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# Multibeam Visualization of Samson Fish Aggregations & Spawning Habitats in Western Australia

## Introduction

In January of 2007, RESON partnered with the Curtin University of Technology (Perth, Western Australia) to run a pilot project to test the functionality of the Seabat 7125-400 kHz for a multibeam-displinary project. Two PhD Theses were supported as part of this project: Miles Parson's work looking at Spawning Behavior of Samson Fish and Iain Parnum's work classifying the Seafloor Habitats in which these fish reside.

Samson Fish (0.5 to 1.42m in length, up to 46 kg in weight) are an important recreational and commercial fishery in which recurring populations of spawning fish occur every summer. They tend to reside in the proximity of a ship graveyard, lying in sandy bottom 18 km off the coast of Fremantle, Australia. Fishing activity has increased over the past years and the affect of this activity upon the Samson Fish is unknown. Prior work has been completed but data is lacking as to the 3-D behavior of these aggregations during spawning. This is a benchmark project in which the Seabat 7125 has been used to simultaneous collect water column data and seafloor information (bathymetry and imagery).

## Methods

The 400 kHz Seabat 7125 was mounted of the S/V Naturaliste and interfaced with a Coda Octopus F180 inertial navigation and attitude sensor.

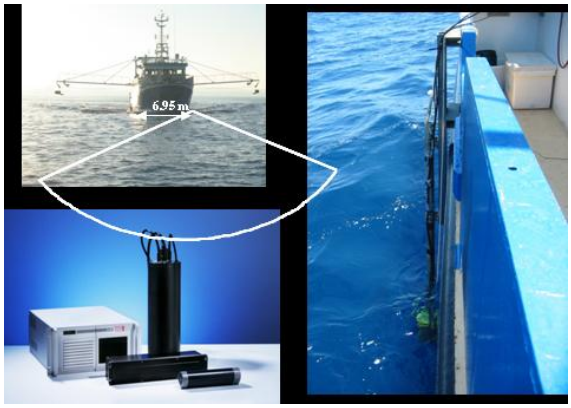


**Fig. 1: Seabat 7125 as mounted on the R/V Naturaliste**

The 400 kHz Seabat 7125 outputs 512 equiangular or equidistant beams across a 131º swath. Furthermore, the 7125 allows the user to adjust the transmit power, receive gain, pulse length, spreading loss and absorption. During the survey, the pulse length was varied between 90 -300 µs (dependent on optimization for water column or seafloor imaging). The power, gain, spreading loss and absorption were also varied as to maximize the performance of the system.

A Kongsberg EK60 scientific echosounder was also installed aboard the S/V Naturaliste to groundtruth the multibeam watercolumn information.

## Water Column Analysis and Visualization

Analysis and Visualization was conducted in SonarData's Echoview software. During the survey, an electrical issue attributed to the ship, introduced acoustical artifacts into the data. To remove the noise, a data subset which did not contain any water column targets was analyzed and the mean detected backscatter for the noise was extracted. This information was then incorporated into a noise removal filter and re-applied with the time-varied gain (TVG). Despite this noise, Sampson Fish were easily detected.

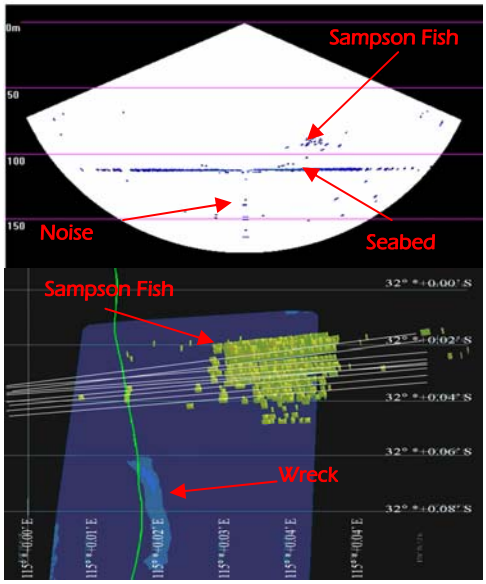


**Fig. 2: Top: Wedge Display showing the seafloor, Samson Fish & associated noise. Bottom: Detected Samson Fish as visualized in Echoview.**

