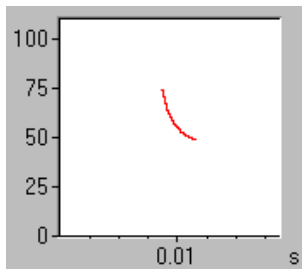


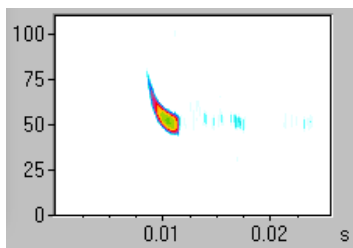
## Correctly measuring maximum and minimum frequencies of bat echolocation calls on a spectrogram using measurement cursors

Minimum and maximum (or start and end) frequencies of bat calls are sometimes measured incorrectly using the measurement cursors of the sound analysis software.

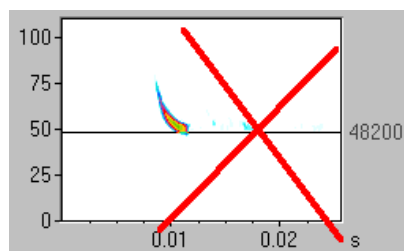
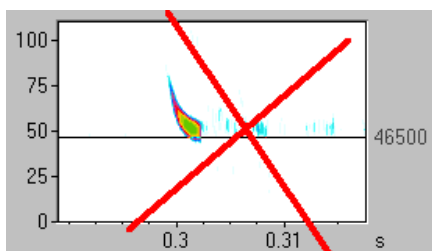
The energy of pure-tone signals (such as bat calls) is concentrated at any time at a single (instantaneous) frequency. Ideally, a bat call representation should theoretically therefore look like this:



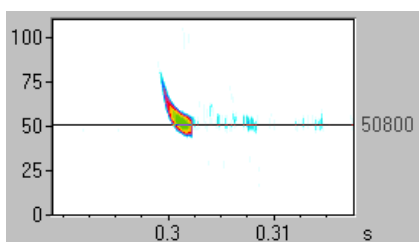
Due to the inherent properties of the spectrographic analysis tools, pure-tone signals are represented as relatively thick bands that have a certain vertical frequency width (analysis bandwidth), which is determined by the specific spectrogram settings (FFT size, windows type, zero-padding options and display contrast settings).



The minimum (or end frequency) of a bat call is therefore not the lower boundary of the visual spectrographic representation:



The minimum frequency of a call is instead always the minimum peak frequency that exhibits the maximum energy (the brightest point on the spectrogram at a certain point in time):



Note that the accuracy of the (start and end) frequency measurements will still be affected by the amount of frequency modulation (the accuracy will drop with increasing frequency modulation).