The AviaNZ Birdsong Analysis Software (v 1.2)

The AviaNZ Team

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This is a brief guide to version 1.2 of the AviaNZ program. We really want feedback on it, particularly what works and what doesn't, how you would like to see it improved, and what other functionality it needs. We are more than happy to talk about our plans as well.

1 Getting Started

In contrast to previous versions, this version of AviaNZ does not require you to run it as administrator in Windows. It places some files in the home directory of your computer; in `C:/Users/username/AppData/Roaming/AviaNZ` *for Windows and* `/.avianz` *for Mac and Linux.*

When the program loads, you are presented with three options in the following start-up screen:

The first option (Manual Segmentation) is described more in Section 2. It enables you to see and manually process audio files. The second option (Batch Processing) takes whole directories (and subdirectories) of audio files and automatically segments the bird calls of a particular species; see Section 3. You can view the output of this automatic segmentation using the first option; the software also produces an Excel file showing the results, see Section 4, but in addition the third option (Review Batch Results) enables you to check the results of the batch processing easily.

2 Manual Segmentation

If you select manual segmentation, you will see a dialog box asking you to select a file to view. Use this in the normal way to select a sound file from a directory. Once you have selected one, the program will ask you to give names for the operator and reviewer. These are useful to keep track of who has looked at different files. Following that, you should see a screen like the one below (Figure 1). This is the main program for manually labelling birdcalls, or reviewing the processing of automatic processes.

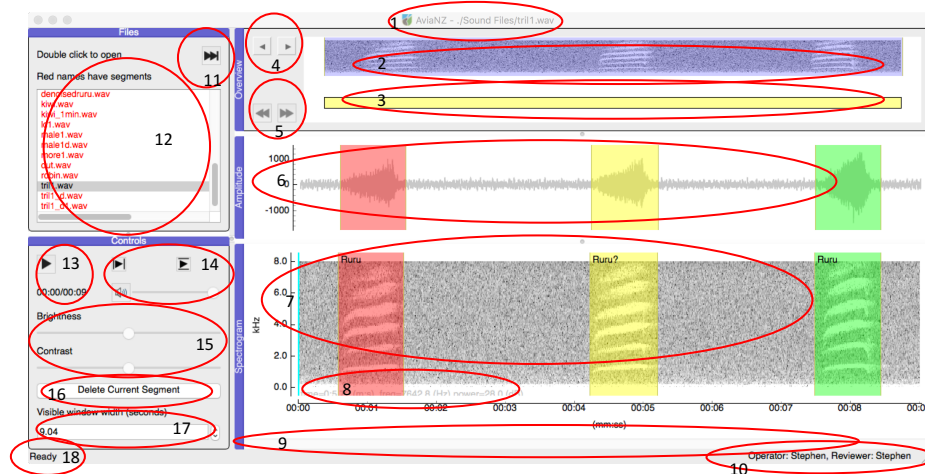The program automatically loads the first 5 minutes of a file.

Figure 1: The interface for manual birdsong annotation and analysis.

- There are five separate areas of the screen within the AviaNZ program (each of which has its name in a blue bar). They are:

  Overview This shows you a picture of the 5 minutes of the file (labelled 2 in the figure). The part you are looking at in the main plots is shown in blue (it's actually the whole file in the example figure). Below it there is a coloured bar (labelled 3 in the figure, and in yellow). There are left and right arrow buttons (labelled 4) and double arrow buttons (labelled 5) on the left of this area. The single arrow buttons move the view in the main area along, while the double arrow buttons move to the previous 5 minutes or to the next 5 minutes of the file (if it exists).

  Files (12) This is a list of files in your current directory. You can double-click on one to select it and open it. Files in red have been annotated, files in black have not. The double arrow button on the top right of this area (labelled 11) moves on to the next file.

  Amplitude plot (6) This shows a picture of the sound file. It's one of the two parts of the interface that you can use to label the birdcalls. If you don't want to see it, you can hide it using the Appearance menu by selecting 'Show amplitude plot' so that it is not ticked.

  Spectrogram plot (7) This is the second picture of the sound file, and the one that has more information and is most useful. It is possible to display information about where the mouse is pointing on the spectrogram (time, frequency, energy value; 8 in the figure) by choosing 'Show pointer details in spectrogram' from the Appearance menu, and to switch it off the same way. There is also a scroll bar to move through the file (9).

  Controls These play the sound file, and modify the appearance of the plots (13–17 in the figure), see Section refsec:controls.

