Using Audacity for bioacoustic analysis

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1 Opening files in Audacity

Download the file C_vagans.wav from http://audioblast.org/keys and open it in Audacity (File: Open). Depending on your computer's operating system and browser you may have to right click on the link to the file to save it to your computer.

When opening files in Audacity you will be asked whether you want to work on the original file, or make a copy. As this file forms part of a training course it is safe to use the original file, but if working on your own files it is always safer to make a copy (Figure 1).

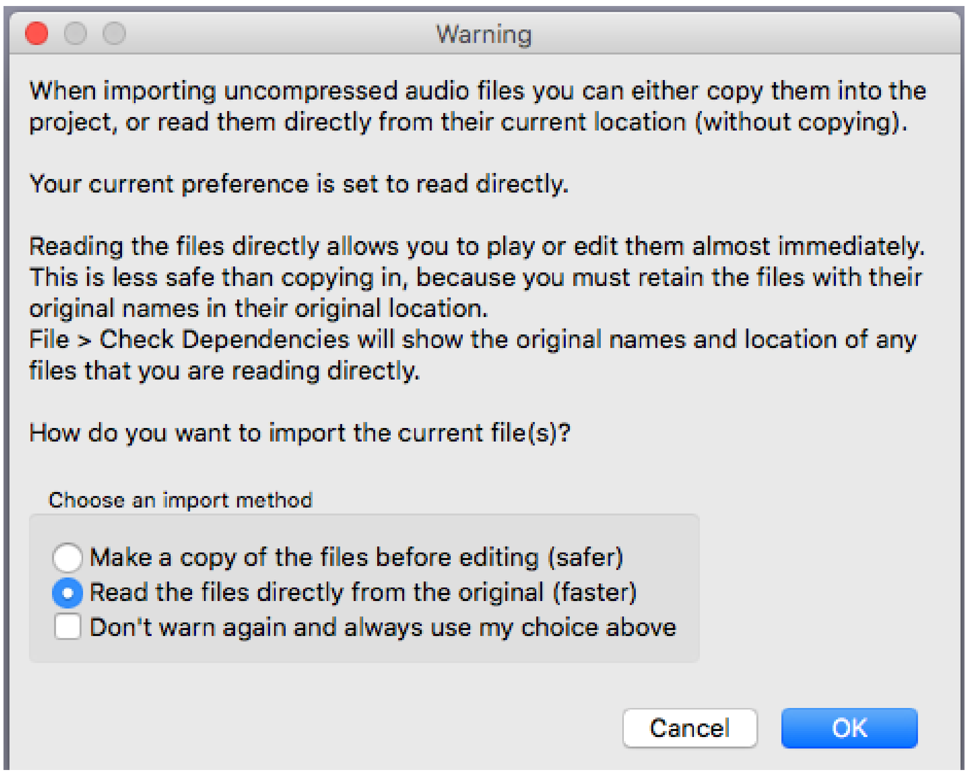

Figure 1:

Figure 2 shows the the file C_vagans.wav opened in Audacity. The default view in Audacity is the *time domain* or *waveform* view. This shows how the amplitude ("volume") of the sound varies with time.

