# Comparison of daily detections from two passive acoustic systems

Samuel L. Denes[1]
Jennifer L. Miksis-Olds[1]
Jeffrey Nystuen[2]
Holger Klinck[3]
Dave Mellinger[3]

1 Applied Research Laboratory, Penn State
2 Applied Physics Lab, Univ. Washington
3 Oregon State University and NOAA Pacific Marine Environmental Laboratory

# Equipment

- AURAL (Multi-electronique, Quebec)
  - Programmable passive acoustic recorder
  - Continuous or sub-sampling modes
  - High capacity storage and power
  - Programmable sampling rate up to 32 kHz
- PAL (Nystuen, APL)
  - Programmable, adaptive sub-sampling recorder
  - Adaptive duty-cycle up to 15%
  - Event detector
  - High sample rate (100 kHz)

# Objectives

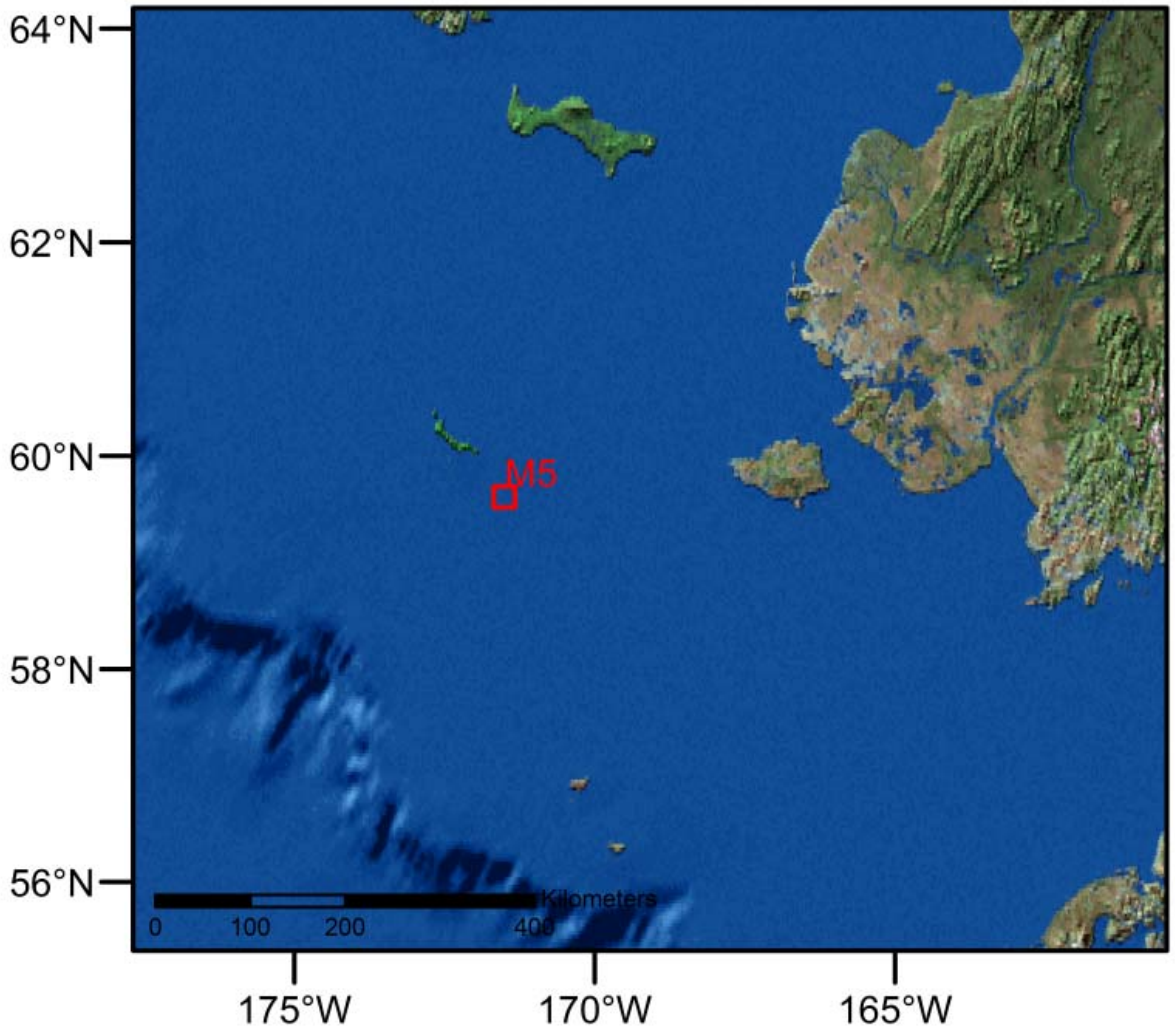
- Compare daily detection performance of co-located sensors
- How do the detection abilities of two duty-cycled passive recorders compare?

