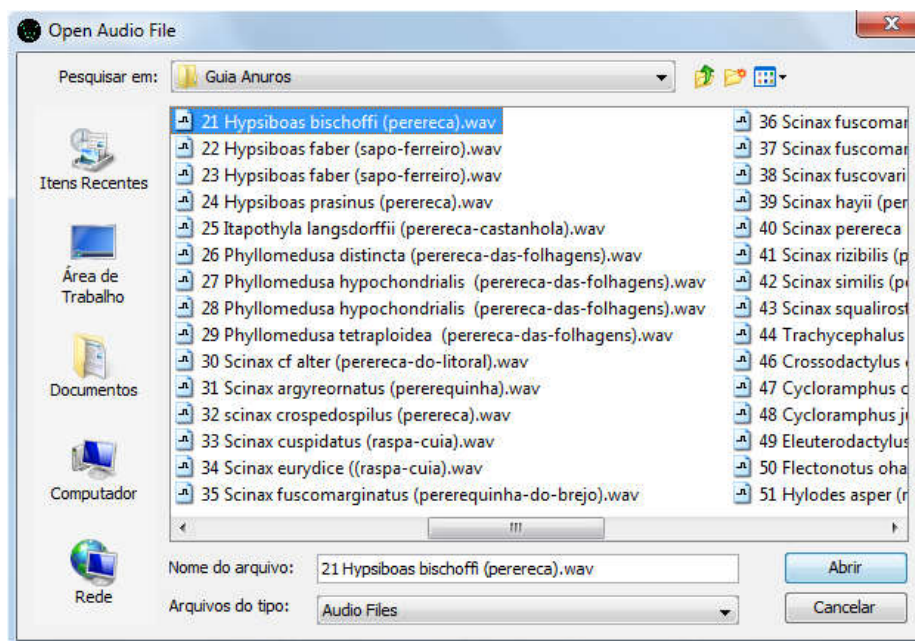


Figure 1.4.1 - “Open Audio File” screen

Select the desired audio file from a folder, and the audio will be included to the current library. WASIS will also create a waveform and a spectrogram in the “Audio Visualization Panel”.



Figure 1.4.2 - “Waveform”

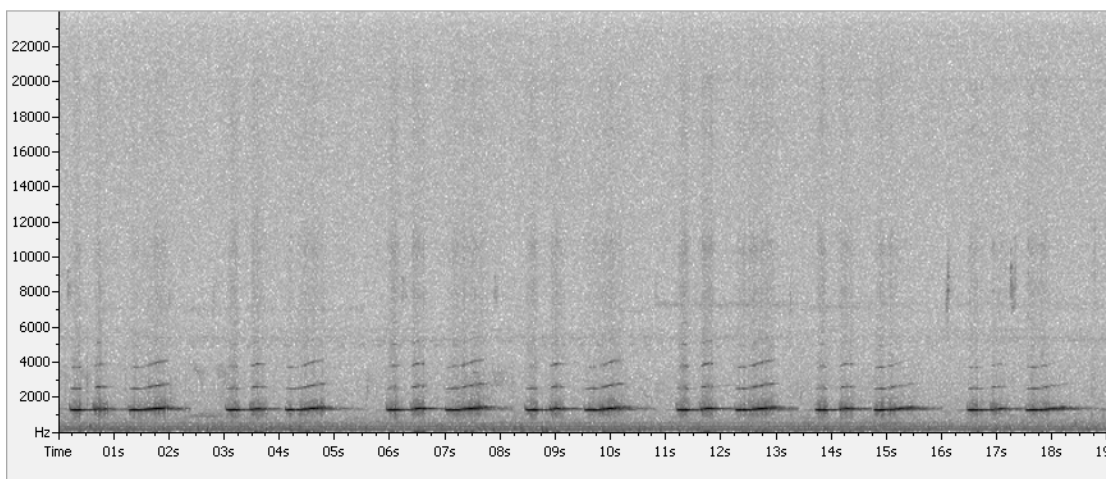
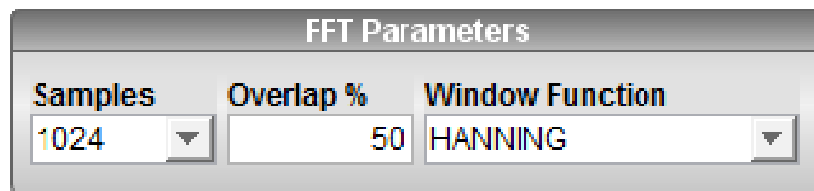


Figure 1.4.3 - “Spectrogram”

The spectrogram is created based on a FFT (Fast Fourier Transform) algorithm and all parameters can be modified by the user through the “Toolbar” controls:

A dialog box titled "FFT Parameters" with a light gray background. It contains three controls: a "Samples" dropdown menu showing "1024", an "Overlap %" text input field showing "50", and a "Window Function" dropdown menu showing "HANNING".

