Hydroacoustic data processing for standard stock assessment using Echoview: Technical manual

by

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The conclusions and recommendations given in this and in other documents in the *Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea* Project series are those considered appropriate at the time of preparation. They may be modified in the light of further knowledge gained in subsequent stages of the Project. The designations employed and the presentation of material in this publication do not imply the expression of any opinion on the part of FAO or MiPAAF or EC concerning the legal status of any country, territory, city or area, or concerning the determination of its frontiers or boundaries.

Preface

The Regional Project "Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea" (AdriaMed) is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by the Italian Ministry of Agriculture Food and Forestry Policies (MiPAAF) and since 2007 from the Directorate General for Fisheries and Maritime Affairs of the European Commission.

AdriaMed was conceived to contribute to the promotion of cooperative fishery management between the participating countries (Republics of Albania, Croatia, Italy, Montenegro and Slovenia), in line with the Code of Conduct for Responsible Fisheries adopted by the UN–FAO.

Particular attention is given to encouraging and sustaining a smooth process of international collaboration between the Adriatic Sea coastal countries in fishery management, planning and implementation. Consideration is also given to strengthening technical coordination between the national fishery research institutes and administrations, the fishery organizations and the other relevant stakeholders of the Adriatic countries.

GCP/RER/010/ITA Publications

The AdriaMed Project publications are issued as a series of Technical Documents (GCP/RER/010/ITA/TD-00) and Occasional Papers (GCP/RER/010/ITA/OP-00) related to meetings and research organized by or conducted within the framework of the Project.

Occasionally, relevant documents may be translated into national languages as AdriaMed Translations (GCP/RER/010/ITA/AT-00).

Comments on this document would be welcomed and should be sent to the Project headquarters:

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Preparation of this document

This document is the final version of the material used for the preparation of the training course on the use of Echoview organized by the AdriaMed Project in cooperation with the MedSudMed Project and carried out from 12th to 14th May 2008 in Ancona, Italy.

Hydroacoustic data processing for standard stock assessment using Echoview. Echoview Technical Manual draws on:

- Echoview training and tutorial materials
- Cited texts and papers
- The NOAA/NMFS protocols
- The Standard Operating Procedures for Acoustics in the Great Lakes

It is hoped that the technical manual will aid you in using Echoview to process your hydroacoustic data for the purpose of standard stock assessment.

Due to its technical nature the manual's topics only provide a general introduction/guide to the issues and types of data processing you may need to consider for your data. For a more solid scientific and theoretical foundation for your work, we advise that you seek further up to date information in the hydroacoustic literature.

Acknowledgements

Higginbottom, I., Woon,S. and Schneider, P.

Hydroacoustic data processing for standard stock assessment using Echoview: Technical manual. *AdriaMed Technical Documents*, 25. GCP/RER/010/ITA/TD-25, Rome: 138pp.

ABSTRACT

This technical manual is written as a guide on how to use Echoview to process hydroacoustic survey data from marine or riverine locations. The theoretical ideas and guides for this manual's processing methodologies are drawn from: i) Simmonds and MacLennan[1] (2005); ii) The Standard Operating Procedures (SOP) for Acoustics in the Great Lakes[2] (2008). In particular the numbered procedures from Chapter 3. Summary of Standard Operating Procedures are cited; iii) The NMFS/NOAA document[3] (2004) – NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling – the Great Lakes SOP draws from this document. Echoview offers many features and settings to facilitate the processing of data for analysis on screen and as exported analyses. Exported analyses can be evaluated in third party database and spreadsheet applications. Many procedures are demonstrated using Simrad EK60 (38kHz, 120kHz) and EK500 data.

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Number	Equation

(1) **Areal density for a single species.**

$$Biomass\ (tonnes/n.mi^2) = \frac{PRC\_NASC}{4\pi10^{\frac{TS}{10}}} \times \frac{Weight}{1000}$$

(2) **Areal density expressed in terms of species mix, species weight and Proportioned Region to Cell Nautical Area Scattering Co-efficient for the species.**

$$Biomass\ density\ (tonnes/n.mi^2) = \frac{\%contribution}{100} \times \frac{PRC\_NASC}{4\pi\bar{\sigma}} \times \frac{Weight}{1000}$$

(2)

Where :

(3)

$$\bar{\sigma} = \sum_{all\ species} \left(\frac{\%contribution}{100} 10^{\frac{TS}{10}} \right)$$

(3)

(4) **Two times the near-field limit.**

$$2R_b = \frac{2a^2 f}{c}$$

Abbreviations

Abbreviation	Full text
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
TVG	Time varied gain
TVT	Time varied threshold
GPS	Global Positioning System
TS	Target strength
ST	Single target
SNR	Signal to noise ratio
NASC	Nautical Area Scattering Coefficient
PRC_NASC	Proportioned Region to Cell Nautical Area Scattering Coefficient

Introduction

Processing hydroacoustic survey data in Echoview

This technical manual is written as a guide on how to use Echoview to process hydroacoustic survey data from marine or riverine locations. The theoretical ideas and guides for this manual's processing methodologies are drawn from:

▶ Simmonds and MacLennan[1] (2005)

▶ The Standard Operating Procedures (SOP) for Acoustics in the Great Lakes[2] (2008). In particular we cite numbered procedures from Chapter 3.Summary of Standard Operating Procedures.

▶ The NMFS/NOAA document[3] (2004) – NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling – the Great Lakes SOP draws from this document.

Echoview offers many features and settings to facilitate the processing of data for analysis on screen and as exported analyses. Exported analyses can be evaluated in third party database and spreadsheet applications.

Many procedures are demonstrated using Simrad EK60 (38kHz, 120kHz) and EK500 data.

Note: This manual's screenshots and EV files were created with Echoview 4.50. Other versions of Echoview may offer a slightly different set of tools and features and display data differently. See also Appendix B: Unable to open Echoview's Technical Manual data files in Echoview.

Training with the manual

What's covered?

This manual provides an introduction to hydroacoustic data processing in Echoview.

Data files from a survey are processed so that you can export information that can be used in estimating biomass and where applicable fish flux in fish counts per hour.

This manual shows you how to do the following with hydroacoustic data:

▶ View and scrutinize data – using EK60, EK500 and HAC data as examples.

▶ Enter calibration settings for the transducer and data

▶ Remove noise, remove unwanted signal

▶ Create a surface line

▶ Create an acoustic bottom line

▶ Manually partition data by using region types and region classes

▶ Detect schools – automated detection of regions

▶ Specify cell size

▶ Apply a Sv or a TS threshold to Sv data

- ► Integrate Sv
- ► Detect single targets
- ► Study TS
- ► Create fish tracks
- ► Use a dB differencing technique with EK60 38 kHz and 120 kHz data to classify species
- ► Apply virtual variables to implement complex data manipulation.
- ► Export analyses for species classified biomass calculations
- ► Export analyses for fish counting
- ► Calculate fish flux for riverine data
- ► Apply Echoview 3D visualization to single beam data
- ► Make an EV file template to automate the processing of hydroacoustic data
- ► Live view EK60 data in Echoview

What is not covered?

This is not intended as a comprehensive user manual.

Further information on Echoview tools and topics can be found in the latest version of the Help file that comes with Echoview. This file can also be viewed online or downloaded with Echoview from the Echoview website: http://www.echoview.com.

Prerequisites

This manual assumes you have the following skills and knowledge:

- ► Familiarity with the basic operation of Echoview. We strongly recommend that you complete the Echoview tutorials before beginning this manual.
- ► Familiarity with one of the following operating systems: Microsoft Windows™ 2000/XP/Server2003™.
- ► A basic understanding of echosounding techniques and hydroacoustic surveying. For more information, see texts such as *Fisheries Acoustics 2nd Ed.* (MacLennon and Simmonds, 2005, Blackwell Science, Oxford).
- ► An understanding of the operation of echosounding equipment. For more information, refer to the operator's manual for the echosounder(s) you will be using.
- ► Echoview is installed.

Typical styles in the manual

The manual uses cross references and URLs, they are indicated by blue text.

What is covered?

Topic completed

What is covered? or Topic completed.

The **What's covered?** text outlines the aims of the topic.

The **Topic completed** text outlines the skills gained from the topic.

Theory

The Theory icon is associated with directly relevant text dealing with hydroacoustic theory or hydroacoustic data processing in Echoview. The text is often used to set up the context for the next data processing step.

Steps

The Steps icon is associated with "cookbook style" instructions for a data processing step.

Tips and tricks

The Tips and tricks section contains further information which may be handy to know. Such information may aid in the development of a deeper understanding of the subject but is not essential for the processing step. Text can cover:

▶ References to the Echoview help file.

▶ Further discussion of the hydroacoustic theory.

▶ Other references or discussion.

Supplied data files

The data files used with this manual's example EV files are provided with the permission of those people or groups listed in the "Acknowledgments" section.

Installation of this manual's data files and templates

The Echoview technical manual is provided as a PDF file with a self installing zip file for the data files and EV files:

▶ Echoview_Technical_Manual.pdf

▶ Echoview_manual.exe (Double-click the .exe file to install to: C:\Myriax\Echoview\Echoview4\Echoview manual)

Solution files

Solution EV files are provided in the respective data folders and are named * (Solution).EV.

1. View and inspect data

What is covered?

To view and initially inspect hydroacoustic data in Echoview you need to:

▶ Add data to a new Echoview EV file .

- OR-

▶ Add data to a new EV file based on a template.

This topic inspects an EK60 single frequency data file. The principles apply to any data file format that Echoview supports.

Echoview and data files

An **EV file** is made up of:

▶ a **Fileset** or **Filesets** containing pointers to survey data files

▶ the results of any edits or Echoview display and analysis settings associated with the survey data

A Fileset is used:

▶ to manage a group of data files

▶ to derive raw variables.

Data files are usually primary information archived from a survey and consist of data logged from echosounders or sonars and other equipment.

Echoview derives raw variables from the data files in a fileset.

When a data file is added to a **Fileset** in an **EV file** the original data *will never be copied or modified in any way*.

You can analyze data in a new EV file based on a template or in a new EV file.

A new EV file based on a template contains *stored* display and analysis settings that can be fine tuned when you add appropriate data.

A new EV file requires you to determine and enter display and analysis settings for your data.

Create an EV file based on a template

For more information about creating and using templates refer to About templates.

1. Start Echoview.
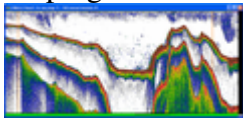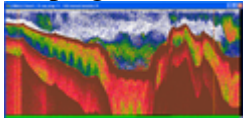
Configure a path for a Templates folder

See also Creating a template.

2. On the **File** menu select **Configuration**.

3. Click the **File locations** page.
   In the **Files types** section click **Templates**.
   Click **Edit**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\9 Templates
   Click **OK**
   Click **OK**

Create an EV file

4. On the **File** menu click **New**.

5. In the **New EV file (Template) dialog box**, click **Echoview manual template.EV**
   Click **OK**.
   This template has stored settings for:
   Best bottom line pick virtual line
   Variable Properties for the Position variable – settings on Data page
   EV file Properties – Echogram page (display Notes for marker regions)
   A virtual variable copy of the Sv echogram configured for along-track display.

6. On the **Filesets – File 1** window click **Add**.

7. Use the Add Data Files dialog box to find the data file:
   C:\Myriax\Echoview\Echoview4\Echoview manual\1 View and inspect\L0014-D20021004-T140000-EK60.raw,
   Click **Open**.

8. On the File 1 page of the Filesets dialog box, the listed Raw Variables are:

Raw Variable	Meaning
Sv raw pings T1	Sv pings from transceiver 1;
	Sv Echogram.
TS raw pings T1	TS pings from transceiver 1;
	TS Echogram

angular position raw pings T1	Angular positions from transceiver 1,
	Angular position echogram
position GPS fixes	GPS fixes
	Cruise track.
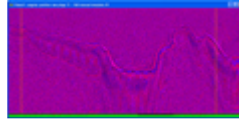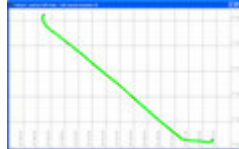
9. To view the Raw Variable: double-click it, or select it and click **Echogram**.

Create a new EV file

1. Start Echoview.

2. On the **File** menu click **New**.

3. In the **New EV file (Template) dialog box**, click **No template**.
   A new EV file is created with default settings.

4. On the **Filesets – File 1** window click **Add**.

5. Use the Add Data Files dialog box to find the data file:
   C:\Myriax\Echoview\Echoview4\Echoview manual\1 View and inspect\L0014-D20021004-T140000-EK60.raw,
   Click **Open**.

6. In the Filesets – File 1 dialog box, the derived Raw Variables are:
   Sv raw pings T1
   TS raw pings T1
   angular position raw pings T1
   position GPS fixes
   (View the descriptions of the Raw Variables in the *Create a new EV file based on a template* section).

7. To view a Raw Variable, double-click the name of the Raw Variable.

About echograms

An echogram is a visual representation of acoustic data. Single beam echograms display pings in the horizontal direction and samples within pings in the vertical direction.
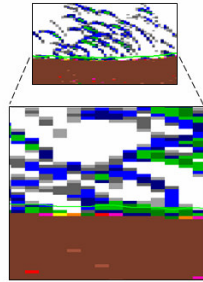
Figure 1. Small rectangle is a part of an Sv echogram showing fish near the sea floor. The large square shows a zoom of the area and clearly shows pings and samples within pings.

Features on an echogram can be a result of:

► Echoes from biological sources
e.g. Individual fish, fish aggregations, plankton, other sea creatures

► Echoes from non-biological or geological sources
e.g. sea floor, sea mounts, structures

► Echoes from noise or reverberation
e.g. ship noise, cavitation, transducer interference, transducer ringing, bergy bits, electronic noise, bubbles in the sea, unwanted biological echoes.
See also Reverberation and noise.

In many cases, information from sources like hydrographic data, local geographic knowledge, trawl or direct sampling data, biology and ecosystem knowledge and echosounder/sonar experience can help you to identify features on an echogram.

Cells

Cells provide a systematic way to partition, refer to and navigate echogram data. Cells are useful at the View and inspect stage and the Scrutinization and Analysis stages.

Cells are referenced by (Layer number, Interval number), where layer and interval are specified on the Grid page of the Variable Properties dialog box:

► The time/distance grid settings specify intervals across the echogram.

► The depth/range grid settings specify layers down the echogram.

Cells are useful for:

► onscreen analyses

► exported analyses

▶ the calculation of density

▶ the calculation of biomass

View echograms and cruise track

8. Use either the new EV file based on a template or the new EV file from step 7.

Onscreen information

9. Click Details 🛈 .
   The Details dialog box (opened by the Details tool), the Information toolbar and the Echoview status bar all respond to the position of the mouse pointer and display useful information.

| 614 | 29.85 | -97.06dB | -73.00dB |

Figure 2. *Information toolbar. Note the Goto ping number feature (ping 614) on the left hand side.*

| Bottom depth: 237.00m, Good | 🛈 | 96082827.ELD | 42° 15.564' S 145° 18.751' E | 28/08/1996 04:51:05.310 |

Figure 3.   Echoview status bar

10. Click the Color legend tool 🎨 .
    The information in the Color legend responds to the active echogram or active window.

11. View the Sv echogram.

Selection, zoom

12. To view an area of interest,

    Click the **Rectangular selection tool** ▢ on the Echogram tools toolbar.
    Make a selection on the echogram with the mouse pointer.
    Use the Zoom tools 🔍➕ 🔍➖ ↕ ▣ or Zoom shortcuts (S, U).
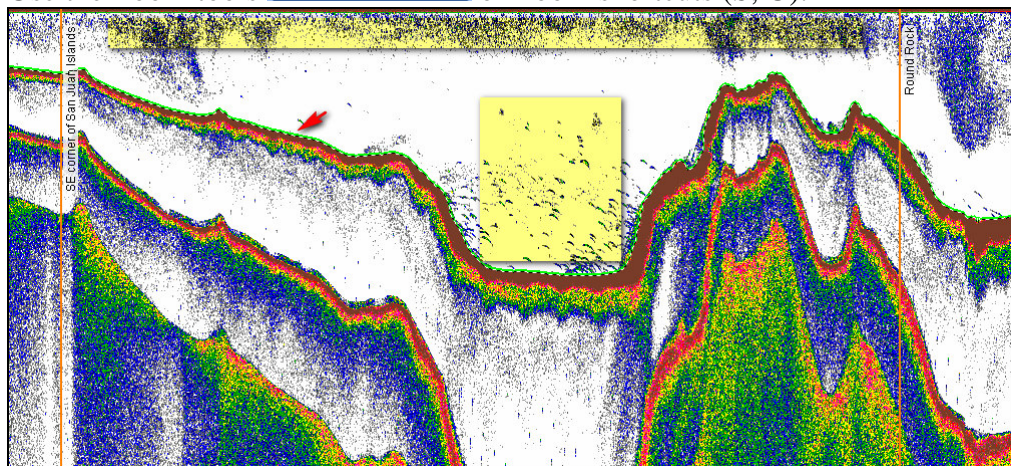
Figure 4. Features of the Sv echogram in the Echoview manual EV file template.

13. Features on Figure 4:
    Highlighted long rectangle – plankton.
    Highlighted square – individual fish.
    Red arrow – points to bright green picked bottom line. Signal directly beneath line is
    the strong signal for the sea floor.
    Strong signals below the picked bottom line are a result of multiple reflections from
    the sea floor.
    Green picked line for bottom (Template file)

Settings

14. To view or use the Variable Properties dialog box for the Sv variable:
    Move the mouse over the active variable
    Select **Variable Properties** on the **Shortcut** (right-click) menu.
    View the pages and settings.

15. On the Display page, under the Echogram colors section observe the settings:
    Color display minimum: -70
    Color display range: 36
    These settings only affect the display of data. Thresholds specifically for analysis are
    set on the Data page.
    To close, Click **OK**.

16. Click on the Sv echogram.
    To see data with weaker echoes press F11 – the Color display minimum changes to -
    71, -72, -73 …
    To see data with strong echoes press F12– the Color display minimum changes to -
    69, -68, -67 …

17. View the TS echogram and repeat steps 10-14.

18. View the Angular position echogram and repeat steps 10-13.

    Observe the Color legend 🎨 – it displays the key to the Minor-axis and Major-axis
    angles.
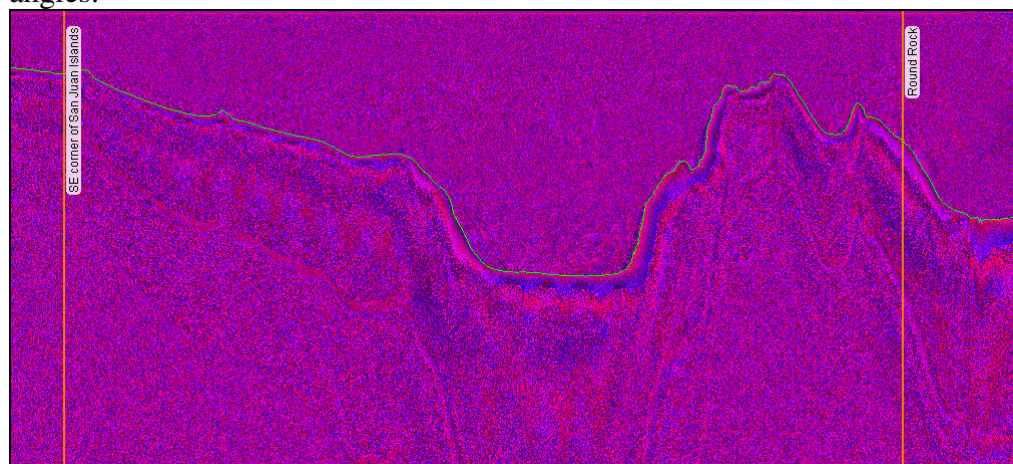
Figure 5. Angular position echogram in the Echoview manual EV file template.

Cruisetrack

19. View the position GPS fixes cruise track variable.
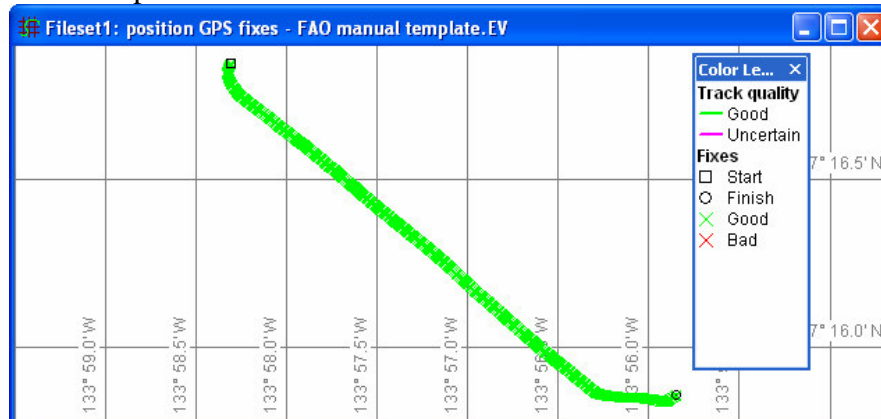
Figure 6.   Cruise track with GPS fixes.

20. Observe the GPS fix information in the Color legend

21. Move over the active window and select Variable Properties on the Shortcut menu.
    View the pages and settings.
    The template file stores the settings:
    Maximum apparent speed: 25 on the Data page.
    On the Display page:
    Show good fixes is selected
    Show scale bar is clear
    As a result, all good fixes are shown and the Scale bar is not displayed.

Synchronization

22. Click Vertical tile

23. Click a variable window and click Auto-synchronization - this places the
    variable in a synchronization group.
    This is a useful feature to view variables using synchronization cues but it can be
    slow for large data files. Alternatively, you can use **Synchronize All Echograms** on
    the Shortcut menu.

Save

24. On the File menu, click Save As.

25. Select the folder in which the Echoview manual data has been saved.
    If you used the standard installation settings, this should be
    C:\Myriax\Echoview\Echoview4\Echoview manual

26. In the Filename box, type a name for your file.

27. Echoview adds the .EV file extension automatically when you save the file.

28. Click **Save**.

29. On the **File** menu click **Close**.

Tips and tricks

Refer to the Echoview Help file for more information regarding the following topics:

- ► EV files
- ► EV file templates
- ► Using EV file templates
- ► Filesets
- ► Supported echosounders, sonars and data file formats
- ► About variables
- ► About echograms - for examples of echograms.
- ► Echogram tools toolbar – for other useful tools and selection tools.
- ► Navigating Echoview
- ► About cruise tracks
- ► Echoview configuration settings
- ► About keyboard shortcuts

Topic completed.

You can now:

- ► Create a new EV file based on a template and add data to it.
- ► Create a new EV file and add data to it.
- ► View a Raw Variable – Sv, TS, Angular position, GPS fixes
- ► Use onscreen sample information:
- ► Use selection tools and zoom tools/shortcuts and echogram synchronization.
- ► Use of the Variable Properties dialog box for echograms and cruise tracks.
- ► Use the Details dialog box
- ► Use the Echoview Status bar
- ► Use the Information bar
- ► Use the Color legend

2. Calibration

What is covered?

The Calibration topic covers the following steps in the Great Lakes Summary of the SOP.

1. Enter sound speed, absorption coefficient, and system calibration settings (10.1.2).

2. Adjust transducer depth.

3. Synchronize time.

EK60 and EK500 data files are used as the calibration examples.

Simrad .DG6 and Biosonics data files demonstrate time synchronization, cruise track/GPS and off-transect issues.

All the described techniques can be applied to any supported data format in Echoview.

Calibration values

Two key parameters for the quantitative analysis of survey data are transducer location and transducer calibration values.

Echoview offers geometry settings for each transducer.

Echoview offers calibration settings for each variable it derives from your data.

Be aware that there may be different calibration values for different variables. Even for a single variable, calibration values may change between pings. For those reasons, many data formats require manual entry of calibration values for each variable – the exception is EK60 .raw files where you can manually or automatically enter values.

Ultimately the choice of which calibration values to apply in Echoview is up to you.

To find calibration values recorded in data files:

- ▶ Inspect data in Echoview.
- ▶ Use Echocheck for supported file formats.
- ▶ Inspect survey logs or other files/recording materials.

The manual entry of calibration values, as outlined in the steps in this topic, can be used with all supported file formats.

Platforms, transducers and geometry

Draft recorded in a EK60 data file

1. Start Echoview.

2. On the **File** menu select **Open**.

3. **Browse** to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\1 View and inspect\My viewing data (Solution).EV
   Click **Open**.

4. Click Details .

5. Click the **Sv echogram**.

6. Inspect the *Ping (from file)* section of the Details dialog box.
   Your mouse pointer points to a sample in a ping and the calibration values are displayed. One of the values is **Transducer draft: 3.5m**.

7. On the Shortcut menu select Variable Properties.

Calibration and Calibration 2 page

8. Click the **Calibration** page.

9. Observe the setting:
   Apply calibration setting: From first ping
   EK60 .raw files reliably contain calibration values written with the first ping and Echoview (as a default) supports using those values for the Calibration, Calibration 2 and Transducer Calibration pages.
   The setting **Manually** is available as well.

Transducer Properties

10. Click the Transducer Properties tool .
    The Transducer Properties dialog box allows you to enter settings and geometry for a transducer associated with your data.

    You can also access Transducers using the Variables and Geometry window -
    refer to Appendix H: Using virtual variables in Echoview.

11. Click the **Location** page.

12. Enter the Transducer draft 3.5m for **Z - Vertical offset (m)**
    Observe the **View from Starboard** and what happens to echograms in the background.

13. Click **OK.**

Data calibration

14. Close the **TS** and **Angular position** echograms and the **Cruise track** window.

15. View the **Filesets** window.

Add second fileset and EK500 data

16. On the **Fileset** menu select **New fileset**.

17. In the Filesets Properties dialog box under Name enter EK500.
    Click OK.

18. Click **Add** on the Filesets window.

19. Use the Add Data Files dialog box to find the data file:
    C:\Myriax\Echoview\Echoview4\Echoview manual\2 Calibration\20070104-162835.ek5,
    Click **Open**.

20. In the Filesets – File 1 window, the derived Raw Variablesfro the EK500 fileset are:

Raw Variables:
- ☑ angular position B1 telegrams T1 (1001)
- ☑ Sv W1 telegrams (power) T1 (1001)
- ☑ Sv V1 telegrams T1 (1001)
- ☑ TS W1 telegrams (power) T1 (1001)
- ☑ position GPS fixes (1008)
- ☑ vessel logs (346)
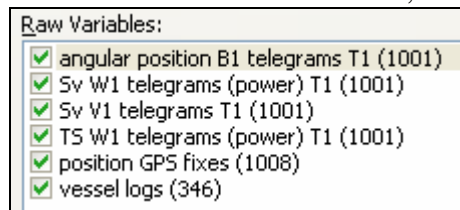
Figure 7. EK500 raw variables.

The EK500 data originates from EK60 echosounder output – it is essentially the same data as the file in Fileset 1. However the transducer draft and calibration values are not recorded in the EK500 file.

EK500 data requires the manual entry of calibration values for each variable – 4 acoustic variables in all.

You will calibrate the Sv power variable in this exercise.

EK500 Sv power calibration

21. Double-click the **Sv W1 telegrams (power)** variable.

22. View the Sv W1 echogram.

23. On the Shortcut menu select Variable Properties.

24. Click the **Calibration** and then the **Calibration 2** page.

25. Enter the required calibration values using the Table 5: EK60 calibration values.
    The transducer is the same as for the EK60 data so you don't need to re-enter the transducer draft.

26. Click **OK**.

27. Open the:
    EK60 Sv raw pings echogram

EK500 Sv power echogram
Close any other windows.
Tile Horizontally .
Zoom in on a fish in one echogram.
On the **Shortcut** menu select **Synchronize Echograms**.

You may also have to **Auto-synchronize** both echograms.

28. Inspect the information about the same sample in both echograms.
The values should be the same.

Save

29. On the **File** menu click **Close** (without saving the file).

30. Or, on the **File** menu, click **Save As**.

31. Select the folder in which the Echoview manual data have been saved.
If you used the standard installation settings, this should be
C:\Myriax\Echoview\Echoview4\Echoview manual

32. In the Filename box, type *Yourname* calibration.

33. Click **Save**.

34. On the **File** menu, click **Close**.

HAC data format

Echoview supports a number of file formats. Among them is the HAC data format for reading and writing generic tuples. Echoview also supports:

► EK500 tuples

► BioSonics 102 tuples

The Echoview help file discusses issues associated with HAC:

► Data files

► Raw variables derived from data

► Calibration setting for data

Continuity of data

After you calibrate all the raw variables, it is useful to check the continuity of the data with respect to time and GPS fixes. Echoview allows you to:

► correct for differences in data file times

► test for uncertain GPS fixes

► identify and mark off-transect data

Information about the conditions of data collection in survey/scientific logs can assist you in

identifying these issues.

The following exercise examines two sets data files that were recorded simultaneously from one vessel, using two different sounders (a BioSonics DT echosounder and a Simrad EY500 echosounder). The clock on one sounder was fast by 7 hours so the data files do not overlap in time. The cruise track contains classic cruise track problems. Only the BioSonics file contains GPS fixes. The data were collected in a lake in New York State.

The exercise omits calibration for expediency and works up the data in a new EV file. If you have the time calibrate the variables. The solution file is:
C:\Myriax\Echoview\Echoview4\Echoview manual\2 Calibration\Continuity of data (Solution).EV

Synchronize time

Two unsynchronized sounders, one sounder turned off for 30 s

1. Start Echoview.

2. On the **File** menu click **New.**

3. In the **New EV file dialog box**, click **No template**.
   A new EV file is created with default settings.

4. On the **Filesets – File 1** window click **Add**.

5. Use the Add Data Files dialog box to find the .DG6 data files:
   C:\Myriax\Echoview\Echoview4\Echoview manual\2 Calibration\
   10012056.dg6, 10012100.dg6

6. Select both .DG6 files and click **Open**.

7. On the Fileset menu select Fileset Properties.

8. In the **Name** section type Simrad
   Click **OK**.

9. On the **Fileset** menu select **New Fileset**.
   In the **Name** section type Biosonics
   Click **OK.**

10. Click the **Biosonics** tab and select **Add**.

11. Use the Add Data Files dialog box to find the.DT4 data files
    C:\Myriax\Echoview\Echoview4\Echoview manual\2 Calibration\
    62752056.DT4, 62752100.DT4

12. Select both .DT4 files and click **Open**.

Offsets in time, aligning filesets

13. Display an Sv Echogram from each fileset.
    Minimize all other Echoview windows.

Tile horizontally

Find a common feature

14. Click the Biosonics Sv echogram.
    On the Display page of the Variable Properties dialog box.
    Color display minimum: -70
    Color display range: 36
    Color scheme: EK500
    Click **OK**.

15. Use the mouse wheel to zoom into a feature that is common to both echograms
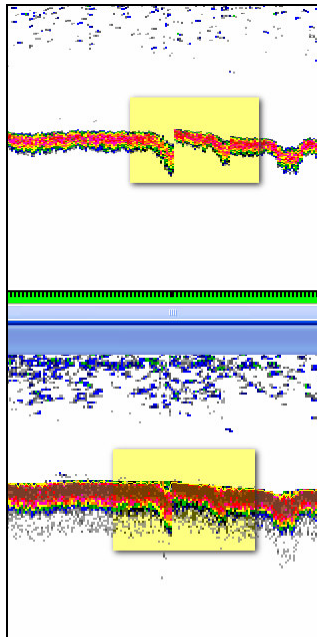
Figure 8.   Zoom on a common feature.

16. On the Details window note the time of the common feature in each echogram – the Biosonics sounder is 7 hours ahead of the Simrad sounder.

Align the times

17. Click the **Simrad** fileset.
    On the **Fileset** menu select **Fileset Properties**.
    Under **Time offset**, select **ADD** and enter **7 hours**.
    Click **OK**.

18. Re-examine the common feature, the times should be the same.

Cruise track problems and GPS fixes

19. Close the S$_v$ echograms.
    Display the **Cruise track** from the **Biosonics** fileset.
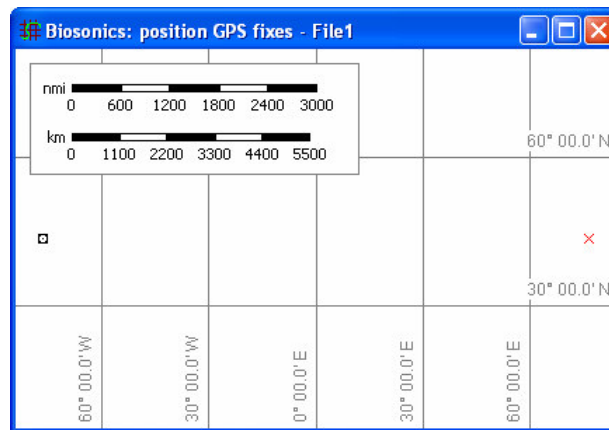
Figure 9. Cruise track (start and end) on the left hand side; across a large latitude a bad GPS fix on the right hand side.

20. On the Shortcut menu select Variable Properties.
    On the Display page
    Select Show good fixes.
    Clear Show scale bar .
    Click OK.

21. Zoom on the cruise track (the square on the left hand side).

Figure 10. An elbow in the cruise track; a large jump due to the sounder being switched off while the vessel was relocating.

22. Display the **Biosonics TS echogram**.
    Tile vertically.
    Narrow the **TS echogram** window to one quarter of its width.
    Click on the cruise track window.
    Zoom until you can clearly see the cruise track elbow, use the mouse to point to the sharp corner and on the **Shortcut** menu select **Synchronize Echograms**.

    You will see a discontinuity on the TS echogram. There is a 30 s gap with one file (62752056.DT4) before the discontinuity and a second file (62752100.DT4) after the discontinuity.

Test for uncertain track status

23. Click on the cruise track window.
    On the **Shortcut** menu select **Variable Properties**.
    Under **Maximum acceptable gap** of the **Data** page enter **20s**.
    Click **OK**.

    The sections of the cruise track that exceed 20s are colored magenta – indicating an uncertain position status. The position status is also shown on the echogram.

Maximum apparent speed

With a small ship GPS fixes can be more erratic. A large ship can have steadier GPS fixes.

The Minimum acceptable gap setting can help to smooth the cruise track.

24. Click on the cruise track window.
    On the **Shortcut** menu select **Variable Properties**.
    Under **Maximum apparent speed** of the **Data** page enter
    5, then 6, then 7, then 8 knots.
    Click **Apply** for each setting and observe the changes in the GPS fixes.

    Bad GPS fixes are displayed – 5 knots, many bad fixes; 8 knots, no bad fixes.

    Survey information (about known bad fixes) and previous experience will help you choose a suitable value for the Maximum apparent speed.

On-transect check

25. Use survey information to verify the latitude and longitude of the cruise track.

26. Use survey logs to find out if any echogram data is off-transect.

Off-transect data

27. Display the **Simrad Sv echogram**.
    The data occurring after 2/10/1996 04:10:14:400 has an unknown position status.