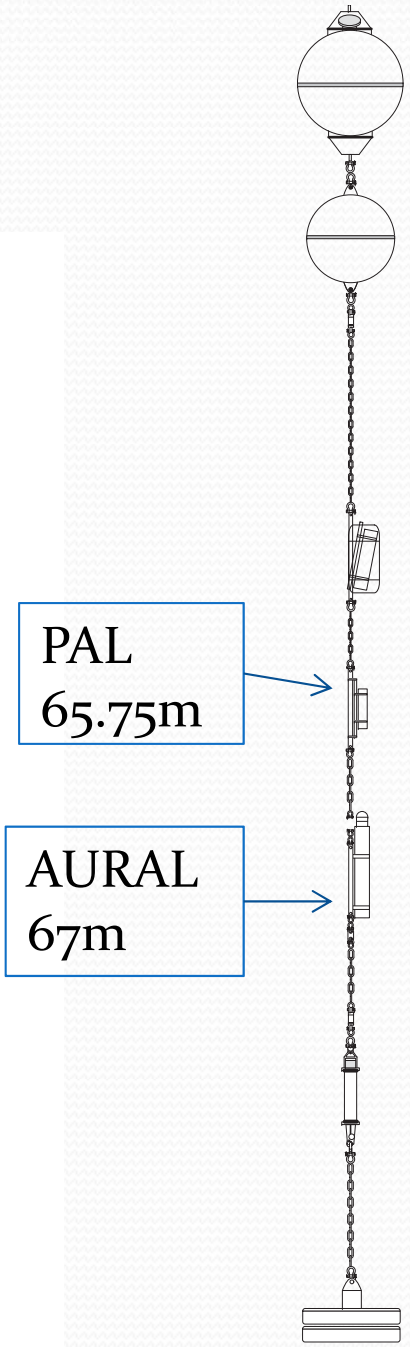
Given

- High frequency signals will be detected by PAL but not by AURAL
- Rare signals, within system bandwidth, will more likely be detected by higher duty-cycle AURAL

