Continuous Monitoring of Marine Mammals, Natural and Man-Made Sound In Georgia Strait and Saanich Inlet using the VENUS Observatory

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Outline:

Why are we interested in cabled hydrophones?

The VENUS hydrophone systems
- Instrumentation
- Preliminary data

Opportunities

Impressions from the last 20 months
Ocean Sound

Natural:
- Wind, waves, precipitation (storms intermittent)
- Lightening (locally very intermittent)
- Earthquakes (rare)
- Ice
- Biological (some frequent, other rare)

Antrophogenic:
- Industrial (increasing, local problem)
- Shipping (increasing everywhere)
- Boating (increasing locally)
- Sonars (increasing power)
- Seismic (increasing)
The effect of man-made sounds on marine mammals has become a clear conservation issue. Overall, global ocean noise levels appear to be increasing as a result of human activity. (e.g., Off central California a 10 fold increase in low-frequency noise from 1960s to 1990s.)” (NOAA report)

Commercial fleet doubled in 38 years to 89,899 in 2003.

"To understand what impacts such noise might have on sound-dependent marine mammals and other sea life, repeated acoustic measurements at multiple sites are needed. (Scripps report 2006)“

Need to study the impact of anthropogenic noise on the ecosystem
Battery operated, self contained, Acoustic Recording Package (ARP)

- Hybrid low freq/hi freq
- 1 hr on/1 hr off duty cycle 1kHz
- 18Gb + 6Gb
- Battery pack ~ 300D cells
- Deployed/recovered from ships
- Not real time
- No flexibility
Underwater

Broad-band hydrophones (10-100,000Hz) w/preamplifier

Prog. Gain
16 bits A/D

PC (No disk)

Clock

Shore

Power, bandwidth and 2-way communication, no problem

VENUS
Saanich Inlet hydrophone system February 2006
Saanich Inlet hydrophone system 2007
VENUS Saanich Inlet 3-hydrophone system

Mammals
Fronts
Boats
Location of sound source
Directional response of system

1.5cm @ 50kHz BW

7.5cm @ 10kHz BW
Lloyd’s mirror
Variability in man-made noise
VENUS Georgia Strait. A Golden Opportunity
Practical Issues:

**Data, data and more data.**

- 9 hydrophones sampled at 200kHz at 16 bits = 3.6Mbytes/sec = 13Gbytes/hour = 312Gbytes/day = 113Tbytes/year.

Event triggering (Changing system parameters).

Recording of averaged spectra.

Real time or near real-time detection of signals of interest.
Group-specific dialects:

‘A’ clan, northern resident Orca community

‘J’ clan, southern resident Orca community
Sometimes Difficult to separate

- Orca ‘A’ clan
- Propeller boat
- Orca ‘A’ clan
- Jet boat
More Practical Issues:

- Navy and National Security issues
  - Remote control over systems. On/Off data bypass.
  - No hard disk space near hydrophones.

Therefore, operating system in non-writeable flash memory and small writeable section for hydrophone code.
Some gained experiences:

- **Hardware reliability**
  - Off the shelf components not holding up.
  - How long is the warranty period? Will anybody know the workings of an instrument in 5 years?
  - Corrosion issues.
Even More Practical Issues:

- **Software reliability**
  - Bugs can be fixed.
  - Changeability.
  - Software might be obvious for one person or team that developed an instrument but this is supposed to last a long time and a number of people will be involved in the lifetime of the instrument/software.

- **Flexibility & Controllable by simple scripts or configuration files.**
THANK YOU