28. Click the **Vertical selection** tool .

29. With the mouse pointer select data from 2/10/1996 04:10:14:400 to the end of the echogram.

30. On the **Shortcut** menu select **Define Region**.
    On the Region browser:
    Name: Off-transect
    Type: Bad data
    Click **Classes**.
    On the **Regions** page, under **Region classes** click **New**.
    On the **General** page of the Region Class Properties dialog box.
    Name: Off-transect.
    Click OK.
    Click **OK**.

> *Class:* Off-transect
> Close the **Region browser**.

31. The Off-transect region now appears on every echogram.

32. On the **File** menu select **Save** - if you would like to save your work.

33. On the **File** menu select **Close**.

Tips and tricks

1. You can use Echoview virtual variables to calculate calibration constants associated with Calibration sphere data. For more information refer to Appendix H From Virtual variables training exercises Exercise 10: Calculating Calibration Constants in Echoview or refer to the Echoview help file page: Using Echoview in the calibration process.

2. When you use virtual variables you can choose to inherit calibration settings from an available variable. See also the help file topic: Inheritance of properties.

3. On the Calibration page of the Variable Properties dialog box, the Calculator button opens the Sonar Calculator dialog. The Sonar Calculator provides settings for the referenced calculation of Sound speed and absorption coefficient for fresh water and sea water.

4. The setting to show position status on echograms is:
   EV file Properties>Echogram>Show on echogram>Position status.
   Other universal echogram display settings are here too.

Refer to the Echoview Help file for more information regarding the following topics:

►   Supported echosounders, sonars and file formats

►   About Echocheck.

►   About calibration settings

►   HAC data files

►   About transducer geometry

►   About cruise tracks

►   About Regions

Topic completed

You can now:

►   Calibrate data

►   Use the Fileset offset feature to synchronize file times.

> ▶ Use Cruise track settings to smooth GPS fixes
>
> ▶ Use bad data regions to remove off-transect data from analysis.

3. Scrutinization

What is covered?

The Scrutinization topic covers the following steps in the Great Lakes Summary of the SOP[2].

1. Add a surface exclusion line (10.1.3).

2. Detect and edit the bottom (10.1.4).

3. Scrutinize echograms for bad data and remove from the analysis (10.1.5).

4. Remove ambient noise (10.1.5).

The Scrutinization stage configures the echogram for the analysis of aggregated and/or single biological organisms. It is at this stage that a surface exclusion zone, an acoustic bottom line, bad data, background noise and other sources of unwanted echo are characterized and accounted for.

This stage is also useful for determining likely analysis thresholds and the possibility of species differentiation in multiple frequency data.

The exercises begin with a calibrated EV file using the single frequency EK60 data examined in Topic 2.

The Solution file is:

C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Scrutinization of data (Solution).EV

Surface exclusion zone

A surface exclusion zone excludes data from the upper part of the echogram from analysis. The zone's data may be unreliable for one or more of the following reasons:

- ▶ It is within 2 times the near-field boundary (R_b) of the transducer – between the transducer and R_b there is a break down of far field conditions[4,5] (2005, 2008).

- ▶ It is affected by physical surface conditions[5,6] (2008, 2005) – caused by wind or rough weather, or "bergy" bits etc.

- ▶ It is affected by vessel noise/bubbles/cavitation/turbulence[5,6] (2008, 2005).

- ▶ It is affected by unwanted biological echo[6] (2005).

- ▶ It is affected by transducer "ringdown".

Starting points for surface exclusion zone scrutinization are:

- ▶ Appendix E: Working range for far-field conditions.

- ▶ Survey logs

- ▶ Appendix D: Examples of echogram interpretation.

▶ Previous experience.

The calibration of transducer location in Transducer Properties accounts for transducer depth.

The outcome is the creation of an Echoview line - initially defined at a specified depth and possible manually edited for local conditions. The line is used as an "Exclude above line" for analysis.

Surface line

1. Start Echoview.

2. On the **File** menu select **Open**.

3. **Browse** to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Scrutinization of data.EV
   Click **Open**.
   The data in the EV file is calibrated with values from the first ping and transducer draft is set to 3.5m.

4. Use the Horizontal band tool ▱ to zoom in on the top of the S_v echogram.
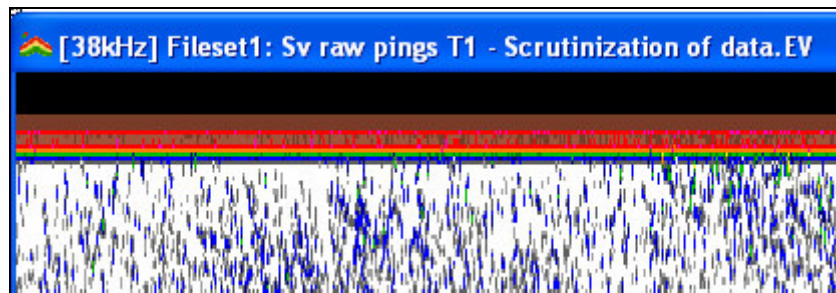
Figure 11.   Top 12m of the Sv echogram. The black band shows the transducer draft (3.5m), the colored banding(3.5 to 6m) is the ringing of the transducer and there are scattered aggregations of plankton.

5. For this data the surface exclusion zone includes:
   Transducer draft: 3.5m
   Transducer ringing: 3.5-6m
   $2R_b$:9.2m (worked example from Appendix E: Working range for far-field conditions.)
   The reverberation from aggregations of plankton will be accounted for at another step – Removing unwanted reverberation.
   Sea surface conditions are calm and there is an absence of bubbles/cavitation.

Create a Surface line at 10m

6. Click the Line draw tool arrow ◠▾, select **New Editable Line**.
   On the New Editable Line dialog box:
   Create a new line: Surface line
   Source Fixed depth: 10m

Click **OK**.
A green line appears at the top of the echogram.

The bottom exclusion zone and the acoustic bottom line

It is important to exclude seabed echo from data used in analysis because the echo strength from the seabed is typically orders of magnitude greater that the echo strength from biological organisms.

The acoustic bottom is the line that defines the boundary between samples in a ping that contain no significant contribution from the seabed echo and those samples that do contain significant contribution from the bottom echo. The line is typically used as the "echo integration stop" within a ping or as the "exclude-below line" in Echoview.

The acoustic bottom line can be based on:

▶ A sounder-detected bottom line derived from the data file (where available).

▶ A line generated by a bottom detection algorithm in post-processing (line pick algorithm).

▶ Manual editing.

▶ A combination of a any of the above.

The acoustic bottom line should be set slightly higher than the detected seabed depth to avoid including data from the beam dead zone[7] (2005) and poorly defined bottoms. A suggested offset is 0.5 m but 0.2 to 1 m is acceptable[8].(2008)

The acoustic bottom line must be verified and faults due to failures in equipment or failures in the detection algorithms must be corrected – usually by manual editing.

The following example does not have a sounder-detected bottom line. If there were one that is of acceptable quality, you could create an editable line that is a copy of the sounder-detected bottom line and then work with that.

e.g.

Click the Line draw tool arrow , select **New Editable Line**.
On the New Editable Line dialog box:
Create a new line: Copy of sounder-bottom
Source Existing line: Sounder detected-bottom
Click **OK**.

Diagnostic aids for creating an acoustic bottom line in this EV file are:

▶ A Best bottom line pick line

▶ An Offset from the line pick line (offset by -2m)

▶ A 1000mx50m grid on the echogram

An analysis has been set up for the space between the line pick of the acoustic bottom and an offset line 2m above the line pick.

The echogram's integram is configured to display mean Sv calculated for the analysis. The along-track display of the cruise track shows mean Sv of the analysis with respect to the echogram grid.

The aim is to exclude unwanted reverberation (seabed or other) in the line pick for the acoustic bottom. Strong mean Sv indicates that a visual inspection and possible edit of the line pick is required.

Appendix G: Hydroacoustic issues associated with acoustic bottom verification is a useful guide on the identification of the dead zone, beam side lobe artifacts and biological reverberation close to the seabed.

Determining the acoustic bottom line

Along track analysis and the Echogram integram as a bottom exclusion diagnostic
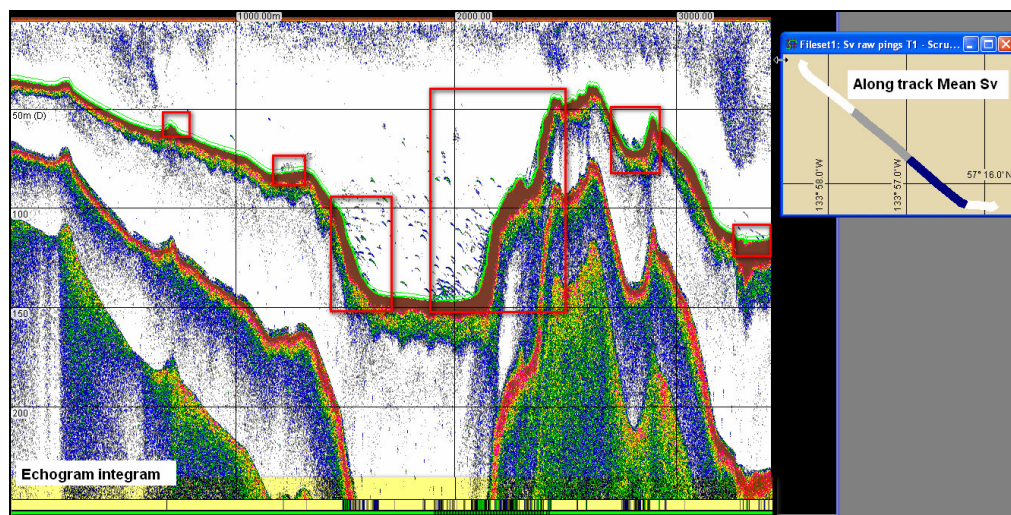
Figure 12.   *Best bottom line pick with a back step of 0.5m. The along- track display shows Mean Sv for the 1000m grid. The highlighted Integram shows the mean Sv between the Offset line and the Best bottom line pick. The red boxes indicate sections of the line pick that need to be verified and manually edited. The line pick algorithm performs poorly in these areas because of the nature of the seabed, the beam's dead zone, beam side-lobe artefacts and the presence fish close to the seabed.*

Line pick algorithm

7. Click EV file Properties to view the line pick settings.
    Line picking algorithm: Best bottom candidate
    Start depth: 10m
    Click **OK**.
    Note: The Backstep (default offset for the line) is 0.5m

8. Click on the S$_v$ echogram.

Inspecting the line pick

9. On the View menu select Cruise track, Copy of S$_v$.

10. Tile vertically the **Sv echogram** and the **Copy of S$_v$** cruise track.
    Zoom in to display the seabed and bottom line.
    Click on a colored section of the cruise track.
    On the Shortcut menu select Synchronize echograms.

    This method is useful if you have a long transect and you want to quick go to areas of concern in the bottom pick in the Sv echogram.

11. From the beginning through to the end of the echogram, inspect the area around the Best Bottom Line Pick line.
    - OR -
    Synchronize to areas of concern using the cruise track as a guide.

    Use a combination of
    Rectangle tool ▢
    Zoom (S)
    The echogram window scroll bars.

    It will be evident where the Best Bottom line pick fails and needs to be manually edited.

Fixing the Acoustic bottom line – a manual line edit of copy of the line pick

12. Click the Line draw tool arrow ⟋▾, select New Editable line.

13. On the New Editable Line dialog box:
    Create a new line: Acoustic bottom line
    Source Existing line: Best bottom line pick (E)
    Offset, Linear function, Multiply depth by: 1.00
    Click **OK**.

14. Click the **S$_v$ echogram**.
    On the **Shortcut** menu select **Variable Properties.**
    Click the **Analysis** page.
    Exclude below line: Acoustic bottom line
    Click **OK**.

15. Display the area around the **Acoustic bottom line**.

16. Click the **Line draw tool arrow** ⟋▾, select **Acoustic bottom line** (to make the Acoustic bottom line active).

    The mouse pointer is now in line edit mode ⟋.

17. Inspect the Acoustic bottom line

18. Freehand draw a new section of line.

or
Make successive clicks to draw straight segments of a new section of line.

To clear a mistake press **ESC** and begin again.

19. Merge your line edits with the Acoustic bottom line.
    On the **Shortcut** menu select **Update Active line**.
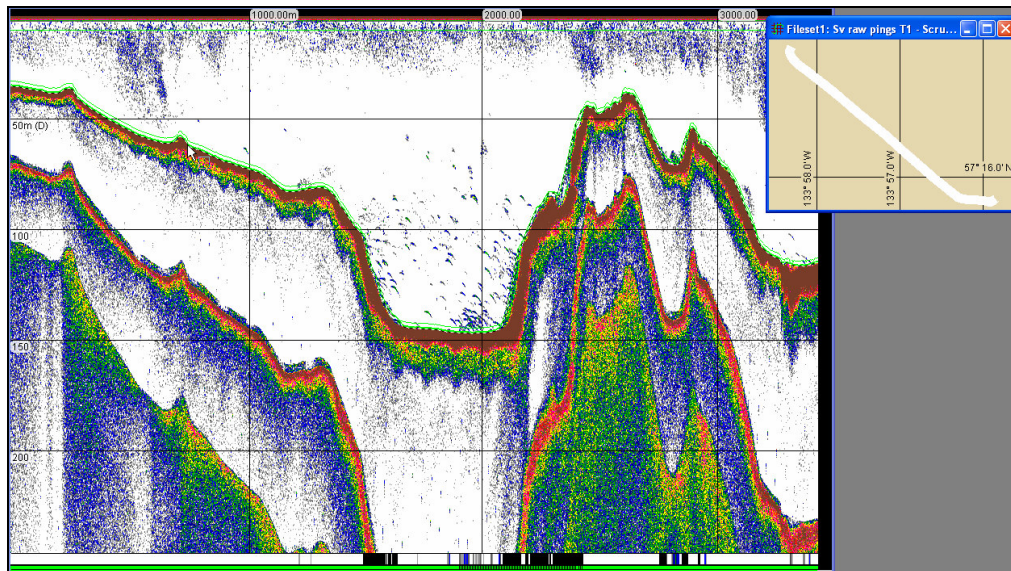
Figure 13.   Verified Acoustic bottom line. Note the changes in the Integram display and the along-track mean Sv display. Compare with Figure 12.

Regions – types and classes

Regions in Echoview are a feature of the EV file and are specified by depth and time. Once defined, a region can be applied to all echograms in an EV file, including virtual echograms.

Two important properties for regions are:

▶ Region **type**- used to describe the intended use for a region (Analysis region, Bad data region or Marker region).

▶ Region **class** - used to group regions for any specified purpose.
  e.g. Plankton surface line to 50m, Fish within 20m of seabed, Shallow schoolers, Deep plankton, Vessel noise.

A bad data region can be used to enclose data (of any type) which is to be excluded from analyses. This is a useful way to exclude data that have known problems, such as data affected by bad weather, interference, ghost bottoms or echosounder malfunction.

Analysis regions can be used to enclose/segregate data which is to be included in analysis. When it is suitable, a 2D schools detection can create a differentiated 'school' region. (see also Regions, species and classes – automated method using the Echoview Schools detection module).

Regions can be used to partition echogram data into classes. Regions must not overlap if you

intend to make use of the relationship:

NASC of a Cell in an echogram = Sum of PRC_NASC of regions in the cell.

Where NASC is nautical area scattering coefficient and PRC NASC is the Proportioned Region to Cell NASC.

The conditions for this relationship to be true are:

– the regions fill the cell completely

– the regions do not overlap with one and another.

Step 6 of the Great Lakes SOP includes a note to consider "the assumption about fish density in bad data regions is important if those regions are large".

Creating regions

Bad data regions

1. Scrutinization of data. EV has no bad data. You do not need to create regions for bad data.

2. However when you do have bad data you can create regions using any of the following selection tools:

   ▶ Rectangle tool

   ▶ Horizontal band tool

   ▶ Vertical band tool

   ▶ Parallelogram tool

   ▶ Polygon tool

   ▶ CTRL+J (create a region for the current ping – the default is a Marker region.)

3. Once the region is created, on the Shortcut menu select Define Region.
   On the **Region Browser**:
   Name: Name of region.
   Type: Bad data
   Class: Create a class or Assign a class
   Click **OK**.
   Bad data regions were created in the section on Off-transect data

Marker regions

4. There are two geographic locations:
   SE corner of San Juan Island at ping 53.
   Round Rock at ping 889.

5. Display the area around the ping (53, 889).

6. Place the mouse over the ping.
    Press CTRL+J

7. On the **Region Browser** click **Classes**.
    Under **Region Classes**, click **New**.
    Name: Geographic marker.
    Click **OK**.
    Click OK.

8. On the **Region Browser**.
    Name: The geographic location.
    Type: Marker.
    Class: Geographic marker.
    Under the **notes section** type the geographic location.
    Close the **Region Browser**.

9. Repeat step 26 then step 28 for the other location.

10. Click the EV file Properties tool .
    On the Echogram page select Show on Echogram: Notes for Marker regions.
    Click OK.

11. Save your EV file.

12. Close your EV file.

Analysis regions

1. On the **File** menu select **Open**.

2. **Browse** to:
    C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Scrutinization and analysis regions.EV
    Click **Open**.

3. Press **F11** or **F12** until the Color Display minimum is **-90dB**
    4 regions are defined according to the distribution of reverberation from fish and plankton.

4. The creation of the **Bottom region** is almost finished. The Bottom region should not overlap with the Densely Populated region. To satisfactorily finish the creation of the Bottom region the region boundary needs to be fixed.
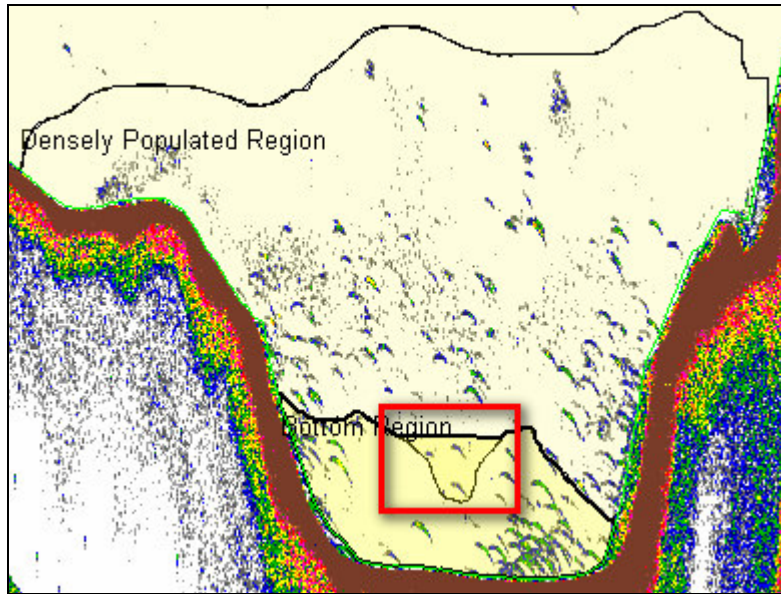
Figure 14.   Overlap of the Bottom Region with the Densely Populated Region.

5. Click the **Bottom Region**.
    Use the mouse wheel to Zoom into the area of concern.

6. Click the Region Edit tool arrow 🚩 ▾ and select Draw.

7. Draw a new boundary line for the Bottom region – follow the lower boundary of the Densely Populated Region.

8. Close the EV file.

Reverberation and noise

Great Lakes SOP advice

📖 Great Lakes SOP Summary

7. Remove ambient noise (10.1.5).

"Calculate noise at 1 m depth in the Sv domain…Noise at 1 m is different for TS and Sv data, but can be calculated from each other."

The SOP advises the Echoview user to integrate noise levels and subtract them after data export.

Section 10.1.5 of the Great Lakes SOP refers to noise removal techniques for Sv (volume scatterers) and TS (single scatterers).

Characterization of reverberation and noise

In their discussion on echo detection, Simmonds and MacLennan[6] discuss reverberation and noise.

"Reverberation is the general term used to describe echoes from unwanted targets." As a consequence, the echoes that you attribute to reverberation are dependent on the purpose of the analysis or survey. If you intend to study fish, then echoes from plankton are reverberation. Conversely, if you intend to study plankton, echoes from fish are reverberation.

On the other hand noise is the term used to describe "unwanted signals that are present in the medium but independent of the echosounder transmission".

This 'background noise' can come from:

▶ Vessel sources e.g. propeller cavitation, machinery, electrical interference etc

▶ Changes with water depth

▶ Flow noise

▶ Animals, rain, wind, waves

▶ Electrical noise from echosounder hardware

Things that affect signal and noise

The choice of transducer frequency dictates the maximum working range and the type of observations you can make[9] (2005). Frequency also constrains beam width and pulse length which affect resolution. Similarly, the absorption coefficient in the medium affects the signal to noise ratio (SNR)[10] (2005).

TS data is affected by an r^4 reduction in signal with range, and Sv data is affected by an r^2 signal reduction with range.

The preceding considerations can give you a starting point for the likely SNR and background noise in your data.

Multiple frequencies

Multiple frequencies can be used to differentiate reverberation and wanted echoes – if there are useful frequency responses to exploit. With multiple frequency data, background noise removal is very important. For more information refer to 5. Multiple frequency data.

Noise removal strategies

Characterize your noise

Graph a ping to determine:

▶ the nature of the noise

▶ the magnitude of the wanted echo

▶ the magnitude of the reverberation.

Single Ping and TVG function
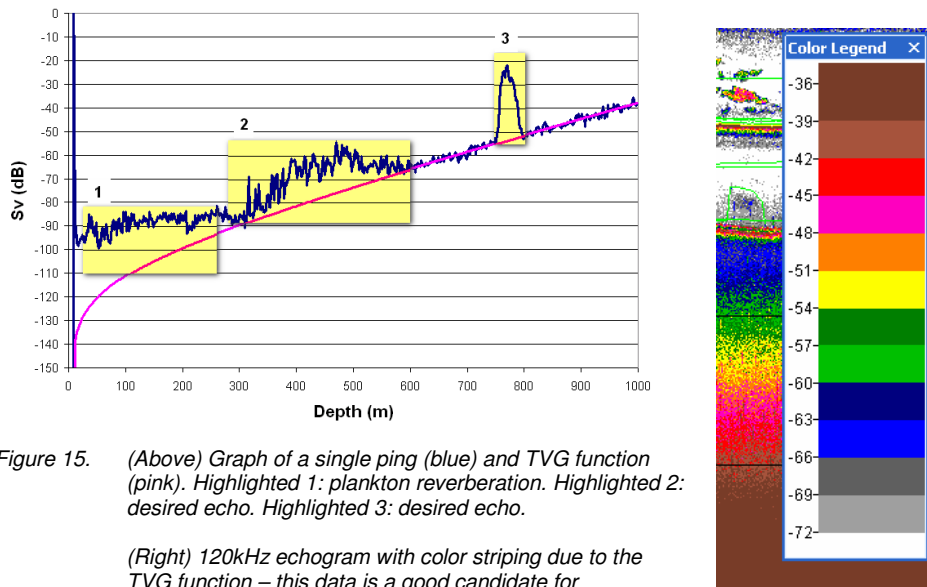
Figure 15. (Above) Graph of a single ping (blue) and TVG function (pink). Highlighted 1: plankton reverberation. Highlighted 2: desired echo. Highlighted 3: desired echo.

(Right) 120kHz echogram with color striping due to the TVG function – this data is a good candidate for background noise subtraction.
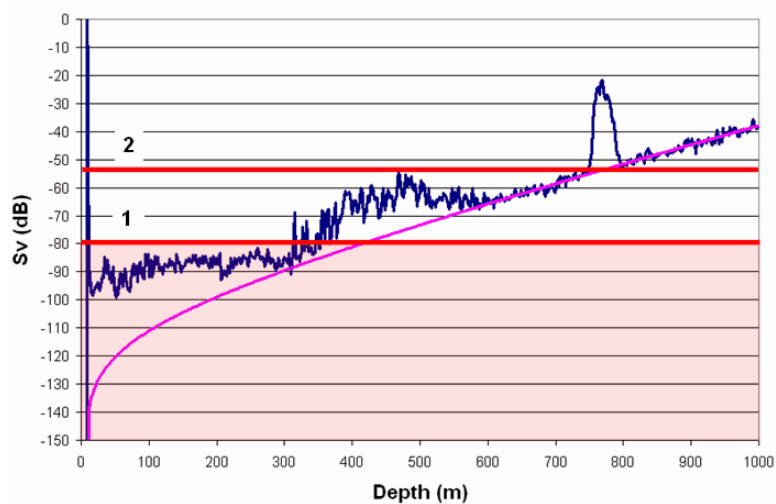
Figure 16. Noise removal and threshold strategies.
The pink line is the 'TVG' noise – if this is subtracted the wanted echo and plankton reverberation remain.

Threshold 1 removes the plankton reverberation and some of the wanted echo at -80dB, however 'TVG' noise remains for echo below 450m.

Threshold 2 removes all echoes below -54dB; 'TVG" noise remains for echo below 800m.

When SNR is >>15dB you can use a constant data threshold or a TVT threshold (where the noise at 1m is determined empirically). Thresholds allow you to ignore noise below a set value however a certain proportion of the noise can remain. The larger the SNR, the smaller the proportion of remaining noise. Another drawback is that any wanted signal below the threshold is ignored.

When SNR is moderate to poor the best strategy is to model the noise and subtract it.

Echoview noise and reverberation features

Echoview offers features (that do not require the Virtual echogram module) to:

▶ Calculate background noise analysis variables (to export) to use in downstream analysis outside of Echoview.

▶ Threshold or filter acoustic data used for analysis.
On the Data page of the Variable Properties dialog box available features can include:

  ▶ Minimum and maximum thresholds

  ▶ Minimum TS threshold

  ▶ Time varied threshold (TVT)

With Echoview's Virtual echogram module you can use operators that apply more complex threshold(s), model TVG noise and subtract modeled noise.

▶ Data generator operator - creates pings to specified settings and ping geometry – useful in modeling TVG noise and in background noise subtraction methods (when used with the Linear minus operator).

▶ Threshold operator – compares data values from two variables.

Another useful feature is the Threshold response graph, where you can view the effect of threshold Sv value (X axis) versus the resulting NASC (Y axis). The graph can be linked to a selection or region and display the threshold response of a single variable or multiple variables.

Whatever the mix of single target scatterers and volume scatterers, the background noise removal/minimization and reverberation removal strategies you use will need to be optimized. The optimization process is in effect a sensitivity study.

Finally, you need to consider the effects of under-estimation or over-estimation of the analysis results due to the noise and reverberation strategies you used.

Noise and reverberation analysis

1. Start Echoview.

2. On the **File** menu select **Open**.

3. **Browse** to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Noise and reverberation analysis.EV
   Click **Open**.

4. Display the 120 kHz Sv echogram.

5. Zoom in so that you can see ping 599 and the fish highlighted in Figure 17.

6. Point to **ping 599**.
   On the **Shortcut** menu select **Graph Ping**.
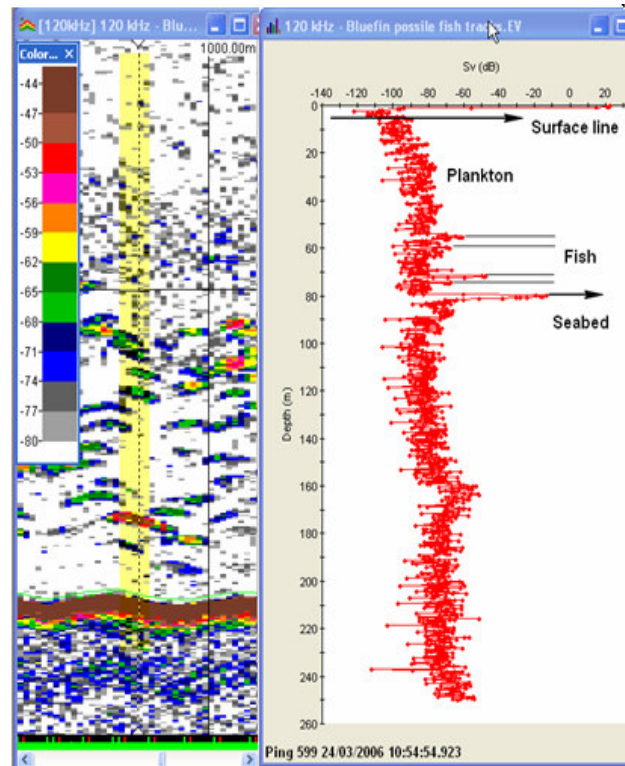
Figure 17.   Graph of ping 599 in the Noise and reverberation analysis.EV file.

7. Observe the features of the ping graph, as labeled in Figure 17.
   The peak Sv for the fish and fish aggregations are greater than 10dB above the plankton and noise. There is also no indication of "TVG' curve in the slope of the noise.

   If you are interested in fish, a threshold for the reverberation from plankton is appropriate here.

Threshold response graph

8. To determine the correct threshold to apply, you can observe the effect of a threshold value on integration results.

9. Close the ping graph.

10. On the **Shortcut** menu select **Variable Properties**.
    Click the **Analysis** page
    Exclude above line: Surface line
    Exclude below line: Acoustic bottom line
    Click **OK**

11. On the **View** menu select **Graph**, **Threshold response**.

(Step 11 configures the Threshold response graph)
On the **Shortcut** menu select **Properties**
Under **Variable** select **120 kHz**
Under **X axis limits**
Select **Custom limits**
Minimum: -100.00
Maximum: -30.00
Steps: Maximum
Click **OK**.

12. On the **Graph** menu select **Linking, Selection**.

13. Click the **Horizontal band** tool
On the 120 kHz echogram,
Make a selection:
From the Surface line to the seabed.
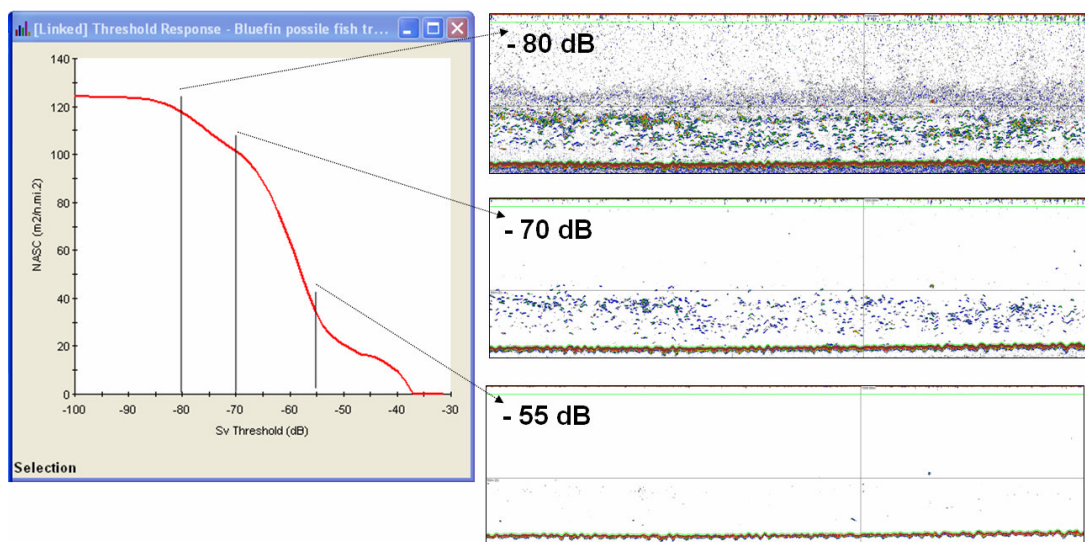
Figure 18.   Threshold response for the 120 kHz Sv echogram – the echograms to the right show the display threshold at -80 dB (plankton and fish), -70 dB (fish) and -55 dB (fish or fish aggregations with strong signal).

14. Observations from the ping graph, the Threshold response graph and varying the Color display minimum suggest that much of the plankton can be removed with a threshold set at -70dB. This leaves a small amount of plankton, the fish and fish aggregations. If you are interested in the fish aggregations with very strong signal a threshold of -55 dB can be used.

Data threshold and integration results

15. Close the Threshold graph.

16. Using the **Horizontal selection** tool
Make a selection from the surface line to the seabed

17. On the **Shortcut** menu click **Integrate selection**.
On the Integration results dialog box, click **Linked**

Note: NASC is 124.03.

18. On the **Shortcut** menu select **Variable Properties**.
Click the **Data** page
Under **Minimum threshold** select **Apply**.
Clear **Lock to Color display minimum** and enter **-70dB** as the minimum threshold.
Click **Apply**.

Note: NASC is 101.30.

19. The choice of a minimum threshold of -70 dB is a compromise – it removes most but not all of the plankton data and maximizes the fish data.

20. Close the EV file (without saving).

Noise subtraction using virtual variables

The next set of instructions use virtual variables to estimate and subtract background 'TVG' noise for a simple example. While another example of the subtraction of background noise and reverberation using virtual variables (multiple frequencies) can be found in the section The dB difference technique implemented using virtual variables.