# Location

- Bering Sea M5
- October 2008 through May 2009



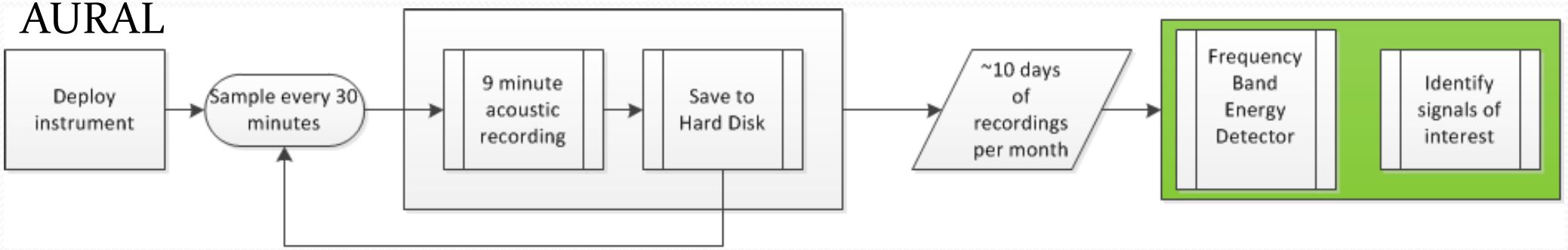



# System Comparison

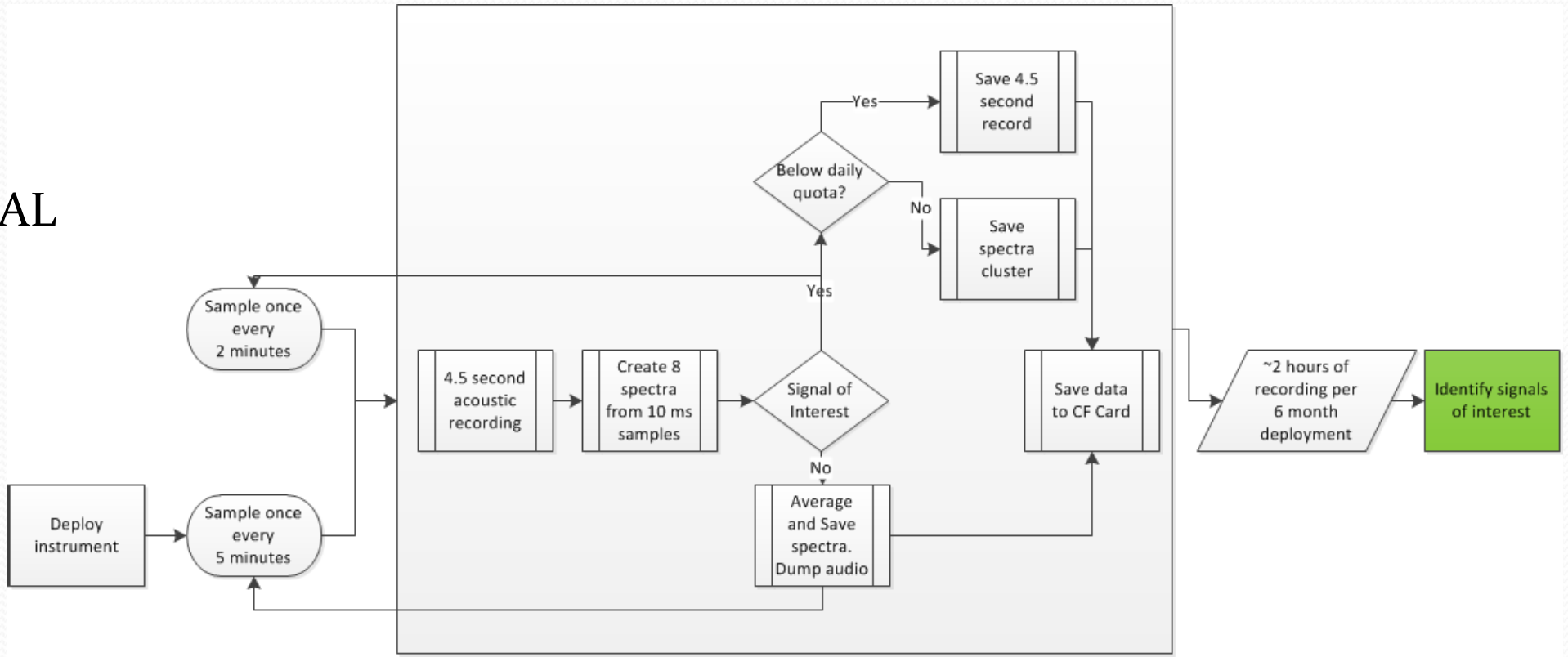
| AURAL | PAL |
| --- | --- |
| Regular data collection (9 min/half hour) | Very low, adaptive duty cycle<br>•Low mode 1.5%<br>•High mode 7.5% |
| Low bandwidth<br>Sub-sampled | High bandwidth<br>Quasi-continuous spectral data |

