

PASSIVE ACOUSTICS MONITORING DENSITY ESTIMATION (PAM DE) – Activity Instructions

Activity summary: This activity is meant to illustrate how to estimate animal density using Passive Acoustics Monitoring Density Estimation (PAM DE). PAM DE is a method used to estimate number of animals from their sounds.

Learning outcomes:

- Understand the concept of “**animal density estimation**”.
- Understand how scientists can estimate animal density by counting their sounds.

Resources:

Marques T, Dornellas L, Guerra A, Marques C, Tempero B, Zacarias M and Hart C (2022) Counting Animals by Recording Their Voices. *Front. Young Minds*. 10:704420. doi: 10.3389/frym.2022.704420

ACCURATE Project. (2022, February 10). Passive Acoustic Monitoring Density Estimation - counting animals from their sounds. YouTube.
<https://www.youtube.com/watch?v=UhyGHVe9HFI>

Thomas, L., & Marques, T. (2012). Passive Acoustic Monitoring for Estimating Animal Density. *Acoustics Today*, 8, 35. <https://doi.org/10.1121/1.4753915>

Sound files for the activity:

- Killer whale
https://www.youtube.com/watch?v=nRYT_6vGzkl&ab_channel=MarineConservationResearch
- Humpback whale
https://www.youtube.com/watch?v=boJ8PzYOhWE&ab_channel=MarineConservationResearch
- Bottle nose dolphin
https://www.youtube.com/watch?v=xl0X3L8XTPc&ab_channel=MarineConservationResearch

Number of people needed for the activity: minimum of 1 (can be done with groups).

Materials needed:

- Printed PDFs available on the “Sampling Activities & Resources” section of the website (see Attachments for guidance).
- Sound files available in the “**Resources**” section of this document (optional).

How to run the activity:

1. Explain the main goal of the activity – estimating the number of animals by counting their sounds – and give some context on PAM DE.
2. Ask what animal the participants would like to work with from the **Average Cue Rate** sheet.
3. Pick up the spectrogram of the selected animal.
4. Count the number of calls on the chosen spectrogram.
 - To show what the animal sounds like and make the activity more immersive, play the sound files provided in the **Resources** section.

Here is how to identify the calls in each spectrogram (marked by green lines):

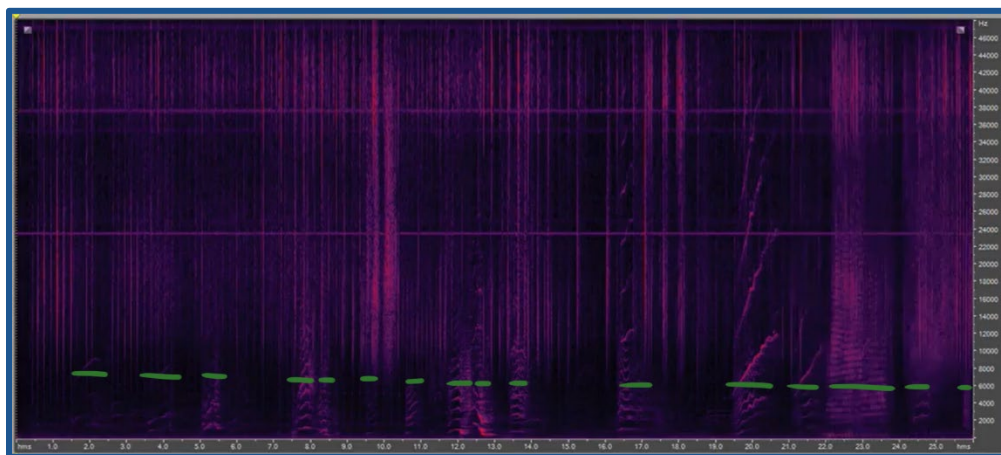


Figure 1 – Killer whale (total number of calls = 16) (**NOTE** – these calls can be difficult to identify, so we recommend watching the video at the same time)

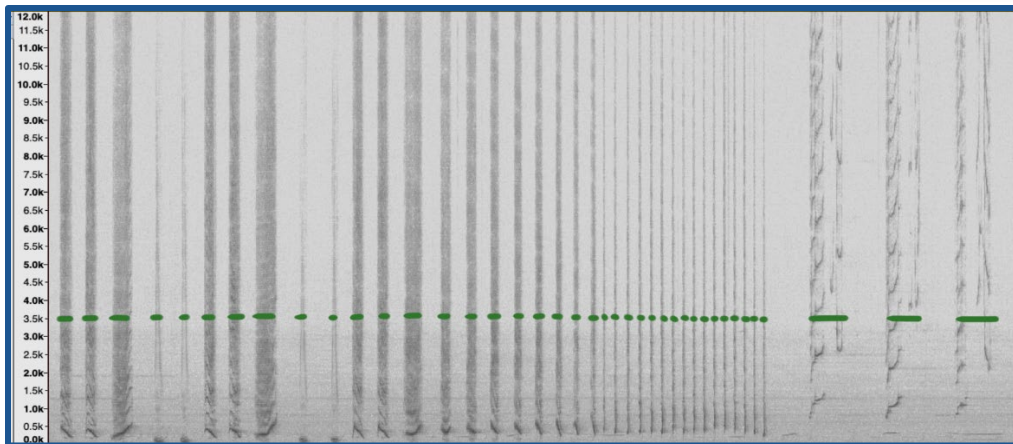


Figure 2 – Humpback whale (total number of calls = 40)

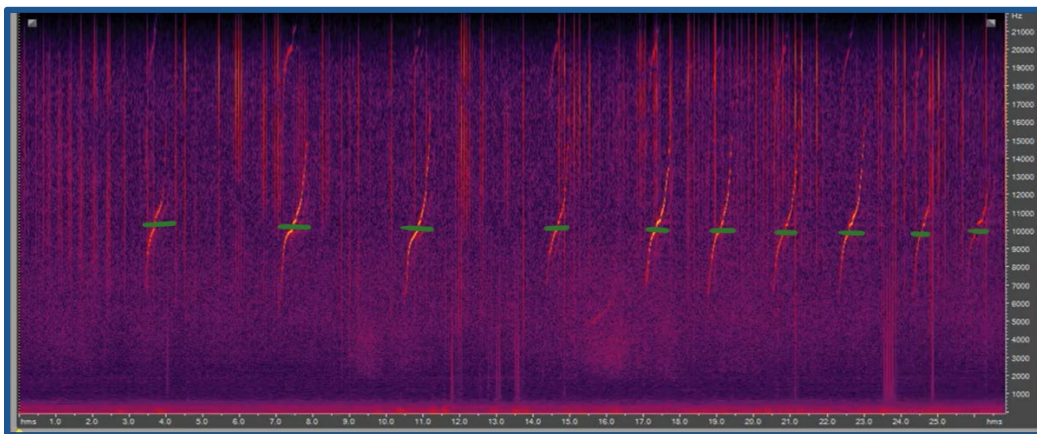


Figure 3 – Bottlenose Dolphin (total number of calls = 10)

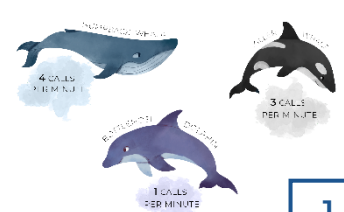
5. On the **STEP 1 sheet**, write down the number of calls counted on the spectrogram (note that the spectrograms represent 5-minute-long recordings).
6. Fill in the **STEP 2 sheet** with the information given by the **Average Cue Rate** sheet.
7. Read **STEP 3 sheet**.
8. Fill in the **STEP 4 sheet** with the information from the previous cards (each **STEP sheet** is colour coded to make this step easier).
9. Solve the equation. You will now have an estimate of the number of animals.

After finishing the activity, you can begin a discussion by covering questions such as:

- How can the movement of the animal affect our estimate?
- How can our estimate change if the animals spend more time silent than what we expected?
- How will our estimate be affected if the sounds are associated with seasonal activity?

Attachments

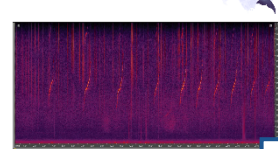
AVERAGE CUE RATES



4 CALLS PER MINUTE
3 CALLS PER MINUTE
1 CALLS PER MINUTE

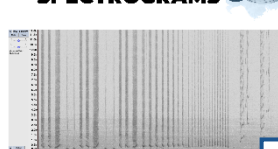
1

SPECTROGRAMS



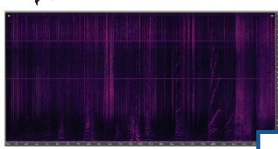
2

SPECTROGRAMS



3

SPECTROGRAMS



4

STEP 1

Count the number of calls on the spectrogram.
How many did you count in the 5 minutes?

calls in 5 minutes

5

STEP 2

How many calls on average do we expect this animal to make?

calls per minute

6

STEP 3

There are probably some calls that we are not seeing on the screen, either because they are too quiet or because the calling is too far away for the microphone to detect the signal.

0.5 (DETECTED PROPORTION)

7

STEP 4

Final step. Fill in the boxes below using the information from the other cards to calculate an estimate for the number of animals calling!

NUMBERS OF ANIMALS

NUMBER OF HUMPBACK WHALES

NUMBER OF KILLER WHALES

NUMBER OF BOTTLENOSE DOLPHINS

8

- PDF FILE NAMES**
- 1 – “average-cue-rates” (A4 and laminated)
 - 2 – “spectrogram-dolphin” (A4 and laminated)
 - 3 – “spectrogram-humpback-whale” (A4 and laminated)
 - 4 – “spectrogram-killer-whale” (A4 and laminated)
 - 5 – “STEP1” (A4 and laminated)
 - 6 – “STEP2” (A4 and laminated)
 - 7 – “STEP3” (A4 and laminated)
 - 8 – “STEP4” (A4 and laminated)