For more information about the estimation of echosounder background-noise levels and SNR, refer to De Robertis and Higginbottom[11](2007) for their discussion of a "simple and effective post-processing technique to estimate echosounder background-noise levels and SNR …".
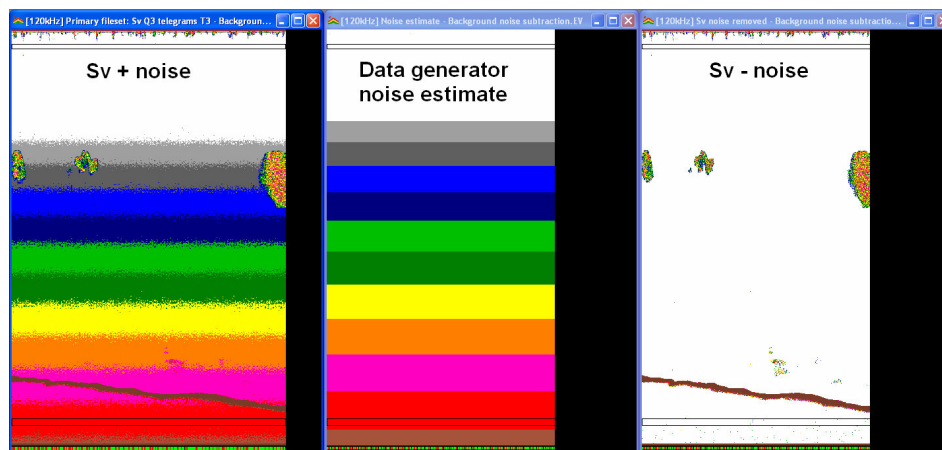
Figure 19.   Sv echograms from the Background noise subtraction .EV file. Sv+noise, Data generator modeling TVG noise, Sv – noise.
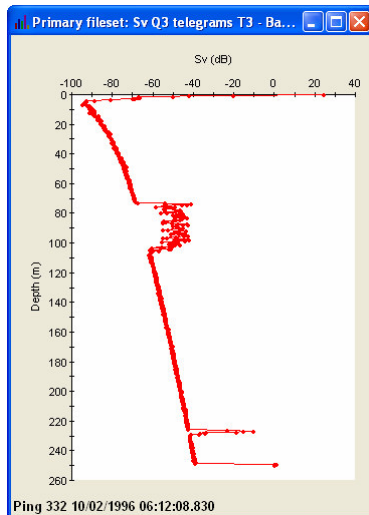
Figure 20. *Ping graph of ping 332 in Sv + noise echogram.*
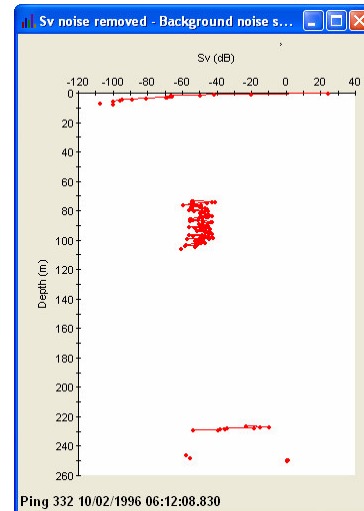
Figure 21. *Ping graph of ping 332 in (Sv – noise) echogram.*
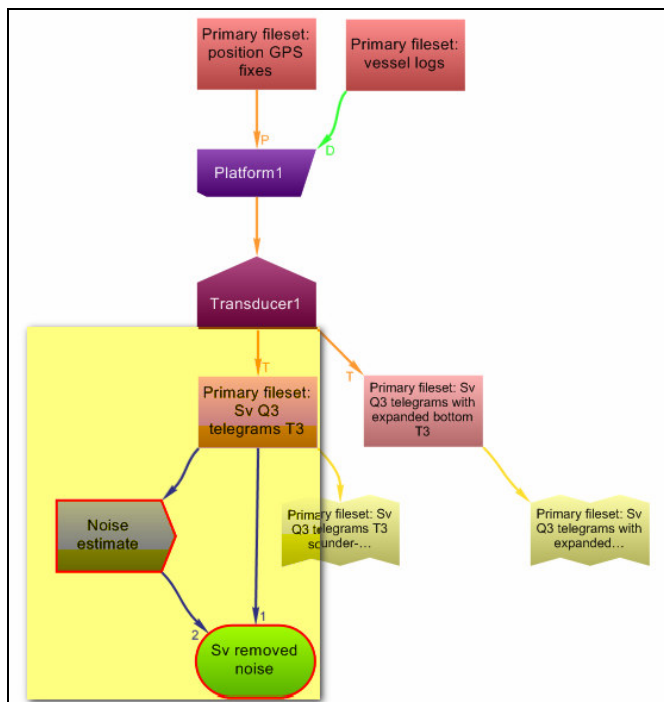
Figure 22. *Virtual variable chain for background noise subtraction.*

1. Start Echoview.

2. On the **File** menu select **Open**.

3. **Browse** to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Background noise subtraction.EV
   Click **Open**.

4. Display the **Sv** echogram.
   Display the **Ping graph** for ping **332**

The echogram and the ping graph shows the wanted echo, echo from the seabed and 'TVG' noise as displayed in Figure 19 and 20.

Two regions have been created in "quiet" parts of the echogram – at the top and below the seabed. The regions can be useful (for integrations) in the investigation of noise and wanted echo.

Model the TVG noise with the Data generator operator

If you haven't used Echoview virtual variables before, we advise you to do some pre-reading with Appendix H: Using virtual variables in Echoview.

5. Click the Variables and Geometry tool .
   On the **All** page
   On the **Shortcut** menu select **New**, **Variable**.
   Name: Noise estimate)
   Operator: Data generator
   Click **OK**.
   On the **Operands** page
   Operand1: Primary fileset Sv Q3 telegrams (i.e. uses the ping geometry of this Sv variable).
   On the **Generator** page
   Output type: Sv
   Algorithm: Constant + TVG curve
   Sv at 1m: -109.9 (arrived at by previous observation - of the effect of TVT threshold on Sv).
   Click **OK**.

Subtract the Noise estimate from the Sv variable

6. On the **Shortcut** menu select **New**, **Variable**.
   Name: Sv removed noise
   Operator: Linear minus
   Click **OK**.
   On the **Operands** page
   Operand 1: Primary fileset Sv Q3 telegrams
   Operand 2: Noise estimate
   Click **OK**.

7. Display the **Noise estimate** variable and the **Sv removed noise** variable.
   Arrange the echograms so that you can see all of them (See Figure 19).

8. On the **Noise estimate** echogram
   On the **Shortcut** menu select **Variable Properties**.
   Change the *Sv at 1m* value, click **Apply** and observe the changes in the **Sv removed noise** echogram.

   A ping graph of a ping running through a school can be useful in this optimization

process. (See Figure 21).

9. Save your EV file under a different name.

Tips and tricks

Refer to the Echoview Help file for more information regarding:

▶ Integram

▶ Along-track cruise track display

▶ About lines

▶ or can be used with the Shortcut menu **Define line-relative regions**, and Region edit tools to create regions incorporating lines like the acoustic bottom line.

▶ Region class.

▶ Region type.

▶ Ping graph.

▶ Threshold response graph

▶ About NASC and PRC NASC

Topic completed

You can now:

▶ Create and edit a surface line.

▶ Create and edit an acoustic bottom line

▶ Assess your data for wanted echo, unwanted echo and noise.

▶ Remove noise and reverberation from analysis.

4. Analysis

What is covered?

This topic covers Sv and TS analysis and single target and fish track analysis.

Also covered are the following steps in the Great Lakes Summary of the SOP.

1. Extract TS data from single echo detections (10.2).

2. Study the TS distribution at different depths (10.4).

3. Set the minimum TS of interest (10.4.2 and 10.4.3).

4. Set the integration threshold (10.4.4).

5. Choose the size of the analysis cell (10.3).

Analysis strategies

The View and inspect, Calibration and Scrutinization stages can give you some insight into the type of analyses you can perform on data.

For Sv data, where echoes cannot be resolved into single echoes, analysis using echo integration is appropriate. It may also be possible to characterize the composition of aggregations. Sv and mean TS (via trawl or direct measurement of single fish) can be used to calculate density and in the end biomass.

Analysis regions can be manually defined. Alternatively, if you have the Echoview Schools detection module analysis regions can be automatically detected.

For Sv data where echoes are single targets (one fish in the beam), analysis using single target detection or echo counting is appropriate. In riverine data fish track analysis can be applied to estimate fish flux.

Further options become available when you have concurrent multiple frequency data. Where biological scatterers exhibit different frequency responses you can use multiple frequency techniques to clearly differentiate echoes from different species. (For more information refer to 5. Multiple frequency data.)

Sv analysis

Regions, species and classes – manual method
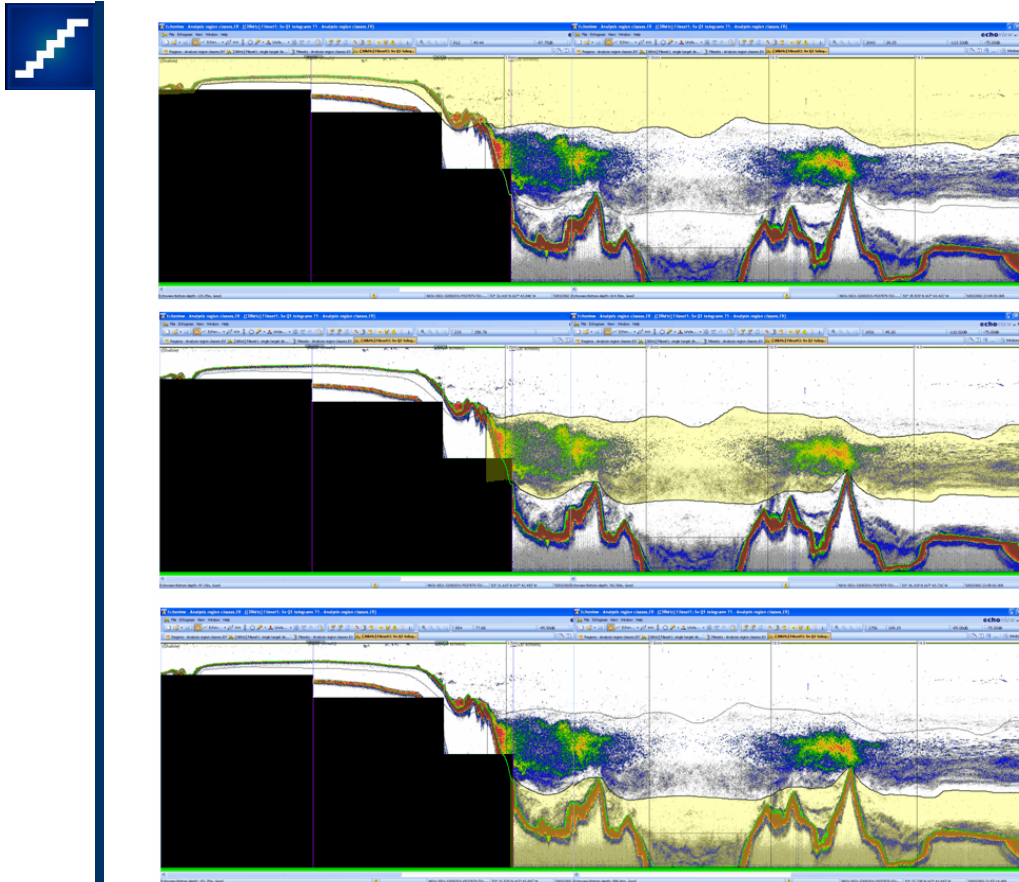
Figure 23.   *Analysis region classes.EV SvQ1 telegrams T1 echogram – the regions do not overlap.*
Top: Small schools analysis region, Shallow class.
Middle: Large Schools analysis region, 500m class.
Bottom: Deep Plankton analysis region, Deep class.

The *Analysis region classes.EV* file uses a set of data files collected in Alaska on a Simrad echosounder and processed with Simrad's BI500 software. In this file, the depth range of the sounder was increased in four steps as the vessel moved from shallow water to deeper water (150 m then 250 m then 500 m then 1000 m).

Some of the features that have been created are:

- ► a surface line called Top
- ► an acoustic bottom line called Echoview Bottom
- ► bad data regions
- ► analysis regions (that do not overlap)
- ► large cells (for training purposes)

The regions and region classes were created using the techniques described in

Creating regions.

1. Start Echoview.

2. On the **File** menu select **Open**.
    Browse to:
    C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Analysis region classes.EV
    Click **Open**

3. View the Sv Q1 telegrams T1 echogram.

4. Click the Region Browser tool .

5. On the echogram, click the regions in turn (see Figure 17) and view the region name, region type and region class.
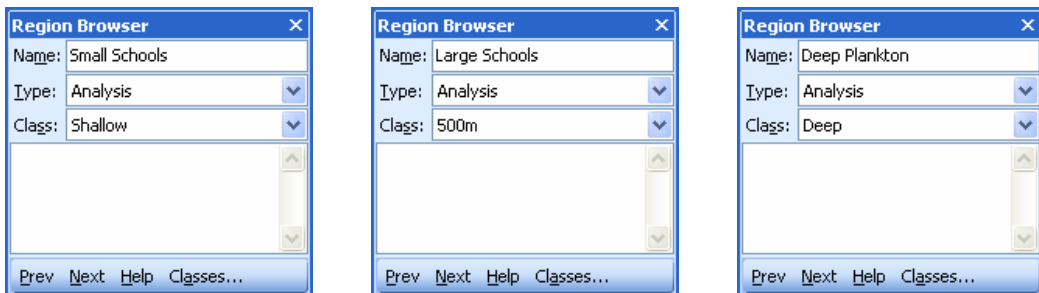
Figure 24.   Details of regions

6. Close the EV file.

Regions, species and classes – automated method using the Echoview Schools detection module
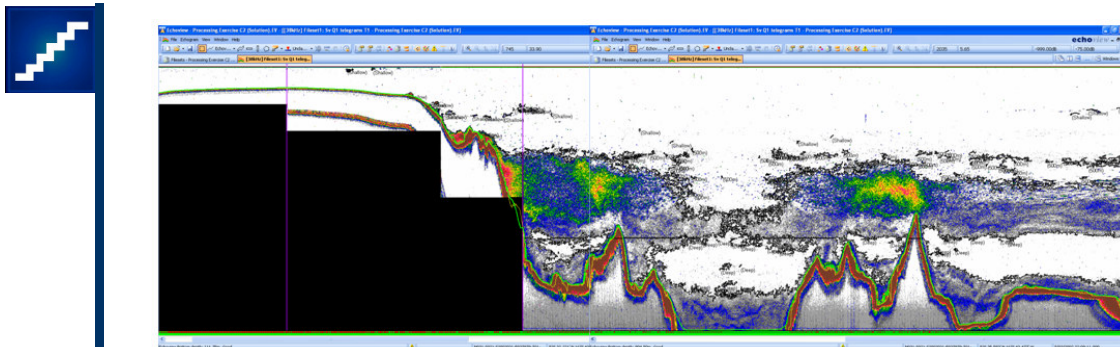
Figure 25.   Schools detection on the echogram data for Figure 17.

The *Schools detection (Solution).EV* file uses same data files as the *Analysis region classes.EV* file.

Some of the features that have been created are:

▶ a surface line called Top

▶ an acoustic bottom line called Echoview Bottom

▶ bad data regions

▶ school regions as a result of applying the schools detection algorithm to successive selections of the echogram data.

One of the advantages of using schools detection is that the regions describing the schools enclose the echo trace produced by the school more precisely than the manual approach. Echoview can then calculate properties of the detected schools.

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Analysis region classes.EV
   Click **Open**

3. Display the SvQ1 telegrams T1 echogram

Delete the analysis regions

4. On the **Echogram** menu click **Region Manager**
   Under the **Region type** list, select **Analysis**
   In the **Action** section, click **Delete regions**
   Click **Yes**
   Click **OK**

Configure Schools Detection

Set a data threshold

5. On the **Shortcut** menu select Variable Properties
   On the **Data** page, select **Apply under Minimum threshold**
   On the **Display** page, under the **Color display minimum** enter **-75 dB**
   Click **OK**

Set the linking distances
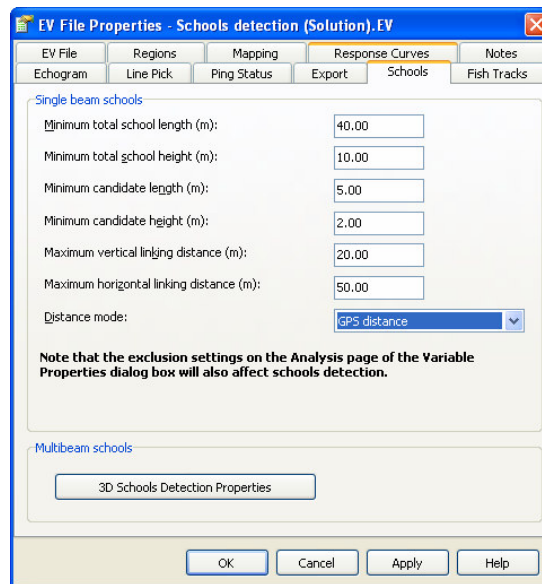
Figure 26.   Schools page of the EV File Properties dialog box – settings for schools detection.

6. Click the **EV File Properties** tool
   On the **Schools** page
   Maximum vertical linking distance = 20 m
   Maximum horizontal linking distance = 50 m
   Click **OK**.

   Note:
   1. Schools detection needs a data threshold to be specified.
   2. This data file spans relatively large distances between pings so you must adjust
   the linking distances to prevent the creation of disconnected schools. You can to
   experiment with lower linking distances to see the effect of linking distance.

Detect Schools – regions and classes

Class 500m

7. Click the **Horizontal band tool**
   Select a band from about 300m depth to 650m depth
   On the **Shortcut** menu click **Detect Schools**
   In the **Assign class** list, click **500m**
   Click **Detect**

Class Deep

8. Click the **Horizontal band tool**
   Select a band from about 650m depth to 1000m depth
   On the **Shortcut** menu click **Detect Schools**
   In the **Assign class** list, click **Deep**
   Click **Detect**

Class Shallow

9. Click the **Horizontal band tool**
    Select a band from about 0m depth to 300m depth
    On the **Shortcut** menu click **Detect Schools**
    In the **Assign class** list, click **Shallow**
    Click **Detect**

Analyze schools – export schools variables

Specify export settings

10. Click the **EV File Properties** tool
    On the **Export** page
    Under the **Integration schools** group select:

    Uncorrected_thickness
    Uncorrected_area
    Corrected thickness
    Corrected_area

    and clear:
    3D_school_volume

    Also clear:
    Noise_Sv_1m (**Integration settings** group)
    Minimum_Sv_threshold_applied (**Integration settings** group
    Maximum_Sv_threshold_applied (**Integration settings** group
    Standard_deviation (**Integration results** group)
    Exclude_below_line_range_mean (**Analysis domain** group)
    Exclude_above_line_range_mean (**Analysis domain** group)
    Click **OK**

Export a school analysis

11. On the Echogram menu select Export, Analysis by Regions, Integration

12. In the Export regions with this class list select 500m

13. Click **Export**

14. File name = **500m schools**

15. Save the EV file with a new file name.

16. Close the EV file.

17. Examine the **500m schools.csv** file in Excel.

Size of the analysis cell

For aggregated echoes in detected schools or in manually defined regions, the size of the analysis cell can be used to differentiate the variation of mean S_v in the aggregation. For example, when aggregations are more than a few hundred meters in extent, smaller cells are useful in capturing mean variations in Sv. The results can then be correlated with companion species or species age or species size.

Integration – on screen

Integrate a cell

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Analysis region classes.EV
   Click **Open**

3. View the **SvQ1 telegrams T1** echogram.

4. Move the mouse pointer over the start of the **500m region**.
   On the **Shortcut** menu select **Integrate Cell**.
   The results are shown on the Integration results dialog.
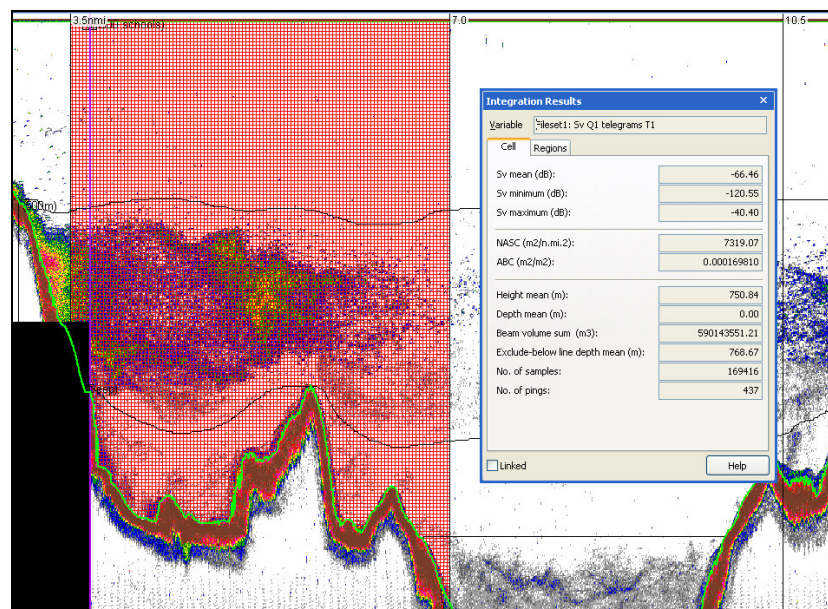
Figure 27.   On screen analysis: cell integration.

Integrate a region

5. Press **Esc**.
   Select the **500m region**.

On the **Shortcut** menu select **Integrate Region**.
The results are shown on the Integration results dialog.
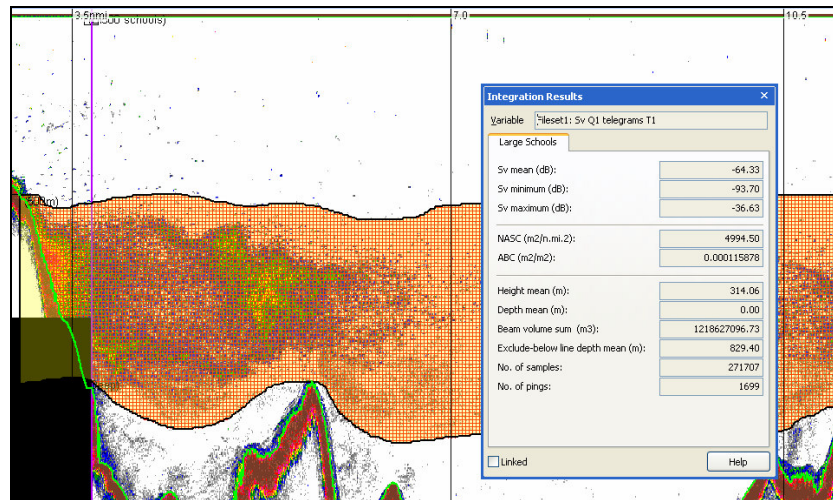
Figure 28.   On screen analysis: region integration.

Integrate a selection

6. Click above the line **Top**.
   Press **Esc**.

   Click on the Rectangular selection tool
   Draw a rectangle over an area of high Sv.
   On the **Shortcut** menu select **Integrate Selection**.
   The results are shown on the Integration results dialog.
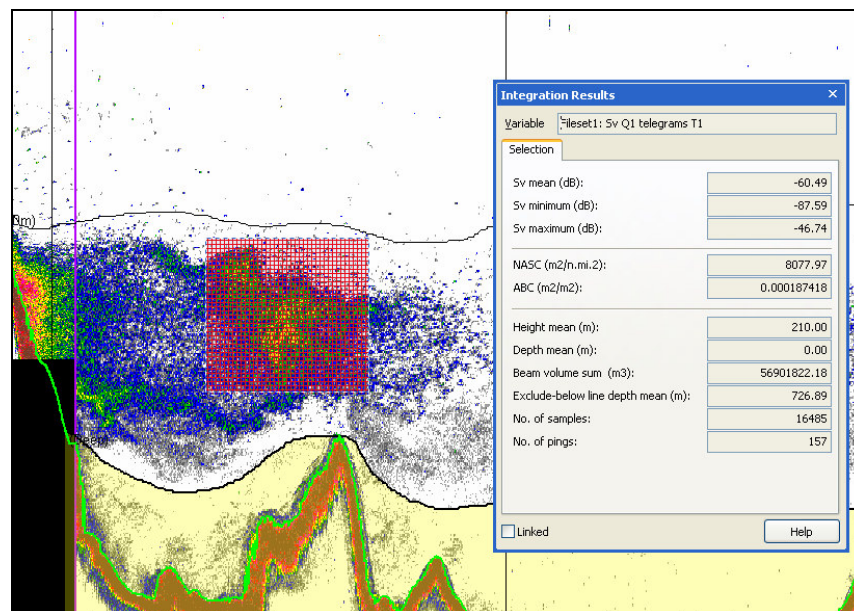
Figure 29.   On screen analysis: selection integration.

7. Echoview offers a range of onscreen integration features. These can be accessed by the **Shortcut** menu and the **Display** page of the **Variable Properties dialog box**.

8. **Close** the EV file.

Single targets

Clues to identifying the presence of single targets in your data are:

▶ Crescent shaped or wavy shaped (from crescents plus platform movement) groups of samples.

▶ Samples that look like fish tracks
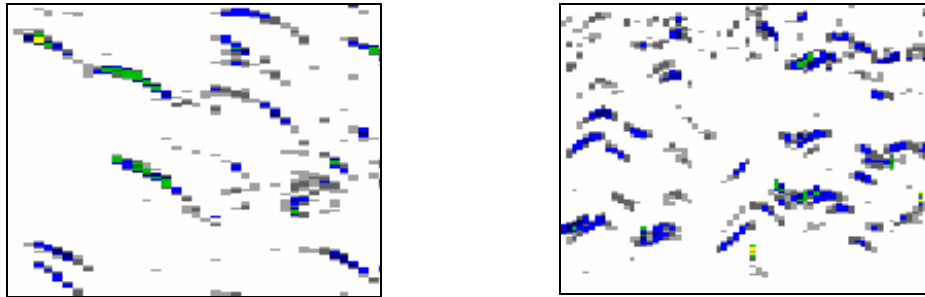
Figure 30.   Left – an example of crescent shaped groups (Ex60 38 kHz data)
Right – an example of wavy shaped groups (Ex60 38 kHz data)

Single target detection algorithms extract data that satisfy detection criteria but not all the identified targets may be valid single targets[12, 13, 14] (2005, 1996, 2001).

It is not possible to obtain valid TS distributions from within dense fish schools using acoustic data. This is because there is always more than one fish inside the sampling volume (unless of course the "school" has a sufficiently low density so that the condition of having a single fish in the sampling volume is fulfilled). This is one of the classic problems of fisheries acoustics.

Single targets data type

A 'single target' in Echoview is the representation of an acoustic echo attributed to a single backscattering target detected within the beam of an echosounder. Each single target has a number of properties: Target Strength and range from the transducer are notable, but many other properties are available for analysis.

Single targets are represented on echograms as colored rectangles. The rectangles are displayed with the width of the ping in which the target was detected and a thickness (height) which is defined as a function of the transmitted or received pulse lengths.

Single target detection raw variables can be derived from data (if they are available). Otherwise Echoview offers single target detection algorithms that you apply to your data using virtual variables.

Echoview also offers single target data manipulation operators for advanced analysis.

Extract TS data from single echo detection

📖 Great Lakes SOP Summary

8. Extract TS data from single echo detection (10.2).

"Run single echo or target detection algorithms. Use the same method when measuring TS of the calibration ball (EV)…."

Study TS distribution at different depths

📖 Great Lakes SOP Summary

9. Study the TS distribution at different depths (10.4).

"Use the TS versus Depth graph. Note that changes in TS distribution with depth may indicate a change in fish species or age group composition with depth or a bias related to the sampling volume and number of targets. Compare different regions of the lake (nearshore, offshore). Define depth layers for analysis based on this TS graph. The data should be analyzed in depth layers with as homogeneous fish species and size structure as possible. Different depth regions may have to be used in different parts of the lake."

Single target detection raw variables – from EK500 data

Figure 31.   Single target detections E1 telegrams T1 echogram, Display thickness is 0.5. The single target and single target properties are highlighted.

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Single targets in EK500 data.EV
   Click **Open**.

3. On the **Filesets** window, view the **Filesets1** page.
   Echoview derives a raw variable, from the EK500 data, called **single target detections E1 telegrams T1**.

4. Display the **single target detections E1 telegrams T1** echogram.
   Observe the single targets.
   Note: To the eye some of the single targets display plausible lines of movement – it would be useful to apply a fish track detection algorithm to this data.

5. **Zoom** in so that you can clearly distinguish the single targets.
   Place the mouse pointer over a single target and observe the single target properties in the Details dialog box.

6. Close the **EV file**.

Single target detection virtual variables via TS and angular position from EK60 data

Echoview derives TS and angular position raw variables from the EK60 data in the following EV file. The recommended single target detection algorithm for this data is a split beam method 2 algorithm.

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Scrutinization of data (Solution).EV

3. Click the Variables and Geometry window.
   On the **Shortcut** menu select **View**, **New View**.
   On the **Shortcut** menu select **View**, **View Properties**.
   Under **Name** enter **Single target detection**.
   Click **OK**.

Single target detection algorithm

4. On the newly created Single target detection view.
   On the **Shortcut** menu select **New, Variable**.
   Under operator select **Single target detection – split beam (method 2)**
   Click **OK**
   On the **Operands** page:
   Operand 1: Fileset1 TS raw pings T1
   Operand 2: Fileset1 angular position raw pings T1

   On the **Single Target Detection** page
   TS threshold: -50
   Pulse length determination level: 6.00
   Minimum normalized pulse length: 0.50

> *Maximum normalized pulse length:* 1.00
> *Beam compensation model:* Simrad LOBE
> *Maximum beam compensation:* 25.00
> *Minor-axis angles:* 0.5
> *Major axis angles:* 0.5
> *Exclude targets above line:* Surface line
> *Exclude targets below line:* Acoustic bottom line
>
> On the Analysis page
> *Exclude above line:* Surface line
> *Exclude below line:* Acoustic bottom line
> Click **OK**.

5. Double click the Single target detection (split beam) method 2 1 variable to display the single targets echogram.
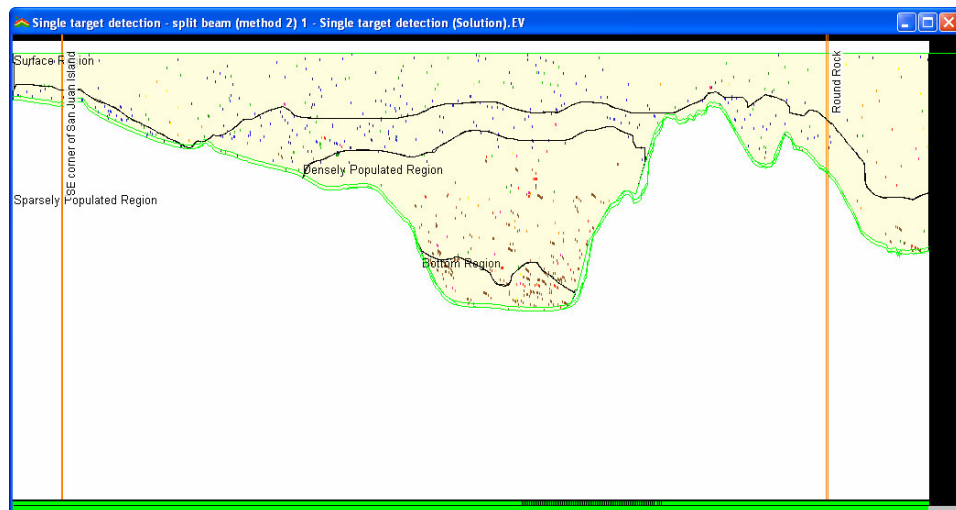
<p align="center">Figure 32.   Single target detection echogram.</p>

Tuning the single target detection settings

Tuning the settings for single target detection involves testing the sensitivity and effectiveness of the algorithm settings on the **Single target detection** page of the **Variable Properties dialog box**.

Initially, widen up all the single target detection parameters with the exception of the Pulse length determination level.

This involves lowering:

- ► TS Threshold (to the minimum of -120 dB),

- ► Minimum normalized pulse length (to the minimum of 0.01),

and raising:

- ► Maximum normalized pulse length (to the maximum of 10),

- ► Maximum beam compensation (to the maximum of 35 dB),

▶ Maximum standard deviation of minor-axis angle (to the maximum of 45°),

▶ Maximum standard deviation of major-axis angle (to the maximum of 45°)

until as many targets are detected as possible. Then study the effectiveness of the settings and the resulting detected targets.

Frequency Distribution

6. Display the TS echogram.
   On the **Shortcut** menu select **Variable Properties**.
   On the Analysis page
   Exclude above line: Surface line
   Exclude below line: Acoustic bottom line
   Click **OK**.

   Click the **Horizontal band tool** ▭
   Select a band from the Surface line to the seabed
   On the Shortcut menu select Graph Selection, Frequency Distribution.
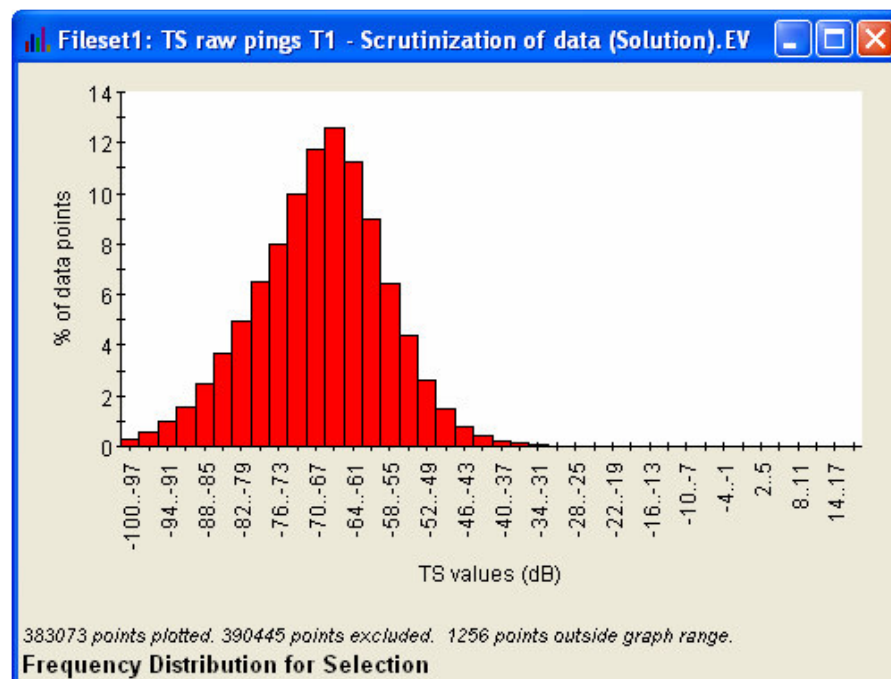
Figure 33.   TS frequency distribution in a horizontal selection – TS echogram.

Study the TS

The following graphs are available for regions or selections. The Frequency distribution graph is available for single-beam variables.

TS Frequency Distribution

7. Display the Single target detection (split beam) method 2 1 echogram (this echogram is used for all the steps in the **Study the TS** section.).

   Click the **Horizontal band tool** ▭

Select a band from the Surface line to the seabed
On the Shortcut menu select Graph Selection, TS Frequency Distribution.
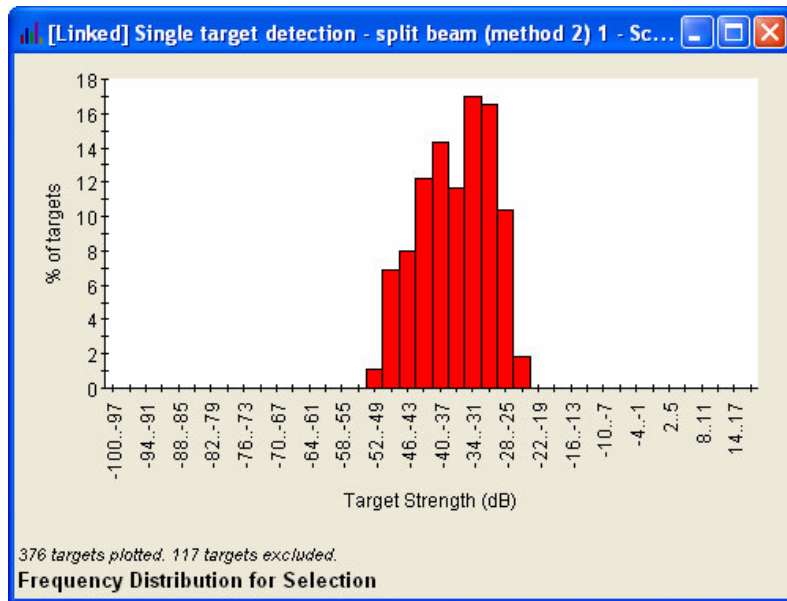
Figure 34.   TS frequency distribution of single targets in a horizontal selection.