# Processes

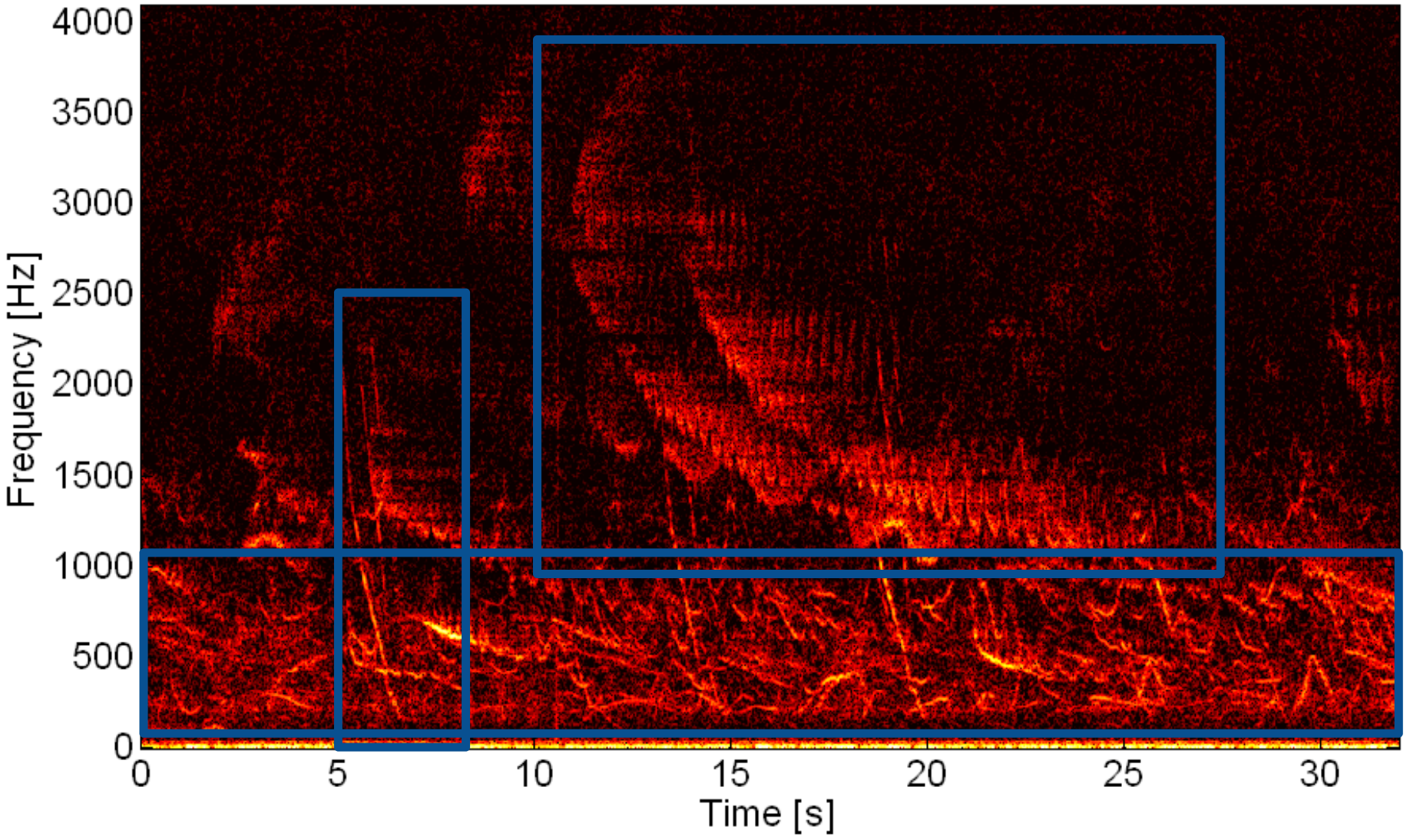
## AURAL




## PAL

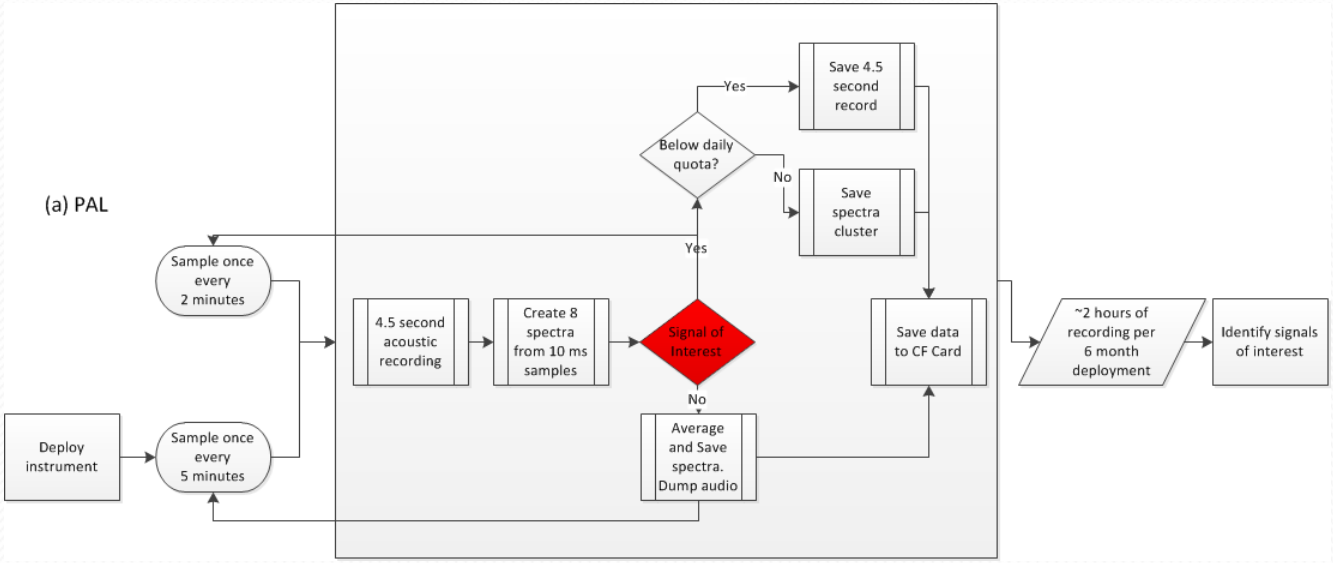


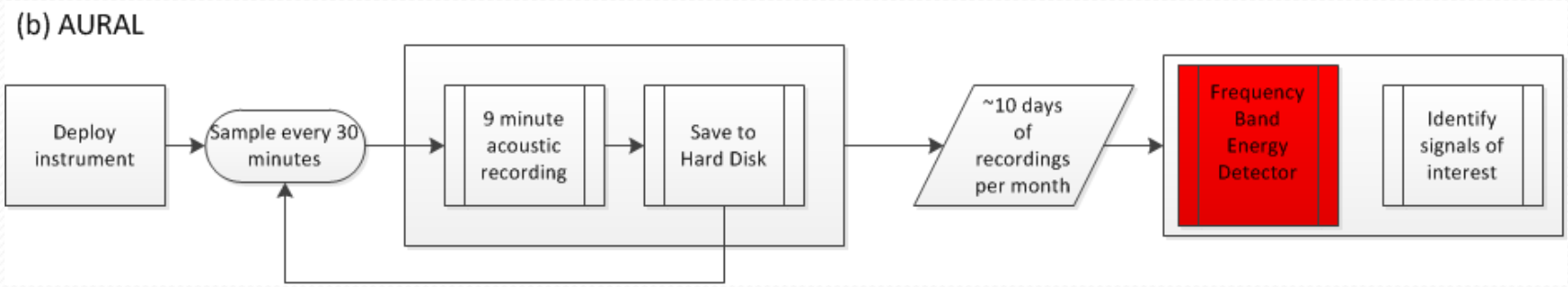
# Spring Recording



# Detection

- Detections from raw time series
- AURAL – Detection conducted post recovery
- PAL – Detection occurred on-board