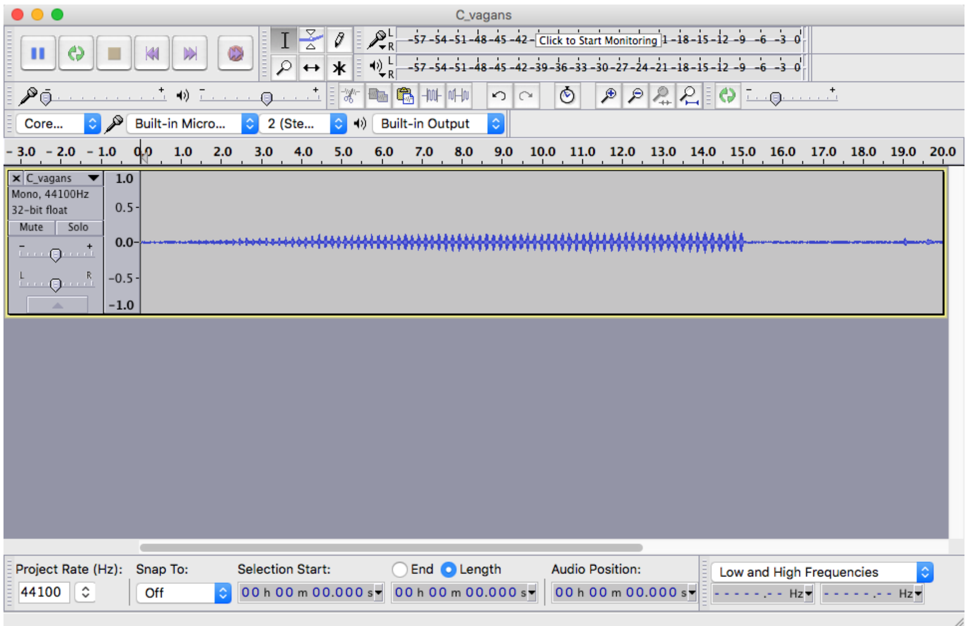

Figure 2:

2 Normalisation

The sound file we have opened does not make full use of the range in amplitude. In order to make individual features of the sound more obvious when analysing them later we can 'normalise' the recording to make full use of the amplitude range available (Effect: Normalize...). The options for the normalisation are shown in Figure 3.

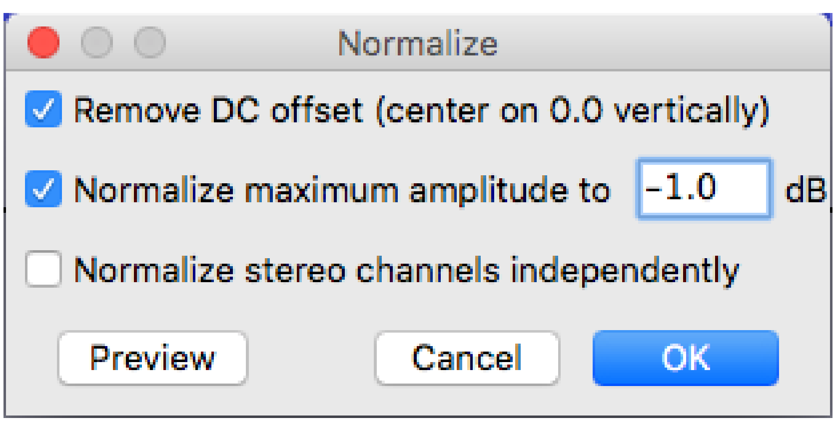

Figure 3:

The effect of the normalisation is illustrated in Figure 4.

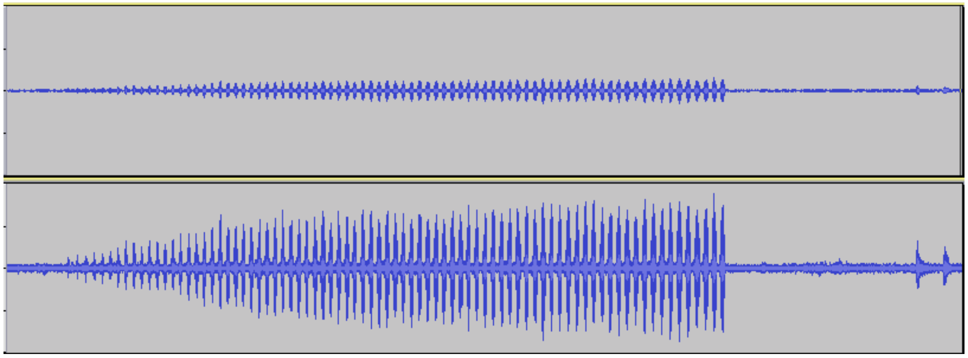

Figure 4:

3 The time domain

The time domain view can be used to measure the duration of features in the time domain. Accurate measurement of durations will require us to zoom in on the features of interest. There are several zoom tools located in the toolbar (Figure 5).