TS Depth

8. Click the **Horizontal band tool**
    Select a band from the Surface line to the seabed
    On the Shortcut menu select Graph Selection, TS vs. Depth
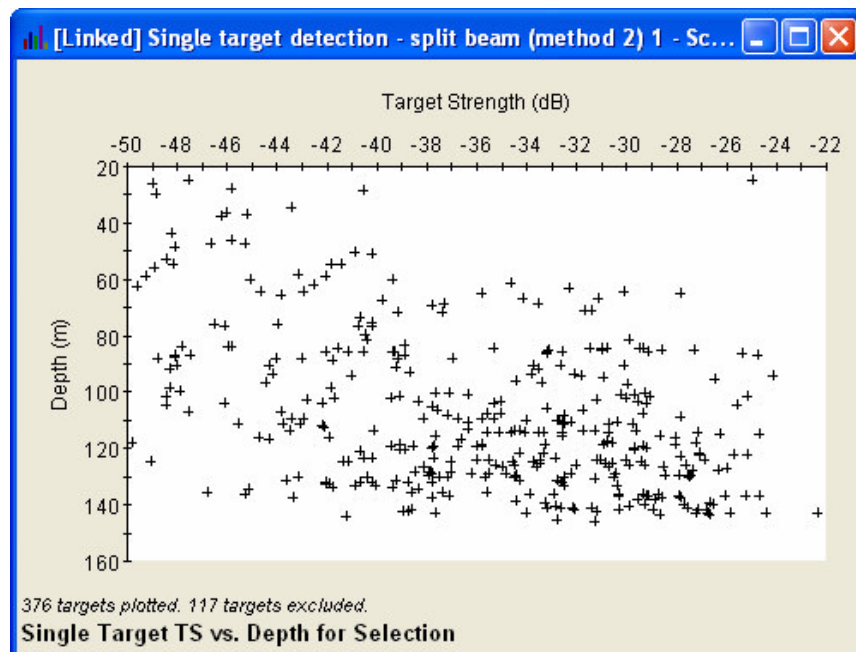
Figure 35.   TS vs. Depth graph.

Angles

9. Click on the Bottom region.
    On the Shortcut menu select Graph Region, Angles.
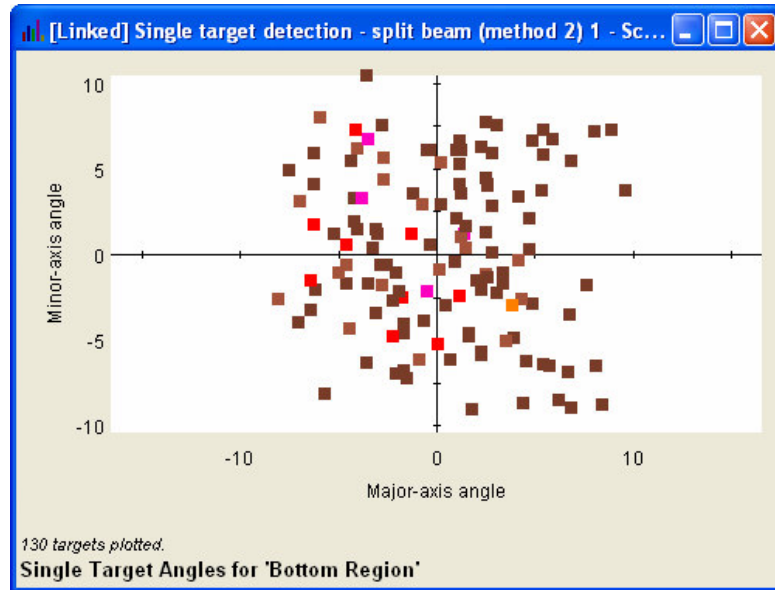
Figure 36. Angles graph.

2D Projections

10. Click on the Bottom region.
    On the Shortcut menu select Graph Region, 2D Projections.
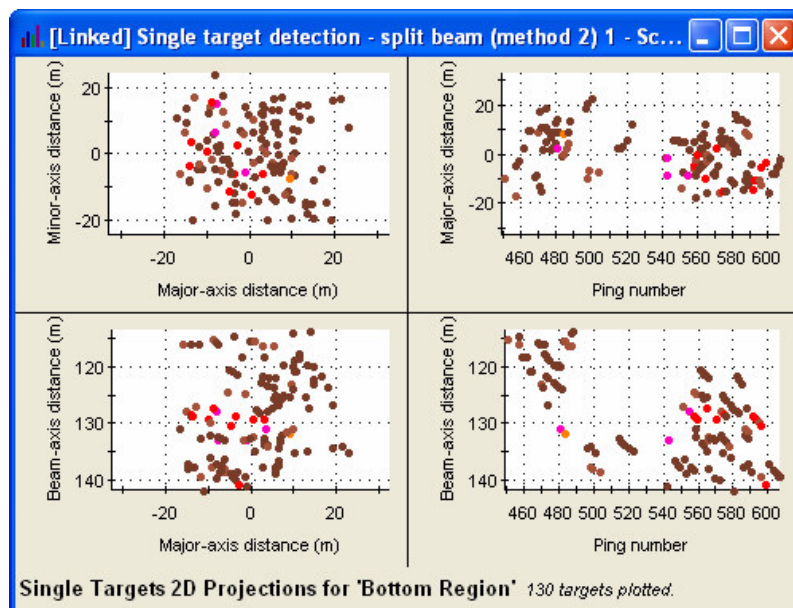
Figure 37. 2D projections graph

3D Single targets graph

11. Draw a rectangular selection around a crescent shaped group of single targets
    On the **Shortcut** menu select **Graph Selection**, **3D Single targets**
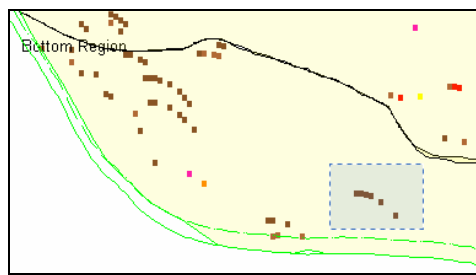
Figure 38.   *Above: a rectangular selection around a crescent shaped group of single targets*

Right: 3D single targets graph of single targets relative to the beam.
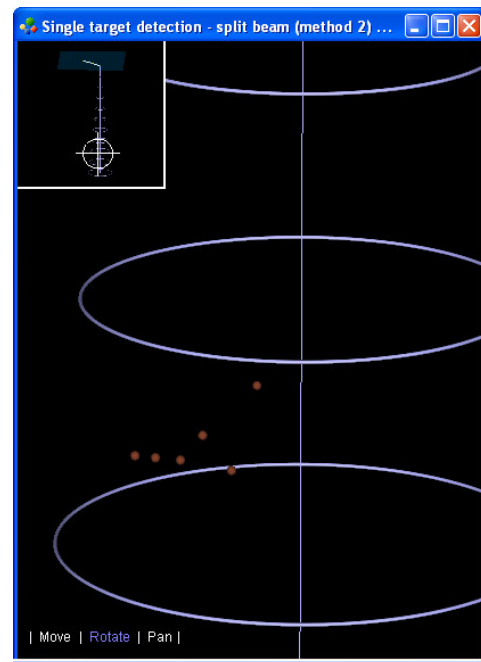
Set the minimum TS of interest

Great Lakes SOP Summary

10. Set the minimum TS of interest (10.4.2 and 10.4.3).

"Based on the measured TS distribution and/or known TS distribution of the fish species of interest, set the minimum TS. Check the TS distribution down to -75 dB to see if smaller targets are likely to be included in the fish TS range. Common values for minimum TS of interest range from -65 to -55 dB, but this depends on survey species or age-class."

Information about the TS distribution can come from relevant literature or previous surveys.

Minimum TS for the Scrutinization example

The fish we are interested in lie in the Densely Populated region and the Bottom region. Observations of the data while the display threshold is varied on the TS echogram suggest that the TS threshold for our fish is -50dB. We have used -50dB as a TS threshold value for the single target detection algorithm.

Set the integration threshold (TS threshold on an Sv echogram)

Great Lakes SOP summary

11. Set the integration threshold (10.4.4).

"The integration threshold should be set to 6 dB below the minimum TS threshold (in the TS domain) to account for observations of all targets above the minimum TS within the half

power beam width.…If it is not possible to set a TS based threshold for integration, choose a lower Sv threshold of -80 dB."

Echoview can apply a TS threshold to Sv data (on an Sv echogram). The intent of such a threshold is to remove samples below a specified TS value. Echoview's algorithm uses the S_v equivalent of the TS threshold in its calculations, so that samples are thresholded out in an unbiased way.

Integration threshold for the Scrutinization example.

12. Display the S_v echogram.
On the **Shortcut** menu select **Variable Properties**.
On the **Data** page:
Under **Minimum TS threshold**
Select **Apply**
TS threshold: -56dB

Click **TS TVG correction settings**
TVG range correction method: Simrad EX60 default
Click **OK**.
Click **OK**.
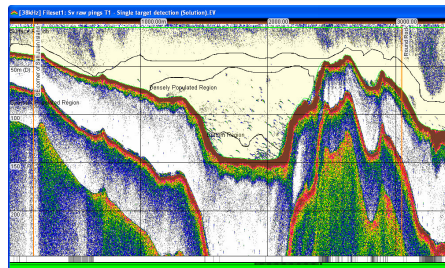
Figure 39.   Sv echogram, no TS threshold.   Figure 40.   Sv echogram, TS threshold = -56dB
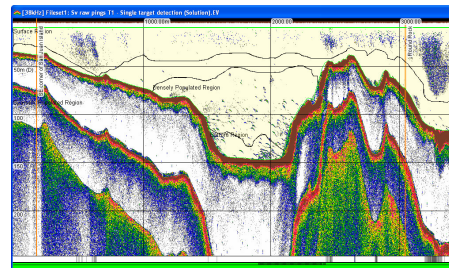
Size of the analysis cell

Great Lakes SOP Summary

12. Choose the size of the analysis cell (10.3).

"This should include 20 to 50 single fish echoes in most cells. We suggest 200 to 500 m long horizontal bins. Range (depth) layers need to be chosen given the fish distributions (see step 10). Integration bins could be shorter if using geostatistics and fish are abundant, or longer if few fish are present. If the depth layers are small, the horizontal distance may need to be increased to get sufficient number of targets in the analysis cells."

Size of the analysis cell for the Scrutinization of data example

13. Display the **Single target detection** echogram.
    On the **Shortcut** menu select **Variable Properties**.
    On the **Grid** page:
    Under **Show time/distance grid** select **GPS distance (m)**
    Distance between grid lines: 250m
    Under **Show depth/range grid** select **Depth/range**
    Separation: 25m
    Click **OK**.

14. Use **rectangular selections** and the **TS Depth** graph **or** the **TS Frequency Distribution** graph to count the number of single targets in the cells of interest.

15. When you achieve a satisfactory cell size, enter the grid values on the **Grid** page of the **Variable Properties dialog box** for the **Sv variable**.

16. **Save** your EV file.

17. **Close** the EV file.

Fish tracking

Fish track detection is used to identify groups of single targets that show a pattern of systematic movement. The targets grouped into a fish track are assumed to have been generated by a single object moving through space.

Echoview's α-β Fish Tracker algorithm implements a fixed coefficient filtering method as presented in Blackman[15] (1986) and discussed by Dawson and Mulligan[16] (2000).

Behaviors in single target data that suggest fish track detection and analysis would be useful include:

▶ Single targets that show a pattern of systematic movement to the eye.

▶ Single targets that occur in groups shaped like crescents or waves (an effect of transducer/platform movement on the crescent shape).

Available algorithms

Echoview offers the choice of two fish track detection algorithms:

▶ The 2D algorithm uses the range and time information of the single targets. Choose this option if your data is from a single beam or dual beam echosounder. You can also choose this option if you want the detection to disregard the angles in split beam data - all targets will be treated as if they were at the centre of the beam.

▶ The 4D algorithm is intended for use with split beam data and uses the angular position information of the targets in the beam in addition to the range and time. It is also used with data from mobile surveys.

The fish track detection process

The identification of single targets as fish track candidates and the formation of fish tracks

can be optimized with the following settings:

Track detection: alpha and beta

Alpha is sensitive to unpredicted changes in position or speed of the target. Beta is sensitive to unpredicted changes in velocity of the target.

For a target that swims or travels in a highly predictable fashion use low alpha and beta values. Conversely, for more erratic target behavior use high alpha and beta values.

Target gate

These settings specify how large a candidate track's acceptance gate for predicted single target movement is in time and space.

Weighting

Assigns a degree of importance to the predicted and observed difference for the candidate single target in TS, minor-axis, major-axis, range or time. Weighting can be applied for all, some or none of these.

Track acceptance

Criteria for an acceptable fish track.

Tuning fish track detection

Empirical tuning of fish detection can be done by:

- ► Visual inspection – on screen.
- ► Detecting tracks with a set of parameters and assigning the results to a region class. This can be done any number of times. The results can then be exported and analyzed.

Editing fish tracks and manual classification

Echoview provides powerful fish track editing and manual classification features. They are provided by the:

Fish track tool

- ► Split and Merge fish tracks

- ► Remove and Add Target(s) from/to a fish track

- ► Delete and Create fish tracks

Region edit tool .

- ► Edit a fish track region using the Region Edit Tool

Fish track detection

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Single target detection (Solution).EV
   Click **Open**.

3. Display the Single target detection (split beam) method 2 1 virtual echogram.

4. Click the EV File Properties tool .
   On the **Echogram** page under **Show on Echogram** clear **Region names** and **Region classes**.
   Click **OK**.

5. On the **Echogram** menu select **Detect Fish Tracks**.
   Note: You can detect fish tracks on the whole echogram or on a selection.

Create a Region class and set detection parameters – tuning using empirical results

6. Under **Assign class**, click **Edit.**
   Under **Region classes** click **New**.
   Under Name enter Alpha 0.5 Beta 0.5.
   Click **OK**.
   Click **OK**.
   Under **Assign class** select **Alpha 0.5 Beta 0.5** from the list.

   Click **Properties**.
   On the **Algorithm** page
   Under **Data** select **4D (range, angles and time)**
   Under **Track detection**
   Alpha: 0.5, 0.5, 0.5
   Beta: 0.5, 0.5, 0.5

   Under **Target gates**
   Exclusion distance: 9.00, 9.00, 1.00
   Missed ping expansion: 0.0, 0.0, 0.0

   On the **Weights** page
   Major axis: 30
   Minor axis: 30
   Range: 40
   TS: 5
   Ping gap: 0

   On the **Track Acceptance** page

Minimum number of single targets in a track: 3
Minimum number pings in a track: 3
Maximum gap between single targets: 3
Click **OK**.

Click **Detect**.

Note: You can tune the detection empirically by repeating step 6 using a different set of parameters and region class. Examine the region classes by on screen analysis (**Shortcut** menu>**Analyze fish track**) or export the results and analyze (see also Exporting TS data – the Fish tracking.EV example).

7. Display the Sv echogram.
   Tile horizontally.

8. On the Single target detection echogram, zoom in on the Bottom region.
   On the Shortcut menu select Synchronize all echograms.
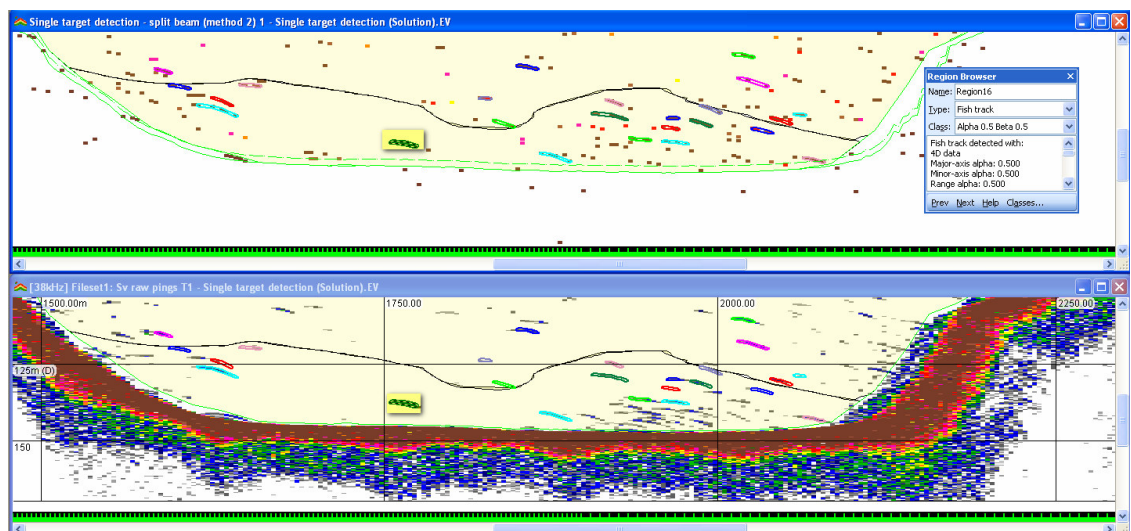
Figure 41.   Top: Single target detection echogram. Bottom: Sv echogram. Both echograms are synchronized and display data in the Bottom region. A detected (and active) fish track region16 is highlighted – fish track regions (colored and thick border) enclose single targets in a fish track.

Fish track tool

9. Click the Fish track edit tool .

10. Click the Region Browser .
    On the Single target detection echogram, click on Fish track region16.

11. Point to the brown single target at ping 522 to the right of fish track region16.
    On the **Shortcut** menu select **Add Target**.
    Fish track region16 extends to include the single target.
    Note: There are many other commands to edit and manually create fish track regions.
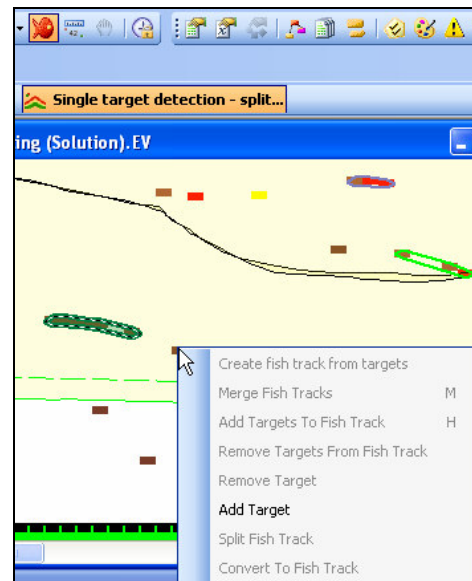
Figure 42. *Fish track region16 and Fish track editing features on the Shortcut menu – only available when the Fish track edit tool* *is selected.*

Fish track analysis

12. You can analyze fish track regions with:

  ▶ any of the TS graphs (cross ref to Study TS section)

  ▶ Shortcut menu > Analyze Fish Track
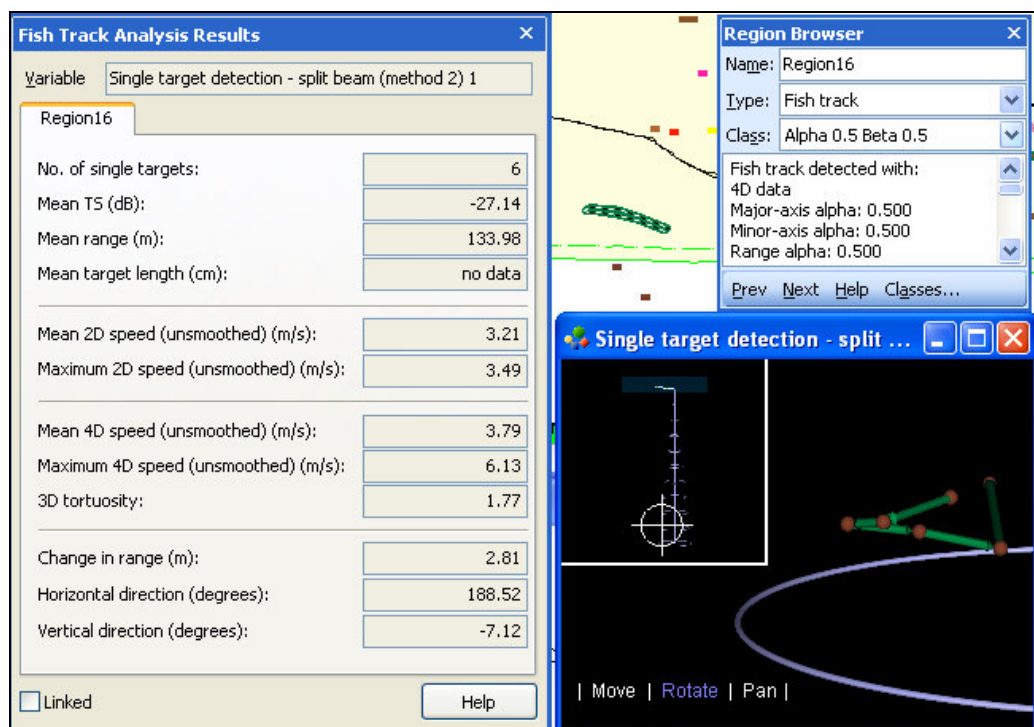
Figure 43. *Fish track region16 and Fish Track Analysis Results and 3D single targets graph.*

13. Save your work under a different file name.

14. Close the EV file.

Tips and tricks

Refer to the Echoview Help file for more information regarding:

- ▶ About regions

- ▶ How to detect and work with schools – Using single, split or dual beam data

- ▶ The Variables and Geometry window

- ▶ How to detect and work with single targets

- ▶ How to detect and work with fish tracks

Topic completed

You can now:

- ▶ Recognize the type of analysis that is appropriate for your data.

- ▶ Partition data with manual regions.

- ▶ Partition data with 2D schools detection regions.

- ▶ Use on screen integration features.

- ▶ Apply single target detection algorithms in Echoview.

- ▶ Use the TS frequency distribution graph and other TS study graphs

- ▶ Specify analysis cells.

- ▶ Apply a TS threshold for Sv data.

- ▶ Apply fish track detection to your data

5. Multiple frequency data

> **What is covered?**
>
> A dB differencing technique is discussed and implemented in Echoview. The example uses EK60 38 kHz and 120k kHz data:

Frequency differencing

You can use concurrently recorded multiple frequency data and dB difference techniques to differentiate the mean volume back scatter of species. Several discussions appears in Simmonds and MacLennan[17, 18] (2005) and work on the subject can be found in papers by Mitson et al[19] (1996), Kang et al[20] (2002) and Korneliussen and Ona[21] (2003).

The basic idea is that target strength is dependent on frequency in different ways for different species. Therefore two species of scatterers (e.g. fish and zooplankton) will, on average, have different mean backscattering strengths at different frequencies. Since the difference is in the mean backscatter it is usual to average the backscatter in cells or regions prior to calculating the dB difference.

This is applied to multiple frequencies allowing a better definition of the frequency response for the classification.

Figure 1. A general schematic description of the relative frequency response, r(f). Bands indicate typical positions of selected acoustic categories when measured at frequencies 18–200 kHz.
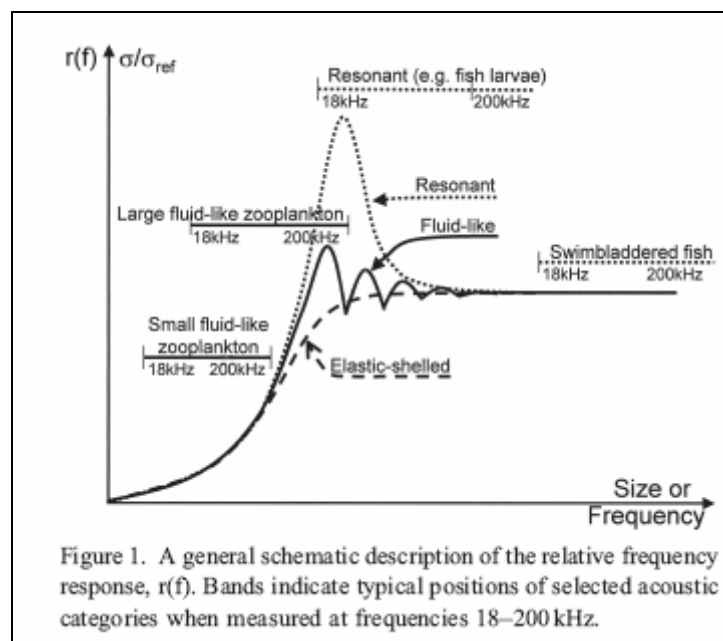
Figure 44.   Figure from Korneliussen and Ona[21]

When you use dB difference techniques, obtaining unbiased measurements requires high signal-to-noise ratio at multiple frequencies. Therefore you need to avoid the integration of noise even for one frequency. As a consequence the technique is limited to the range at which the highest frequency has a good SNR. Refer to De Robertis and Higginbottom[22] (2007) for an approach to this subject.

The dB difference technique implemented using virtual variables

In this example we use virtual variables to create a "dB difference" echogram and then classify areas of the original echogram according to specified dB difference criteria.

It illustrates the use of various virtual operators to implement a typical approach to dB differencing. The procedure outlined is not necessarily complete or applicable to any particular species classification task. You are referred to the scientific literature for working examples of this type of analysis.
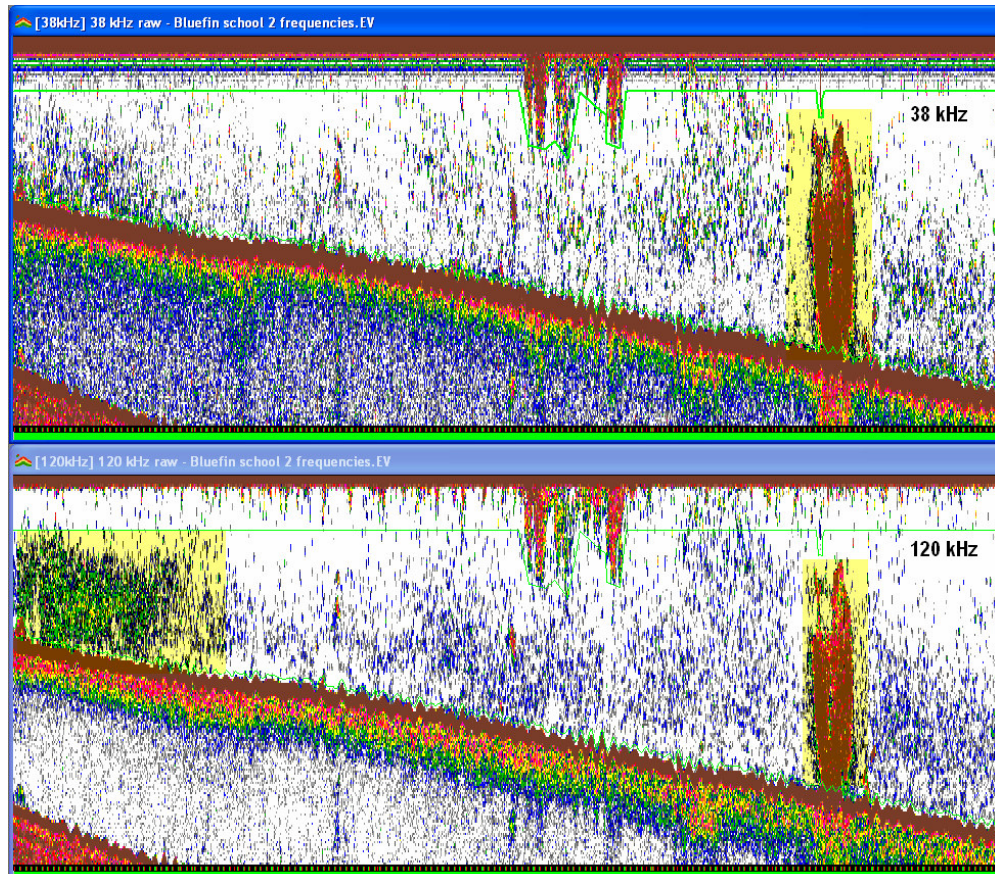
Figure 45.   Sv echograms of EK60 data from a 38 kHz and a 120 kHz transceiver. The color display minimum is -90dB for both echograms. The highlighted areas show an aggregation on the RHS in the 38 and 120 kHz echograms and an aggregation on the LHS on the 120 kHz echogram.

The data depicted in Figure 45 will be used to demonstrate dB differencing techniques. It is visually obvious that the shallow aggregation has a stronger frequency response at 120 kHz. You would also be able to see this behavior using the Frequency response graph (View menu, Graph Frequency response). The data was recorded outside Wineglass bay in Tasmania – fish that live in the region include Barracuda, Striped trumpeter, Australian salmon and Bream.
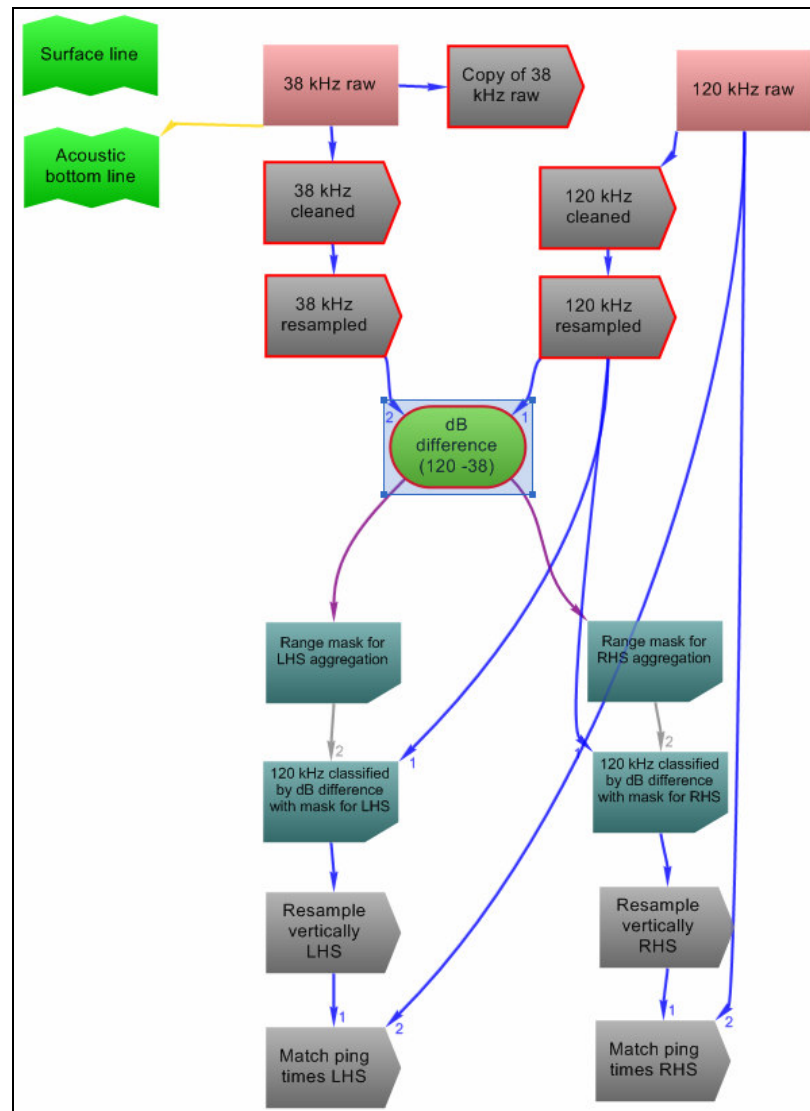
Figure 46. *dB difference technique- the Echoview chain of virtual variable*

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\5 Multiple frequency data\Bluefin school 2 frequencies.EV
   Click **Open**.

3. Display both Sv echograms

Calibration

4. The calibration for the EK60 data is from the first ping. Transducer 1 is named 38 kHz and Transducer 2 is 120 kHz.

Surface line

5. The EV file has an editable Surface line. It was first created at a fixed depth of 5m. This value is slightly larger than R_b but not $2R_b$ because the seabed is 20-35m deep

and $2R_b$ will exclude some of the LHS aggregation. Note the bands in the 38 kHz echogram in the first 5m are transducer ringdown. The Surface line has been edited to exclude an aggregation at the surface.

Acoustic bottom line

6. An editable line has been created using a Best bottom line pick. The Acoustic bottom line has been edited to skirt around seabed echo fixing areas where the line pick failed (at the RHS aggregation near the seabed). Note there are scatterers on the seabed.

   Exclude above line and Exclude below line have been selected on the Analysis page of the Variable Properties for Sv variables

Regions

7. It is possible to apply schools detection on the RHS aggregation –its mean Sv is about -48 dB. However the mean Sv for the LHS aggregation is about -77 dB.

Noise

8. Ping graphs show that wanted echoes are above the noise and TVG noise is not evident at the depths we are interested in. No noise strategy is applied for this exercise.

Sv analysis – dB differencing

9. Click the Variables and Geometry tool
   Click the View 1 page

Process data

Applies exclusions from the raw variable and changes excluded data points to 'no data'.

10. On the **Shortcut** menu select **New**, **Variable**.
    Name: 38 kHz cleaned
    Operator: Processed data
    Click **OK**
    Click the **Operands** page
    Operand1: 38 kHz raw
    Click the **Calibration** page
    Under I**nherit calibration settings from:** select **No inheritance**.
    Click **OK**.

11. On the **Shortcut** menu select **New**, **Variable**.
    Name: 120 kHz cleaned
    Operator: Processed data
    Click **OK**
    Click the **Operands** page
    Operand1: 120 kHz raw

Click the **Calibration** page
Under I**nherit calibration settings from:** select **No inheritance**.
Click **OK**.

Resample data

12. On the **Shortcut** menu select **New**, **Variable**.
   Name: 38 kHz resampled
   Operator: Resample by number of pings
   Click **OK**
   Click the **Operands** page
   Operand1: 38 kHz cleaned
   Click the **Calibration** page
   Under I**nherit calibration settings from:** select **No inheritance**.
   Click the **Resample** page
   Under **Input**
   Ping selection: All pings in interval
   Number of pings in interval: 4
   Under *Operation*
   Resampling operation: Mean
   Select **Weighting/Interpolation range**
   Under **Output**
   Select **Custom Ranges**
   Start range: 0
   *Stop range:*35
   Number of datapoints: 35
   Click the **Calibration** page
   Under I**nherit calibration settings from:** select **No inheritance**.
   Click **OK**

13. On the **Shortcut** menu select **New**, **Variable**.
   Name: 120 kHz resampled
   Operator: Resample by # pings
   Click **OK**
   Click the **Operands** page
   Operand1: 120 kHz cleaned
   Click the **Calibration** page
   Under I**nherit calibration settings from:** select **No inheritance**.
   Click the **Resample** page
   Under **Input**
   Ping selection: All pings in interval
   Number of pings in interval: 4
   Under *Operation*
   Resampling operation: Mean
   Select **Weighting/Interpolation range**
   Under **Output**
   Select **Custom Ranges**

Start range: 0
*Stop range:*35
Number of datapoints: 35
Click the **Calibration** page
Under I**nherit calibration settings from:** select **No inheritance**.
Click **OK**

dB difference

14. On the **Shortcut** menu select **New**, **Variable**.
Name: dB difference (120-38)
Operator: Minus
Click **OK**
Click the **Operands** page
Operand1: 120 kHz resampled
Operand2: 38 kHz resampled
Click the **Calibration** page
Under I**nherit calibration settings from:** select **No inheritance**.
Click **OK**.

