**Bug list:**

1. **Double detections-** Currently we have found that detections are sometimes (rarely) doubled and will appear twice in the selection review. This issue is derived from the combining of multiple events during the USV\_Clean process (see documentation). In some instances a single USV will be detected as two separate, non-overlapping events, resulting in a double detection.   
     
   One method for eliminating these doubles requires combining detections that fall within an arbitrary window of one another. We have avoided implementing this procedure, as there would likely be debate over the size of such a window. Currently, we encourage users to watch for doubled detections and to eliminate doubles by rejecting one of the two detections in the selection review. Future revisions will allow the user to define the acceptable interval between windows or the acceptable interval between detection peak times, under which detections will be combined.
2. **Artifact Detection-** Artifacts will be detected along with USVs. This is not necessarily a ‘bug’ but rather a product of the detector design. As mentioned in the documentation, we have designed the selection review tool to provide an opportunity to review detections and eliminate detected artifacts. Indeed, by allowing artifacts to be detected, the detector is also more sensitive to the detection of USVs. Thus, the detector reduced human scoring time rather than eliminating it. While enticing, the prospect of eliminating human review altogether is currently premature.   
     
   Future tools might use spectrogram correlation techniques to determine detections that correlate highly with known artifacts in order to suggest detections that might be eliminated.
3. **Selection Review of Large files-** Currently the selection review processes information needed for reviewing detections prior to the review process. This initial processing time allows for a very fluid review process. Nevertheless, files with large numbers of detections may take a long time to load and the data structure for these files may become too large for windows to adequately handle. Future revisions will change the calculations so that they occur on the fly, thereby eliminating the aforementioned file size problem.

**Future Directions:**

1. Develop a computer-generated series of templates for 22-kHz USVs with varying durations and frequencies. A collaborative effort would be needed to test this detector.
2. Develop tools to provide summary statistics for detected USVs using information contained in the USV log files.
   1. For example:
      1. Cumulative distribution of observed frequencies
      2. Inter-call intervals
3. Develop edge detection procedures to find the boundaries of USVs within detection windows
   1. Subsequent uses for this technique:
      1. Determine USV duration automatically
      2. Bandwidth detection
      3. Define Contours for each USV
      4. Use contours to determine the number of pitch modulations and classify call types.
      5. Use contours along with principle component or cluster analysis techniques in order to define recurring syllables in USVs.
4. Develop machine-learning algorithms for further classification of USVs
   1. Computer should return a guess for FF, FM, or Trill.
   2. Determine if voting schemes or other methods might allow reliability to be increased over time.
   3. Consider attempting to implement fine grained categories from Wright et al., 2010
5. Develop tools for the summary of whole datasets.
   1. Note: This might be done more effectively using current tools to export log files as excel files and then processing these files using custom MATLAB Programming.
6. Develop ongoing summary of template effectiveness by returning template usage statistics during USV\_Clean. Eliminate superfluous templates (if any).