## Water Column Results

The analysis of the aggregation behavior showed significant movement (90m over a 15m period) in comparison to single-beam surveys conducted at the beginning of the season. Such movement included condensing and expanding of the aggregation over the plan area. This movement has been attributed to vessel avoidance behavior combined with an attraction to the wreck.

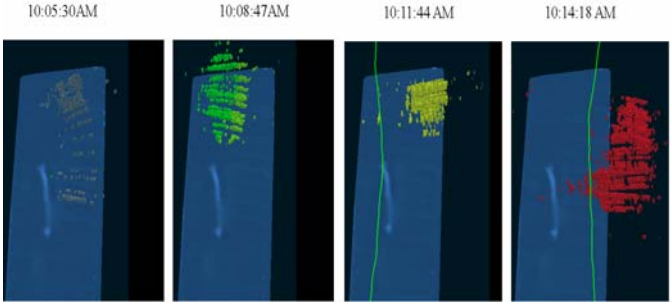


**Fig. 3: Short-term aggregation behavior of a Samson Fish aggregation. The green line represents the vessels track.**

Further analysis shows varying target strengths within the aggregation possibly indicating the presence of other species.

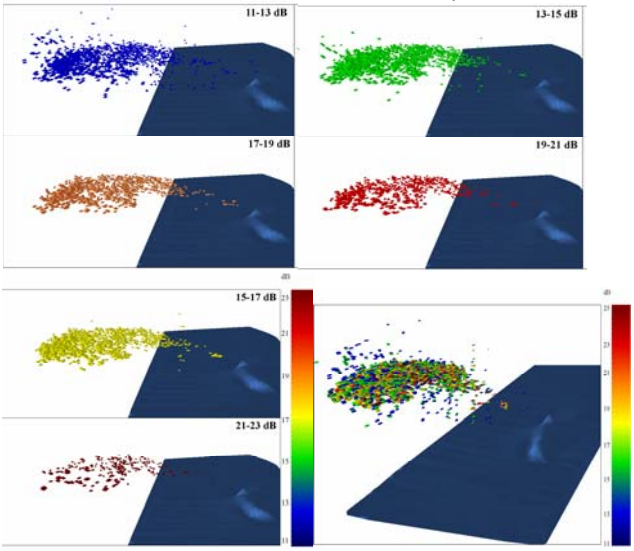


**Fig. 4: Spatial visualization of backscatter variations across an entire aggregation**

## Seafloor Bathymetry and Imagery Processing

The bathymetry and imagery information was acquired and post-processed using the RESON PDS2000 software. The Snippets backscatter imagery was further processed utilizing algorithms developed by CMST.

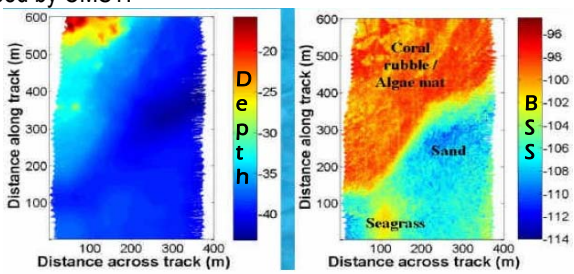


**Fig. 5: Depth and Backscatter Strength (BSS) for a sample survey region**

To maximize the acquisition of high-quality bathymetry, time-varied gain (TVG) is applied to the acoustic information. However, TVG results in saturation of the imagery data in the nadir region. The technique developed by CMST involves the removal of the TVG from the Snippets information. Trends of the backscatter strength (BSS) are analyzed and the TVG is re-applied as to remove any acoustic artifacts due to saturation or other attributing factors.