Range mask

15. On the **Shortcut** menu select **New**, **Variable**.
Name: Range Mask for LHS aggregation
Operator: Data range bitmap
Click **OK**
On the **Operands** page
Operand1: dB difference (120-38)
On the **Data range bitmap** page
Minimum in-range value: 3
Maximum in-range value: 25
Click **OK**.

The in-range values were optimized by visual inspection of the Range mask echogram and later on with the final echogram for the LHS. You want to isolate the LHS aggregation.

16. On the **Shortcut** menu select **New**, **Variable**.
Name: Range Mask for RHS aggregation
Operator: Data range bitmap
Click **OK**
On the **Operands** page
Operand1: dB difference (120-38)
On the **Data range bitmap** page
Minimum in-range value: -20
Maximum in-range value: 0
Click **OK**.

The in-range values were optimized by visual inspection of the Range mask echogram and later on with the final echogram for the RHS. You want to isolate the RHS aggregation.

Classification by dB difference

17. On the **Shortcut** menu select **New**, **Variable**.
Name: 120 kHz classified by dB difference with mask for LHS
Operator: Mask
Click **OK**
On the **Operands** page
Operand1: 120 kHz resampled
Operand2: Range Mask for LHS aggregation
Click **OK**.

18. On the **Shortcut** menu select **New**, **Variable**.
Name: 120 kHz classified by dB difference with mask for RHS
Operator: Mask
Click **OK**
On the **Operands** page
Operand1: 120 kHz resampled
Operand2: Range Mask for RHS aggregation
Click **OK**.

Return to ping geometry of raw variable

This step approximates the ping geometry of the 120 kHz raw variable – to facilitate visual comparison for the dB difference results.

19. On the **Shortcut** menu select **New**, **Variable**.
Name: Resample vertically LHS
Operator: Resample by number of pings
Click **OK**
Click the **Operands** page
Operand1: 120 kHz classified by dB difference with mask for LHS
Click the **Resample** page
Under **Input**
Ping selection: All pings in interval
Number of pings in interval: 1
Under *Operation*
Resampling operation: Mean
Select **Weighting/Interpolation range**
Under **Output**
Select **Custom Ranges**
Start range: 0.10
*Stop range:*249.89
Number of datapoints: 1301
Click **OK**.

20. On the **Shortcut** menu select **New**, **Variable**.
    Name: Resample vertically RHS
    Operator: Resample by number of pings
    Click **OK**
    Click the **Operands** page
    Operand1: 120 kHz classified by dB difference with mask for RHS
    Click the **Resample** page
    Under **Input**
    Ping selection: All pings in interval
    Number of pings in interval: 1
    Under *Operation*
    Resampling operation: Mean
    Select **Weighting/Interpolation range**
    Under **Output**
    Select **Custom Ranges**
    Start range: 0.10
    *Stop range:*249.89
    Number of datapoints: 1301
    Click **OK**.

21. On the **Shortcut** menu select **New**, **Variable**.
    Name: Match ping times LHS
    Operator: Match ping times
    Click **OK**
    Click the **Operands** page
    Operand1: Resample vertically LHS
    Operand 2: 120 kHz raw
    On the **Match Ping Times** page
    Allowed (slop): 600
    Click **OK**.

22. On the **Shortcut** menu select **New**, **Variable**.
    Name: Match ping times RHS
    Operator: Match ping times
    Click **OK**
    Click the **Operands** page
    Operand1: Resample vertically RHS
    Operand 2: 120 kHz raw
    On the Match Ping Times page
    Allowed (slop): 600
    Click **OK**.

23. Save EV file under another name.

24. Close Echoview.

Figure 47. dB difference echograms and the 120 kHz raw variable from the worked example
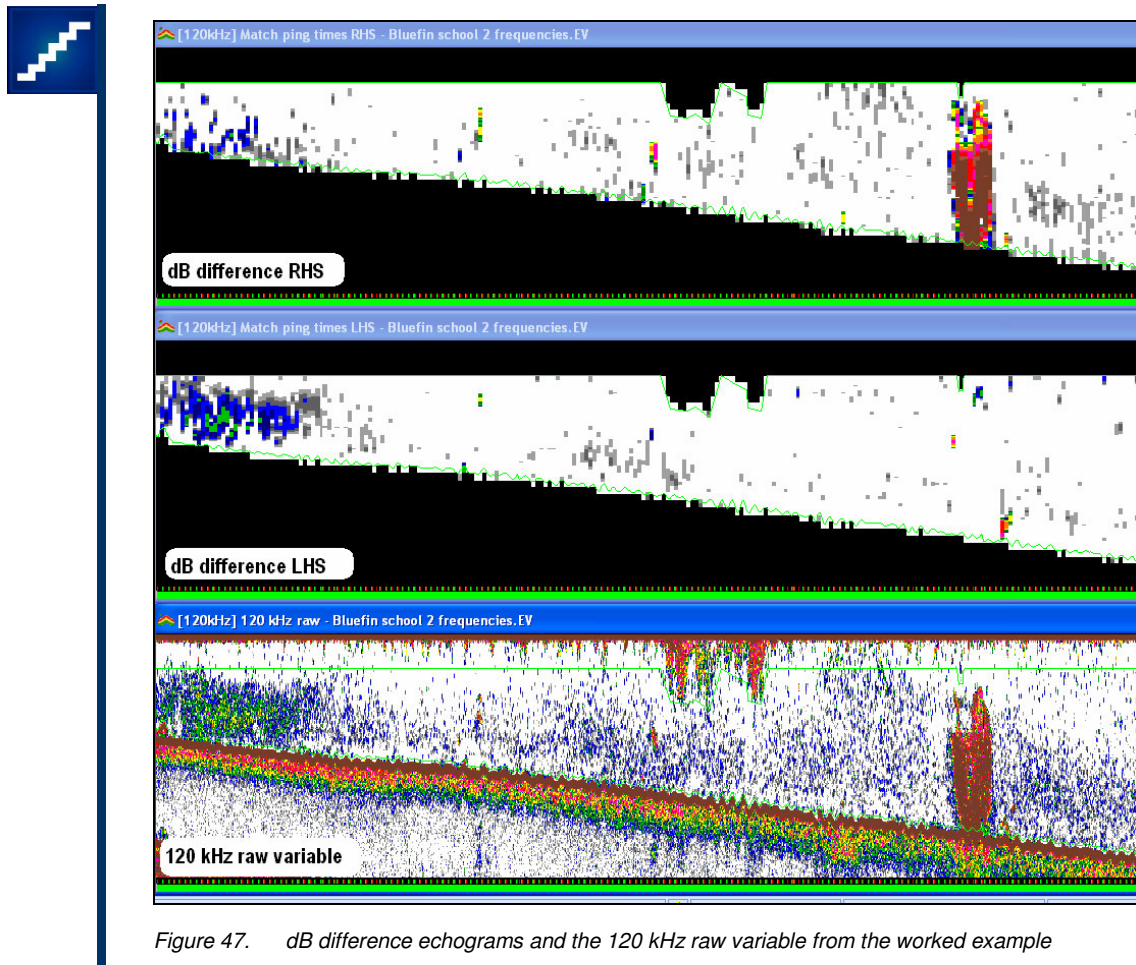
Tips and tricks

Refer to the Echoview Help file for more information regarding:

► Operators

► Virtual variables

► The Variables and Geometry window

Topic completed

You can now:

► Assess whether your data is suitable for frequency differencing analysis.

► Apply a dB differencing technique with Echoview virtual variables.

6. Exporting data and further calculations

What is covered?

The Exporting data topic covers the export of analyses and calculations for areal density and fish flux. A discussion about the estimation of biomass is also included.

The following steps in the Great Lakes Summary of the SOP are covered:.

1. Export integration and TS data (10.5).

2. Check for bias in situ TS (11.2).

3. Calculate fish density (11.3 and 11.4).

4. Apportion the acoustic fish density to different fish species (11.5).

5. Make assumptions about fish in surface and bottom zones (11.5).

6. Calculate fish density by species (11.4 and 11.5).

7. Calculate uncertainty (11.6).

Export integration and TS data

Great Lakes SOP Summary

13. Export integration and TS data (10.5).

Exporting analyses from Echoview

You can export data and analysis results from Echoview to use in further calculations and more complex analyses.

Analysis export

The export of analyses is available from the Echogram and Scene menus and includes:

▶ Analysis by Regions

▶ Analysis by Cells

▶ Analysis by Regions by Cells

The exports and analysis variables available will depend on the Echoview modules that are licensed and the type of echogram you are exporting from.

Data from analyses can be exported in Database and Spreadsheet formats. Such exports are distinct from exporting data (i.e. the export of sample values).

The Export page of the EV File Properties dialog box is used to select the variables and format of export files generated by the Export menu commands.

Export type	Available from	Analysis by Regions	Analysis by Cells	Analysis by Regions by Cells
Integration	Sv echograms	Integration by Regions (echogram)	Integration by Cells	Integration by Regions by Cells
Single targets analyses	Single target echograms	Single target analysis by regions	Single target analysis by cells	Single target analysis by regions by cells
Single targets frequency distribution	Single target echograms	Frequency distribution of single targets by regions	Frequency distribution of single targets by cells	Frequency distribution of single targets by regions by cells
Fish Tracks analyses	Single target echograms	Fish track analysis by regions	Fish track analysis by cells	N/A

Table 1: Table of Echoview integration and TS export analyses.

Data export

Data values from files read by Echoview and data values generated by Echoview can also be exported. This is distinct from the export of analysis results from Echoview.

Data that are available for export include:

► Data (and underlying data) values

► Single targets

► Target lengths

► TS Frequency distribution

► Lines

► Region definitions

Exporting integration data – the Analysis region classes.EV example

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Analysis region classes.EV
   Click **Open**

3. Display the Sv echogram.

Configure the export

4. Click **EV File Properties**
   Click the **Export** page
   Under **Export these analysis variables**:
   Clear all **Analysis variable groups**.

   Under the **Analysis common group**
   Select
   Num_layers
   Num_intervals

   Under the **Analysis doamian group**
   Select
   Height_mean
   Depth_mean
   Layer_depth_min
   Layer_depth_max
   Thickness_mean

   Under the **Analysis export group**
   Select
   EV_filename

   Under the **Integration results group**
   Select
   Sv_mean
   NASC
   PRC_NASC

   Under **Analysis by cell**s
   Select Spreadsheet format
   Click **OK**

Export integration analyses (s$_v$ mean, NASC)

Export an Integration by Cells

5. On the Echogram menu select Export, Analysis by Cells, Integration

6. Browse to a folder to put the export file into
File name: NASC Cells
Click **Save**

Export an Integration by Regions by Cells

7. On the Echogram menu select Export, Analysis by Regions by Cells, Integration

8. *Export regions with class:* All classes
Click **Export**
Browse to a folder to put the export file into
File name: NASC Regions by Cells
Click **Save**

9. In your export folder, threshold be two files:
NASC Cells.csv
NASC Regions by Cells.csv

10. Close the EV file.

Exporting TS data – the Fish tracking.EV example

Single targets analysis

1. Start Echoview.

2. On the **File** menu select **Open**.
Browse to:
C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Fish tracking (Solution).EV
Click **Open**.

Configure the exports

See also Configure the export.

3. Click **EV File Properties** .
Click the **Export** page
Under **Export these analysis variables**:
Inspect all the analysis variable groups and note which variables have been selected.
Click **OK**

Export integration analyses (s$_v$ mean, NASC, PRC_NASC)

4. Display the **Sv** echogram.

Integration by Cells

5. On the Echogram menu select Export, Analysis by Cells, Integration

6. Browse to a folder to put the export file into
   File name: Fish tracking NASC Cells
   Click **Save**

Integration by Regions by Cells

7. On the Echogram menu select Export, Analysis by Regions by Cells, Integration

8. *Export regions with class:* All classes
   Click **Export**
   Browse to a folder to put the export file into
   File name: Fish tracking NASC Regions by Cells
   Click **Save**

Export Single targets analyses (mean TS)

Cells by Single targets

9. Display the Single target detection echogram.

10. On the Echogram menu select Export, Analysis by Cells, Single Targets

11. Browse to a folder to put the export file into
    File name: Fish tracking by cells by single targets
    Click **Save**

Regions by Cells by Single targets

12. On the Echogram menu select Export, Analysis by Regions by Cells, Single targets

13. *Export regions with class:* All classes
    Click **Export**
    Browse to a folder to put the export file into
    File name: Fish tracking by regions by cells by single targets
    Click **Save**

Export (TS) Frequency distribution analyses

14. On the On the Echogram menu select Export, Analysis by Cells, Frequency Distribution.

15. Browse to a folder to put the export file into
    File name: Fish tracking by cells by frequency distribution
    Click **Save**

16. On the Echogram menu select Export, Analysis by Regions by Cells, Frequency Distribution

17. *Export regions with class:* All classes

Click **Export**
Browse to a folder to put the export file into
File name: Fish tracking by regions by cells by frequency distribution
Click **Save**

18. Close the EV file.

Fish track analyses

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Fish tracking (Solution).EV
   Click **Open**.

3. Display the Single target detection echogram.

Configure the exports

See also Configure the export.

4. Click **EV File Properties**.
   Click the **Export** page
   Under **Export these analysis variables**:
   Inspect all the analysis variable groups and note which variables have been selected.
   Select **Direction_horizontal** (useful for determining if the fish is going upstream or downstream).
   Click **OK**

Export Fish track analyses

Fish tracks

5. On the On the Echogram menu select Export, Analysis by Regions, Fish tracks.

6. *Export regions with class:* All classes
   Click **Export**
   Browse to a folder to put the export file into
   File name: Fish tracking by regions by fish tracks
   Click **Save**

Single targets in fish tracks

Configure the export

7. .Click EV File Properties
   Click the Export page

Under Analysis by Cells, select Database Format
Click OK

8. On the On the Echogram menu select Export, Analysis by Cells, Fish tracks.

9. *Export regions with class:* All classes
Click **Export**
Browse to a folder to put the export file into
File name: Fish tracking by cells by fish track
Click **Save**

Note: Five export files are created. There is one line per target/fish track combination, and one column per analysis variable. This provides access to the single target data associated with each fish track. Because any one target can be included in more than one track, it may appear more than once in a file, once for each fish track it belongs to.

10. Close the EV file.

Check for bias of *in situ* TS

Great Lakes SOP Summary

14. Check for bias of *in situ* TS (11.2)

"Check for quality of *in situ* TS measures for each analysis cell using the N_v index. Use the average σ_{bs} by depth region to calculate the N_v index. This is used to test if *in situ* TS can be used for density estimates. If N_v is > 0.1, replace the average σ_{bs} in that cell with average σ_{bs} in surrounding cells or from the appropriate depth layer."

For more detailed discussion of this step refer to Great Lakes SOP Chapter 11. Survey Calculations section 11.2

Calculate fish density

Great Lakes SOP Summary

15. Calculate fish density (11.3 and 11.4).

"Calculate fish density by dividing ABC with mean σ_{bs} for each analysis cell. A density per unit area is obtained by summing over all layers in each bin. Fish•ha^{-1} is obtained from fish•m^{-2} by multiplying by 10,000. Be careful if using NASC to include the 4π term (Table 1)."

Apportion acoustic fish density to different fish species

Great Lakes SOP Summary

16. Apportion the acoustic fish density to different fish species (11.5).

"This is a critical step that should rely on current and previous experience from the lake, temperature profiles, and catch data.…"

Make assumptions about fish in the surface and bottom exclusion zones.

Great Lakes SOP Summary

17. Make assumptions about fish in surface and bottom zones (11.5).

"Decide how to deal with fish present in the surface and bottom exclusion zones (4.9). The report should be specific on what assumptions are made for these acoustic dead zones and if the choice was to exclude these areas from analysis."

Calculate fish density by species

Great Lakes SOP Summary

18. Calculate fish density by species (11.4 and 11.5). Calculate average fish density by species with the appropriate statistics for the survey design used.

Density calculations in a spreadsheet – the Analysis region classes.EV example

Areal density of species

1. In a spreadsheet program open NASC Regions by Cells.csv.

2. With the following data and equation calculate the areal density each region contributes to interval number 5 and complete the table.

    NASC and PRC_NASC are briefly discussed in Regions – types and classes and are highlighted as topics of further interest at the end of the Scrutinization section.

$$Biomass\ (tonnes/n.mi^2) = \frac{PRC\_NASC}{4\pi 10^{\frac{TS}{10}}} \times \frac{Weight}{1000}$$

(1)

Region class	TS of scatterers in that region class	Weight of one specimen	Biomass Areal Density of that species (tonnes/n.mi^2)
Shallow	-60 dB	0.5 kg	
500m	-40 dB	1 kg	
Deep	-80 dB	0.001 kg	

Table 2: Areal density by region.

Apportion backscatter to different species

This is a more complicated scenario in which it is assumed each region class is not populated with one species (or type) of scatterer but a mix.

3. With the following data and equation calculate the biomass each species contributes to interval number 5 and complete the table.

$$Biomass\ density\ (tonnes/n.mi^2) = \frac{\%contribution}{100} \times \frac{PRC\_NASC}{4\pi\overline{\sigma}} \times \frac{Weight}{1000}$$

(2)

Where :

$$\overline{\sigma} = \sum_{all\ species} \left(\frac{\%contribution}{100} 10^{\frac{TS}{10}} \right)$$

(3)

Region class	Species	% contribution (by number)	TS of scatterer	Weight	$\overline{\sigma}$	Areal Biomass Density (tonnes/n.m i²)
Shallow	Small schoolers	10	-60 dB	0.5 kg		
	Plankton	90	-80 dB	0.001 kg		
500m	Large schoolers	5	-40 dB	1 kg		
	Plankton	95	-80 dB	0.001 kg		
Deep	Plankton	100	-80 dB	0.001 kg		

Table 3: Areal density by species mix.

4. Calculate the total contribution of each species to interval number 5. Complete the following table:

Species	Areal Biomass Density of that species in Interval 5 (tonnes/n.mi²)
Plankton	
Small schoolers	
Large schoolers	

Table 4: Areal density for interval 5.

5. You have just completed the steps of a rudimentary density estimate using Echoview exports. The PRC_NASC for defined regions was combined with estimated species distribution within those regions to arrive at an estimate of tonnage each species contributed to the measured signal.

A file with worked calculations for this section is located at:
C:\Myriax\Echoview\Echoview4\Echoview manual\6 Export and further calculations\Density calculations (Solution).xls

In the following exercise, you will find how Echoview provides more convenient features and export variables to automate much of this process and how it allows for a detailed mix of species.

Density exported from Echoview – the Analysis region classes.EV example

1. Start Echoview.

2. On the **File** menu select **Open**.
    Browse to:
    C:\Myriax\Echoview\Echoview4\Echoview manual\6 Export and further
    calculations\Integration export (Solution).EV
    Click **Open**

Define the species composition of each class

3. Click the **EV File properties** tool.
    Click the **Regions** page

    In the **Species** section click **New**
    Name: Small Schoolers
    Expected mean TS (dB): -60
    Expected mean weight (kg): 0.5
    Click **OK**

    Repeat with:
    Name: Large Schoolers
    Expected mean TS (dB): -40
    Expected mean weight (kg): 1

    And again with:
    Name: Plankton
    Expected mean TS (dB): -80
    Expected mean weight (kg): 0.001

4. Under the **Region Classes** section
    Select **Shallow**
    Click **Properties**
    Click the **Species Allocation** page
    Double-click the **Small Schoolers** row
    Proportion of fish of this species for region class: 10
    Click **OK**

    Double-click the **Plankton** row
    Proportion of fish of this species for region class: 90
    Click **OK**

    Repeat for **Region Class = 500m**
    % Large Schoolers: 5
    % Plankton: 95

    Repeat for **Region Class = Deep**

% Plankton: 100

5. Click the Export page
    Select these new variables from the Biomass group:
    Density_number
    Density_weight
    Select Spreadsheet format (single file)
    Click OK.

Export integration analyses

6. On the **Echogram** menu select **Export > Analysis by Regions > Integration**
    Export regions with class: All classes
    Click **Export**
    File name: Biomass Regions
    Click **Save**

    Note: Biomass analysis variables are calculated and exported for each valid region/species combination in this export.

7. On the **Echogram** menu select **Export > Analysis by Cells > Integration**
    File name: Biomass Cells
    Click **Save**

8. On the **Echogram** menu select **Export > Analysis by Regions by Cells > Integration**
    Export regions with class: All classes
    Click **Export**
    File name: Biomass Regions by Cells
    Click **Save**

    Note: Biomass analysis variables are calculated and exported for each valid region/cell/species combination in this export

9. You should have three more files now:
    Biomass Regions.csv
    Biomass Cells.csv
    Biomass Regions by Cells.csv

Examine the exported data

10. Using a spreadsheet program open each of the three data files just created and examine their contents. You will see that Echoview has included species in the breakdown of data.

11. Open the file:
    C:\Myriax\Echoview\Echoview4\Echoview manual\6 Export and further calculations\Complex density estimates (Solution).xls

    The calculations in this spreadsheet present the values exported from Echoview alongside our calculations.

> The columns headed **Density_number** and **Density_weight** contain data exported from Echoview. The columns headed **My Excel Density_number** and **My Excel Density_weight** reproduce in Excel the Echoview calculations.
>
> The yellow section labeled **Compare these with results from C:\Myriax\Echoview\Echoview4\Echoview manual\6 Export and further calculations\Density calculations (Solution).xls** reproduces the calculations for interval 5 from C:\Myriax\Echoview\Echoview4\Echoview manual\6 Export and further calculations\Density calculations (Solution).xls.

Biomass calculations – going from areal density to mass
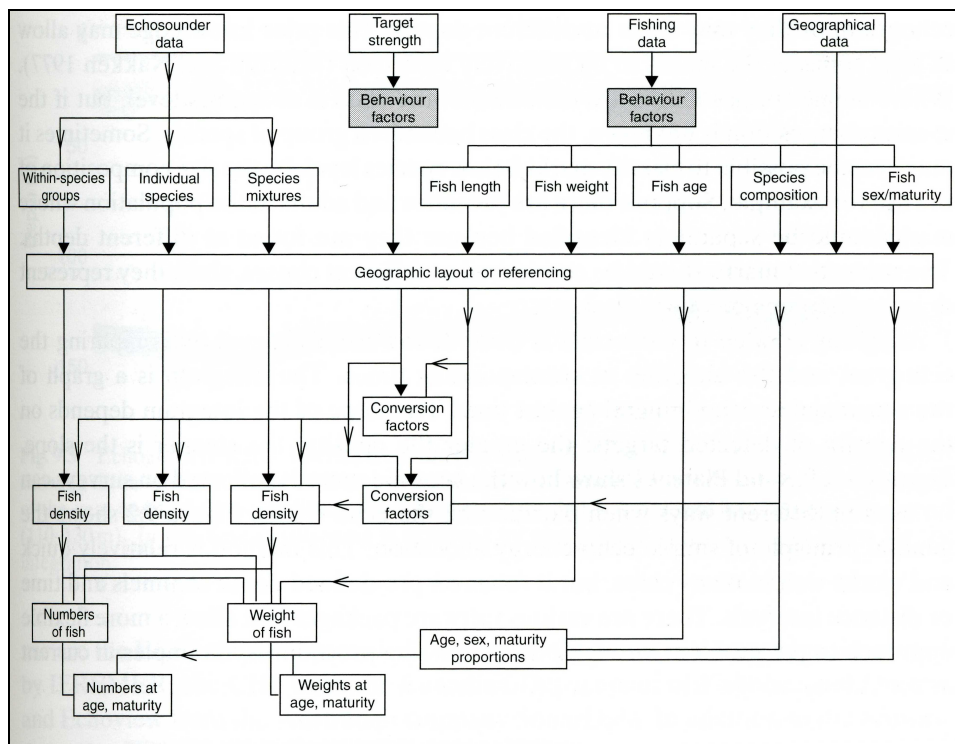
Figure 48.   *Fig 9.1 from Chapter 9 Data Analysis - Simmonds and MacLennan[1] "Flow diagram showing the basic data and analysis procedures for obtaining fish abundance estimates from acoustic and biological data*

Figure 48 is taken from Simmonds and MacLennan Chapter 9 Data Analysis. The flow diagram and discussion of "Abundance estimation" in sections 9.5 to 9.8 provide a guide to calculating biomass. Sections 11.4 and 11.5 of the Great Lakes SOP discuss this as well.

Fish track analysis

Exported fish track data can be opened in a spreadsheet for further post-processing. Topic 8 of the Echoview tutorial *Introduction to DIDSON data processing* presents a detailed treatment of fish track analysis using Microsoft Excel.

The topic is reproduced in Appendix I: Introduction to DIDSON data processing. Topic 8 Calculations and graphs. The complete tutorial can be obtained from the Echoview website.

Fish track detection, using fish tracks and region classes is useful in the empirical study of fish detection sensitivity.

Calculate uncertainty

Great Lakes SOP Summary

"19. Calculate uncertainty (11.6). Calculate uncertainty of the estimate including all aspects of uncertainty that is known at the time. List the sources of uncertainty included in these calculations."

Final checks

Great Lakes SOP Summary

"We also recommend as a final check of the data:

1. Check to make sure all intervals are represented, unless the interval is excluded due to bad data classification.

2. Sort segments and/or layers to see if any unreasonable fish densities are found. Refer back to echogram to see if the segments with the highest fish densities match up with dense fish areas on the echograms."

Reports – inclusion of standard information

Great Lakes SOP Summary

"Reports presenting fish density derived from acoustic data should include the following information:

1. Hardware and software used, including version.

2. Ping rates, pulse duration, field calibration information, beam width.

3. Single echo detection parameters.

4. The minimum threshold level that is considered to represent the fish of interest and the method used for noise removal.

5. The noise level at 1 m (Sv domain preferred) and the detection limit (range) for the smallest fish of interest.

6. Information on the number of analysis cells with high N_v values.

7. A graph of representative TS distributions for layers with differences in this distribution. Alternatively, provide a graph of TS versus depth.

8. Information on decision rules for allocation of fish density to different species.

9. Average fish density and method used for calculations (geostatistics, cluster sampling, etc.).

10. Estimates of uncertainty, acknowledge which factors were included in the estimates.

11. Map of the spatial distribution of fish density along transects to visualize spatial patterns and variability."

Tips and tricks

Refer to the Echoview Help file for more information regarding:

► Exporting in Echoview

► About exporting analyses

► About exporting data

Topic completed

You can now:

► Configure export analysis variables.

► Export analyses from Echoview.

► Use exported analyses to calculate areal density for different species.

► Understand the procedures to estimate and scientifically report biomass.

7. Advanced visualization

What is covered?

This topic covers advanced visualization in Echoview using scenes and 3D objects created from your data. Visualization and data fusion in Eonfusion is also discussed.

Scenes in Echoview
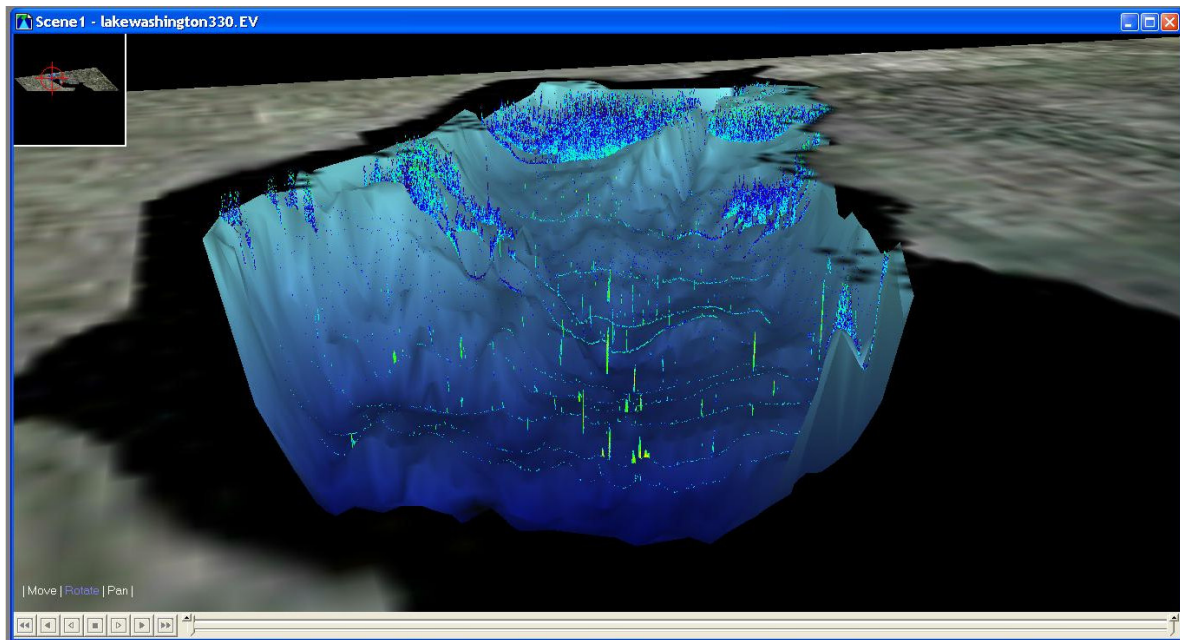
Figure 49.   Scene showing 3D objects created from data collected in Lake Washington – bottom surface, fish and macrophytes.

Echoview scenes offer advanced visualization of echogram data, where 3D objects can be created and displayed in 3D space with respect to time.

3D objects that can be created from single beam echograms are:

► A surface from a line – the 3D representation of a line (such as the bottom pick or the surface line).

► Echogram curtains - the 3D representation of an echogram.

► 3D Single targets - 3D points that represent single targets.

► 3D Fish track – 3D points that represent single targets in a fish track.

Single beam echogram curtain, 3D single targets, 3D fish tracks
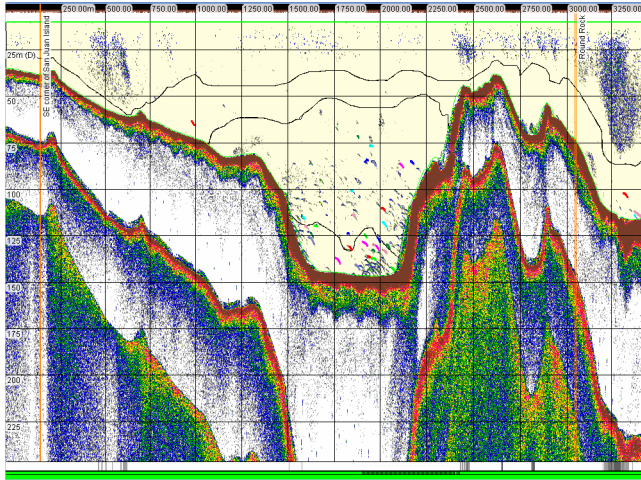
Figure 50.   Fish track (Solution).EV – Sv echogram with detected
fish tracks and minimum TS threshold
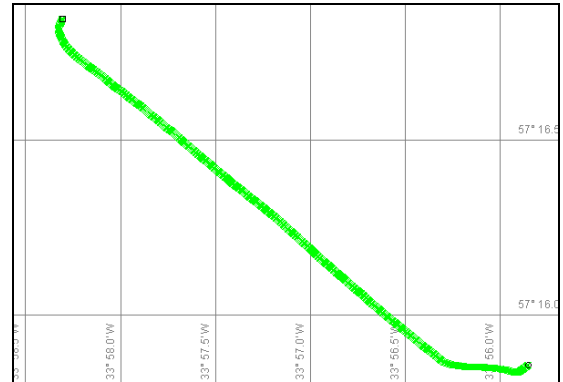
Figure 51.   Cruise track for the echogram in Figure 50.
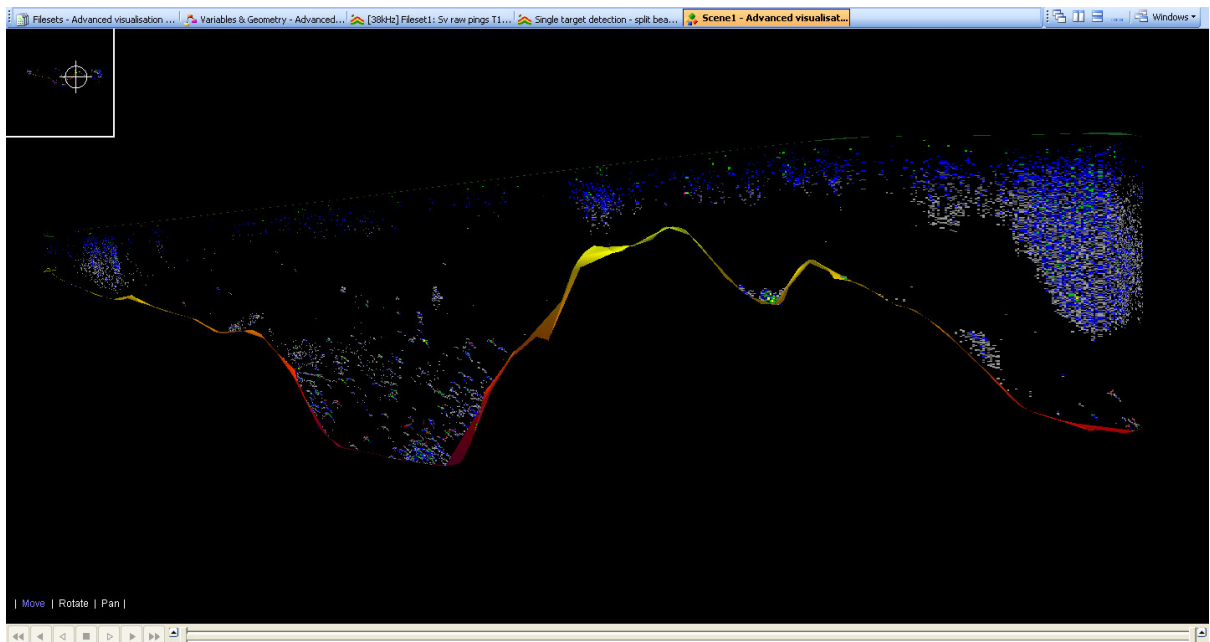
Figure 52.   Echoview scene (Northward view) displaying 3D objects created from the echogram in Figure 50. A surface created
from the acoustic bottom line and 3D single targets, 3D fish tracks and an echogram curtain.

Fish tracking (Solution).EV example

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\4 Analysis\Fish tracking
   (Solution).EV
   Click **Open**.

Create a surface from a line

3. Display the Single target detection echogram.

4. On the **Echogram** menu select **Create 3D Object**, **Surface from Line**.
   Surface name: Top
   Line: Surface line
   Click **Create**.
   Click **OK**

   Repeat step 4
   Surface name: Acoustic bottom surface
   Line: Acoustic bottom line

Create 3D Single targets, 3D Fish tracks

5. On the Echogram menu select Create 3D Object, Single Targets.
   Click OK.

6. On the Echogram menu select Create 3D Object, Fish tracks
   Click OK.

Create an echogram curtain.

7. Display the **S_v echogram**.

8. On the Echogram menu select Create 3D Object, Curtain
   Under Transparency
   Select Values below the color display minimum
   Select Bad Data
   Select Outside exclusion lines
   Click Create
   Click OK.