  In addition, there are two extra parts to the interface:

  Menu The menu at the top of the screen. The name of the current file is shown in the title of the window (1).

  Bar at the bottom At the very bottom of the screen there is an area (marked 18) that gives any status updates from the program, and on the right, information about the currently selected Reviewer and Operator (marked 10).

- You can drag the five screen areas around and reorder them if you wish, by dragging the blue bar on the top or left of them. You can also make them into their own windows by double-clicking on the blue bar. If you decide that you made a mistake doing that, then there is an option in the Actions menu to 'Put docks back' that returns them to the original configuration.

- To load a new file, either choose 'Open sound file' in the File menu, or just double click one in the Files screen area (double clicking on a folder will open that folder), or click on the button labelled 11 to move to the next file.

- If you want to move to a new directory, either use the '..' option at the top of the list of files to navigate around your computer's file system, or use the 'Open sound file' in the File menu.

- To restart the program, for example so that you can start doing some batch processing, choose 'Restart' from the File menu. To quit completely, choose 'Quit'.

2.1 Spectrogram and Amplitude

- The two main plots (Amplitude and Spectrogram; 6 and 7) show a section of a sound file. The part you are looking at is highlighted in blue in the top (Overview: 2) picture. Sometimes people only want to look at the spectrogram. If you are one of these people, in the Appearance menu there is an option 'Show amplitude plot', which is initially ticked. Click on it to remove the tick and the amplitude plot will vanish. If you change your mind, choose the option again. You can also hide the list of files (12) and the annotation overview (3) in the same way. AviaNZ will remember your choice in future uses.

- Sometimes spectrograms don't look good initially, for example because of high noise. You can modify the brightness and contrast of the spectrogram using the two sliders marked 15 in the figure. You can also use a different colour scheme, and invert the colour map (swap black and white), by choosing the relevant options in the Appearance menu.

2.2 Zooming and Scrolling

- The part of the file you can see can be changed by:
  - dragging the scroll bar below the spectrogram (9)
  - clicking on the left or right arrows on the right of the Overview picture (labelled 4)
  - dragging the blue highlight in the Overview picture itself (labelled 2).
  - clicking on any of the boxes in the bar below the Overview picture (labelled 3)

  The amount of the file that you can see (the visible width) can be changed by either:
  - dragging the ends of that blue highlight in (2)
  - changing the 'Visible window width (seconds)' in the Controls dock (labelled 17) by clicking on the up and down arrows, or typing in a new number.

- You can also view a restricted amount of the spectrogram by reducing the visible frequency band. To do this non-destructively, use the 'Change spectrogram parameters' dialog in the Appearance menu, and change the Lowest and Highest Frequency options.

2.3 Moving Through Long Files

- If files are longer than 5 minutes, use the double arrows labelled (5) to move to the next or previous sections. Note that there is a 10 second overlap between the files. You can change the page size and the amount of page overlap by choosing the relevant options in the 'Interface Settings' in the Interface menu, as will be described later. The times on the axis below the spectrogram show locations in the full file. Note that operations like denoising and segmentation apply to the visible 5 minute portion of the file, not the whole file.

2.4 Playing the Sounds

- You can play the sounds visible on the screen using the 'Play' button at the top-left of the Controls section (labelled 13). The button turns into a 'Pause' button while playing (or you can press the 'Escape' key). The light blue bar in the spectrogram plot (7) shows where the playback is up to. When paused, you can drag this bar if you want to hear a particular part of the file. Move the mouse over it, and the bar will go red. Then click and drag to move it. The time below the play button shows the length of the file and the current position of the blue bar in minutes and seconds. You can change the volume of playback using the slider in (14). You can also play a segment of sound, assuming that a segment is selected. We will cover this below.

- To stop playback and have the slider return to the start of the visible section, press the Stop button instead.

- When a segment is selected (so that it is blue – segments are covered next) you can use the two play buttons in 14 in the picture to play just that small segment. The difference is that the one on the left plays all the frequencies in the sound file, while the one on the right will play only the frequencies highlighted, so that you can isolate particular frequencies of a call. This is particularly helpful when there is high level of background noise that is in a particular frequency range, such as cicadas, or where there are overlapping calls in different frequency bands.

2.5   Performing Segmentation

- Segmentation has changed slightly in this version of the software.