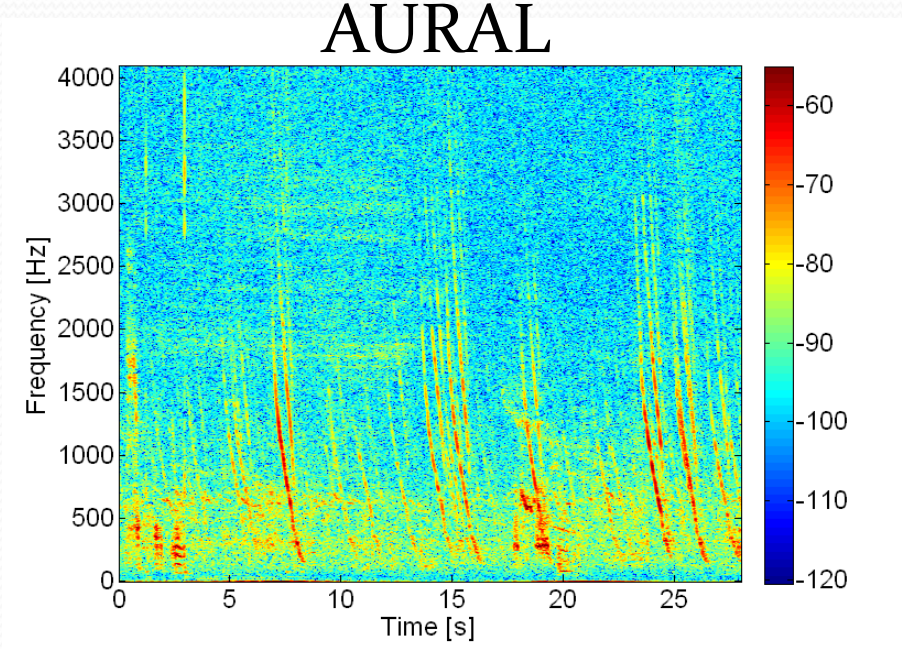


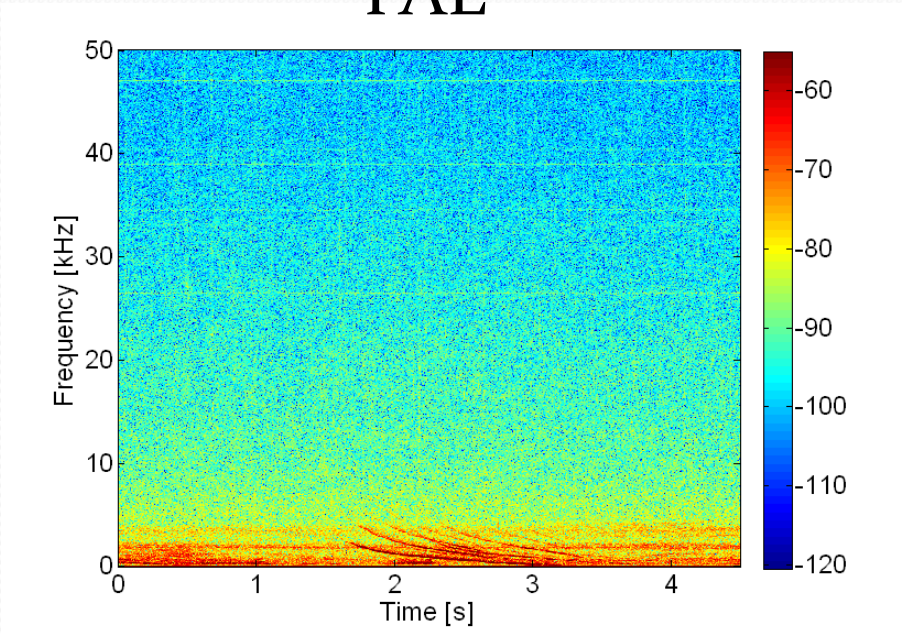
# Classification

- Two independent human classifiers
  - Aurally
  - Visually

AURAL




PAL



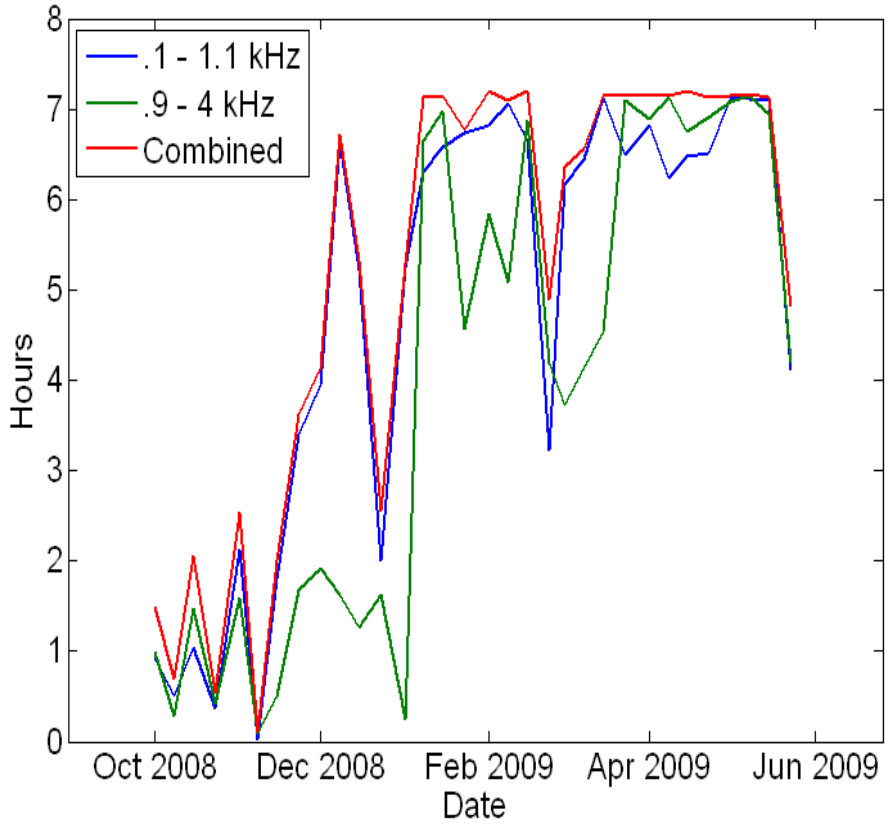
# Results

| | Total Days Detected | Days Detected by AURAL only | Days Detected by PAL only | Days Detected by Both |
|---|---|---|---|---|
| Bowhead Whales | 25 | 7 | 0 | 18 |
| Humpback Whales | 8 | 3 | 5 | 0 |
| Odontocetes | 7 | 3 | 2 | 2 |
| Bearded Seals | 17 | 4 | 0 | 13 |
| Walrus | 12 | 7 | 1 | 4 |
| Ribbon Seals | 12 | 4 | 1 | 7 |
| Echolocation clicks | 18 | 0 | 18 | 0 |

