

# Invisible but detectable: listening for wild Amazonian manatees (*Trichechus inunguis*)

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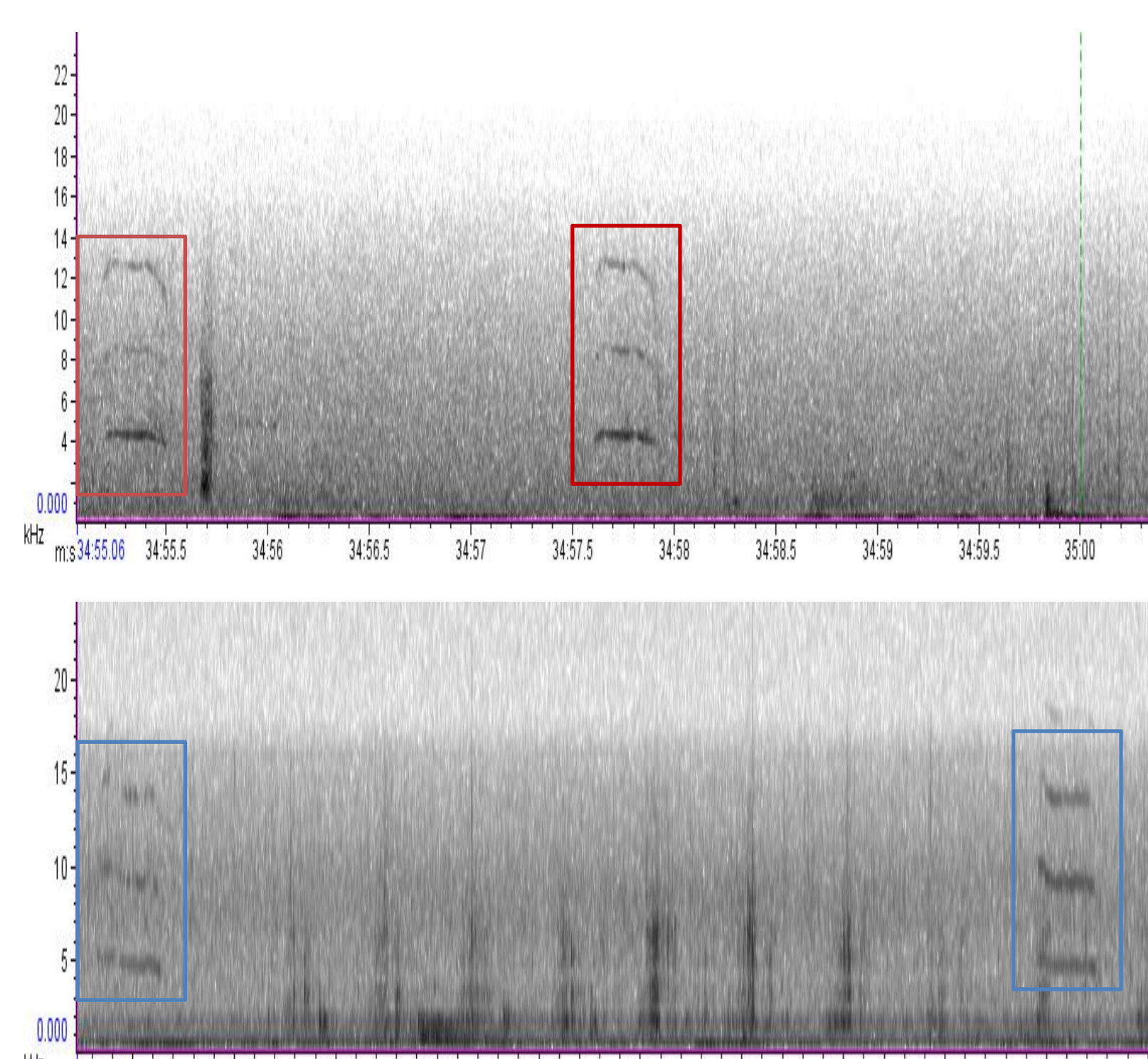
**Introduction** Direct observation of wild Amazonian manatees (*Trichechus inunguis*) is almost impossible due to low water visibility (<1m) and the cryptic behavior of the animals that became extremely shy after centuries of hunting (Best 1982, 1984). Alternative non-invasive methods are needed to monitor populations of this endangered species, which is both endemic to the Amazon region and the only exclusively freshwater manatee (Rosas 1994). *T. inunguis* is known to emit sounds in captivity (Evans & Herald 1970; Sonoda & Takemura 1973; Sousa-Lima et al. 2002) that can be attributed to specific individuals and to different sexes and age classes (Sousa-Lima et al. 2002). Here we provide the first published recordings of Amazonian manatee sounds in the wild and evidence that PAM can be used for detection and monitoring of these elusive mammals in the wild.

## Objectives:

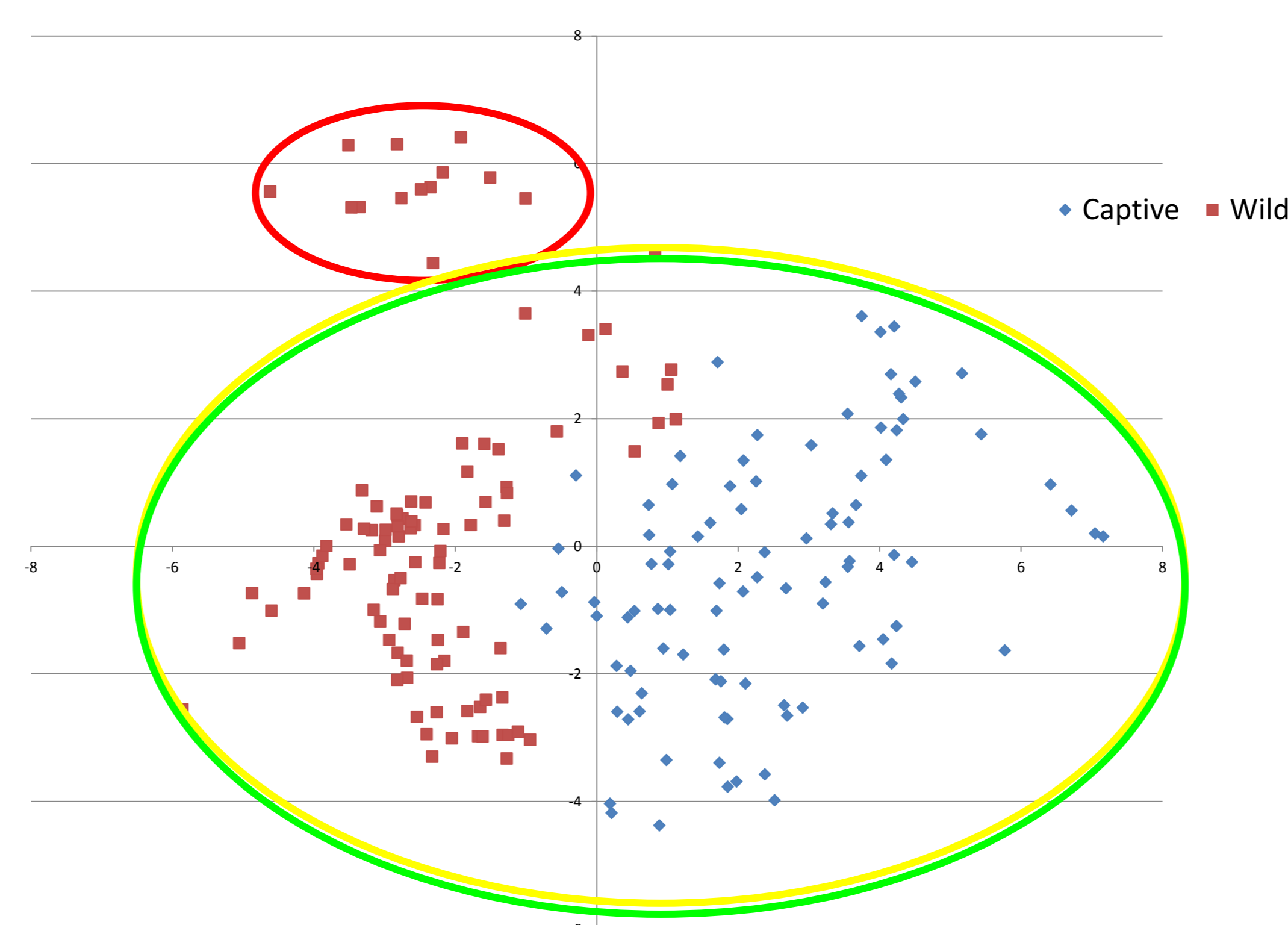
- 1) to obtain recordings of manatees in the wild, and compare them with recordings from captivity,
- 2) to verify if Amazonian manatees can be detected in the wild using PAM.

**Methods** (See Figure 1) Manual identification of calls was done in Raven Pro 1.4 (Cornell Lab of Ornithology) using following parameters: Hann window; 256 points window size. Clear calls with high signal-to-noise ratio were selected for extraction of the acoustic parameters. The acoustic parameter values obtained in the wild were used to compare with values from captive animals (Sousa-Lima et al. 2002; Dantas 2009).

**Results** We recorded 114 calls in the Urini Lake, 166 calls in the Purus River (Rosas et al., 2003), and 35 calls in Pacaya Samiria National Reserve. Eighty seven (87) calls were selected from the Brazilian sample of calls; 13 from the Peruvian data set and 94 calls from captive individuals (Figure 2). We found no significant differences for peak fundamental frequency (t-test;  $p = 0.88206$ ) between wild and captive calls. Principal component analysis grouped wild and captive calls from Brazil together and separated calls obtained in the wild from Peru (Figure 3). Additionally, the frequency modulation pattern and overall aspect of the signals recorded in the wild were recognized by experts in the field as manatee calls (Figure 2).



**Figure 2** Spectrograms of: A) wild manatee call recorded in Brazil and B) captive manatee call recorded at INPA.



**Figure 3** Plot of first and second PCA axes showing 2 main groups, one circled in red showing calls from wild individuals from Peru and a second larger group circled in yellow and green showing calls from wild and captive individuals from Brazil.

**Discussion** The calls recorded in the wild matched information and calling rates for Amazonian manatee calls in captivity. *T. inunguis* has seasonal reproduction with births peaking between February and May (Best 1982, 1984). Our recordings were made shortly after the birth period; therefore we probably recorded the most vocal individuals: lactating females (3-5.5calls/min: Dantas 2009) and their calves (2-8 calls/min: Dantas 2009; Sousa-Lima et al. 2008). The use of playback of calls to acquire the Brazilian data might have elicited calls back from less vocal individuals (other adults call less than once per minute, Sousa-Lima et al. 2002; Dantas 2009).

**Conclusion** It is possible to detect and monitor Amazonian manatee populations in the wild by means of passive acoustics especially during and following the peak of birth for the species.

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**Figure 1** Recordings between June and July in the Amazon River basin in Brazil during manatee acoustic surveys in the Urini Lake (Yellow Triangle, Amanã Sustainable Development Reserve) and in the Purus River (Green Triangle; Rosas et al. 2003) were done using a Sony Walkman Pro (WM-D6C; flat audio frequency response 0.04-15kHz  $\pm 3$  dB) and an omnidirectional hydrophones (model 50Ca of the Cetacean Research Technology – CRT or HTI 94 SSQ) with a sensitivity of -161dB re 1 $\mu$ Pa and a frequency range response of 0.01-310kHz in response to captive manatee calf calls played back using an Oceaner underwater speaker (DRS-8, frequency range 0.1-16kHz with peak resonance frequency at 4.5kHz, 158dB re 1 $\mu$ Pa). In Peru, recordings were made opportunistically in July at Pacaya Samiria National Reserve (Red Triangle) during fish surveys conducted by Operation Wallacea (Rountree 2012) with a SQ26-H1 recorder system from CRT (frequency response of up to 40kHz). The animals were never seen during the recordings.

