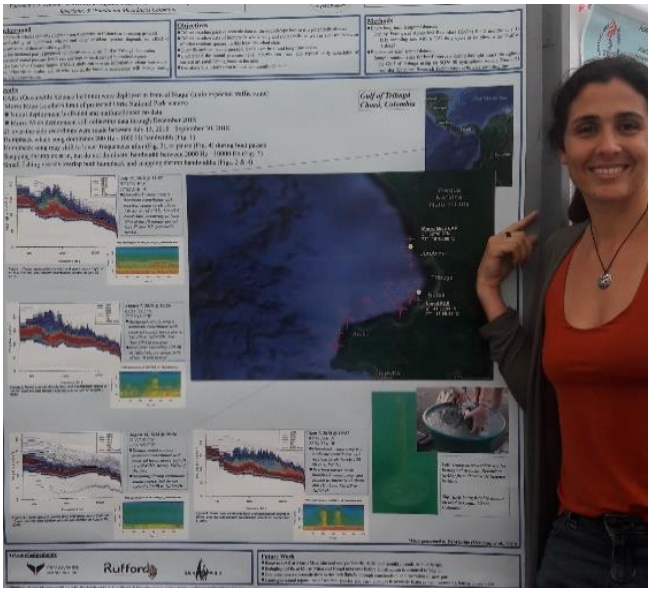
Project Update: January 2019

Congress Solamac

Our team participated in the XII SOLAMAC (Sociedad Latinoamericana de Especialistas en Mamíferos Marinos / Latin American Society of Specialists in Aquatic Mammals) and the XVIII RT (Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur / South American Meetings of Experts who Work on Marine Mammals) joint conference that took place from November 5th to 8th 2018, in Lima, Peru. Valeria González presented the team's poster with preliminary results on the 8th.



SOLAMAC was created in 1996 during the 7th RT (*Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur*) in Viña del Mar, Chile.

The next SOLAMAC / RT conference will take place in Bahia (Brazil).

https://www.exoticca.com/america/america-del-sur/brasil/cataratas-del-iguazu

UPDATE ON THE PROJECT

Recovering the EARs

Both EARs were recovered successfully in July 2018 insomuch as they were relocated and brought to the surface despite turbulent conditions which created very low visibility for SCUBA diving. A user error in programming the EARs was discovered to have resulted in no recording of data. The problem was addressed with the manufacturer of the EAR, and the batteries still had nearly full charge, so arrangements were made to redeploy them for a second attempt. After discussing the poor visibility conditions with the SCUBA company, we decided not to redeploy at the Nuquí site. The luck we had recovering it will not likely hold in the future so we eliminated the risk of losing expensive equipment. We decided that next year a vertical mooring will need to be made using an acoustic release. The Morro Mico site was successfully redeployed in October 2018 after a couple of weeks' delay for rough weather conditions. That EAR is still recording as of mid-January 2019. It was recovered on January 12th 2018 by the SCUBA company and sent to Dr Seger to have data downloaded and be returned to the manufacturer until it is needed again next year.

Despite this setback, a few silver linings have been recognised. Fortunately, the port construction will not likely start until at least 2020, so the next year still presents an opportunity for baseline data collection at multiple sites. Also, many baseline soundscape projects focused on humpback whale breeding grounds tend to sample during the times when humpback whales are present and, therefore, are the dominant sound source. This is an intrinsic bias that neglects the true baseline of the environment during the other three quarters of the year when humpback whales are not singing. By redeploying in October 2019 we will not only capture the last part of the humpback breeding season to get an idea of what baseline status is then, but will also monitor the decline of singing activity as it gives way to the non-whale-dominated season that resident species naturally must adapt to. In this way, we will get a better idea of how a port's year-round operation will affect seasonal cycles in the Gulf of Tribugá. Even though this project began with a humpback whale focus,

an unfortunate error has resulted in an opportunity to explore broader aspects of the fluctuations in baseline soundscapes.

Fig 1. Underwater anchor site at Morro Mico for one of the Ecological Acoustic Recorders (EARs) from Oceanwide Science Institute. The EAR has been removed in this image but attachments and a bright buoy for searching ease have been left for next year's deployment.

Short-term spatial dataset

The research team conducted 21 opportunistic over-the-side hydrophone recordings of humpback whale song between July and September 2018 in the Gulf of Tribugá. These were not only for Christina Perazio's song study, but also as back-up acoustic point surveys. The first step in exploring these temporally and spatially stratified short-term (10 to 30 min) acoustic samples was to view the spectrograms and note sound sources present. The second step was to begin processing power spectral densities to identify: (1) whether certain sources could be automatically detected and classified for cyclical behavior; and (2) which bandwidths represented the presence of each known species / sound source. Four examples of what we found in the first pass of the data were presented at SOLAMAC. The remainder of the files are currently being analysed in-depth.

Fig. 2. EARs' GPS positions (white stars) and over-the-side recordings' locations (purple stars). The four big stars represent the data samples given in the examples presented here.

For now, important observations include:

- Humpback whale song dominates the 200 Hz - 1000 Hz bandwidth (Example 1).
- Humpback song may shift to lower frequencies after (Example 2), or pause (Example 4) during, boat passes. The spectrograms showed in these examples illustrate how anthropogenic sounds could affect humpback whale songs.
- Snapping shrimp exist in, but do not dominate, the bandwidth between 2000 Hz - 10000 Hz (Example 3).
- Small fishing vessels overlap both humpback and snapping shrimp bandwidths (Example 2 & Example 4).

Example 1: July 25, 2018 at 12:07 (05°31'31.9"N/ 77°32'27.0"W)
Humpback whale song is a dominant contributor with received sound levels above 130 dB re 1µPa²/Hz, has a bimodal bandwidth, and occurs at least 90% of the 10 minute period (see 5th and 50th percentile peaks).

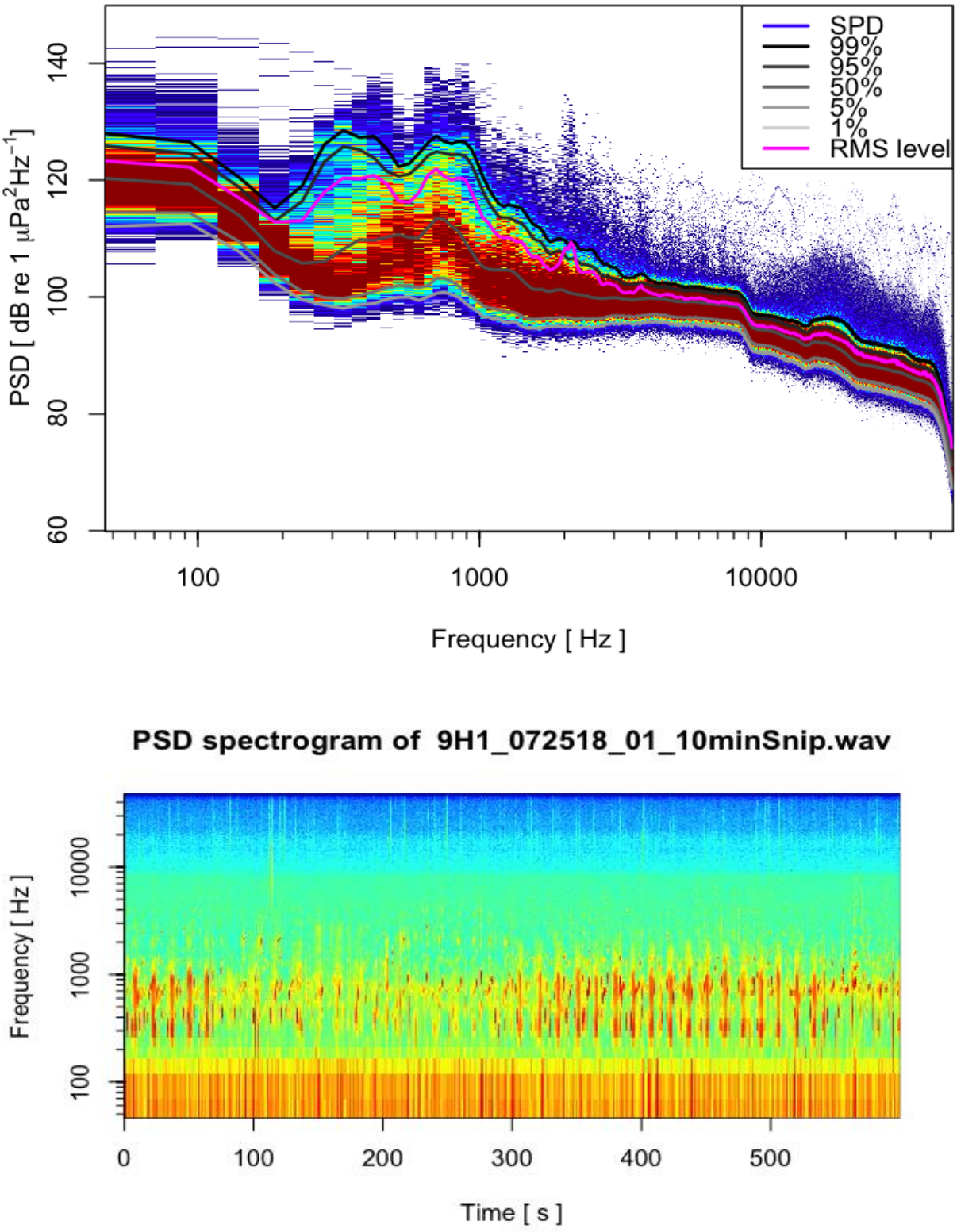


Figure 3: Power spectral density (top) and spectrogram (bottom) of 10 min over-the-side random soundscape sample on July 25, 2018.

Example 2: August 7, 2018 at 10:26 (05°36´54.5"N/ 77°29'41.0"W)
Humpback whale song is a dominant contributor with received sounds levels above 140 dB re 1µPa²/Hz and occurs less than 50% of the time. Boat passes can exceed 120 dB re 1µPa²/Hz for about 50% of the 10 min period. Of note is how some humpback whale song units at 1000 Hz either stop for a bit or are masked during a boat passage during 350-400 seconds. Also, the lower song units (between 100 and 300 Hz) shifts to a higher pitch (about 400 to 800 Hz (*see note at end of document)) at the beginning of the boat pass. Additional data analysis of the general song structure will assist in determining whether these song changes were predictable phrase shifts or not. If not, then the argument could be made that the boat pass correlated with a change in singing behavior.

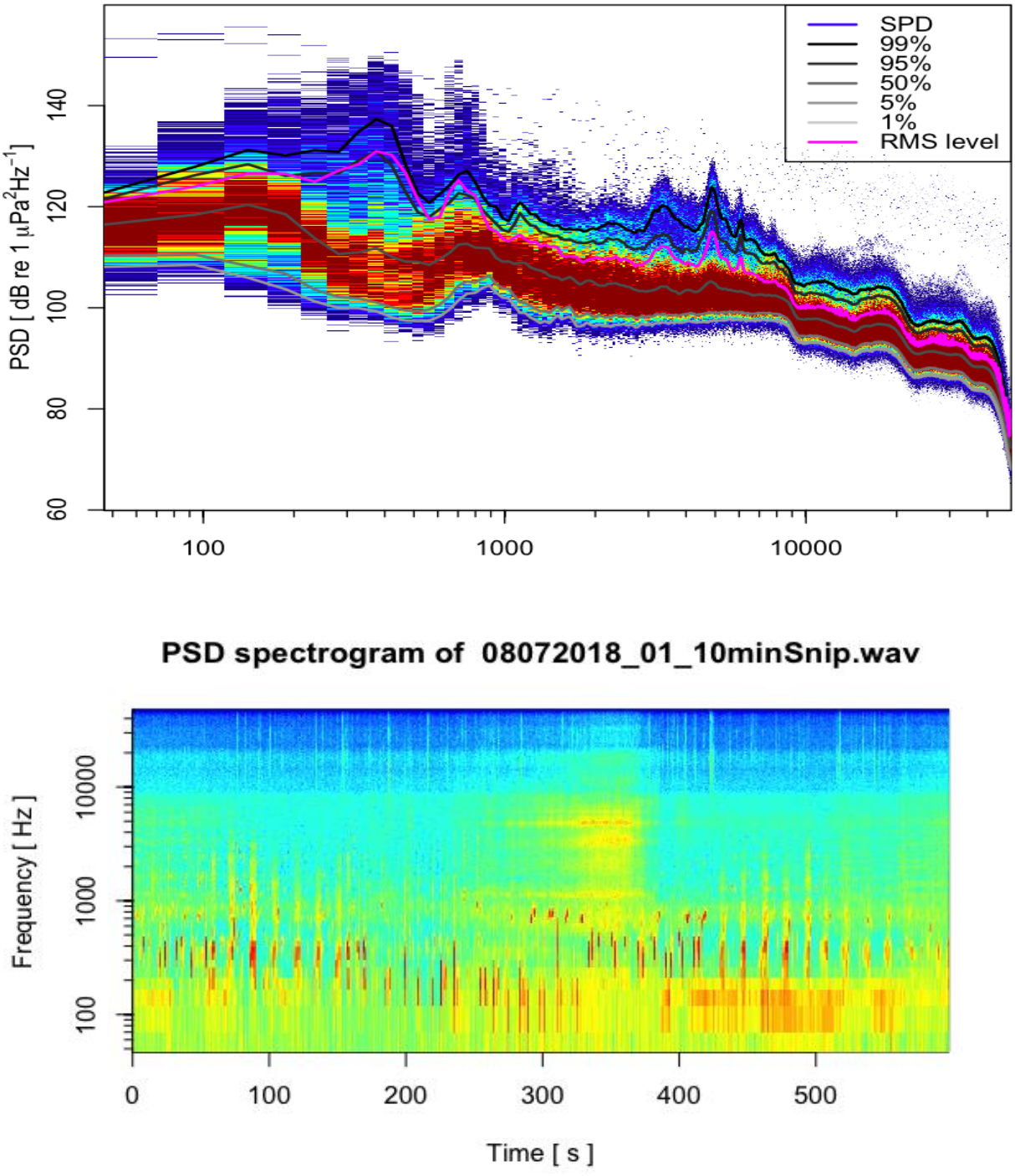


Fig 4: Power spectral density (top) and spectrogram (bottom) of 10 min over-the-side random soundscape sample on August 7, 2018. Humpback whale song units are the red portions of the spectrogram.

Example 3: August 18, 2018 at 08:56 (05°37'48.7"N/ 77°21'46.7"W)
Distant sound sources are a dominant contributor to low frequencies with received levels above 120 dB re 1µPa²/Hz nearly 100% of the time. Snapping shrimp are a continuous sound source at higher frequencies but do not exceed 120 dB re 1µPa²/Hz.

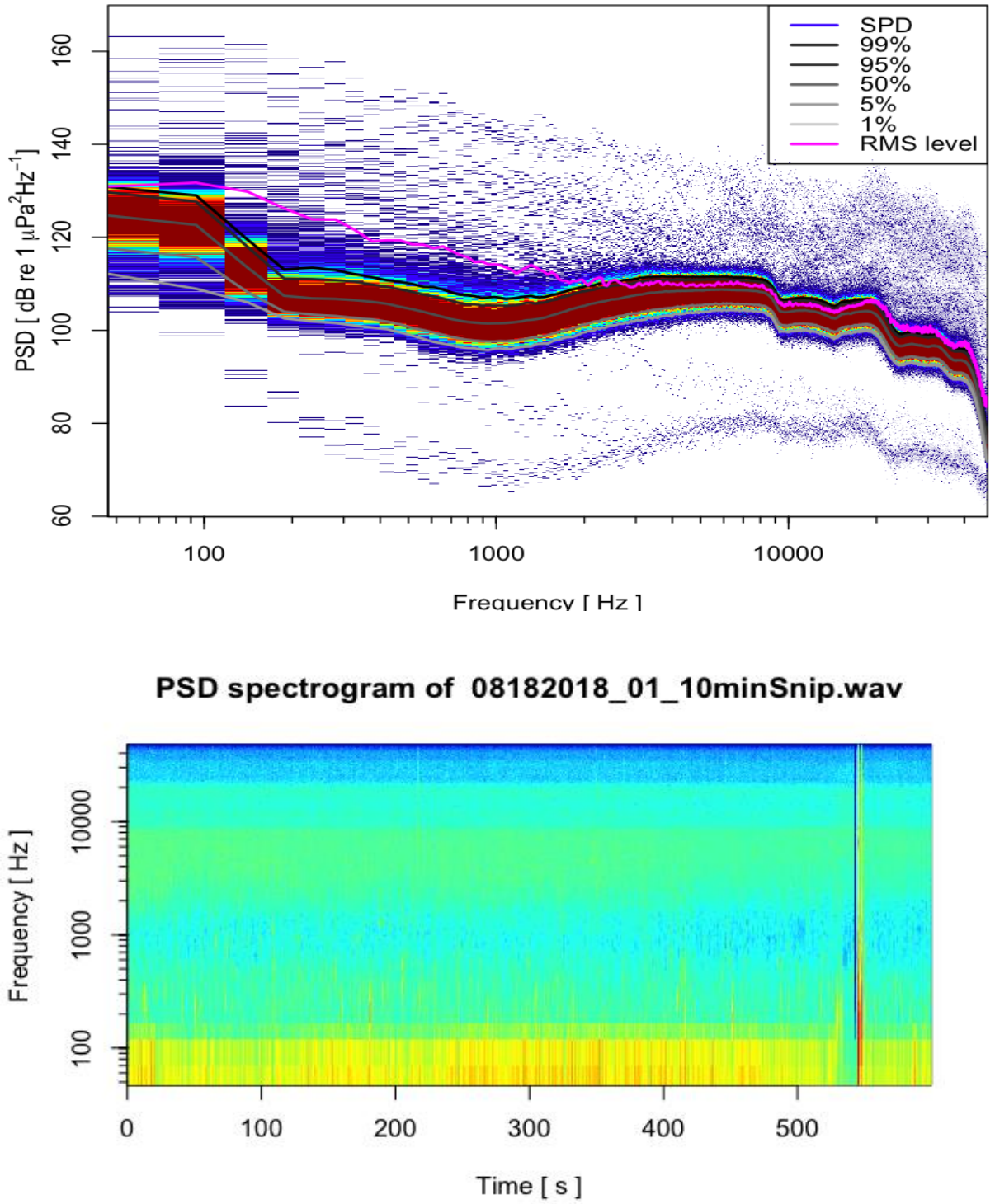


Fig. 5: Power spectral density (top) and spectrogram (bottom) of 10 min over-the-side random soundscape sample on August 18, 2018. Snapping shrimp occupy the 1100 to 9000 Hz band and low frequency din is found below 100 Hz.

Example 4: Sept 1, 2018 at 10:47 (05°39'25.0"N/ 77°20'21.0"W)
Humpback whale song is a moderate contributor with received levels barely above 120 dB re 1µPa²/Hz. Two boat passes mask humpback whale song, and exceed its intensity at about 800 Hz above 120 dB re 1µPa²/Hz. Of note again is the difference in song structure during and between the boat passes as compared to before and after. Again, further analysis of the general song structure in the area will help us better understand if such changes were likely a behavioural response to the boat noise.

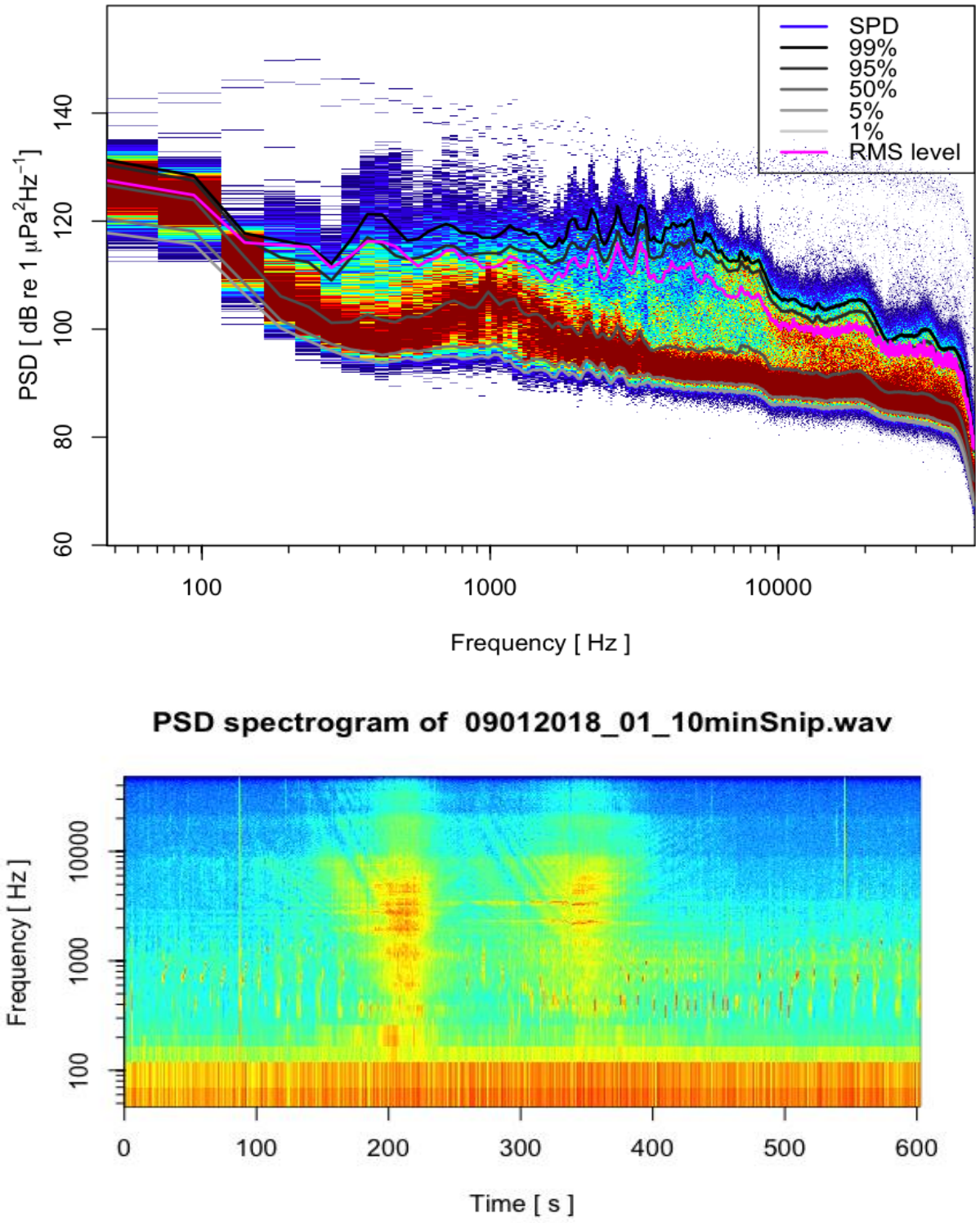


Fig. 6: Power spectral density (top) and spectrogram (bottom) of 10 min over-the-side random soundscape sample on September 1, 2018.

*__Example 2__: Note- What is interesting about this is the dominant peak frequency band that I found in my 2013-2016 analysis for ASA was roughly between 300-500, and that was where most energy was reliably focused and it was consistent across individuals and years. So, my thought was that they would not switch OUT of that band, because it may be the one that is most conclusive to propagation of sound …so it makes sense to me that they would actually switch up into that band if there was boat noise. And the upper frequencies were not identified as peaks, so it makes sense that they don't use them if there is excess noise because they aren't the important ones. Anyway, this looks fine, I just wanted to share these thoughts.