# Man hour effort

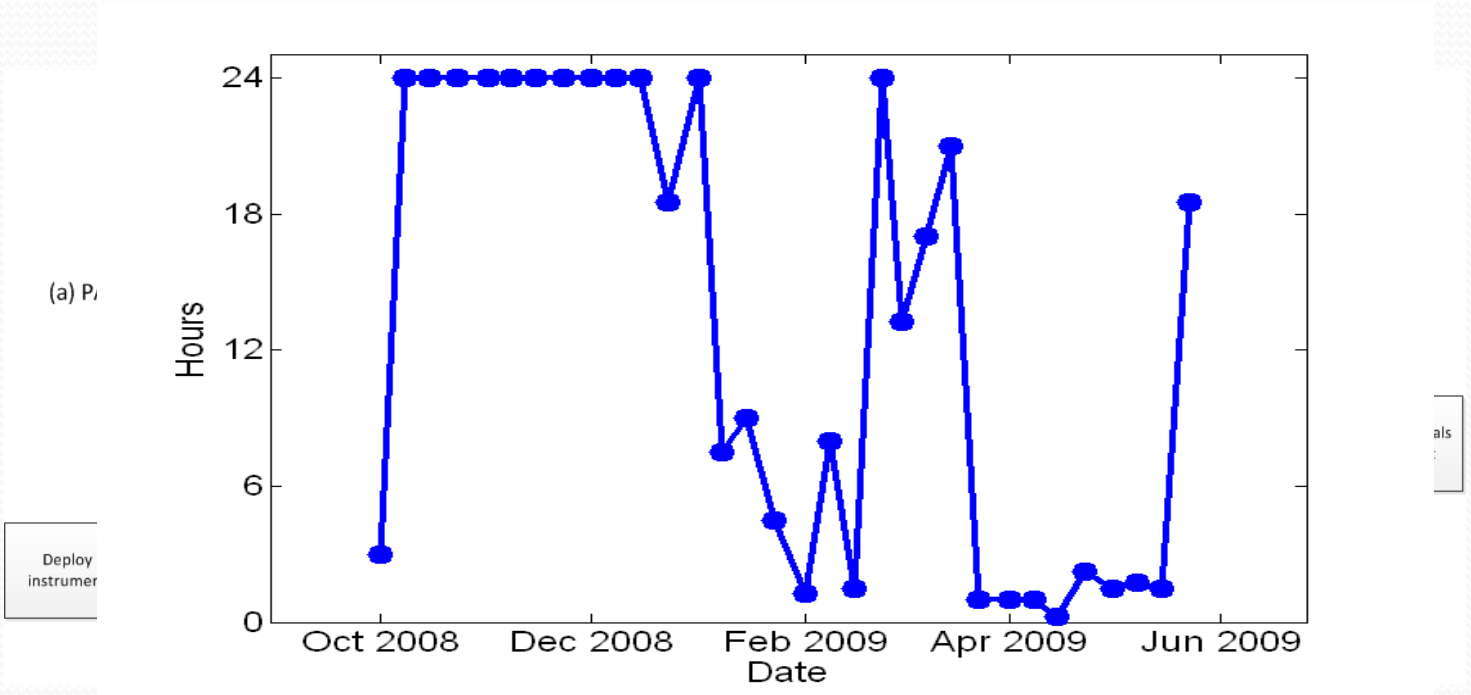
AURAL

Datasets from two energy band detectors up to 7.2 hours of recordings per day (14.4 hours per day total)