Add 3D objects to a scene

9. On the **View** menu select **Scene**, **New Scene**.
   On the **General** page of the **Scene Properties dialog box:**
   Vertical exaggeration: 4.0
   Color scheme: Seascape

   On the **Objects** page
   Select **3D Fish Track group1**
   Select **Acoustic bottom surface**
   Select **Echogram curtain1**
   Select **Top**
   Click **OK**.

   Refer to Figure 52 for a screenshot of the scene.

Scene navigation and features

10. Click **Move**.
    Click and drag the mouse left, right or up and down to move in the scene.

11. Click **Rotate**.
    Double click at the center of the curtain –this sets the center of rotation.
    Click and drag the mouse left, right or up and down to rotate relative to the center of rotation in the scene.

12. Use the mouse wheel to bring the 3D object closer to you.

13. The **Shortcut** menu is context sensitive with respect to objects in the scene. It provides access to scene and object features.
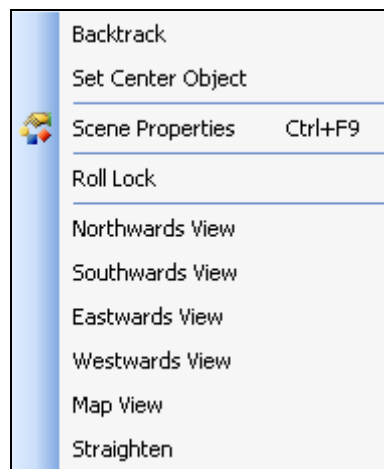
Figure 53.   Scene Shortcut menu.

14. The scene time slider and replay controls allow you to view objects in time.
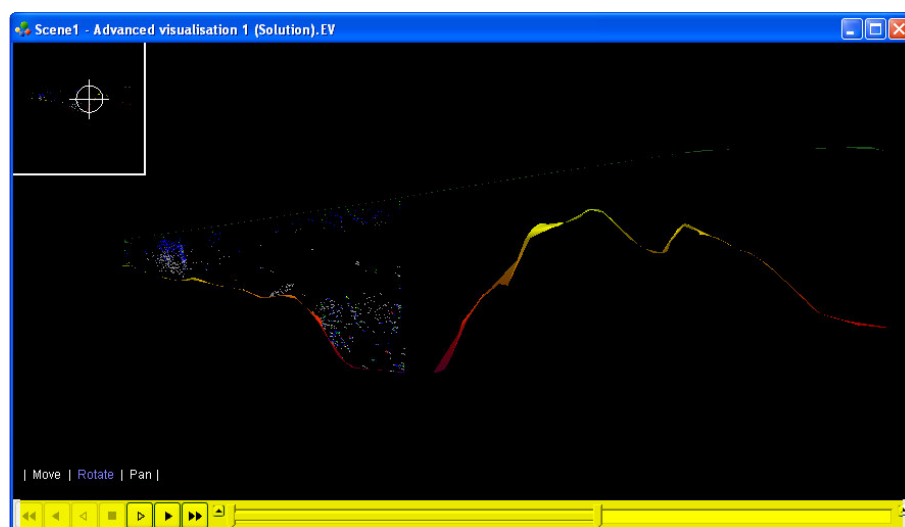
Figure 54.   Scene with the time slider and scene replay controls (highlighted).

15. Save your work to a different file name.

16. Close the EV file.

Echogram curtains with an imported surface.
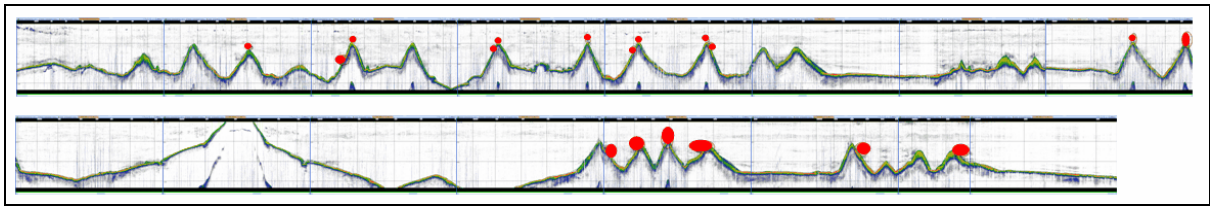
Figure 55.   Single beam echogram for the cruise track in Figure 56. Red dots mark fish echoes on a sea mount
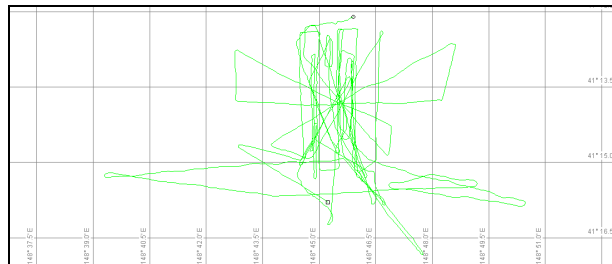
Figure 56.   Cruise track for the single beam echogram in Figure 55.

Figure 57.   Echoview scene with an imported surface representing Tasmania. The red circle indicates the cruise track displayed in Figure 56.
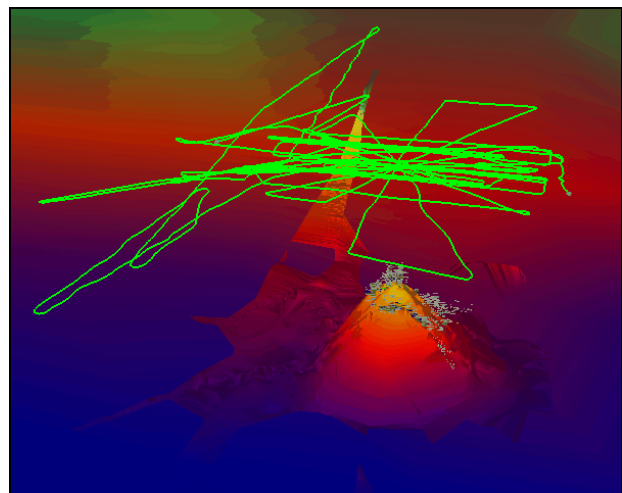
Figure 58.   Zoom-in on the Westward view of the Echoview scene depicted in Figure 57. The green line is the cruise track, the sea mount is represented by a surface created from the acoustic bottom line and the grey features around the sea mount are the echogram curtain displaying regions of interest (fish echoes).
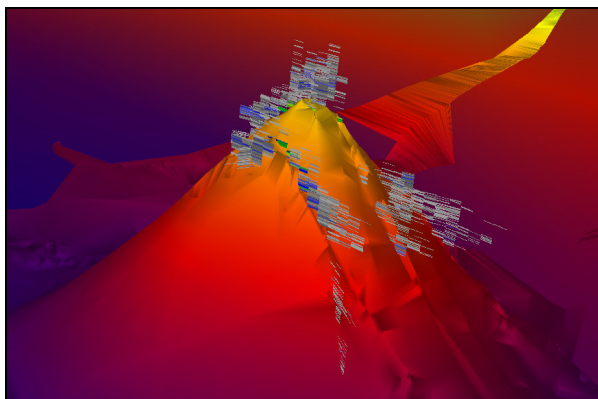
Figure 59.   (Left) Closer view of the fish in the regions of interest.

Advanced 3D visualization - regions of interest and imported surfaces.

The Advanced visualization 2.EV file contains pre-created surfaces from lines – the acoustic bottom line surface traces out the shape of a hill.

The survey was conducted over a single hill this is difficult to discern from the Sv echogram.

You should also observe that regions have been created around areas of interest (schools) on each transect and that the echogram provides no real sense of the spatial distribution of these schools.

On the Variables and Geometry window, virtual variables can be used to create an echogram that only contains data in the regions of interest. You will create a curtain containing only regions of interest and then import a surface. The surface covers the entire Tasmanian coastline and allows you to view the surveyed area in a wider geographical context.

Screen shots of Advanced visualization 2.EV and Advanced visualization 2 (Solution).EV show the echogram data, cruise track and scene are show by Figures 54 to 58.

1. Start Echoview.

2. On the File menu select Open.
    Browse to:
    C:\Myriax\Echoview\Echoview4\Echoview manual\7 Advanced visualization\Advanced visualization 2.EV
    Click Open.

Virtual variables to display the regions of interest
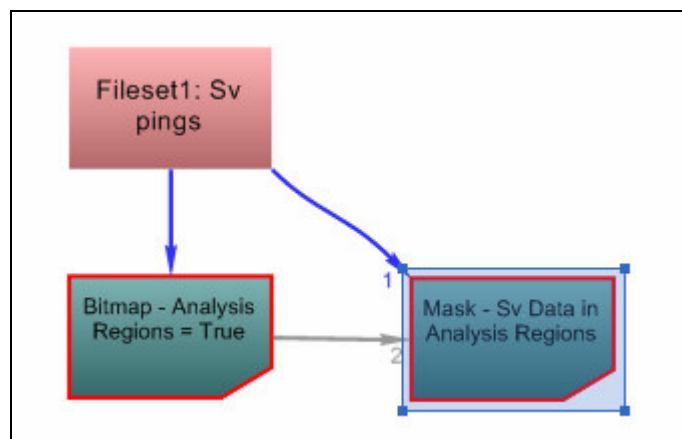
Figure 60.   Variable and Geometry window: virtual variable chain to display the regions of interest.

3. Click the Variables and Geometry window

4. Display an echogram of the **Bitmap - Analysis Regions = True** variable.

    Note: The Region Bitmap operator has been used to create a Boolean variable on

which the analysis regions are assigned a true value and all other data are assigned a false value. The settings and operands for the virtual variable can be viewed on Variable Properties.

5. Display an echogram of the **Mask - Sv Data in Analysis Regions** variable.

   Note: The Mask operator has been used to create a Sv echogram in which the Sv values from operand 1 (the Sv variable) are displayed in areas corresponding to true values in operand 2 (the Boolean variable). That is, the echogram displays Sv values in the analysis regions and -999.0 for all other samples.

Create a curtain containing only regions of interest

6. On the **Echogram** menu select **Create 3D object**, **Curtain**.
   Name: Fish schools only curtain
   Select **Values below the color display minimum** (this will remove the white background from the echogram)
   Select **Outside exclusion lines** (this will remove data that is part of the regions but is below the bottom exclusion line)
   Click **Create**
   Click **OK**.

   Note: In practice it would be preferable to create a separate curtain for each area of interest, i.e. create a curtain from a vertical selection that encompasses each school. The resulting curtains will have a higher resolution than a curtain created from an entire echogram

Add the curtain to a scene

7. On the **View** menu select **Scene**, **Scene1**

8. On the **Shortcut** menu select **Scene Properties**
   Click the **Objects** page
   Select **Fish schools only curtain**

   Click **Properties** (for the Fish schools only curtain)
   On the **Display** page, clear **Outline curtain border**
   Click **OK**
   Click **Close**

   Note: The scene shows a clear spatial distribution of schools that is difficult to visualize from the single beam echogram.

Import a surface

The surface you will use is a low resolution version of a surface that was originally created by GEOSCIENCE AUSTRALIA (www.ga.gov.au). A low resolution surface is used because the original file is very large and may cause slow performance on machines with limited graphics processing power. The low resolution surface was created using Echoview's "resample" functionality and export functionality, i.e. the high resolution file

was imported into Echoview on a machine with powerful graphics processing capabilities and was resampled at a lower resolution, then exported as a .csv file.

9. On the **View** menu select **Scene Manager**.
   Click the **Objects** page
   Click **Import**
   Select **Tasmania (low res).csv**
   Click **Open**

   Surface Name: Tasmania (low res)
   Maximum triangulation distance: 10000.00
   Click **Import**

10. Display **Scene1**

11. On the **Shortcut** menu select **Scene Properties**
    Click the Objects page
    Select **Tasmania (low res)**
    Click **OK**

12. On the **Shortcut** menu select **Map View.**

    Note: The cruise track of the survey area is visible on the north-east of Tasmania just off the edge of the continental shelf.

13. Move in on the survey area and other areas of interest – use a combination of mouse wheel, Move and Rotate.

14. Close the EV file without saving.

Because Echoview has no limit on the number of filesets, you could take data from other surveys around the Tasmanian coast and add them to the same scene. This would allow you to navigate between survey areas and make geographic comparisons that would be very difficult to visualize using only two dimensional displays.

Visualization in Eonfusion

Echoview echogram data can be exported to Eonfusion for advanced spatio-temporal visualization and analysis with other diverse data.

Eonfusion is a unique new software product. It provides cutting-edge processing and visualization of time-varying spatial data through an interface that is flexible, easy to use and intuitive.

Eonfusion's use of true data fusion means that the data are genuinely integrated, yielding insight that you've never had before and results that you didn't know were possible. Explore our site to find out more at
http://eonfusion.myriax.com/home.

Tracking: bathymetry, backscatter and whale track

Oceanography: sea surface temperature comparison
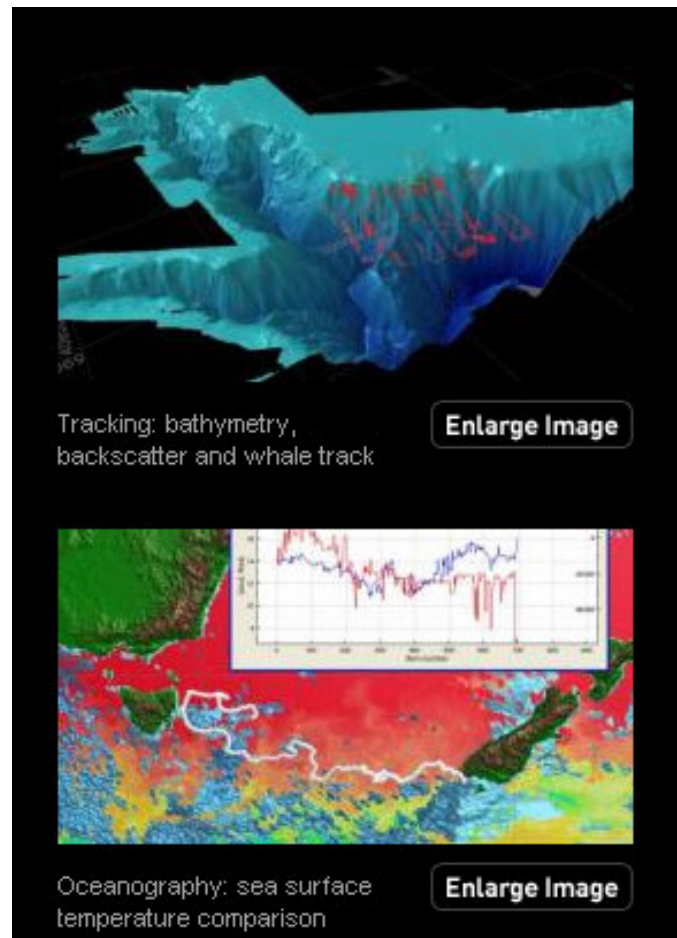
Figure 61.   Two images from the Eonfusion image gallery:
http://eonfusion.myriax.com/applications/image_gallery
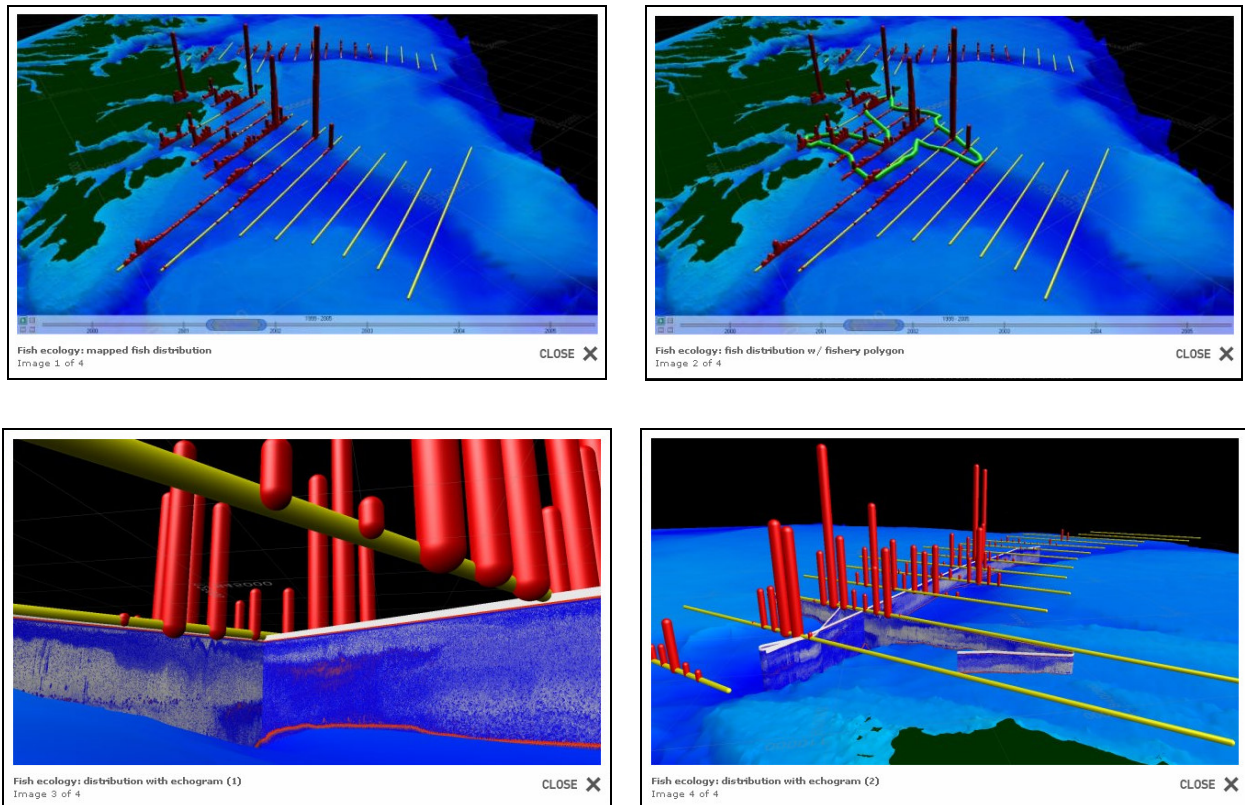
Figure 62. These images (1,2,3,4 left to right and down) were generated from an Eonfusion scene that combines land shapes, bathymetry, transect definitions and an array of fish abundance estimates derived from echosounding. The fish abundance estimates were generated from data gathered during multiple surveys per year over the course of several years. Once the data are in the scene it's simply a matter of moving the time slider to see the changes in fish distribution within a given year and from year to year.

The scale-independent nature of Eonfusion's data handling engine and scene view means that the original high-resolution raw data can also be loaded into the scene and viewed with the spatially summarized plots. This provides an intuitive and dynamic environment within which outliers and anomalies can quickly and easy be investigated within the source data.

Myriax gratefully acknowledge Chris Wilson and Paul Walline (NOAA-NMFS Alaska Fisheries Science Center) for providing these data.

Tips and tricks

Refer to the Echoview Help file for more information regarding:

▶ About scenes

▶ Table of contents – Using Echoview > Working in 3D

Topic completed

You can now:

▶ Create 3D objects from single beam echogram data.

▶ Add 3D objects to scenes.

▶ Use scenes to display your data in three spatial dimensions and time.

8. Echoview templates and live viewing of data

> **What is covered?**
>
> In this topic you will learn how to create an EV file template or a live viewing template. Creating a new EV file based on a template allows you to automatically apply pre-configured processing steps when you add data to the new EV file. This saves time when you work with similar data.
>
> The second part of this topic discusses how to use Echoview to live view data.

About templates

New EV files can be based on a template. Templates provide a way to store and apply regularly used EV file settings and processing methodologies.

New EV files based on a template are created with a one-time copy of all the settings stored in the template. When you add data, the stored settings are applied but can then be tailored to the data – the template itself is unaltered and can be used as a base for future new EV files

Templates are normal EV files (stripped of references to echosounder data files) stored in a nominated template folder or live viewing template folder

A table of the objects and settings that are copied from a template appears in the Echoview Help file on the About templates page.

Creating a template

The Scrutinization of data (Solution).EV file contains all the Echoview processing steps and settings required to prepare specific EK 60 data for analysis. If you have additional data recorded under the same conditions, then to a first approximation that EV file can be used with the additional data. In effect the Scrutinization of data (Solution).EV file can be used as a template.

1. Start Echoview.

2. On the **File** menu select **Open**.
   Browse to:
   C:\Myriax\Echoview\Echoview4\Echoview manual\3 Scrutinization\Scrutinization of data (Solution).EV
   Click **Open**.

3. On the **File** menu select **Configuration**.

4. Click the **File locations** page.
   In the **Files types** section click **Templates**.

Click **Edit**.
Browse to:
C:\Myriax\Echoview\Echoview4\Echoview manual\9 Templates
Click **OK**
Click **OK**
On the **File** menu click **Save As**.
Browse to:
C:\Myriax\Echoview\Echoview4\Echoview manual\8 Templates
Under **File name** type **Scrutinization template**
Click **Save**.

5. On the **File** menu click **Close**.

6. A live viewing template folder and live viewing templates are created in a similar fashion. Use steps 3-4.
In the **File types** section click **Live viewing templates**.

Using a template

When you create a new EV file, Echoview will offer you a list of available templates from the location specified for Templates.

7. On the **File** menu click **New**.

8. Click Scrutinization template.EV
Click OK

9. Examine the new EV file:
there are no data files in Fileset1

10. Add the data file:
C:\Myriax\Echoview\Echoview4\Echoview manual\1 View and inspect\L0014-D20021004-T140000-EK60.raw

11. Examine the Variable Properties settings and Variable and Geometry window.

12. On the **File** menu click **Close**.
- OR –
Save your new EV file.

13. Close Echoview

Live viewing of data

Simrad ER60 software logs raw data from an Ex60 echosounder, but in order to get a real time display of that data in Echoview as it is being logged, you need to also run Echolog 60.

The Live viewing module allows the near real-time display of data logged from some supported echosounders (currently Simrad Ex60, EK500, EA500, and SM2000 FR).

When live viewing is started, Echoview automatically creates an EV file. It will use an appropriate live viewing template if one is available.

Echograms, rectangular selections, schools detection, linked graphs, cruise tracks and scenes will respond to newly arrived data when live viewing.

All (licensed) Echoview functionality is available during live viewing. This means you can, for example, run echo integrations, detect schools or fish tracks and create virtual variables on live viewed data. Virtual echograms created in a live viewing EV file will also scroll and update automatically providing multiple-frequency and other analyses in real time.

The Echoview website offers a Live viewing tutorial that demonstrates the use of the Echolog 500 logger. For further information refer to:

http://www.echoview.com/Tutorials.shtm

Echolog module

The Echolog programs are free but must be licensed for use.

The Echolog 60 module enables the live viewing and/or data compression of .raw data from Simrad Ex60 echosounders.

Features include:

- ▶ Echolog 60 for live viewing, logging and/or data compression of Ex60 echosounder data.
- ▶ Echozip 60 for data compression of data files logged by Ex60 echosounders
- ▶ Echodepth for displaying sounder-detected depths during logging.
- ▶ Echosim 60 for simulating an EK60 for testing and set-up purposes.

For more information about other Echolog modules refer to the Echoview website: http://www.echoview.com/AboutEchoview.shtm#Detail

Basic logging and live viewing

This example uses Echosim 60 and Echolog 60 to simulate live viewing.

Echosim 60 simulates a Simrad EK60 that is logging raw data – raw data comes from the Ex60 raw data folder and is written to the EK60 Survey folder.

Echolog 60 broadcasts raw data from Simrad Ex60 echosounders as it is being written by the ER60 or EK60 software – data is read from the Survey folder and is broadcast.
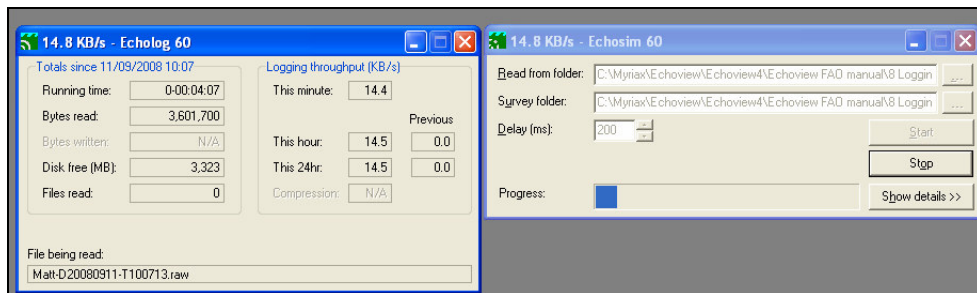
Figure 63. Right – Echolog 60 window. Left – Echosim 60 window.
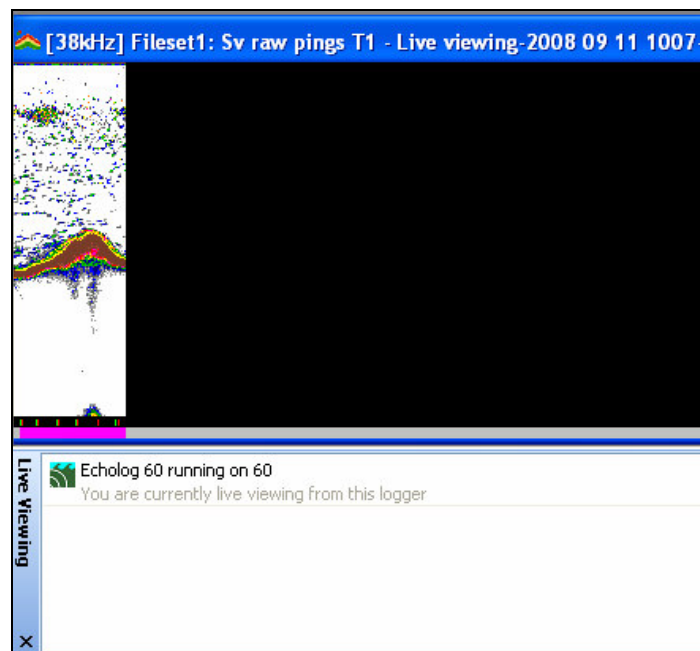
Figure 64. Bottom – Live Viewing dialog box with one Echolog 60 logger broadcasting.
Top – Echogram of the Sv T1 variable updating as data is broadcast from Echolog 60.

Launch Echolog 60

The Echolog 60 window is a display only window, which tells you when data is being logged and other information

1. On the Windows Start menu
   Select All Programs, Echoview, Echolog 60

2. If the EK60 Survey folder doesn't exist, the Settings dialog box opens automatically, and requests that you to specify a folder to log data to.

   Click **Browse** (to the left of the EK60 survey folder box)
   Browse to
   C:\Myriax\Echoview\Echoview4\Echoview manual\8 Logging and Live Viewing
   Click **Make a new folder**

*Folder name:*EK60 Survey folder.
Click **Close** (Settings window)

Configure Echolog 60

3. Right-click on the **Echolog 60** title bar, and select **Settings**.

4. Browse to select an EK60 survey folder
C:\Myriax\Echoview\Echoview4\Echoview manual\8 Logging and Live
Viewing\EK60 Survey folder

5. Leave the remaining six settings at their default value

6. Clear Data compression

7. Click **OK**

Other Echolog features

8. Right-click the **Echolog 60** title bar, and select **Network Information**.
Click **OK**.

   This is a simple way to determine your IP address and how much logging space you
   have available.

9. Right-click the **Echolog 60** title bar, and select **Reset Statistics**
This command will reset all counters to zero

10. Leave Echolog 60 running
Echolog 60 is now ready for operation, and will broadcast any data that is written
into the survey folder. All instances of Echoview running on the network will be
able to display the broadcast data in real time.

   For testing or exercise purposes use Echosim 60 to simulate the Ex60 sounder.
   Echosim takes an existing data file and writes to the survey folder in the same way
   as the Ex60.

Start Echosim 60

11. On the Windows Start menu
Select All Programs, Echoview, Echosim 60

12. Under **Read from folder** browse to select
C:\Myriax\Echoview\Echoview4\Echoview manual\8 Logging and Live
Viewing\EK60 raw data

13. Under Survey folder browse to select
C:\Myriax\Echoview\Echoview4\Echoview manual\8 Logging and Live
Viewing\EK60 Survey folder

   Note: This is the directory to which Echosim will write data and must be the same
   folder from which Echolog 60 reads data (see EK60 survey folder setting).

14. Set **Delay (ms)** to **200**

Note: This specifies the time between the writing of 2 consecutive pings to the survey folder.

15. Click **Start**

16. Click **Show details**
You should see the Bytes written value growing, and the progress bar advancing as Echosim writes data. After a slight delay, you should see the Bytes read value on the Echolog 60 window increasing. Echolog 60 is now broadcasting the data it reads from the survey folder.

Tip: You can also view the changes in files using Windows Explorer. You will need to display the survey folder and press the F5 key to refresh the file details.

Note: Data is logged to the survey folder (by Echosim or an Ex60 sounder) regardless of whether Echolog 60 is running. Echolog 60 is only required to enable live viewing of the data in Echoview, or compress the EK60 raw data files in real time.

Live viewing

17. Start Echoview

Click Live viewing .
The Live viewing dialog box displays detected Echolog applications.

18. Select the **Echolog 60** logger you have running by double clicking its entry

Note: Echolog applications are named by default as the name of the computer running Echolog. This name is displayed in the Live viewing dialog box. Double clicking an entry displays the Live viewing variables dialog box, which lists variables available for live viewing.

19. Select the first variable in the list **EK60/ES60 Sv raw pings T1**
Click **OK**

Note: Echoview will display an echogram which is updated automatically as data is broadcast by Echolog 60.

Using Echoview during live viewing

Most functions in Echoview are available during live viewing. Many update automatically during live viewing e.g. echograms, advancing and extending rectangular selections on echograms, schools detection, linked graphs and scenes

20. **Zoom in** to an area on the right hand edge of the visible data
Wait a moment; Echoview will scroll automatically as data arrives

21. Zoom out

22. **Zoom in** to an area on the left
Wait a moment: Echoview will maintain the current view, but you will see the

horizontal scroll bar move and resize as data arrives

23. Open the **Filesets** window, and from there open the echograms of the other variables.
    Minimize the Filesets window.
    Tile horizontally

    Tip: Scroll all echograms to the far right to see them update in real time.

Selection movement during Live Viewing

You can choose the way in which rectangular selections move during live viewing. Selections can remain stationary, advance with new data, or extend as new data is received. Graphs that are linked to selections will update with advancing or extending selections as new data is received.

24. Make a rectangular selection on the **Sv** echogram
    Use the **Rectangle tool** or the **Vertical band tool**
    On the **Echogram** menu, select **Selection Movement**, **Extending**.

    Wait a moment until new data arrives and notice that the left boundary remains stationary in time while the right boundary extends relative to the last live viewing ping.

25. Make another rectangular selection on a **Sv** echogram
    On the **Echogram** menu, select **Selection Movement**, **Advancing**.

    Note: On the Selection Movement list, the currently selected movement appears with a bullet next to it.

    Wait a moment until new data arrives and notice that both the left and right boundaries of the selection move in time and the width of the selection remains the same.

26. On the View menu, select Graph, Threshold response.
    Under Variable list, select Fileset1:Sv raw pings T1
    Click OK

27. On the **Graph** menu, select **Linking**, **Selection**
    As new data arrives, the graph is updated accordingly.

28. Close the EV file without saving.

29. Close Echosim 60 and Echolog 60.

Tips and tricks

Refer to the Echoview help file for more information regarding:

▶ About templates

▶ About template folders

▶ About live viewing

▶ Using live viewing

Topic completed

You can:

▶ Create and use EV file templates and live viewing EV file templates

▶ Set up Echolog 60 to broadcast data for live viewing in Echoview.

▶ Use live viewing features for selections.

References

No. **Reference**

Introduction

1 Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2).

2 **Standard Operating Procedures for Acoustics in the Great Lakes**

Prepared for The Study Group on Fisheries Acoustics in the Great Lakes. Great Lakes Fishery Commission. Version 1.0. Based on discussion in the Study Group 2002-2006. January 16, 2008.

3 Members of NOAA Fisheries Science Centers, U.S. Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service.(January 15, 2004) **NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling .**

Scrutinization

4 Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p39-40.

5 **Standard Operating Procedures for Acoustics in the Great Lakes. Chapter 10. DATA PROCESSING AND ANALYTIC DECISIONS** *10.1.3 Surface exclusion zone*.

6 Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p63.

7 Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). pP198, 5.4.5 Integration near the seabed.

8 **Standard Operating Procedures for Acoustics in the Great Lakes. Chapter 3. SUMMARY OF STANDARD OPERATING PROCEDURES** procedure 5.

Detect and correct the bottom (10.1.4).

9   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p66, Fig 2.27.

10   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p41 Fig 2.10.

11   De Robertis, A., and Higginbottom, I. (2007). **A post-processing technique to estimate the signal-to-noise ratio and remove echosounder background noise.** ICES Journal of Marine Science, 64: p1282–1291.

Analysis

12   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p227.

13   Foote, K.G. (1996) **Coincidence echo statistics.** J. Acoust. Soc. Am. 90: p959-64.

14   Gauthier, S., and Rose, G.A. (2001) **Diagnostic tools for unbiased in situ target strength estimation.** Can. J. Fish. Aquat. Sci. 58: p2149–2155.

15   Blackman Samuel S. (1986) **Multiple Target Tracking with Radar Applications**, Artech House, Massacheusetts.

16   Dawson J. and Mulligan T. (2000) **Echo selection and trace formation: techniques, interactions, and advancements.** Proceedings of the Fifth European Conference on Underwater Acoustics, ECUA 2000: 1455-1460.

Multiple frequency

17   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p262, Chapter 7 Plankton and Micronekton Acoustics.

18   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-

10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2). p334-336.

19   Mitson R.B., Simard Y. and Goss C. (1996) **Use of a two-frequency algorithm to determine size and abundance of plankton in three widely spaced locations.** ICES Journal of Marine Science, 53: 209-215.

20   Kang, M., Furusawa, M., and Miyashita, K. (2002). **Effective and accurate use of difference in mean volume backscattering strength to identify fish and plankton.** ICES Journal of Marine Science, 59: 794–804.

21   Korneliussen, R. J., and Ona, E. (2003). **Synthetic echograms generated from the relative frequency response.** ICES Journal of Marine Science, 60: 636–640.

22   De Robertis, A., and Higginbottom, I. (2007). **A post-processing technique to estimate the signal-to-noise ratio and remove echosounder background noise.** ICES Journal of Marine Science, 64: 1282–1291.

To download this abstract and example materials go to the following address:

http://www.echoview.com/Newsletters/2007Nov.shtm#Noise

Appendix E

23   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2) p39

24   Simmonds J. and MacLennan D. (2005) **Fisheries Acoustics: Theory and Practice. Second edition**, Blackwell Science. Fish and Aquatic Resources Series 10. (ISBN-10: 1-632-05994-X, ISBN-13: 978-0-632-05994-2) p40

Appendix G

25   Kloser R.J., Ryan T.E., Williams A., Lewis M. (2001) Final Report FRDC Project 99/111 **Development and application of a combined industry/scientific acoustic survey of orange roughy in the eastern zone**.

Appendix A: Echoview® DVD installation guide

Overview

This installation guide explains how to install Echoview and associated software from the Echoview DVD.