Samples	Overlap %	Window Function
1024	50	HANNING

Figure 1.4.4 - “FFT Parameters”

Notes:

As default, WASIS uses audio files in .WAV format with 44.1 kHz of frequency sampling rate. In case of a file with different configuration, WASIS will automatically convert the file to the default format.

Chapter 2 - Working with Audio Files

This chapter will explain how to work with audio files in details. The basic audio features are controlled inside the “Audio Visualization Panel” and the “Control Toolbar”.

The spectrogram plays a major role in the sound analyzes, since all extracted data come from it. To extract data for analyzes, select a desired area by pressing the left mouse button in the initial point, dragging it to the final point, and releasing the mouse button.

To commit the selection, right-click the mouse button inside the spectrogram area and a menu will pop up with the following options:

- Add new sound unit: It is the identification (ID) of the selection and it is named with a letter and a number. For each new sound unit added, its identification will follow a sequence: A1, A2, A3, ..., An;
- Add new sound unit for new species: If more than one species is seen in the spectrogram, this option is available for better organization of the selections.

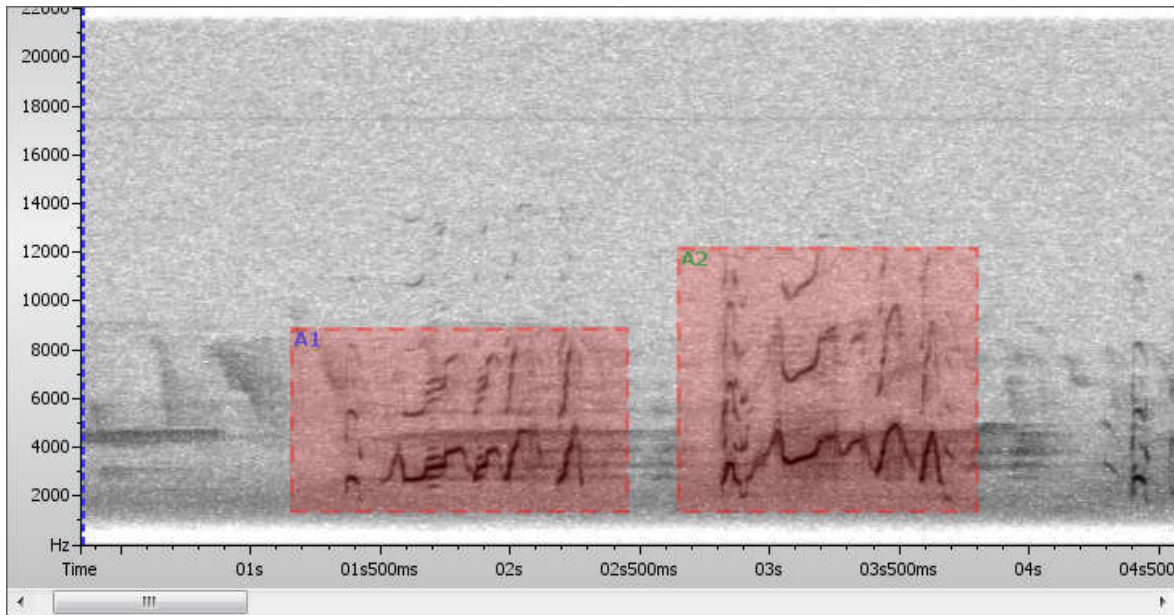


Figure 2.1 - “Spectrogram” selections with their respective identification.
A1 is marked in blue because it was saved into the database, while A2 is green - not saved into the database

There are also two options remaining when the spectrogram is right-clicked:

- Zoom in selection: Increase the selected area, showing it in more details;
- Show selection list: Gives information about all the selections of the current audio file, as well as allowing the deleting selections (Figure 2.2).