- You select and edit a segment by clicking on it with one of the mouse buttons (left or right), and create one by using the other mouse button. You can select which performs which action using the 'Mouse settings' of the 'Interface settings' in the Appearance menu.

- There are three options for how to create a segment. You select one of them in the 'Mouse settings' of the 'Interface settings' in the Appearance menu:
  - Start and stop a full frequency band by clicking (i.e., click once at the correct time for the start of a segment, move the mouse to the end, click again, the box covers all frequencies)
  - Start and stop a limited frequency band by clicking (i.e., click once at the correct time and frequency (in the spectrogram) for the start of a segment, and then again at the time and frequency for the end)
  - Drag a limited frequency band box (i.e., click and hold the mouse button and drag the mouse to the correct end point in both time and frequency)

- While the segment is being made, it is red. At the end it will turn blue, and a drop-down menu will then appear asking you to label the segment.

- To choose the type of bird, click on the name. If the type isn't in the list, move to 'Other'. If it isn't in the second list, at the bottom of that list is a selectable box (it probably says 'Albatross'). Clicking on it provides the complete list of birds. If there is something missing from there, choose 'Other' from it, which is at the very end. It will ask you to enter a name. From then on this name will appear in the list. If you click anywhere on the screen except on a bird name in the menu then the menu will disappear and the bird type will be labelled as 'Don't Know'.

- By default these lists update dynamically, so that bird types you have chosen appear at the top of the list. If you don't like that, then you can disable it in the 'Interface settings'.

- If you find that the colours make it hard to see the data underneath the boxes you can make them transparent using the 'Make dragged boxes transparent' option under 'Annotation' in the 'Interface settings'. You can also choose different colours if you have particular preferences.

- If you select a segment that already exists then it will turn blue and the menu will reappear so that you can correct mistakes.

- You can avoid seeing the menu by pressing the shift key on the keyboard when you click to finish the segment. The program will then give the segment the same label as the previous box that you labelled. This is very useful when there is one bird calling repeatedly.

- You can also show that you are uncertain by pressing the control button when you click to segment (command button on a Mac computer). The names of the birds will then have a question mark after them.

- By default, the software only allows one bird type to be specified for each segment. However, there may be times when you wish to label multiple species in one box (for example, for the dawn chorus). In that case, choose 'Default to multiple species' in the 'Interface settings'. Now, when you choose a bird from the list it will be ticked, and the menu will not close automatically, allowing you to make

multiple selections. To unselect something, click on it again. When you make a new segment, 'Don't Know' if selected by default. Choosing any other option deselects 'Don't Know'. You can reselect it if you do want that it in the list.

- The segments that are drawn on the screen have different colours. They are changeable in the 'Interface settings', but by default are:

  Blue This segment is currently selected. You can play it by pressing the buttons in 14, or give it a new label.

  Green This segment has been labelled with a bird name.

  Yellow This segment has been labelled with a bird name with a question mark.

  Red This segment has been labelled as 'Don't Know'.

- These colours match the rectangles underneath the overview (labelled 3). For each 10 second segment of the file, these boxes are:

  White if there are no segments,

  Red if there are 'Don't know' segments,

  Yellow if there are question marked segments, or

  Green if all the segments in that section are labelled with definite species.

- You can click on those rectangles in (3), and they will update the amplitude and spectrogram plots to show that section of the file. This is a good way to move through the file quickly.

- Segments can be moved by dragging them, or resized by dragging the left and right ends, just like the Overview highlight. For bounded-frequency boxes, drag the handle on the top right corner of the box to resize. (All these interactions use the non-drawing mouse button.)

- Segments can be deleted by selecting them (so that they turn blue) and then clicking on the 'Delete Current Segment' in the Controls (16). You can also just press the delete or backspace key on the keyboard.

- To delete all of the segments, use the 'Delete all segments' option in the Actions menu.

- Segments are saved automatically, so that you can't lose your work.

2.6   Menu Options

Appearance Menu

Changing appearance The first four options in the menu hide or reveal the amplitude plot (6), list of files (12), annotation overview (3), and information about where the mouse is pointing in the spectrogram (8).

Choose colour map This enables the user to select a colour map they prefer to the standard grey one. There is also an option to swap black and white (inverting the colour map).

Change spectrogram parameters A set of options to modify the spectrogram. Enables changes of the windowing function, width and increment of the FFT, and the option to not subtract off the mean. The 'Multitapering' option can make very noisy spectrograms look better, but it takes a lot of computer time. The two sliders at the bottom of the dialog enable the user to non-destructively show a limited frequency band in the spectrogram. The axis in the plot shows what is visible.

