Using a DIDSON to Estimate Salmon Escapement: Introduction

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Acknowledgements

- California Department of Fish and Game, Fisheries Restoration Grants Program
- Redwood State and National Parks
- Orick Chamber of Commerce
- U. S. Geological Survey
- Humboldt State University
History

Hydro-acoustics and sonar used in a variety of applications

- Stock assessments in lakes and reservoirs
- Sport fishing
- Mapping seafloor
History

- DIDSON technology developed for U. S. Navy by University of Washington, Applied Physics Laboratory to detect mines
  - Limpet Mine Imaging Sonar (LIMIS)
  - Dual-Frequency Identification Sonar (DIDSON)
Some DIDSON Applications

- Monitoring frequency of salmon redd construction relation to environmental variables.
- Predator–prey interactions in turbid water.
- Evaluating trawl by–catch.
- Estimating salmon escapement.
- Fish behavior
Salmon Escapement

- Alaska Department of Fish and Game adapted DIDSON technology to estimate escapement.
  - ADFG employs 27 DIDSON units for this purpose.
- Other federal, state and provincial agencies now using DIDSON for similar purposes.
How a DIDSON Works

- Components
- Concepts
- Specifications
- Resolution
- Deployment
Components

Computer

What?

DIDSON

Cable
The acoustic lenses focus and form an acoustic image on the transducer array at the rear of the sonar. Electronics convert that acoustic image into a digital image on a computer screen.
Unlike scanning sonars that provide still images, DIDSON is a dual beam sonar that provides dynamic (video) images.

Dual beam = 2 frequencies (1.1 and 1.8 MHz).

The apparent observation view is perpendicular to the expected view.
- Objects ensonified from the side appear to be viewed from the top
- Objects ensonified from above appear to be viewed from the side.
Image quality

- DIDSON produces high quality, almost photo quality, video acoustic images
- Operates at zero light and high turbidity.
- At right – image of pipe and roots in Sacramento River.
Data Interpretation is Intuitive

- **DIDSON**
  - Real time direction.
  - Swimming behavior visible.

- **Split-beam Sonar**
  - “radar blips”.
  - Not possible to determine direction.
  - Size is weakly related to target strength.
# Fish passage observation technology comparison

<table>
<thead>
<tr>
<th></th>
<th>Optical Camera</th>
<th>Acoustic Camera</th>
<th>Traditional Sonar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Resolution</td>
<td>500,000 pixels (video)</td>
<td>50,000 pixels (HF mode)</td>
<td>500 range data bins</td>
</tr>
<tr>
<td>Maximum Range (m)</td>
<td>&lt; 1 (in turbid water)</td>
<td>12 (HF mode)</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Field-of-View (degrees)</td>
<td>77</td>
<td>29</td>
<td>6</td>
</tr>
</tbody>
</table>

DIDSON Specifications

- **Identification Mode**
  - Operating Frequency 1.8 MHz
  - Beamwidth (two-way) 0.3 deg H by 14 deg V
  - Number of beams 96
  - Range 1 m to 15 m

- **Detection Mode**
  - Operating Frequency 1.1 MHz
  - Beamwidth (two-way) 0.6 deg H by 14 deg V
  - Number of Beams 48
  - Range 1 m to 35 m

- **Both Modes**
  - Field-of-view 29 deg
  - Sonar weight in air (300m) 7.7 kg (17 lbs); in water 0.7 kg (1.6 lbs)
  - Dimensions 30 cm by 20 cm by 17 cm (12-in. by 8-in. by 7-in.)
In high frequency mode
96 beams
Each:
  0.3° horizontal
  14° vertical
Total field:
  29° horizontal
  14° vertical
DIDSON Resolution

- Cross-range resolution: \((\text{range}/2)/\text{num}_\text{beams}\)
- Down-range resolution: \(\text{Window-Length}/512\)
- Example: Range 30 m using a 40-m window
- Std LF
  - Cross-range resolution = \(1500/48 = 31\) cm
  - Down-range resolution = \(4000/512 = 8\) cm
- Example: Range 2 m using a 1.25-m window
- Std HF
  - Cross-range resolution = \(100/96 = 1\) cm
  - Down-range resolution = \(125/512 = 0.24\) cm
Deployment

Pole mount

“H” mount
96 or 48 pulses skim along the surface sending back reflectance as a function of range and beam number.

The display maps the reflectances. Objects ensonified from the side appear to be seen from above and generally have an acoustic shadow.
The fish statistics automatically store into a text file. One gets the total count, the frame in which a count was made, fish direction, range, length, and the time the fish passed the center beam.
Discussion & Questions