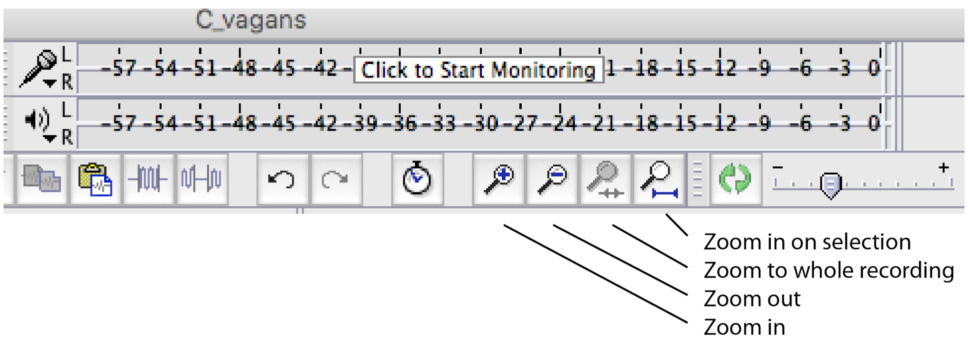

Figure 5:

Zoom in on a region of the recording and identify a feature to measure the duration of. Use the mouse cursor to select the region of the waveform you wish to measure. Ensure that the selection option is set to Length rather than End (Figure 6). If you are trying to measure features of short duration you will need to ensure that the units selector is set to the option with milliseconds (Figure 7). The duration of the selection, in the units you selected, are shown in the text box under the End/Length selectors.

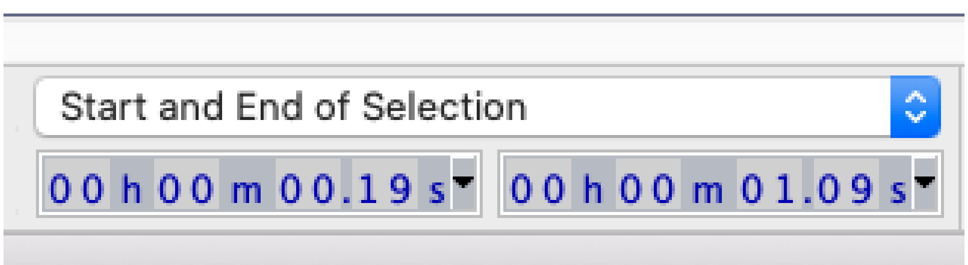

Figure 6:

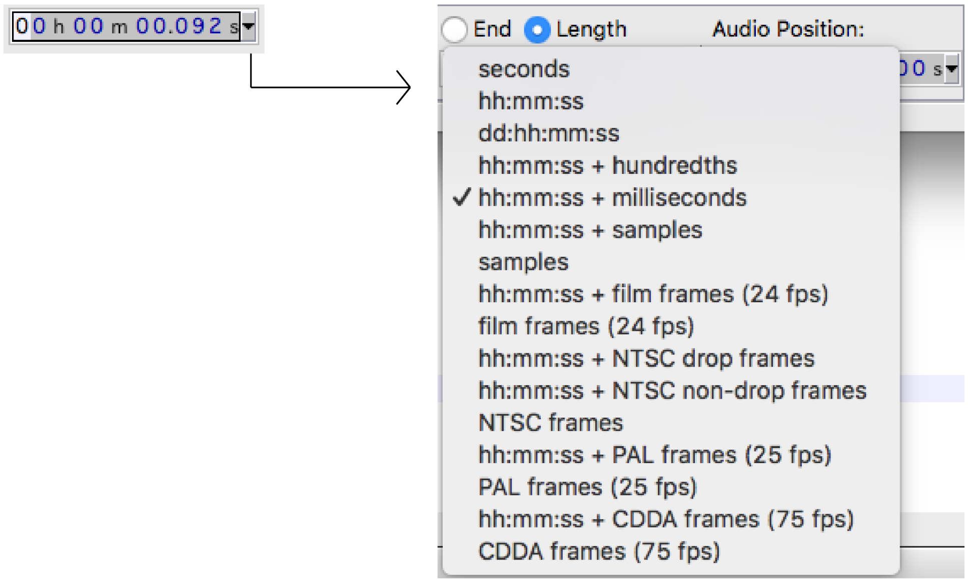

Figure 7:

Many insect sounds are produced by stridulation: rubbing a series or raised areas or protrusions (the file) against a plectrum (often an enlarged wing vein). Each back-and-forth motion of the file against the plectrum results in a syllable, syllables may be grouped into groups (”echemes”) or form a continuous song. More complex songs may be composed of echeme sequences. There may therefore be many different features to measure the duration of, often with very different durations.