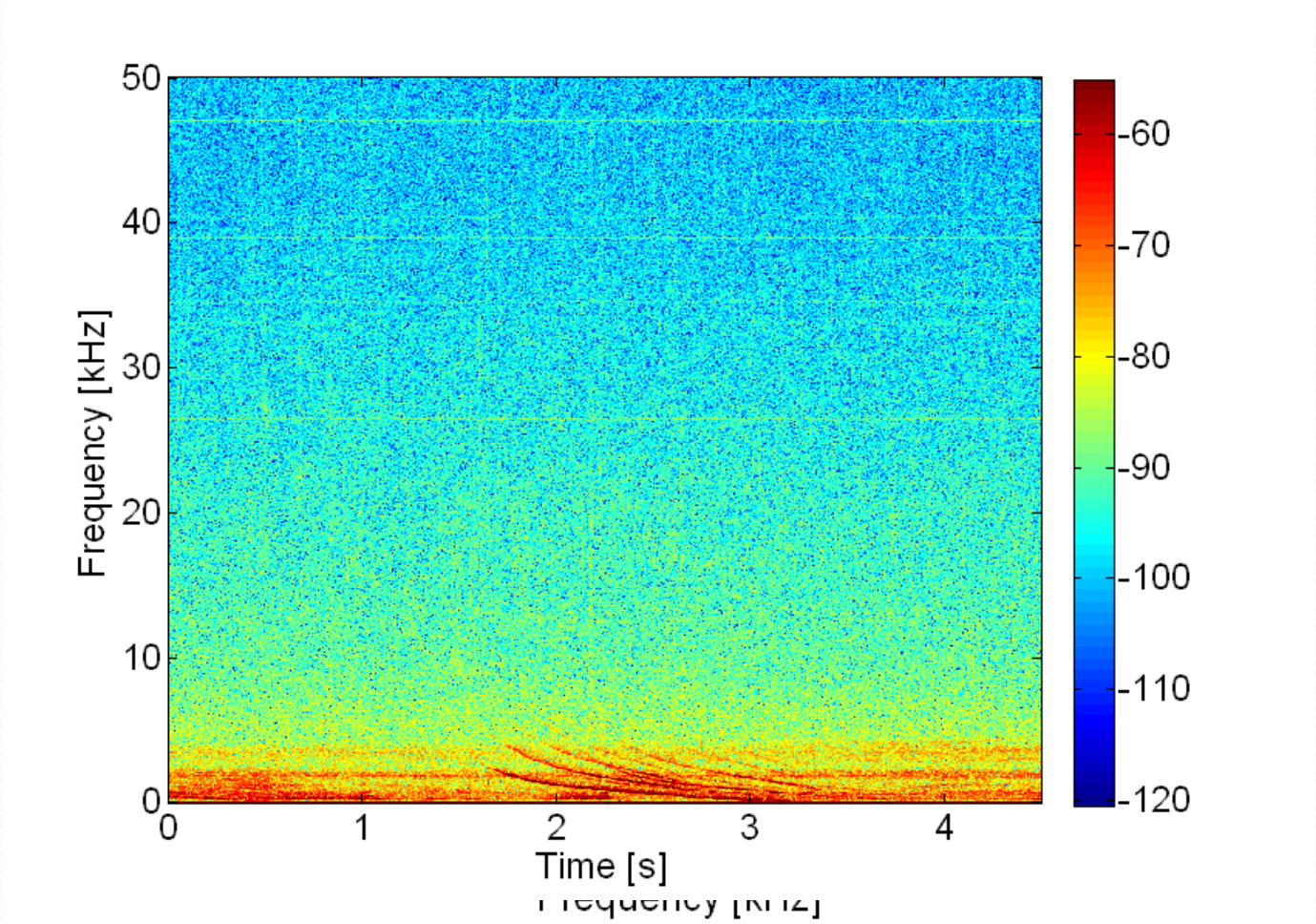


# PAL Quotas Exceeded

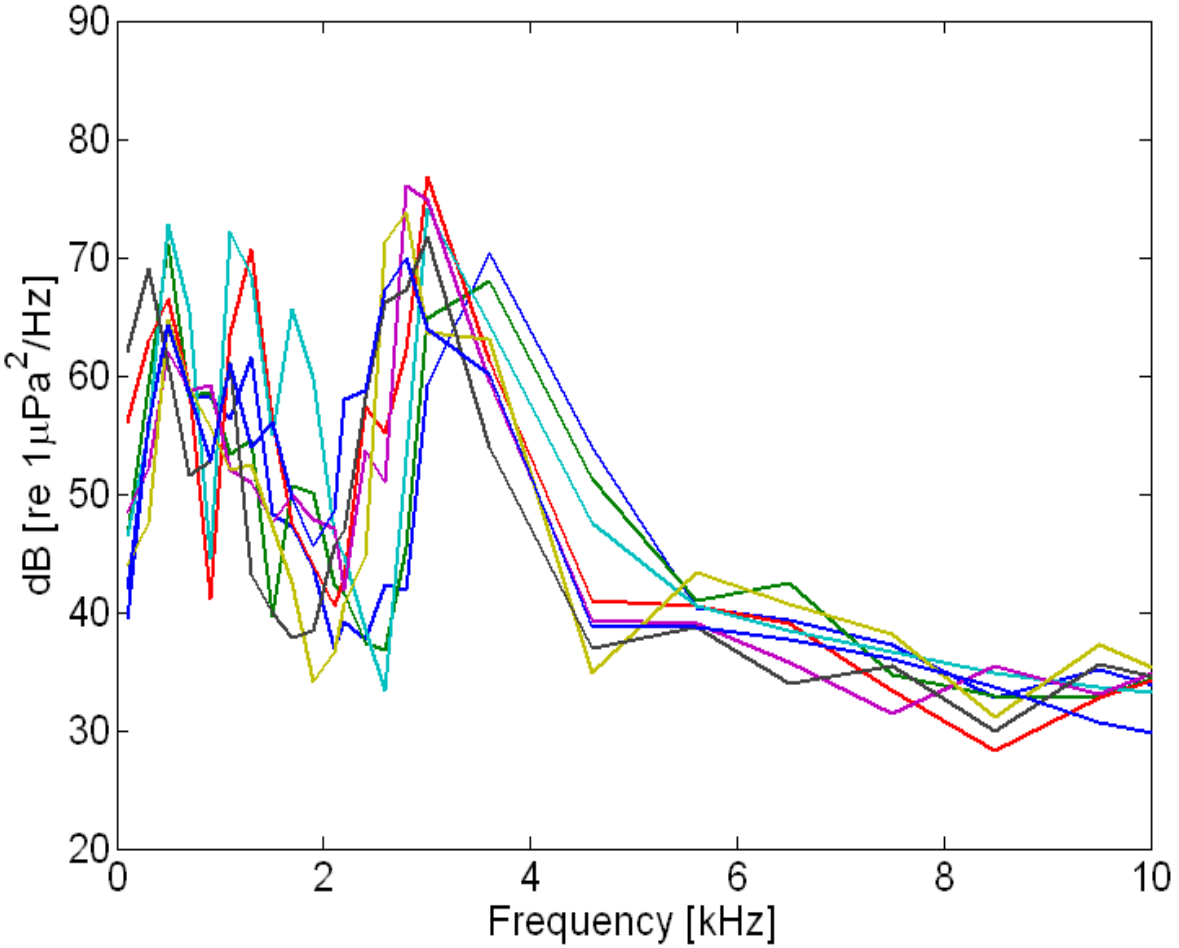
- High rate of transient signals
  - January through May
- Some AURAL daily detections classified after PAL soundbite quota exceeded
  - PAL continued to collect spectra clusters



# Spectral Classification: Ribbon Seals



# Multiple signals



# Results

| | Total Days Detected | Days Detected by AURAL only | Days Detected by PAL only | Days Detected by Both |
|---|---|---|---|---|
| **Bowhead Whales** | **25** | **7** | **0** | **18** |
| **Humpback Whales** | **8** | **3** | **5** | **0** |
| **Odontocetes** | **7** | **3** | **2** | **2** |
| Bearded Seals | 17 | 5 1 | 0 | 12 16 |
| **Walrus** | **12** | **7** | **1** | **4** |
| Ribbon Seals | 12 | 5 1 | 1 | 7 10 |
| **Echolocation clicks** | **18** | **0** | **18** | **0** |

# Spectral classifier confidence

| | Recall | False Alarm |
|---|---|---|
| **Bearded Seal** | **43** | **9** |
| **Ribbon Seal** | **27** | **6** |

# Summary

- Overall daily detections from the two systems was similar
- Periods of high vocalization by multiple species limited the acquisition of these vocalizations with the PAL

# Acknowledgements


- Work funded by ONR Marine Mammal Program
- Mooring maintained by NOAA PMEL
- Crew and officers of NOAA ships Miller Freeman and Oscar Dyson


# Questions?