Make read only When reviewing a segmentation it is possible to click on the plots by mistake, adding further segments. This option avoids this problem. It can be turned off by selecting it again.

Interface settings This option enables the user to customise several things about AviaNZ, such as the annotation colour scheme, length of the annotation overview sections, and auto save frequency. The user can also choose how much of a file is loaded automatically. There is a tick box under 'Human classify' labelled 'Save corrections'. This option is used when reviewing the automated segmentation results (see Section 2.6 and Sections 3–4). It is also possible to change the lists of birds you are using. There is an option to set the operator and reviewer, this facility can also be found in the File menu.
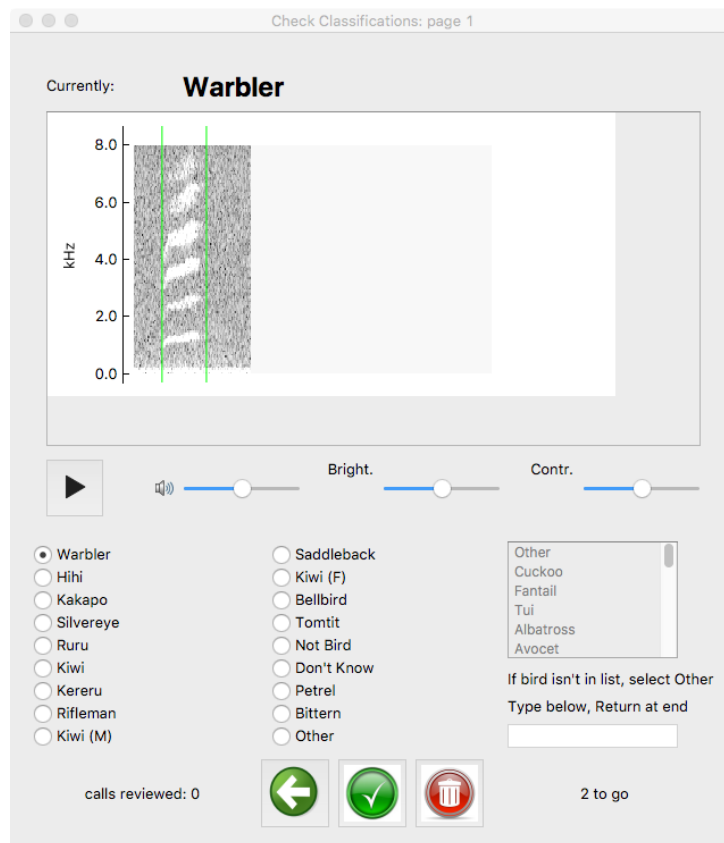
Figure 2: Example of outputs for Human Review [All segments].

Actions Menu

These options will mostly provide dialog boxes that ask you to make choices.

Delete all segments Does what it says.

Denoise Runs some programs that try to get rid of the noise in the sound file so that the birdcalls are easier to see.

Add metadata about noise Allows the user to specify if the sound file is particularly corrupted by noise, and also to identify the type(s) if known. This can be an optional datafield, or made compulsory for each file by choosing the appropriate option in the 'Interface settings'.

Show fundamental frequency Plots an estimate of the fundamental frequency for each call as a red line on the spectrogram.

Segment You can ask the computer to segment the calls automatically. We currently provide 3 options, and you can try them to see how well they work.

Human Review These two options provide two different ways to view the segments and their labels for easier checking. The option to Show all pages (in 'Interface settings') decides on whether to view segments in an entire file, or just the current 5 minutes of it.