4 The frequency domain

While the time domain view allows for easy measurement of the duration of features, it does not allow for the measurement of the frequency of the song. In order to do examine this we must switch the view of Audacity from ’waveform’ to ’spectrogram’. This is illustrated in Figure 8.

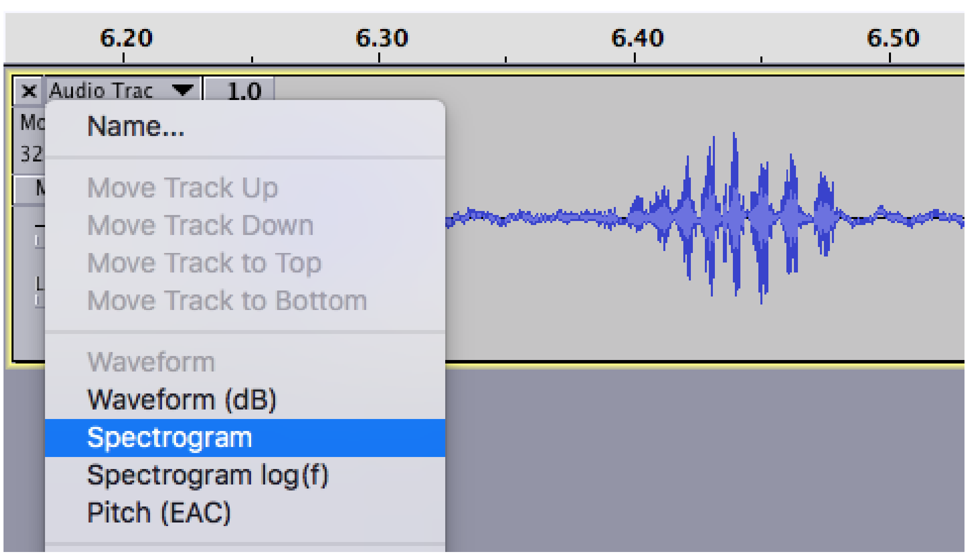

Figure 8:

A comparison of the waveform (time domain) and spectrogram (frequency domain) views is given in Figure 9. The spectrogram shows frequency on the vertical axis, regions of brighter colouration show a greater amplitude for that frequency.