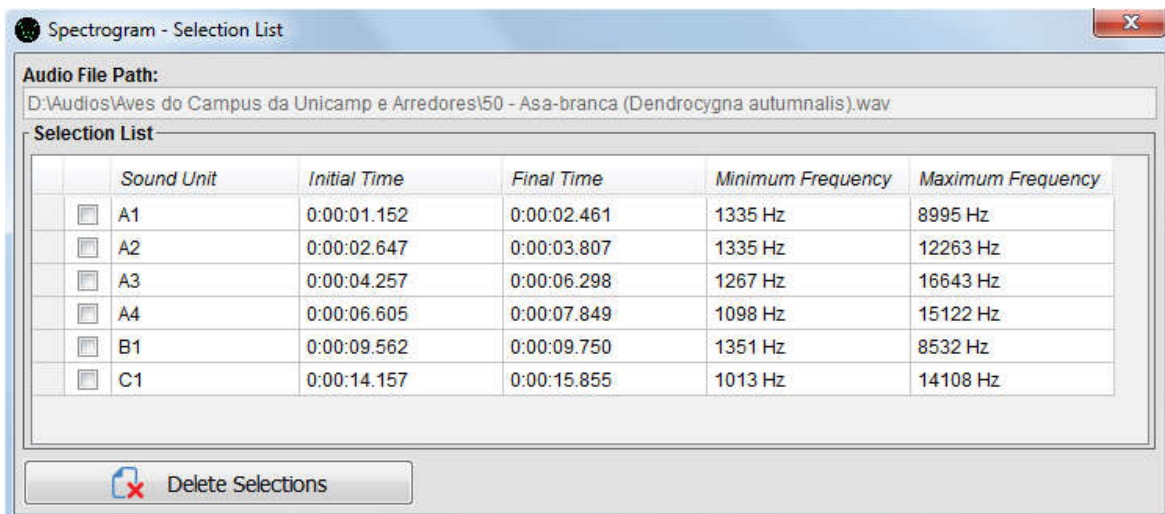


Figure 2.2 - “Spectrogram – Selection List” showing the all selections of an audio file

To save the selections to the database, choose “File/Save Audio File...” or its respective button on the toolbar. All selections and their data are listed on the “Selections Not Saved”. Check the selections and press the “Save Audio File Data” button.

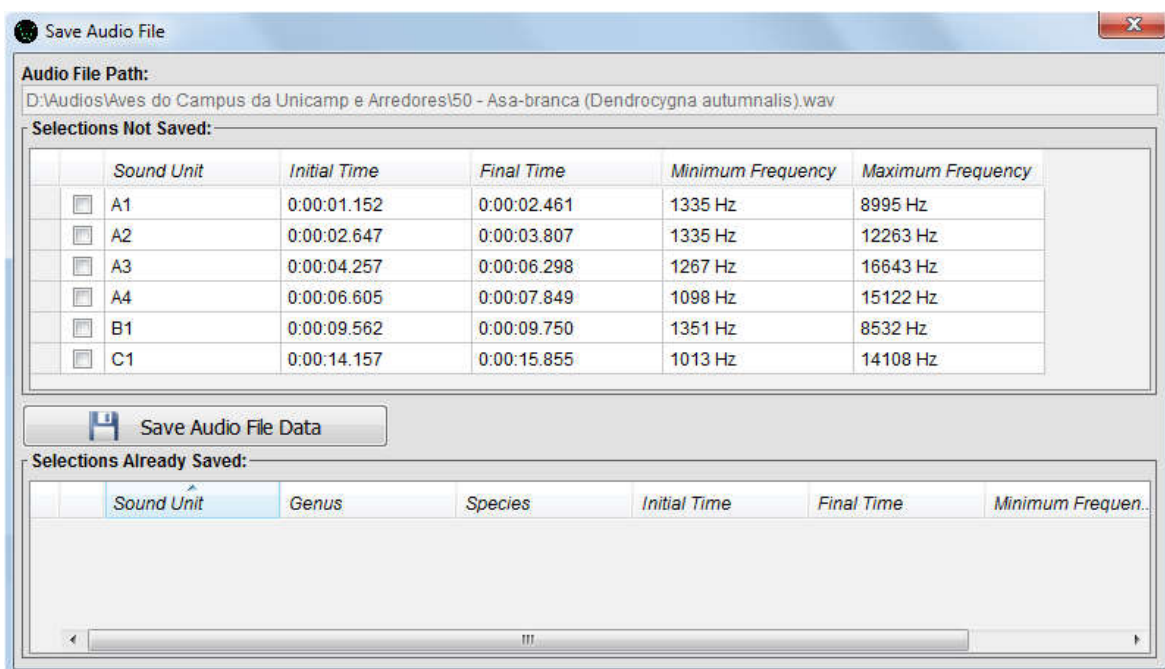


Figure 2.3 - “Save Audio File” screen. The first list refers to the selections that were not saved in the database. The second list refers to the selections that are already saved in the database

A new screen appears with the some fields about the recording related to the scientific classification, location, date and time, etc. After filling out the fields, press the “Save Audio File Data” button.

Save Audio File - Data

Audio File Information

Audio File Path: os\Aves do Campus da Unicamp e Arredores\50 - Asa-branca (Dendrocygna autumnalis).wav Voucher Number

Scientific Classification

Phylum: Chordata Class: Aves Order: Anseriformes

Family: Anatidae Genus: Dendrocygna Species: autumnalis

Common Name - Portuguese: Asa-branca Common Name - English: Black-bellied Whistling-Duck

Recording Information

Country: Brazil State: São Paulo City: Campinas

Locality: Latitude: Longitude:

Day: 20 Month: 6 Year: 2015 Time / Hour:

Call Type: Recordist: Leandro Tacioli

Observations

Sound Unit	Initial Time	Final Time	Minimum Frequency	Maximum Frequency
A1	0:00:01.049	0:00:02.815	0 Hz	11743 Hz

Save Audio File Data

Figure 2.4 - “Save Audio File - Data” screen

Notes:

All databases in the software WASIS are created by its users. Any information that were not saved correctly, might give incorrect results in the audio comparison.

Other basic functionalities are located at the “Control Toolbar”:

- Audio Player: Plays the full audio file or part of it depending on the selections made by the user.



Figure 2.5 - “Audio Player” commands (Play, Pause and Stop)

- Zoom Tool: Displays a magnified view of the waveform and spectrogram.



Figure 2.6 - “Zoom Tool” commands
(Top: Zoom In - Time; Zoom Out - Time; Reset Zoom - Time)
(Bottom: Zoom In - Frequency; Zoom Out - Frequency; Reset Zoom - Frequency)

- Current Time: It shows the current time of either a selection or when the audio file is being played.

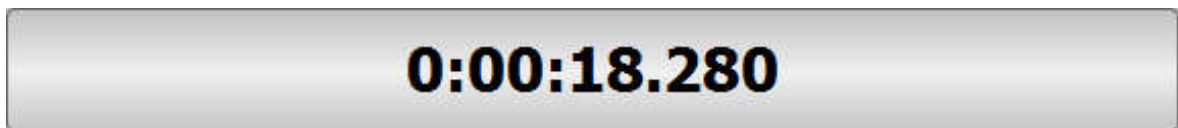


Figure 2.7 – Current time

- Current View/Active Selection: Shows the starting/ending time and frequencies that are being viewed and selected.

	Start	End	Length	Start	End	Length
View	0:00:00.000	0:00:23.733	0:00:23.733	0 Hz	22050 Hz	22050 Hz
Active Sel.	0:00:03.853	0:00:06.297	0:00:02.444	1686 Hz	10931 Hz	9245 Hz

Figure 2.8 – Current view and active selection

Chapter 3 - Audio Comparison

There are two different ways to compare an audio file:

Brute Force Comparison

This comparison method is based on the direct comparison of the information extracted from the audio files.

Open an audio file and make selections as previously mentioned. After that, go either to the menu “*Identify/Compare Sounds*” or its respective button on the toolbar. The following screen will appear:

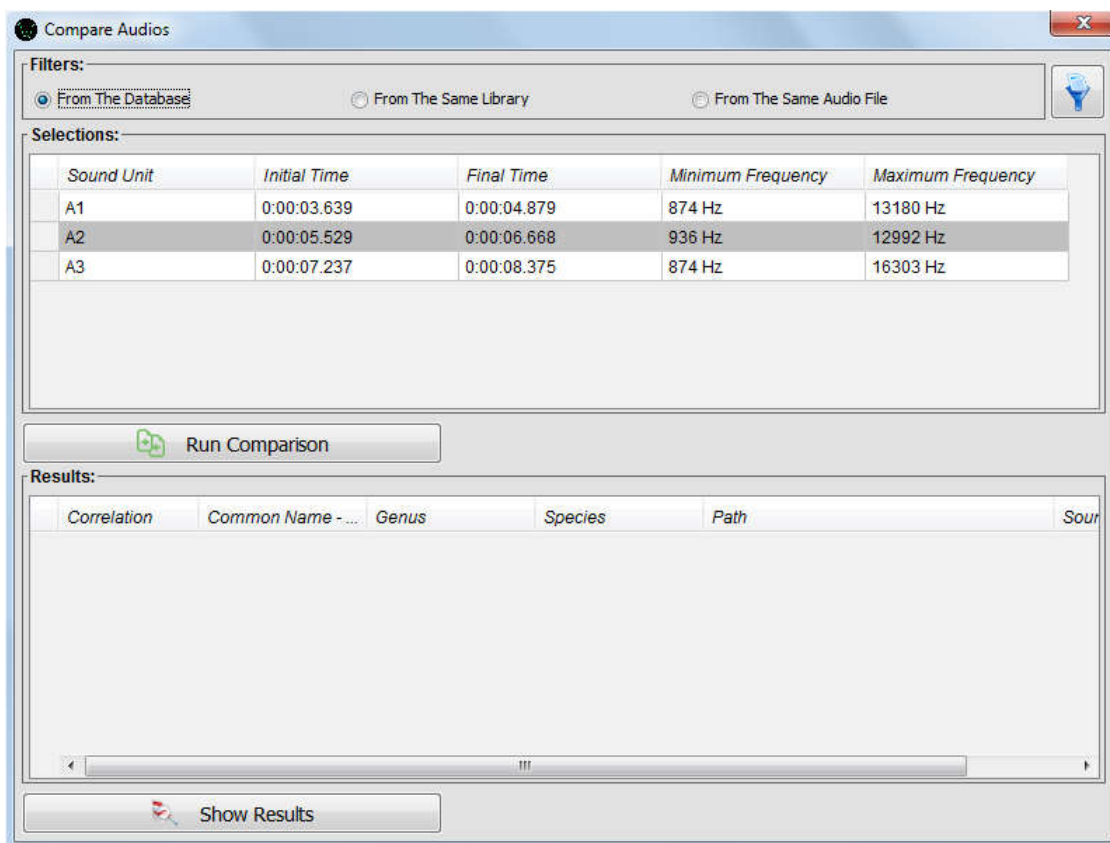


Figure 3.1 – “Compare Audios” screen

There are some filters that limit the databases where the comparison will be performed:

- From the Database: Compare the current selections to the whole database;
- From the Same Library: Compare the current selections only with the audios contained in the same library;
- From the Same Audio File: Compare only the selections in the same file, not considering any database.

The user can also choose among other filters to narrow down the results and perform faster identification. For example, if one knows that the animal he/she wants to identify is a bird, just click on the right-side button of the filters and a new screen appears:

Figure 3.2 - Audio Comparison filters

After choosing and filling in the desired filters, the user can click over a selection and all the comparison results will be shown.

Correlation	Common Name - ...	Genus	Species	Path	S
0.9974	Anu-preto	Crotophaga	ani	D:\Audios\Aves do Campus da Unicamp e...	A:
0.9112	Anu-preto	Crotophaga	ani	D:\Audios\Aves do Campus da Unicamp e...	A:
0.8788	Anu-preto	Crotophaga	ani	D:\Audios\Aves do Campus da Unicamp e...	A:
0.7852		Physalaemus	olfersii	D:\Audios\Guia Sonoro dos Anfíbios Anuro...	A:
0.7827	Cambacica	Coereba	flaveola	D:\Audios\Aves do Campus da Unicamp e...	A:
0.7689	Trinca-ferro	Salpator	similis	D:\Audios\Aves do Campus da Unicamp e...	A:
0.7652	Curicaca	Theristicus	caudatus	audio_samples\Aves\01 - Curicaca (Ther...	A:
0.7607	Curicaca	Theristicus	caudatus	audio_samples\Aves\01 - Curicaca (Ther...	A:

Figure 3.3 - Results from a Brute Force Comparison

The results of this comparison are all based on correlation analyses of the power spectra extracted from the spectrogram. *Pearson Correlation* Coefficients computes the similarities between the target audio and the audio contained in the filters, and presents a ranked list according to the correlation results. A double-click on any record of the results, shows the comparison between the audio file from the selection list and the audio file from the result list.

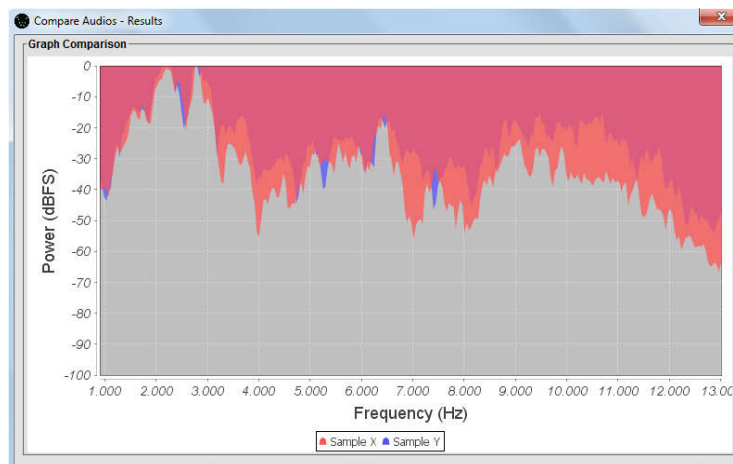


Figure 3.4 – Comparison between the target audio file from the selection list (Sample X) and the audio file from the result list (Sample Y).

Class Model Comparison

Commonly, this comparison method employs supervised machine learning algorithms for animal identification. The main purpose of this method is to design a classification scheme that can best predict the classes/labels for unseen data (the audio file that one wants to identify). These algorithms create class models based on sets of meaningful information extracted from the audio files of several species at the same time, and assign just one model for each species.

The current version of WASIS uses Hidden Markov Model (HMM) for Class Model Comparison. The user can go either to the menu “*Identify/Compare Sounds – Hidden Markov Model*” or its respective button on the toolbar, and the following screen will appear:

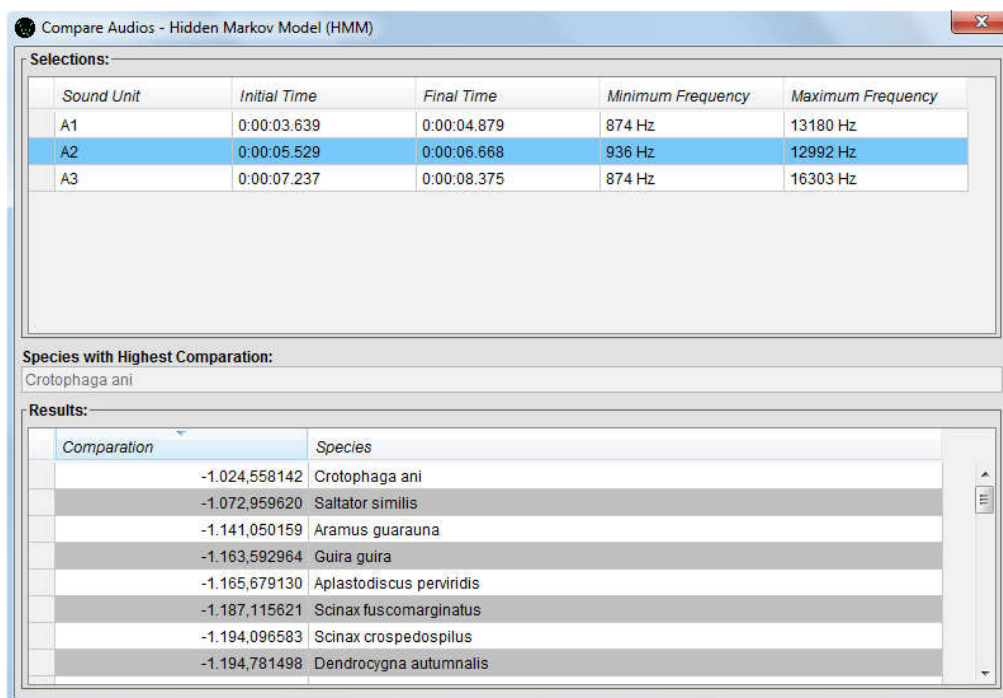


Figure 3.5 – Class Model Classification using Hidden Markov Model

Click over a selection and all the comparison results will be shown on the bottom panel, and the species with highest comparison score will be highlighted.

Notes:

This WASIS version does not provide a screen for training and creating the audio models necessary for Class Model Comparison yet. All the identification results will be based on models previously created.