Note: The installation or use of the software on the Echoview DVD indicates acceptance of the license conditions. Please read the license agreement displayed during the installation process.

Before you begin

You must be logged in as an administrator or power user during installation. You must also run Echoview once under an administrator or power user account to ensure registry settings are correct.

The successful operation of Echoview requires that certain Microsoft programs and operating system patches are present on your computer. The Echoview installation program checks for the required software updates and informs you if any need to be installed that are not found. Please consult Myriax if you need assistance installing a patch.

Warning: Echoview bases these checks on the English language version of the software. If you are using another version of the software you should refer to the Microsoft website or contact Echoview support (support@echoview.com) before installing any recommended updates.

Consult Echoview Help for minimum and recommended hardware requirements.

During the installation process you will be asked to choose the folders in which to install Echoview and other files. You should use the default settings unless you have a valid reason not to do so.

Note: Installation of a major release will by default create a new Echoview folder, i.e. C:\Program files\Myriax\Echoview\Echoview4. Installing a minor release (or revision) will overwrite the previous minor release of Echoview. If you wish to keep a previous release of Echoview, we recommend you rename the Echoview folder or move the folder before running the installation.

Installing Echoview from DVD

Displaying the installation menu

Insert the Echoview DVD into the DVD drive of your computer. The Echoview installation menu should be displayed. If it is not displayed, use Windows Explorer to browse to the root folder of the Echoview DVD then double-click `Autorun.exe`.

Echoview installation menu

Installing Echoview

To install Echoview on your hard drive, click **Install Echoview** and choose an installation option:

- **Typical**. This is recommended if you use a Simrad Ex60 (EK60, EA60, EA400 and EQ60, ES60 and EY60) echosounder or Simrad Ex500 (EK500 and EA500) echosounder. In addition to files and programs included in the Compact installation, this installs the Echolog 500 and Echolog 60 modules and some example scripts for the scripting module.

- **Custom**. This is recommended if you want to select which programs and files to install. All programs and files that are installed by the Compact and Typical installation options will be available for selection along with some additional options. You can also use this option if you have already installed Echoview and wish to install additional programs and files. You must use this option if you wish to install Echocheck and Echocalc GPS.

- **Compact**. This is recommended if you use an echosounder that is not listed above. This option installs Echoview, Echoview Help, and some example data files.

Installing the HASP dongle driver

The HASP dongle device driver is required if you are running a licensed copy of Echoview. During installation of Echoview a dialog will appear prompting you to install the driver. Click **Yes** if your copy of Echoview is licensed, or if you are using a time dongle (see the Dongle Installation Guide for further details). In all other cases click **No**.

The driver can also be installed at a later date using the program provided in the Useful Items\Dongle Driver folder.

Installing other programs

To access other programs and files on the Echoview DVD click **Browse DVD**. Other programs that may be of use can be found in the Useful Items folder. Each folder contains a ReadMe file that provides further information and installation instructions.

Installing the tutorials

A number of tutorials are included on the Echoview DVD to help you learn how to use Echoview and explore some of its basic features. To install the tutorials click **Browse DVD**, open the Documentation\Tutorials folder, then double-click the tutorials you wish to install. The following tutorials are provided:

- Getting started with Echoview (GettingStarted.exe)
- Introduction to Integration (IntroToIntegration.exe)
- Introduction to Fish Tracking (IntroToFishTracking.exe)
- Introduction to Live Viewing (IntroToLiveViewing.exe)
- Introduction to DIDSON data processing (IntroToDIDSONDataProcessing.exe)

You will also need to double-click DataFiles.exe to install the tutorial data files.

The tutorial handbooks are installed in the following folder: C:\Myriax\Echoview\Echoview4\Tutorials by default. They are provided as PDF documents and you will need to have Adobe Acrobat Reader installed on your computer to view them. If you do not have a copy of Adobe Acrobat Reader already installed you can install it from the Useful Items\Adobe Acrobat Reader folder on the Echoview DVD.

Assistance

For assistance with the installation of Echoview, please contact Echoview support:

- email support@echoview.com,
- phone +61 3 6231 5588 or fax +61 3 6234 1822.

For assistance using Echoview, do one or more of the following:

- complete the relevant tutorial(s),

- refer to the Echoview help file (this is the primary source of information about Echoview), or

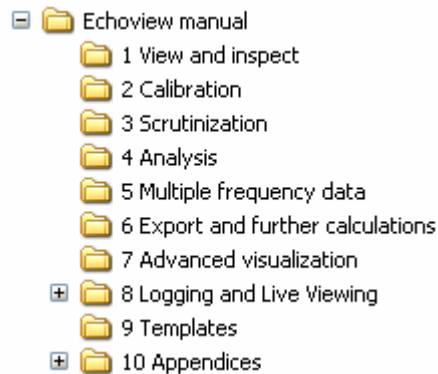- contact Echoview support (support@echoview.com).

Appendix B: Unable to open Echoview's Technical Manual data files in Echoview.

Unable to open topic files in Echoview

1. If you cannot find the files:
   The files for this manual's topics are typically located in:
   C:\Myriax\Echoview\Echoview4\Echoview manual.

   The file path may be different if you chose to install the manual elsewhere on your system. If the files are not in this folder, use Windows Explorer to search for them. If they are not loaded on your machine, reinstall the manual and data files from the Echoview Technical manual DVD. See also Supplied data files.

2. If you cannot open the files:
   You have a version of Echoview that is older that the version of Echoview this manual's EV files were created with. Upgrade to Echoview 4.50 or higher.

Appendix C: Abstracts of hydroacoustic survey protocols and the Great Lakes Standard Operating Procedure (SOP)

NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling

January 15, 2004. Prepared by: Members of NOAA Fisheries Science Centers, U.S. Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service

"Appendix 1:

NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling at the Northeast Fisheries Science Center

Atlantic herring (Clupea harengus) spawning stock biomass in the Georges bank region. Biomass estimates are derived by scaling the abundance estimates by an empirical length-weight relationship. Age-based estimates are derived from the age composition of the trawl catches."

"Appendix 2:

NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling at the Alaska Fisheries Science Center

The Alaska Fisheries Science Center (AFSC) conducts acoustic-trawl surveys in the Bering Sea and Gulf of Alaska. The target species is walleye pollock (Theragra chalcogramma). Abundance–at-age estimates from these surveys, along with bottom trawl survey data and fishery catch data, are used to model population size, and, in turn, to establish quotas for the commercial fishing industry under the auspices of the North Pacific Fishery Management Council."

"Appendix 3:

NWFSC Regional Protocols For the Joint Canadian and U.S. Pacific Hake Acoustic Survey

Scientists from the United States (NOAA Fisheries) and Canada (Department of Fisheries and Oceans) jointly conduct periodic acoustic surveys of Pacific hake, *Merluccius productus*, along the west coasts of both countries. The age-specific estimates of total population abundance derived from the surveys are a key data source for the joint US-Canada Pacific hake stock assessments and ultimately act as the foundation for advice on international harvest levels."

Standard Operating Procedures (SOP) for Acoustics in the Great Lakes

Prepared for The Study Group on Fisheries Acoustics in the Great Lakes and the Great Lakes Fishery Commission. Version 1.0 Based on discussion in the Study Group 2002-2006.

January 16, 2008.

"The goal of fisheries acoustic surveys in the Great Lakes is to provide estimates of species-specific biomass and abundance of the primary forage fish (primarily alewife, rainbow smelt, and coregonids). Acoustic surveys are currently being conducted on all of the Great Lakes and some inland lakes, including Lake Champlain. Techniques and equipment reflect differences among the surveys with respect to target species and assessment goals as well as site-specific history of equipment…. The NMFS/NOAA acoustic SOP was provided to the *Study Group* for evaluation of its applicability to the Great Lakes. In the development of this Great Lakes SOP, we modified sections of the NMFS SOP when appropriate and, in cases where our SOP was unique, developed our own procedures."

Appendix D: Examples of echogram interpretation

The following screen shots of echograms displayed in BioSonics Visual Analyzer and the interpretations are included in this manual with the kind permission of Mr. James Dawson and Mr. Robert McClure of BioSonics.

BioSonics, Inc.
4027 Leary Way NW
Seattle, WA 98107
USA

Web: www.biosonicsinc.com

Note: Some echograms display data from a horizontally mounted transducer, these have an additional label - Horizontal mount. Where echograms do not have this label, the data is from a vertically mounted transducer.

Intensity steps
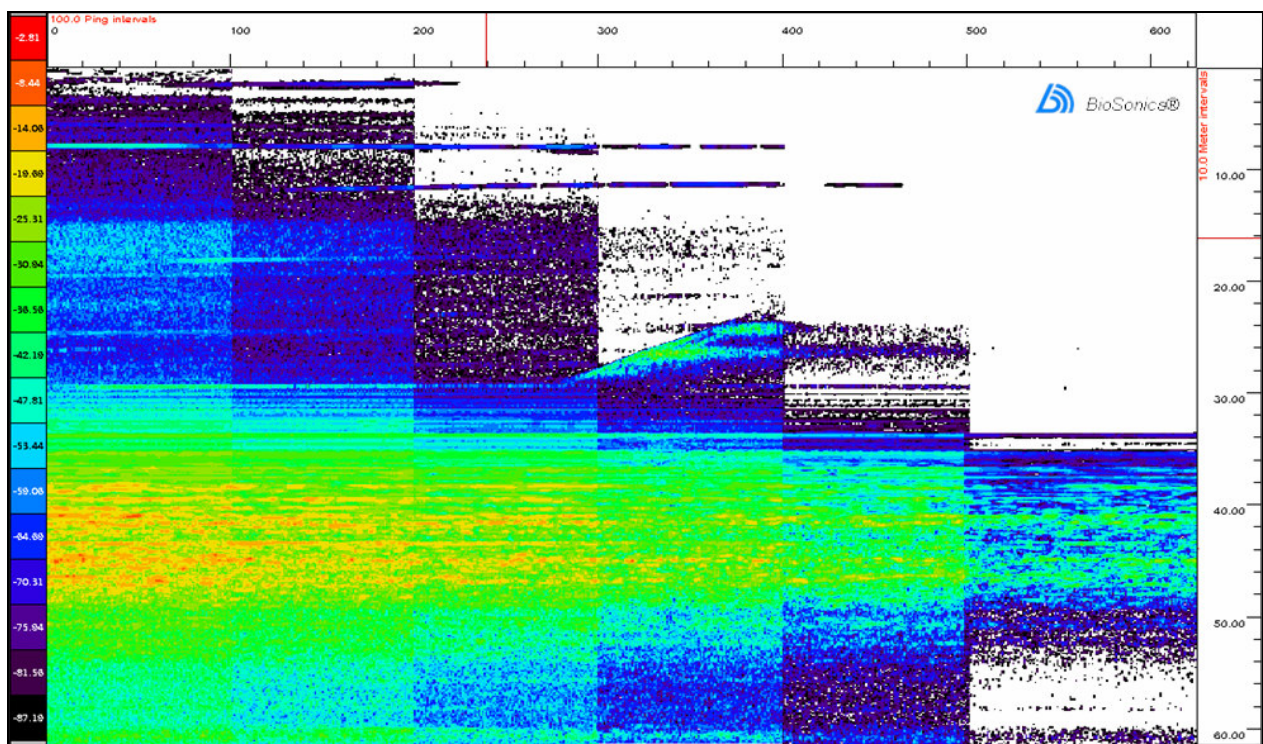
Figure 65.   Intensity steps. These could be produced by reducing either receiving gain or transmit power, or by increasing threshold.

Time-series or Echogram of large target (high sensitivity)
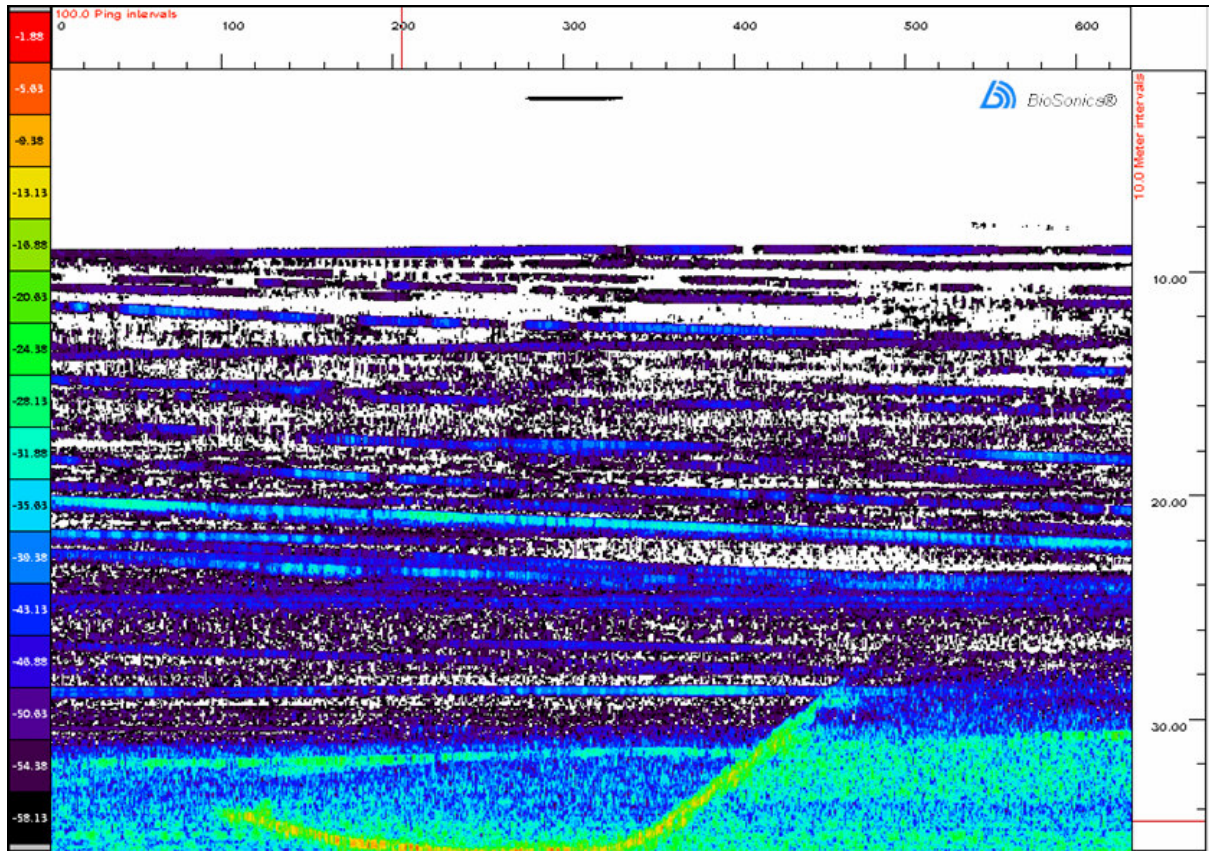
Horizontal mount.

Figure 66.   *This image represents about 2.5 minutes. The image of the large target is seen as the yellowish pattern at far range. The horizontal streaks are produced by several types of targets. The short black line at close range is probably a small fish passing through the beam. The horizontal blue streaks are structures located on the bottom, such as rocks, pilings, and other fixed targets. Other horizontal streaks have a slight angle to them, such as the one starting at about 20 m range and ending at about 22 m. These are moving targets, and are most likely neutrally buoyant targets kicked up from the bottom by the large target, and passively drifting through the beam.*

Fish at maximum observational range
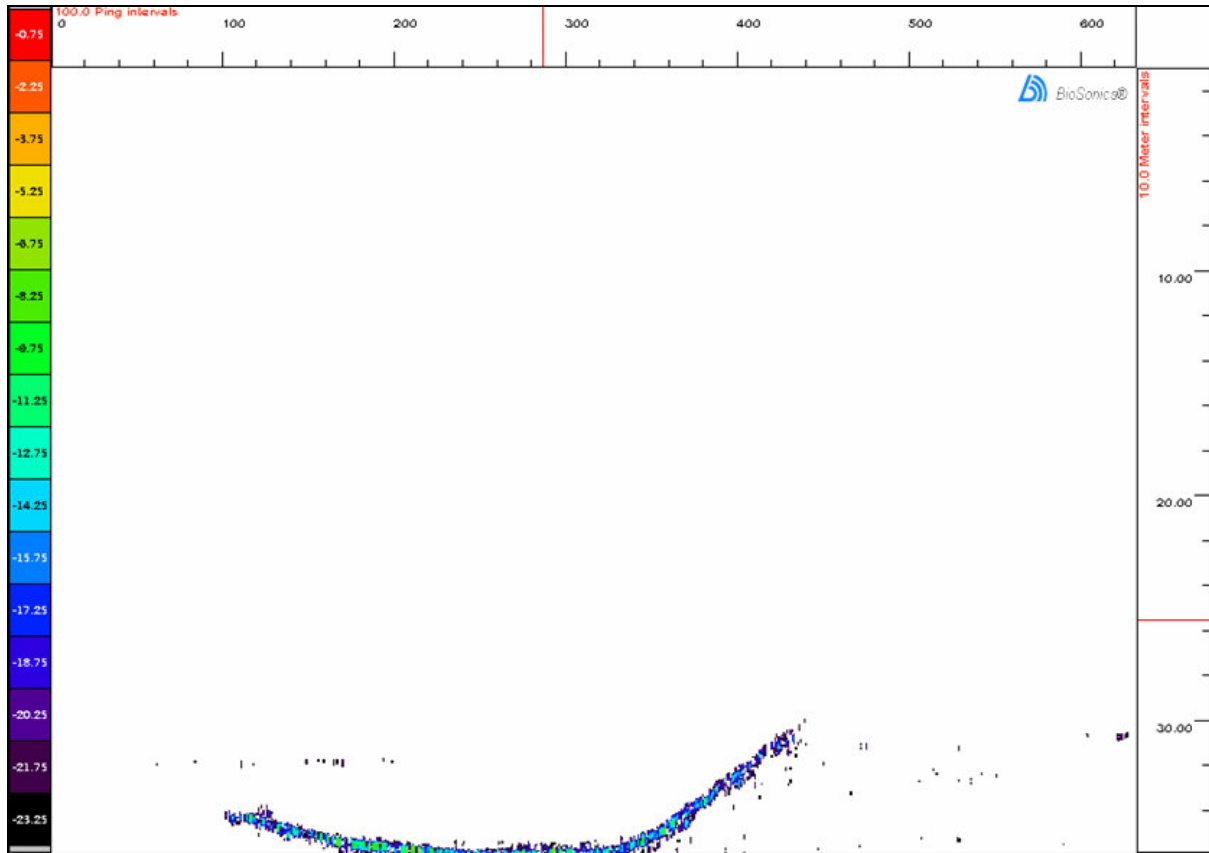
Horizontal mount.

Figure 67.   A fish, at maximum range. It maintains a relatively constant distance from the transducer and then moves closer after ping #300 until it moves out of the acoustic beam.

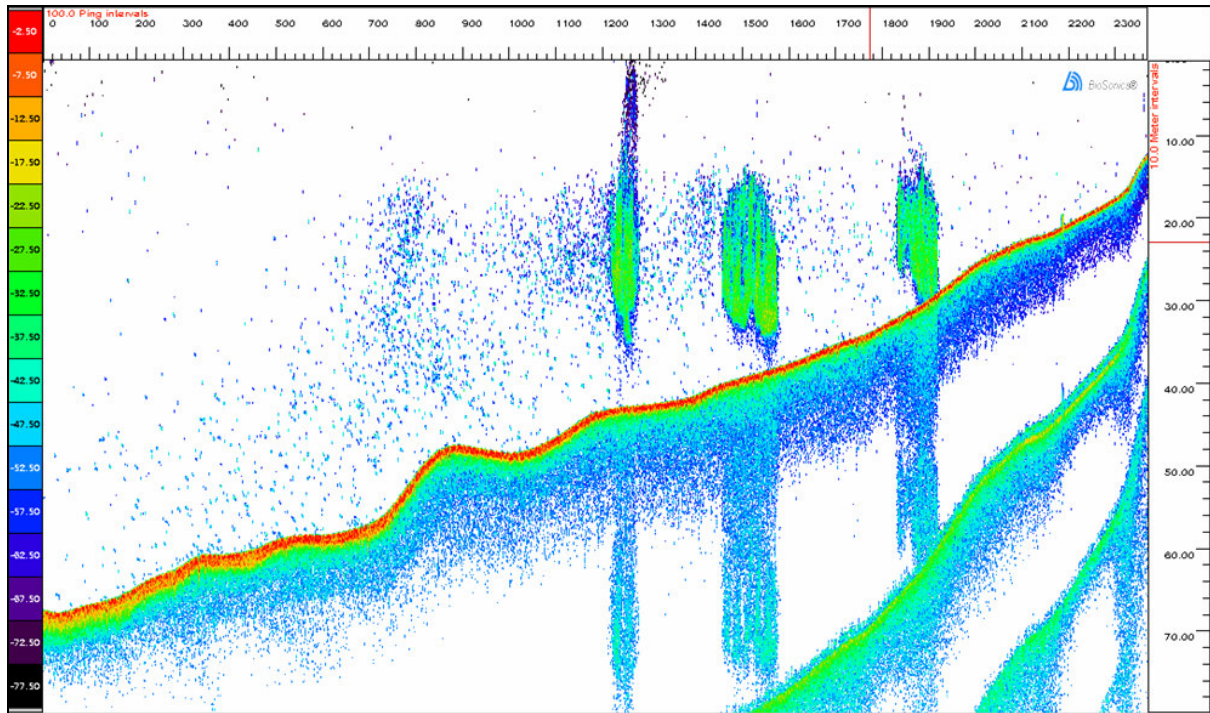# Herring aggregations, bubbles, 2nd and 3rd echoes

Figure 68.   Herring aggregations (schools). Visible are second and third bottom echoes, also visible are the second echoes from schools. The low energy signals above the school to the left are bubbles released as the fish are migrating up in the water column.
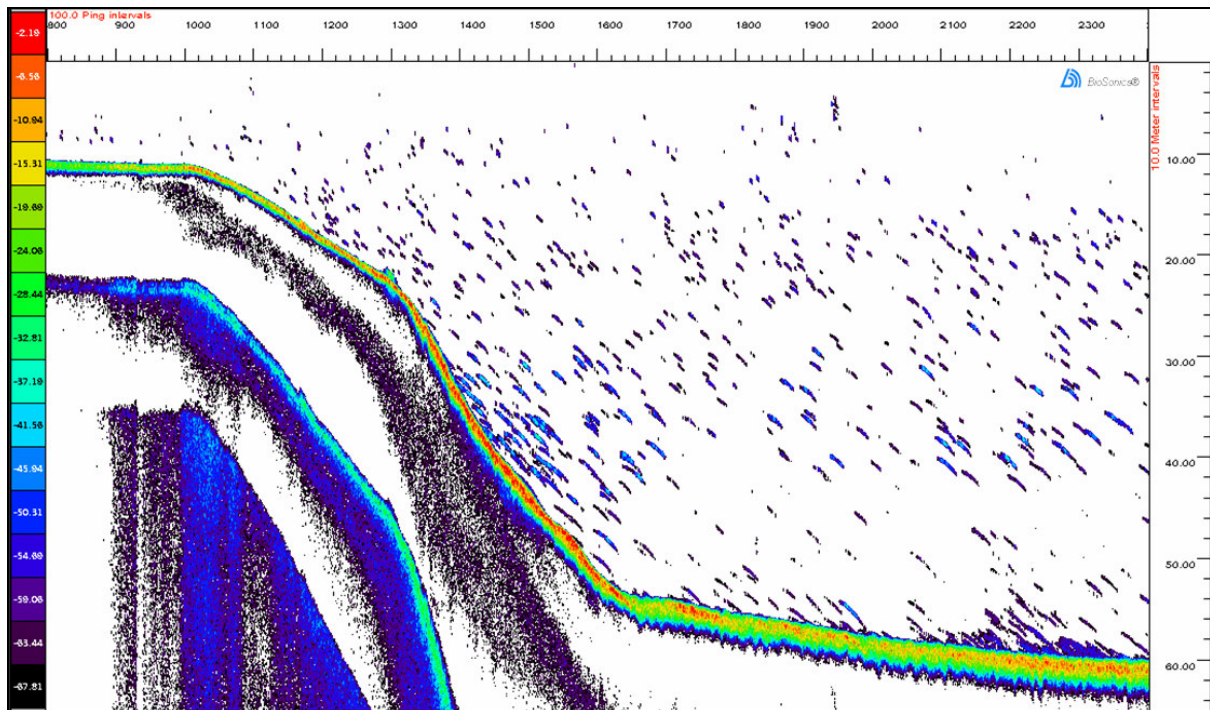
Transducer tilted – diving fish

Figure 69.   Transducer tilted, tow fin nose down, makes it appear as though the fish targets are 'diving'.
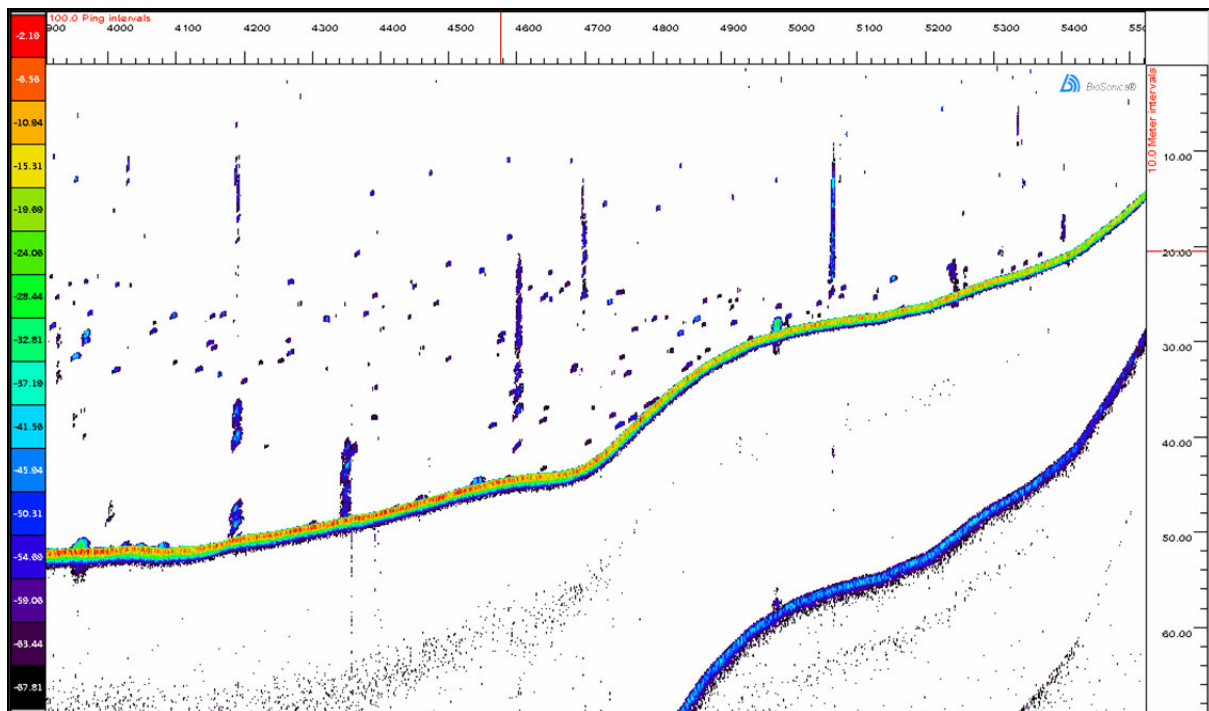
Bubbles from sediment

Figure 70.   Bubble columns rising from the sediments, either methane or more likely hydrogen sulfide gas.
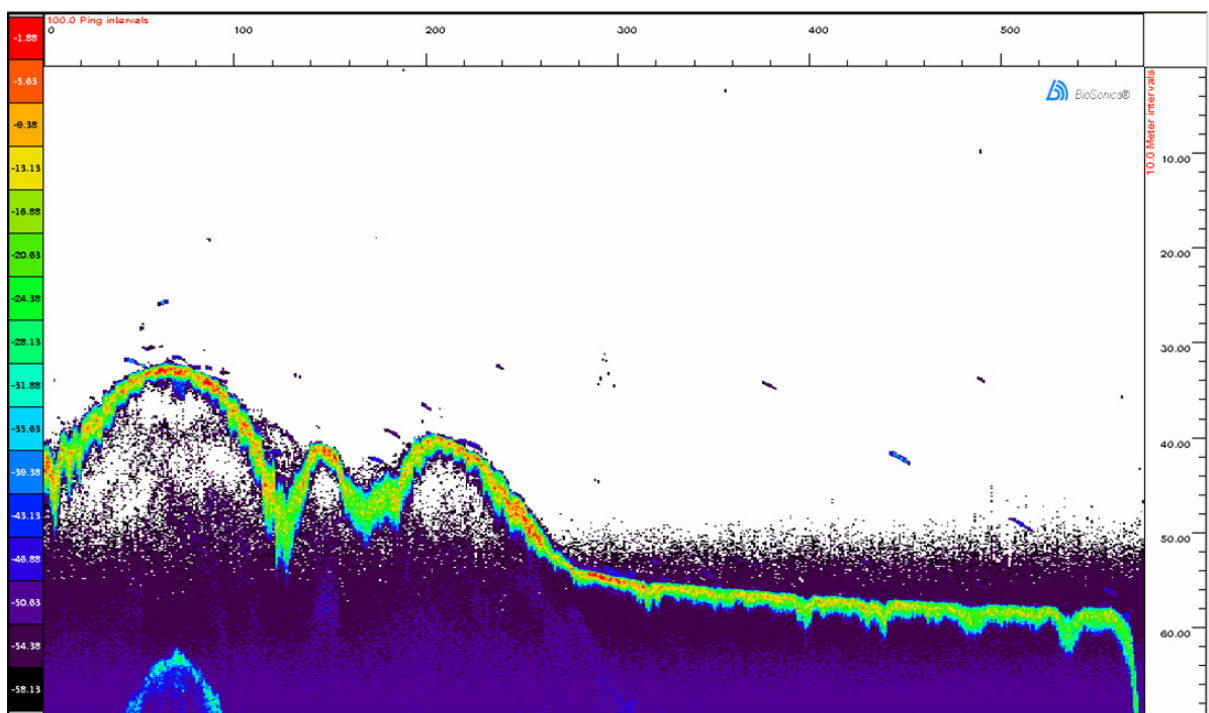
System noise

Figure 71.   System noise – here is an example of electronic noise that has been amplified above the threshold level. This noise is not acoustic in nature. It would also be present in ambient mode and visible with echosounder in 'passive mode'. Always a good idea to operate your system in passive mode when you have a new or changed installation to ensure that your system noise (from the echosounder or the environment) is minimal or absent.
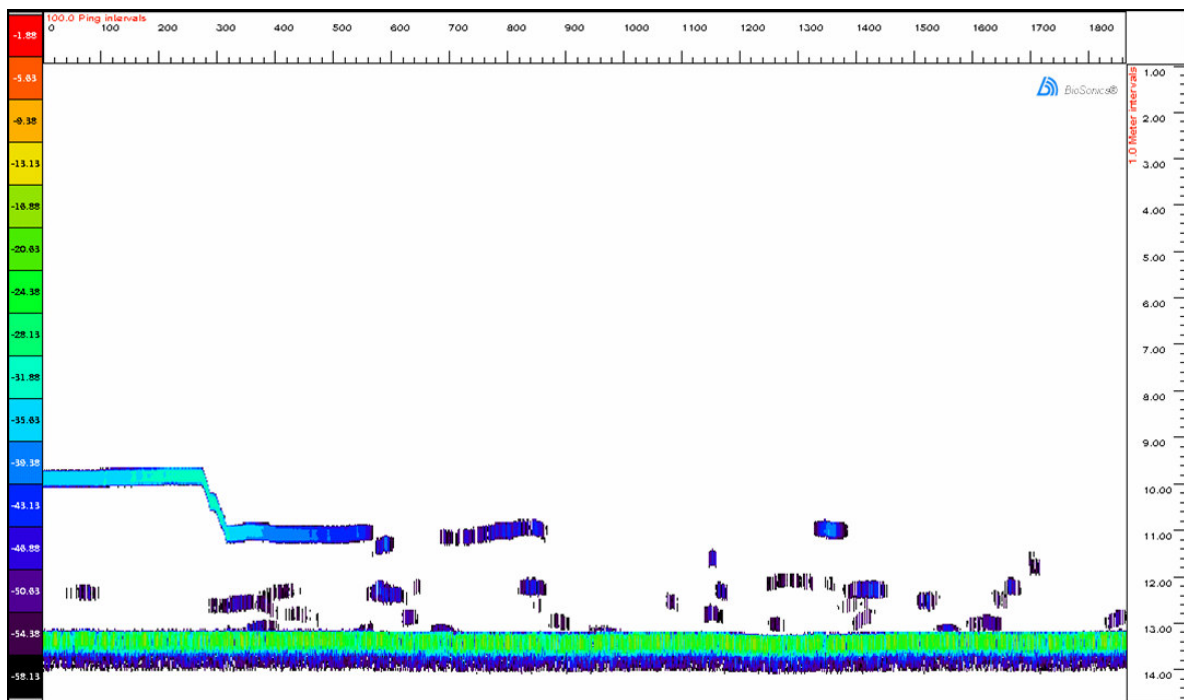
Standard sphere calibration

Figure 72.   Standard sphere calibration with 'helpers' (fish attracted to the calibration sphere).

Multi-path reflections from fish when the beam is grazing the boundaries.
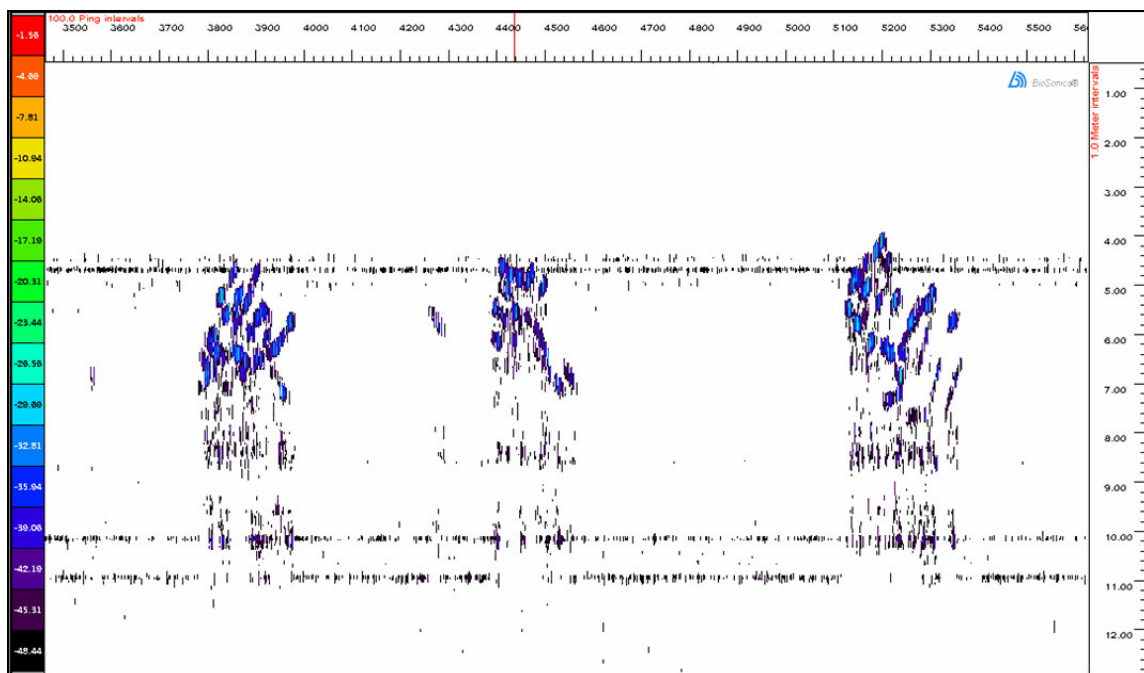
Horizontal mount.