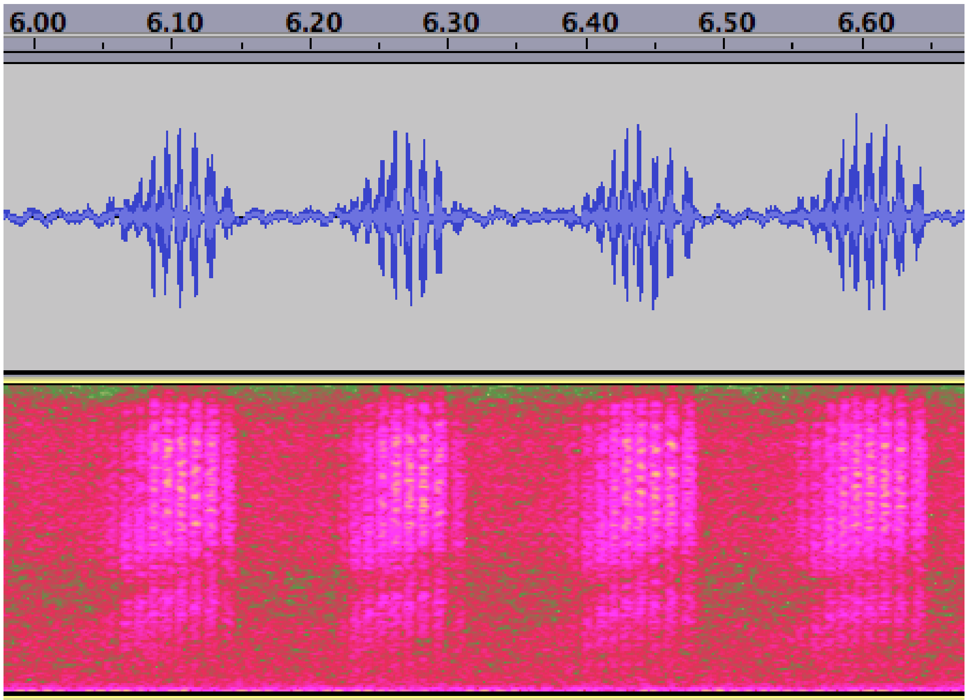

Figure 9:

The spectrogram view is good for getting an overview of the frequencies present in a song, but it is hard to analyse directly. To analyse the frequency, select the region to analyse, then click Analyse: Plot Spectrum... Figure 10. The Plot Spectrum plots frequency (x-axis) against the amplitude of that frequency (y-axis). It can be seen that for this species the distribution is bimodal, and that this can be related to the spectrogram view. Moving your cursor over the plot allows individual values to be read.

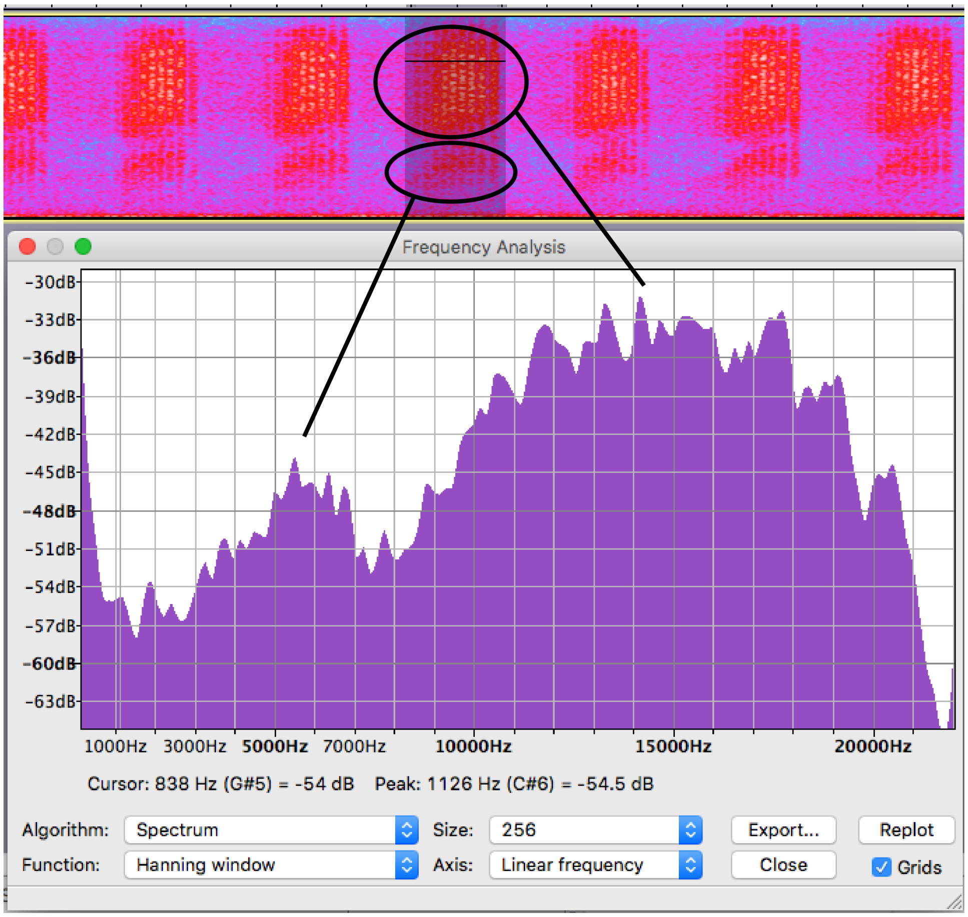

Figure 10:

You can see that for this species the song covers a wide range of frequencies, this known as a *broadband* signal and is typical in grasshoppers and bushcrickets. The true crickets have a much narrower frequency spectrum (narrowband signal) as their song is modified by resonators (special regions of the wing). For comparison the song of the mole cricket *Gryllotalpa vineae* is given in Figure 11.

