Identification of Galápagos sperm whale (*Physeter macrocephalus*) vocal clans in 2022-2023 using a novel automated coda detection software

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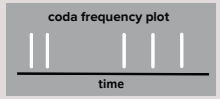
Background

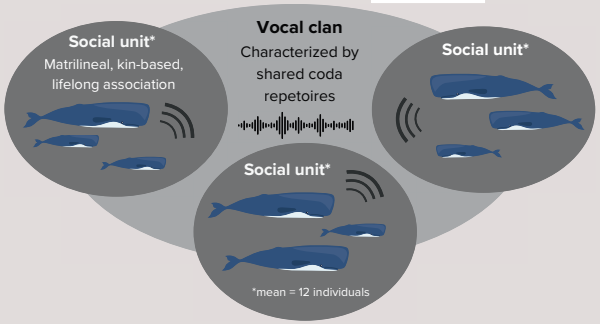
Codas are:

- The primary social vocalization produced mainly by female sperm whales
- Each 3-40 rhythmic bursts of clicks
- Distinct from echolocation, which is used by sperm whales primarily for feeding
- Key to the species' **behavioural ecology, population biology, and culture**

(Cantor et al. 2019)



What to know what codas can sound like?



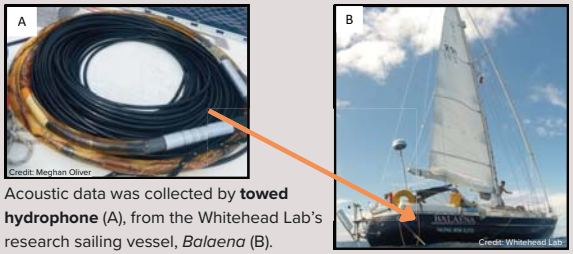
Technological advancements: The **first automated** coda analysis software was innovated by Gubnitsky et al. (2024): aiming for faster, more accessible attainment of vocal clan data compared to traditional manual coda analysis.

Research Objectives

1. **Test and compare the efficiency of the first automated coda detection software to traditional manual methods**
2. **Identify the 2022-2023 vocal clans of Galápagos sperm whales**

Field Data Collection

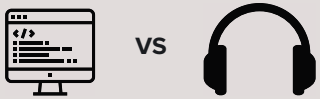
Surveys were made over two field seasons in 2022-2023 (total: 121 days), offshore of the **Galápagos Islands, Ecuador.**



Acoustic data was collected by **towed hydrophone** (A), from the Whitehead Lab's research sailing vessel, *Balaena* (B).

Data Analysis

1. **Testing automated detector versus manual audting**



- Files analyzed by: **automated detector** and **manual auditing.**
- Efficiency of detector was evaluated as a tradeoff between software **recall** - finding all the codas - and **precision** - only finding codas.
- Success rate of each method at finding codas was calculated by:

$$\text{success rate} = \frac{\#\text{ of recordings with codas confirmed}}{\#\text{ of recordings with codas suspected}}$$

2. **Vocal clan identification, following coda detection and annotation**

Automated coda detection → **Manual coda annotation using "CodaSorter"** → **Vocal clan assignment using "IDCall"**

Results: Automated Detector Testing

- Maximizing detector efficiency **prioritized high precision over high recall** (optimal values, precision:recall = 0.5:0.13)
- **Using the automated detector reduced human analysis time,** compared to manual auditing (average daily recording length for manual analysis: 0.87 hours with automated detector vs 2.29 hours with manual auditing)

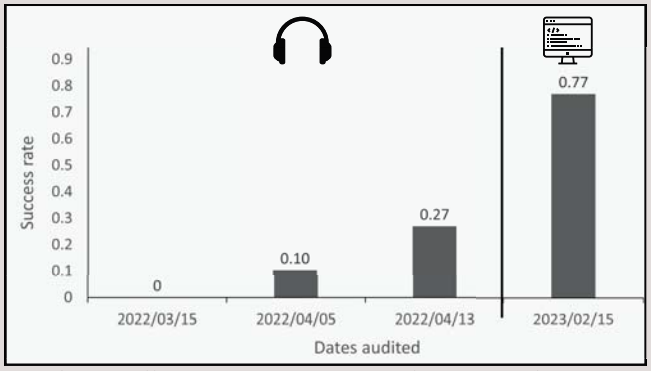
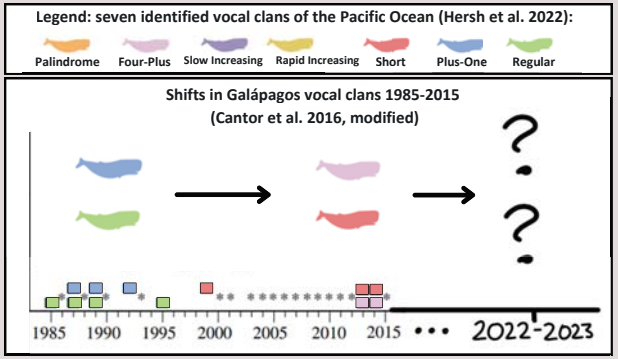


Figure 1 Success rate of finding codas, measured as the proportion of recordings with confirmed codas out of total with suspected codas for each date analyzed, using manual auditing (left side) versus the automated detector (right side).

Main Takeaways

- With optimized software parameters and constraints, the automated detector **saves human auditing time and has higher success rate of finding codas**, compared to manual auditing methods
- This testing demonstrates that automated software could enable methods for **faster and more efficient coda analysis**
- Next steps: **annotating codas** found by automated detector to build a dataset for **vocal clan identification**

Next Steps: Vocal Clan Identification



Which vocal clans were present in the Galápagos in 2022-2023?
How can this data be used to help inform historical datasets?
What does this implicate for these populations' behavioural ecology?

References

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