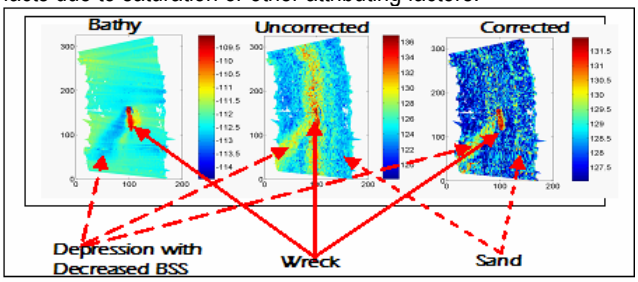


**Fig. 6: Illustration of the steps used to correct the Snippets Data**

The backscatter information is finally corrected and normalized to backscatter signal strength (BSS) in decibels.

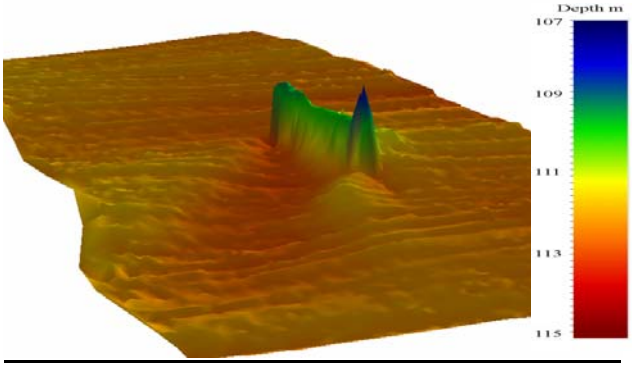


**Fig. 7: Bathymetry from a single line over the wreck in 115m**

## Multidisplinary Approach – One Sonar – Several Products

The multidisplinary approach applied during this project allowed for the simultaneous collection of several data sets from a single sonar. In addition, the performance of the 400 kHz Seabat 7125 allowed for the derivation of several high quality data products including:

- ✓ Bathymetry with a Quality of IHO Special Order 1 out to 115m
- ✓ Snippets
- ✓ Sidescan
- ✓ Water Column Backscatter

By combining all of the products into a single image, the investigators have been able to analyze the Samson Fish Spawning Behavior as it relates to both environmental (i.e. substrate and morphology) and temporal (vessel traffic, oceanography, etc) conditions.

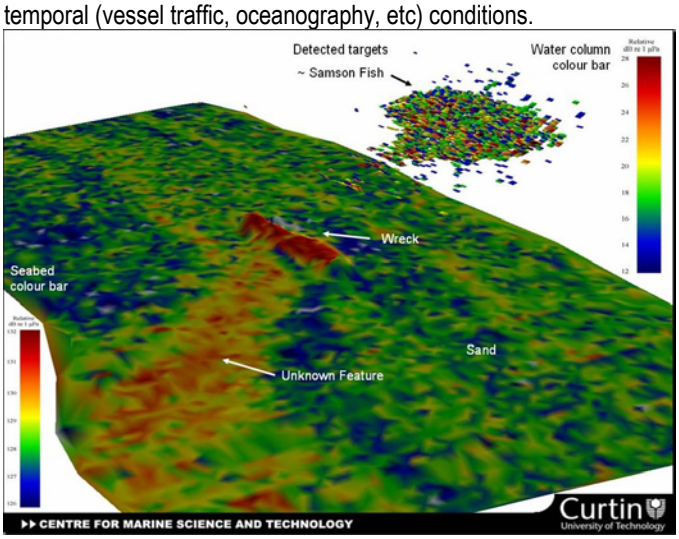


**Fig. 8: Seabat 7125 as mounted on the R/V Naturaliste**

The analysis of these 3-Dimensional products have not only confirmed variation in aggregations throughout the season but outlines effectiveness of collecting simultaneous seafloor and water column data sets.

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