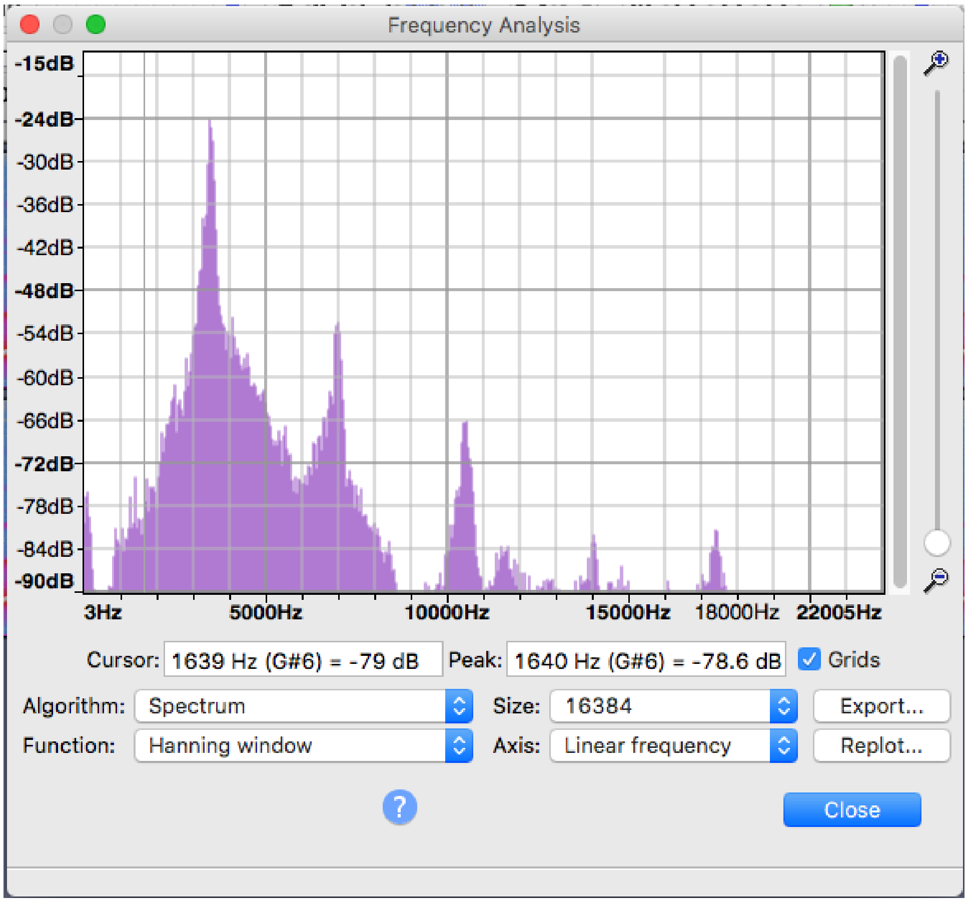
Frequency Analysis
-15dB
-24dB
-30dB
-36dB
-42dB
-48dB
-54dB
-60dB
-66dB
-72dB
-78dB
-84dB
-90dB
3Hz
5000Hz
10000Hz
15000Hz
18000Hz
22005Hz
Cursor: 1639 Hz (G#6) = -79 dB
Peak: 1640 Hz (G#6) = -78.6 dB
Grids
Algorithm: Spectrum
Size: 16384
Export...
Function: Hanning window
Axis: Linear frequency
Replot...
Close

Figure 11: