A novel approach to measurement of underwater sound levels in a dangerous tidal fjord using a miniature self-contained acoustic recorder

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TURNAGAIN ARM, ALASKA: BEAUTIFUL BUT DEADLY
Winds and tides can concoct a deadly brew in Alaska's Turnagain Arm

By Craig Medred

3 rescued from rock at Alaska's Turnagain Arm

By The Associated Press Fairbanks Daily News-Miner

Turnagain Arm Mudflats Dangerous to Belugas, Beachcombers

2:06 a.m. EST, August 23, 2012 | By Blake Essig, Channel 2 News
"WINDY CORNER"
HIGHWAY STRAIGHTENING

PROPOSED CONNECTION TO EXISTING TURNAGAIN ARM TRAIL

PROPOSED CHUGACH STATE PARK GRAVEL PARKING AREA

PROPOSED CHUGACH STATE PARK NORTHBOUND PARKING AREA

4,500’ OF NORTHBOUND AND SOUTHBOUND AUXILIARY LANES

DIVIDED HIGHWAY IMPROVES SAFETY

EMERGENCY RESPONSE LAUNCH RAMP

RAILROAD REALIGNMENT

WINDY CORNER 105-107

PROPOSED THROUGH LANE
PROPOSED PEDESTRIAN TUNNEL
PROPOSED EMERGENCY RESPONSE ACCESS
EXISTING RIGHT-OF-WAY
PROPOSED RR TOP OF EMBANKMENTS

PROPOSED LEFT-TURN LANE
PROPOSED GRAVEL AREA
PROPOSED PARKING AREA
PROPOSED PATHWAYS (ADA ACCESSIBLE)
PROPOSED AUXILIARY LANE
TRADITIONAL OFFSHORE RECORDING METHODS UNSUITABLE
GENERAL-PURPOSE ACOUSTIC RECORDING TAG

Spotted dolphin photo by Robin Baird, Cascadia Research. NMFS Scientific Research Permit No. 731-1774.
ACOUSONDE™ 3A TECHNICAL

- 22.1 cm long, 3.2 cm diameter
- 262 g (with battery, in air; 86 g in seawater)
- Low-power hydrophone recording band 20 Hz – 9.3 kHz
- HF hydrophone option; max sample rate 464 kHz

- Up to 3000 m operating depth (pressure xcdr limited)
- 208 MHz (max) 32-bit ARM9 core with 32-bit bus
- Adjustable clock speed and core voltage
- DMA-based data acquisition and storage
- 3D compass, 3D accelerometer, temperature, pressure
- Data retrieved via USB drag-and-drop
REMOTEly OPERATED RECORDING PLATFORM?

- Stability in rough conditions
- Buoyant enough to support Acousonde recorder
- Propulsion can tow Acousonde against current
- Range sufficient to minimize near-shore effects
- Low cost
- …Remote-control boat?
INEXPENSIVE REMOTE RECORDING PLATFORM - #1

ASA-ASJ Honolulu • 30 Nov 2016  Burgess & McGuire: Measuring underwater sound in a dangerous tidal fjord
INEXPENSIVE REMOTE RECORDING PLATFORM - #2

- Traxxas “Blast” R/C speedboat
- 60 cm long, 15 cm beam
- Remote-control range approx 300’ (91 m)
- 16 knot top speed (third-party estimate)
- Room for miniature DGPS receiver/logger inside hull
- $160
STUDY GOAL: *MINIMUM LEVELS AT DIFFERENT TIDAL CONDITIONS*

- **DATA:**
  - 50 to 80 m from shore
  - 1 m depth
  - Drift period 40 s to 4 min depending on currents

- **PROBLEMS:**
  - Local impulsive noise and periodic strumming
  - Potential road & aircraft noise artifacts

- **SOLUTIONS (POSTPROCESSING):**
  - Analyzed 40 Hz – 9.3 kHz (filter LF effects)
  - Analyzed using sliding 0.3-s window (filter impulses)
  - Use minimum results found
### MINIMUM BROADBAND LEVELS

**40 Hz – 9.3 kHz**

<table>
<thead>
<tr>
<th>TIDAL CONDITION</th>
<th>WINDY CORNER</th>
<th>BROADBAND SPL dB re 1 μPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max recorded in Cook Inlet by Blackwell &amp; Greene (2003) - flooding</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>Flooding, near peak flow</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Ebbing, near peak flow</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>Low tide</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>High tide</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Min recorded in Cook Inlet by B&amp;G (2003) – high tide</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

Windy corner measurements made at 1-m depth
B&G flooding at 10.5-m depth, B&G high tide at 6-m depth
CONCLUSIONS

- Potential blasting sounds may be more audible underwater in Turnagain Arm than originally expected.
- Toy boats are fun!
- But the toy boat *did not make this study possible*;
- Rather, the *miniature recorder* made this study possible to be done with a platform as simple and inexpensive as a toy boat.
- Therefore, miniature acoustic recorders are even more fun than toy boats.
ACKNOWLEDGEMENTS

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http://www.acousonde.com