> **Human Review [All segments**] This option shows the segments one-by-one in time order (Figure 2). To play the segment, click on the play button. Green bars mark the limits of current segment, and a couple of seconds of context are provided around it. You can also change the spectrogram brightness to make it easier to review. If the label is correct, click on the green tick, which will make the next image load. If not, select the correct label before clicking the tick button. If you have allowed multiple species selection you can pick several options. To delete a segment, click on the red dustbin button. To move back to the previous one, click the back arrow; note that this will not save your current changes.
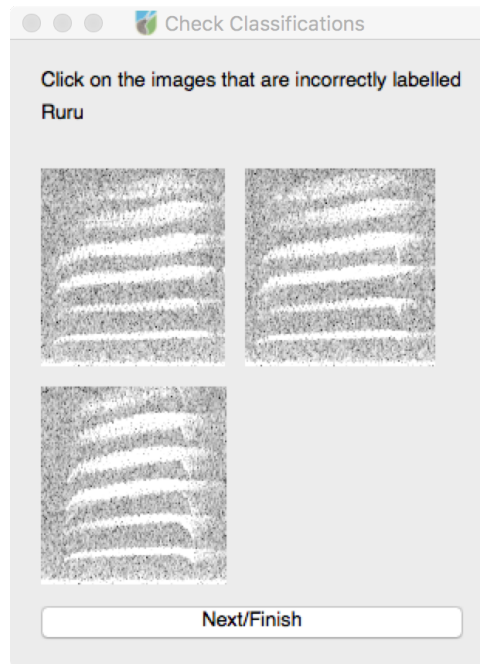
Figure 3: Example of the window for Human Review [Choose species].

Human Review [Choose species] This option asks you to choose a bird from those found in the current file. For each segment that is wrongly labelled, click on its picture (the colour map will change). These segments will be deleted (Figure 3). By default, the program will automatically save the corrections in a temporary folder so that they can be used to help us improve these classifications in the future. You can stop this behaviour in the 'Interface settings' interface. You can change the brightness and contrast here as well, and also play the sounds by hovering on the image, and then clicking on the play button when it appears.

Export segments to Excel This enables the user to save a summary of the annotation of the currently opened file into an Excel workbook (in the same location as the current sound file), as is described in Section 4.

Save as image Saves the spectrogram currently visible on the screen as an image.

Save selected sound Saves a selected segment as a short sound file.

Help Menu

Help Gives access to this file.

Cheat sheet Provides a set of examples of common bird calls.

3 Automatic Segmentation of a Folder

- If you select 'Batch Processing' from the starting window, you will see a screen like the one below (Figure 4). Navigate to a folder containing recordings to process. If this folder contains subfolders, the program will work through all of the folders inside the original one. It ignores any files that already have annotations. Choose the species that you are interested in detecting from the drop down list, or select 'All Species'.

- Press the 'Process Folder' button to start the program. Note that this is a very computationally intensive process, and will take a long time (hours) if there are lots of files to process, and make your computer hard to use for anything else.

- If you stop the processing partway through, AviaNZ will try and restart from the place it got up to last time if you restart it.

- Once it has finished, the window will close and the AviaNZ start screen will reopen so that you can review the outputs. You can either do this in the manual review interface, or use the 'Review Batch Results' option in the starting screen. A similar menu to the 'Batch Processing' option will prompt you to select a folder with previously processed files. If you choose 'All species' then you will see a screen like Figure 2, while if you select a particular species, you will see a screen like Figure 3.

- AviaNZ also produces an Excel spreadsheet, as is described in Section 4. Note that the 'All species' option will delete the Excel files for individual species to ensure that everything is consistent. The information is then held in the one spreadsheet.
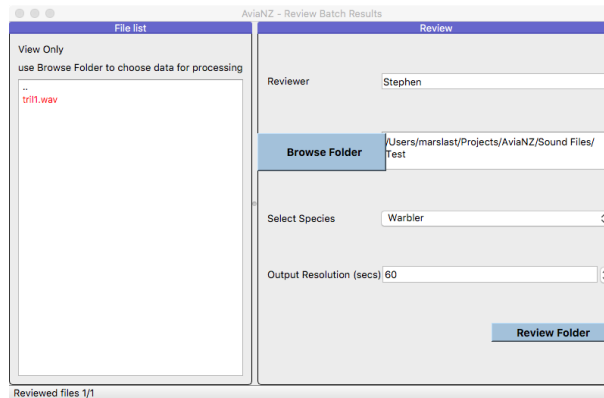

Figure 4: The interface for batch processing.

4 Outputs

- The AviaNZ program aims to provide detailed and easy-to-review outputs. An Excel file (with the name 'DetectionSummary' followed by species selected) will be generated with three sheets of outputs in the same directory as the files. If this file already exists, the new results will be appended to the end of each sheet.

- The three sheets of the Excel workbook are:

  1. start and end times of each birdcall detected
  2. presence/absence of the target species (or set of species) in each recording
  3. presence/absence of the target species (or set of species) in each time interval that the user specifies (by default 60 seconds)

- In addition to the Excel file, for each sound file AviaNZ generates an annotation file of the automated detections that the user can open and review in either the main interface or using the 'Review Batch Results' option.