Figure 73.   Multi-path reflections from fish when the beam is grazing the boundaries. Visible are both the direct echo from the fish and the later echoes which come from the acoustic beam being refracted off the surface or the bottom.

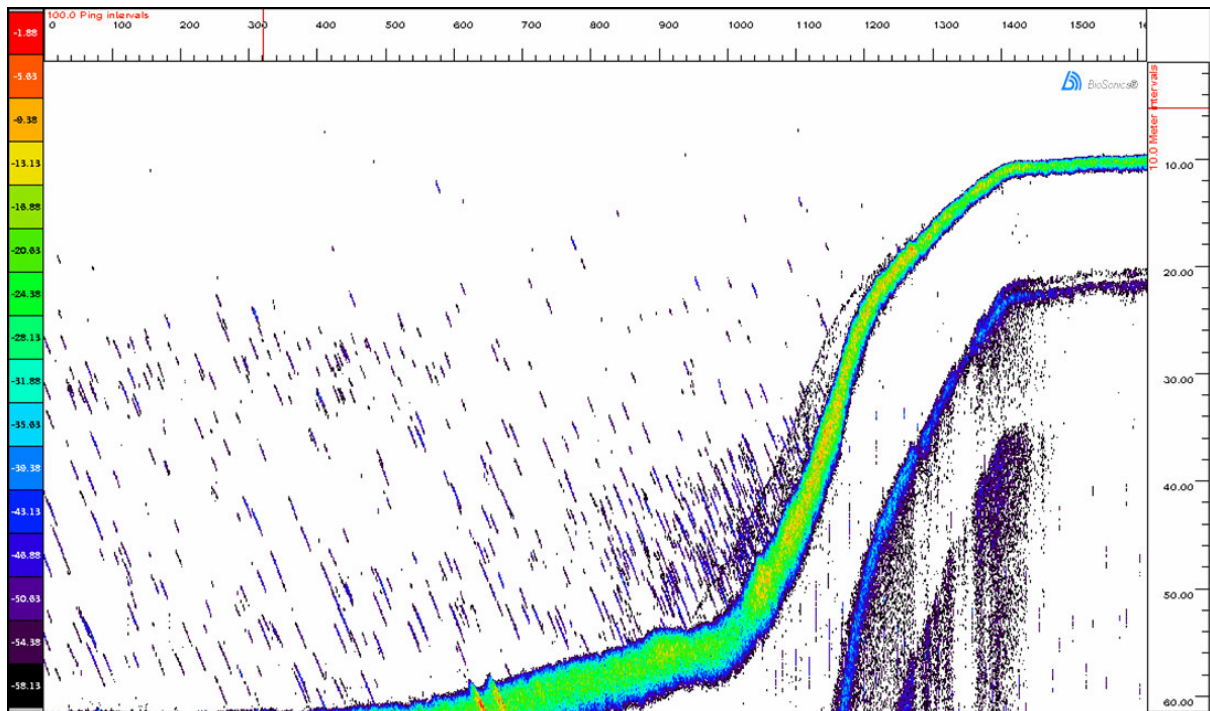# Side-lobe reflection from steep side of basin and tilted transducer mount

Figure 74.   Side-lobe reflection from steep side of basin. Tilted target traces indicate a tilted transducer mount.

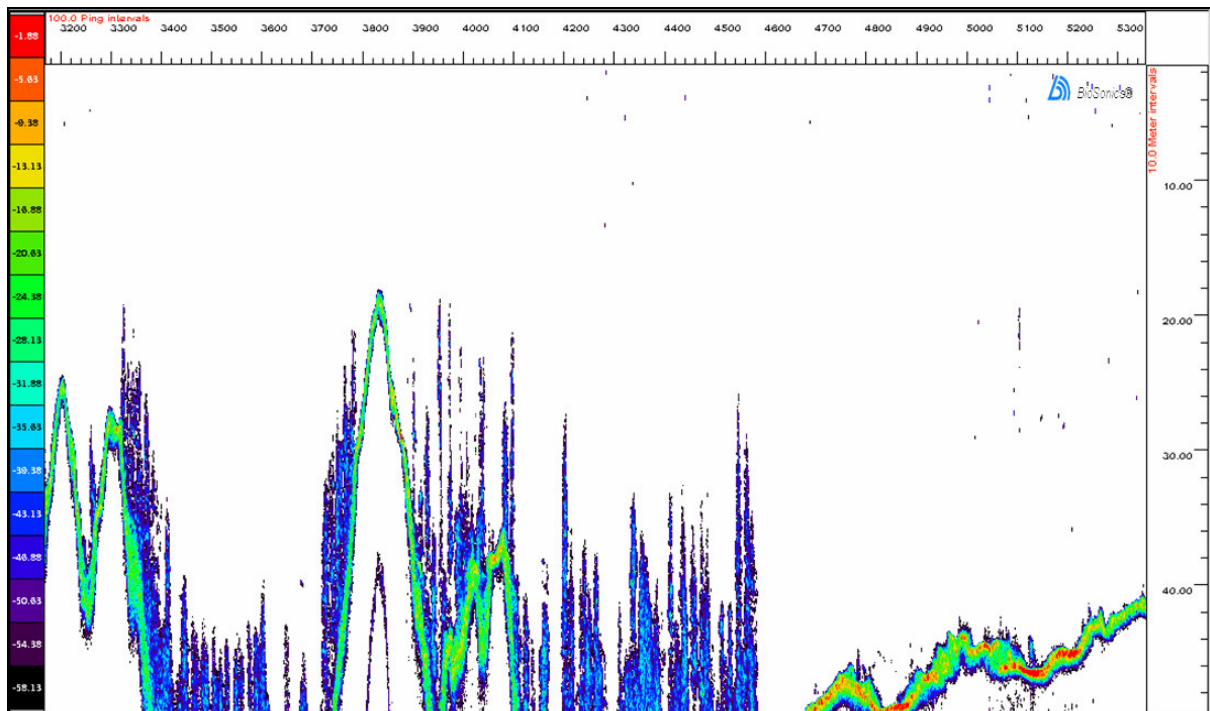# Standing Timber – trees on the bottom of a flooded river valley.

Figure 75.   Standing timber – trees on the bottom of a flooded river valley.

Mobile survey, horizontally aimed beam, Sacramento River.
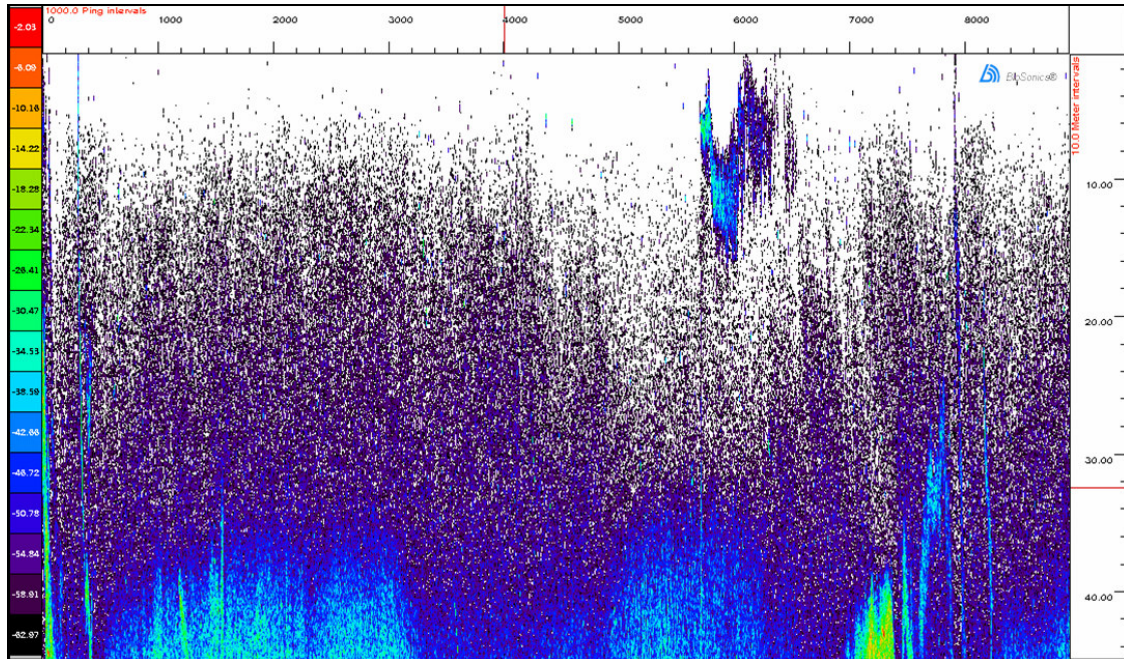
Horizontal mount.

Figure 76.   Surface reverberation, 10-35 m, strong reflections at 35+ m are far bank. Near range target is boat plus wake. Mobile survey, horizontally aimed beam, Sacramento River.
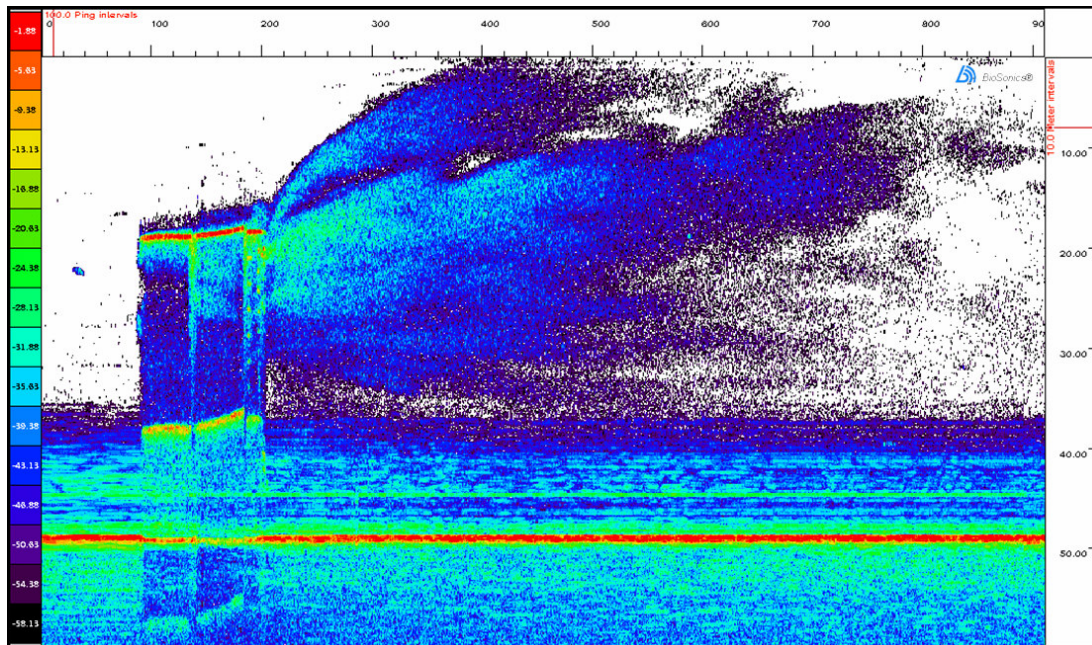
Boat wakes.

Horizontal mount.

Figure 77.   Boat wakes. Red signature is side of barge, horizontal aiming in the Illinois River. Note reflections both from bow wave and from entrained air. Note double or second echo from side of barge and tug. Note reduction in far side red echo.

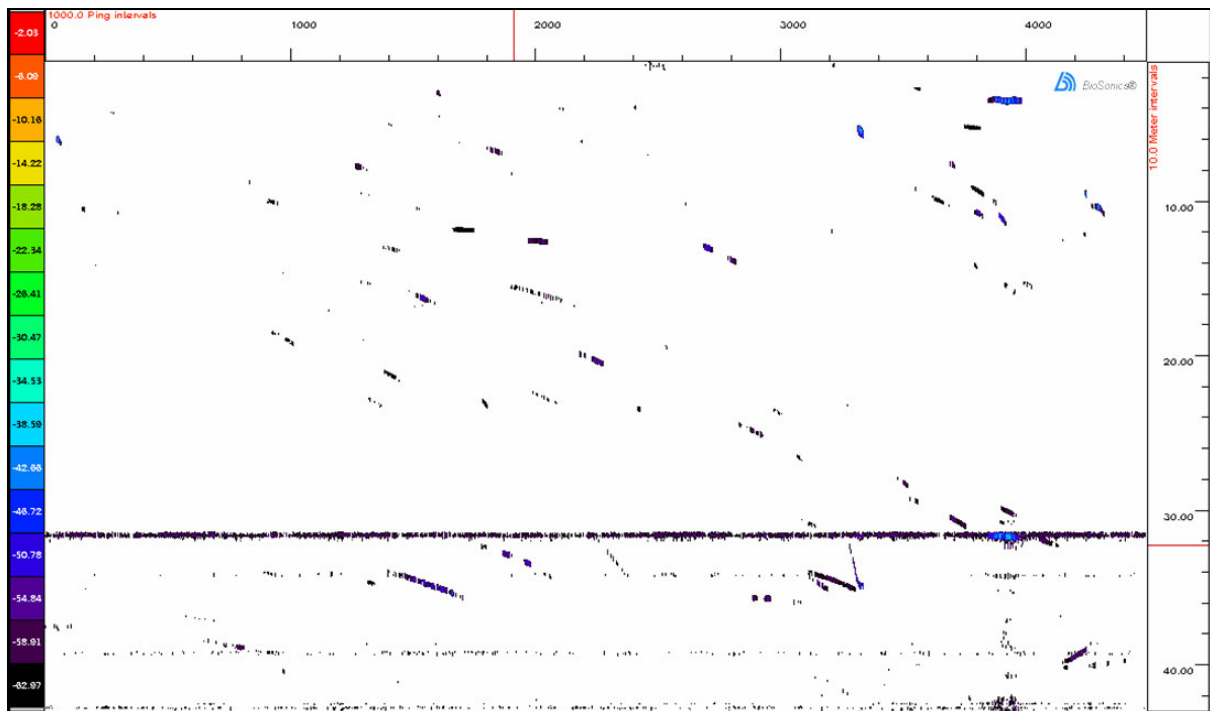# Structure, targets heading in different directions

Figure 78.   *Structure – beam hitting a fixed structure near the turbine intake on a dam. The horizontal band at approximately 32m is the echo from a protruding structure on the side of the dam. Note "Long-to-Short" and "Short-to-Long" targets, indicating that targets are not all heading the same direction during detection.*
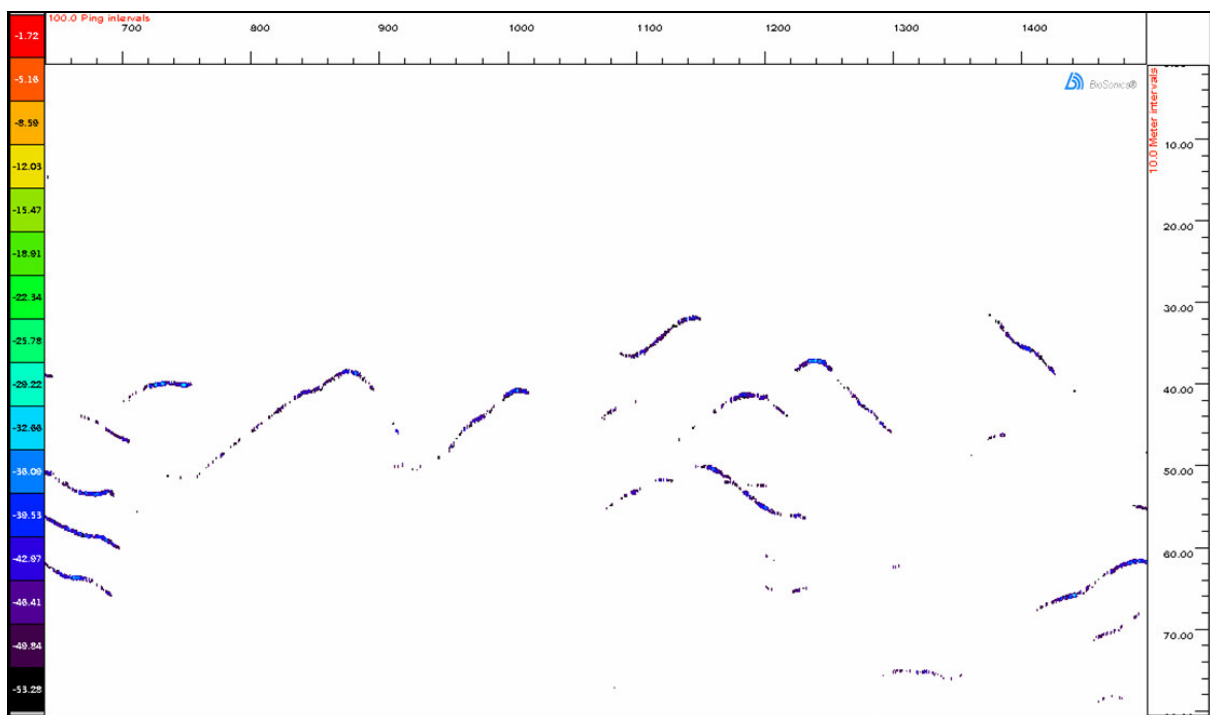
Wallowing fish

Horizontal mount.

Figure 79.   *Wallowers – fish spending a long time in the beam, moving closer then farther and then closer to the transducer.*
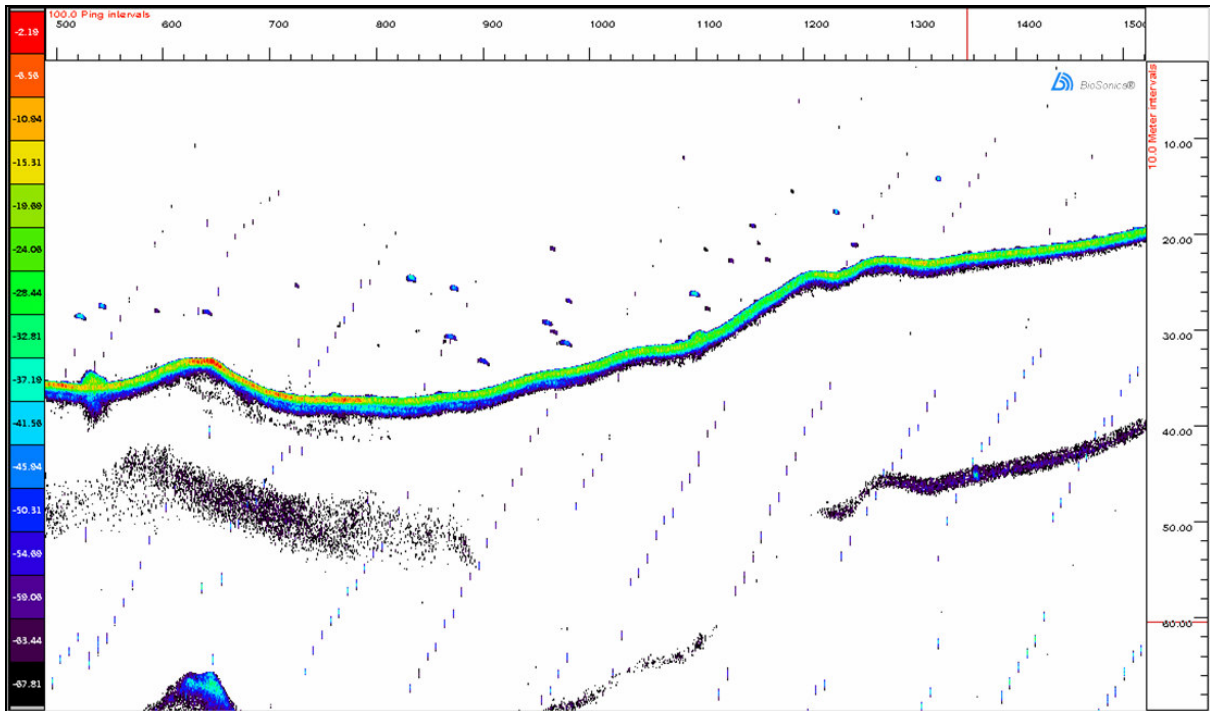
Cross-talk

Figure 80.   Cross-talk from another echo sounder.

Appendix E: Working range for far-field conditions.

Variable	Definition
a	Transducer diameter (m)
f	Frequency (Hz)
c	Sound speed (m/s) $c = \lambda f$
λ	Wavelength (m)
α	Absorption coefficient (dB/m)
R_b	Near field range boundary[23] (m) [Simmonds and MacLennan 2005] $R_b = \dfrac{a^2}{\lambda}$ And also, $R_b = \dfrac{a^2 f}{c}$
$2R_b$	Range for far field conditions[24] [Simmonds and MacLennan 2005] $2R_b = \dfrac{2a^2 f}{c}$ (4)

An example:

Simrad 38-7 38k Hz Single beam EK60 transducer.

> a = 424mm = 0.424m
>
> f = 38kHz
>
> c = 1490 m/s

$2R_b$ = 9.2m

Note: Non-ceramic transducers, which have poor physical damping can produce transducer ring noise that extends even beyond the $2R_b$ range.

Appendix F: EK60 output saved to the EK500 data format.

Calibration settings or transducer draft are not recorded in a file when EK60 output is saved in the EK500 data format. However if your data is also saved in the EK60 data format, you can calibrate the EK500 Sv power variable by using the calibration values recorded with the EK60 data. You will also need to calculate Sv Gain and wavelength - EK500 Sv power calibration values.

Use the Ex60 Power to Sv and TS calculation page in the Echoview help file. For the EK60 the Transducer gain and Sa correction are in separate terms within the equation. To calculate Sv gain (on its own), the terms are brought together.

Calculated Sv Gain* for .ek5 file = Transducer gain (EK60) + Sa correction (EK60)

Calculated Wavelength (m) = speed/frequency

Table 5: EK60 calibration values

Calibration settings	EK60 (from first ping) Sv calibration settings
Transducer 1 Transducer draft (m)	3.5
Absorption coefficient (dB/m)	0.0098139
Sound speed (m/s)	1465.00
Transmitted power (W)	1000.0
Two-way beam angle (dB re 1 Steradian)	-15.50
Transducer gain (dB)	21.9600
Sa correction (dB)	-0.68
Transmitted pulse length (ms)	1.024
Frequency (kHz)	38
Calibration 2 page	Check apply TVG range correction. Offset = 2
Calculated Wavelength (m) = speed/frequency	0.03855263
Calculated Sv Gain* for .ek5 file = Transducer gain + Sa correction	21.28

Appendix G: Hydroacoustic issues associated with acoustic bottom verification

Acoustic beam dead zone

Simmonds and MacLennan[7] (2005) discuss the topic *Integration near the seabed*. They consider the 'dead zone' for cases of the acoustic beam perpendicular to a horizontal seabed and to a seabed slope. They also discuss the traditional corrections and assumptions for fish in the dead zone and the impacts on estimates of abundance.

An example of experimental dead zone measurements for a sloping seafloor is in the report by Kloser and Ryan et al[25] (2001). The screenshot (below) displays their calculations.

For a 38 kHz system[25] where the pulse length is 3ms, they calculated a mean experimental dead zone height of 25m for a seafloor slope of 16 degrees.
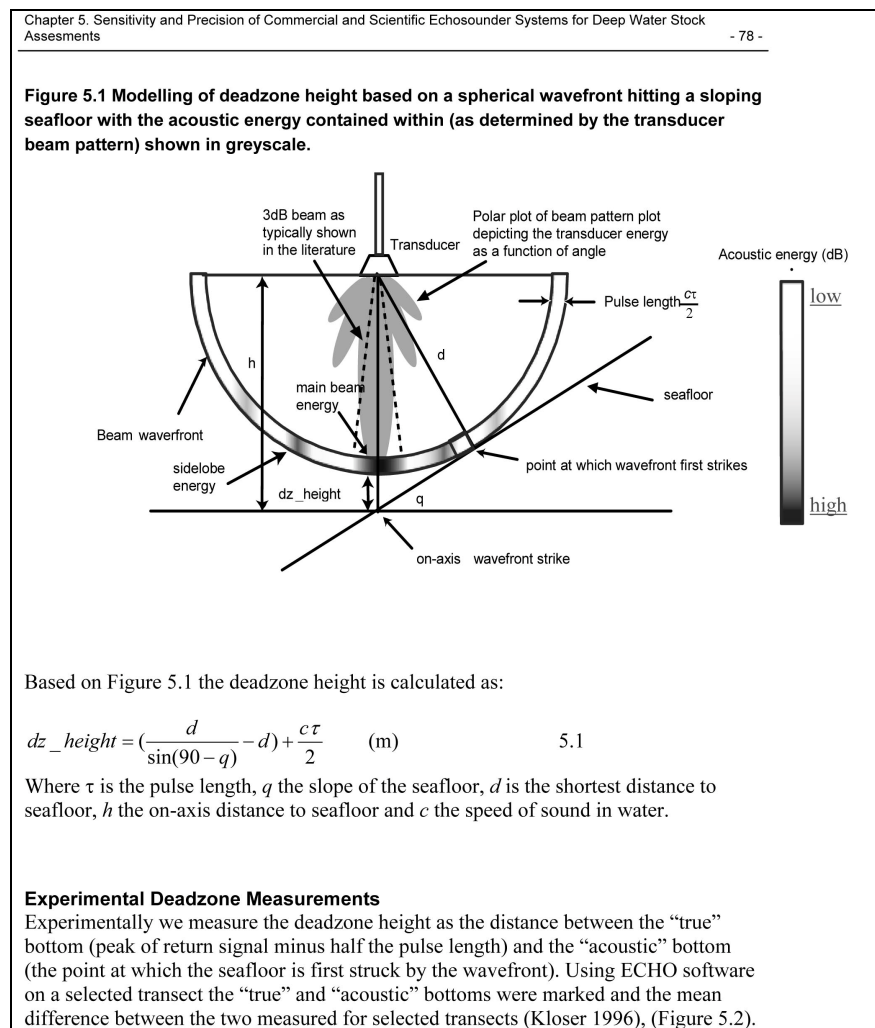

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Figure 5.1 Modelling of deadzone height based on a spherical wavefront hitting a sloping seafloor with the acoustic energy contained within (as determined by the transducer beam pattern) shown in greyscale.

Based on Figure 5.1 the deadzone height is calculated as:

$$dz\_height = (\frac{d}{\sin(90-q)} - d) + \frac{c\tau}{2} \quad \text{(m)} \quad\quad\quad 5.1$$

Where τ is the pulse length, q the slope of the seafloor, d is the shortest distance to seafloor, h the on-axis distance to seafloor and c the speed of sound in water.

Experimental Deadzone Measurements
Experimentally we measure the deadzone height as the distance between the "true" bottom (peak of return signal minus half the pulse length) and the "acoustic" bottom (the point at which the seafloor is first struck by the wavefront). Using ECHO software on a selected transect the "true" and "acoustic" bottoms were marked and the mean difference between the two measured for selected transects (Kloser 1996), (Figure 5.2).

Figure 81.   'Modelling the dead zone' , Kloser and Ryan et al[25] p78.

Signal from beam side lobes

A slope in the seabed can produce signals from the side lobes of the beam under certain conditions. The report by Kloser and Ryan et al[25] (2001) contains an example of identified side lobe interference
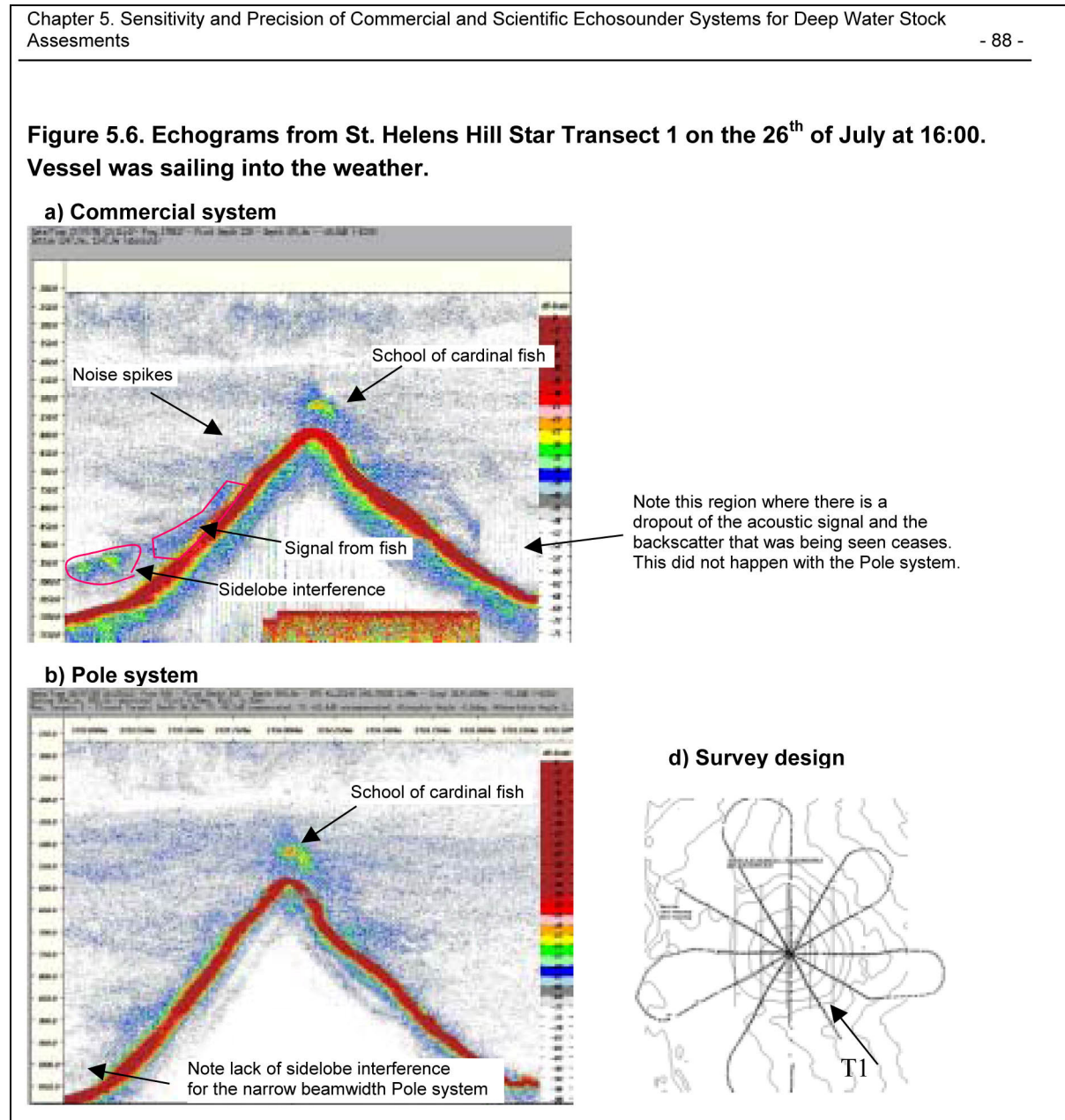

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Figure 5.6. Echograms from St. Helens Hill Star Transect 1 on the 26th of July at 16:00. Vessel was sailing into the weather.

a) Commercial system

School of cardinal fish

Noise spikes

Note this region where there is a dropout of the acoustic signal and the backscatter that was being seen ceases. This did not happen with the Pole system.

Signal from fish

Sidelobe interference

b) Pole system

School of cardinal fish

d) Survey design

Note lack of sidelobe interference for the narrow beamwidth Pole system

T1

Figure 82.   An example of side lobe interference from Kloser and Ryan et al[25] p88.

Appendix H: Using virtual variables in Echoview

A powerful way to process echogram data is to use synthetic or virtual echograms*. In Echoview, a virtual variable (virtual echogram) is created by applying an operator (a mathematical algorithm) to one or more input acoustic variables (operands). Operands may be raw variables or other virtual variables.

Operators may be chained to create additional virtual variables; that is, by using the output of one virtual variable as input to another.

You view and manage virtual variables using the Variables and Geometry window .

Variables and Geometry window

You can view raw variables, lines, transducers and virtual variables in the Variables and Geometry window. Use Shortcut menu selections to create, delete and manage variables and geometry.
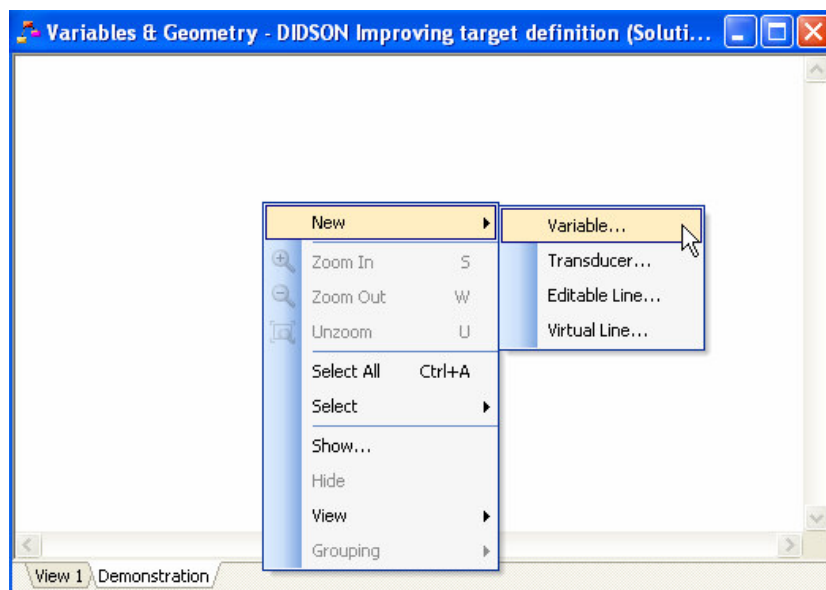
Figure 83. Shortcut menu (right-click) in the Variables and Geometry window. Creation of a virtual variable.

* *Fisheries Acoustics* 2nd Ed. (Simmonds and MacLennan, 2005), p334

Operators

To create a new variable.

> ▶ On the **Shortcut** menu select **New**, **Variable**.

To create a new editable line.

> ▶ On the **Shortcut** menu select **New**, **Editable line**.

To create a new virtual line.

> ▶ On the **Shortcut** menu select **New**, **Virtual line**.

Then:

Name and select an operator on the New variable dialog box.
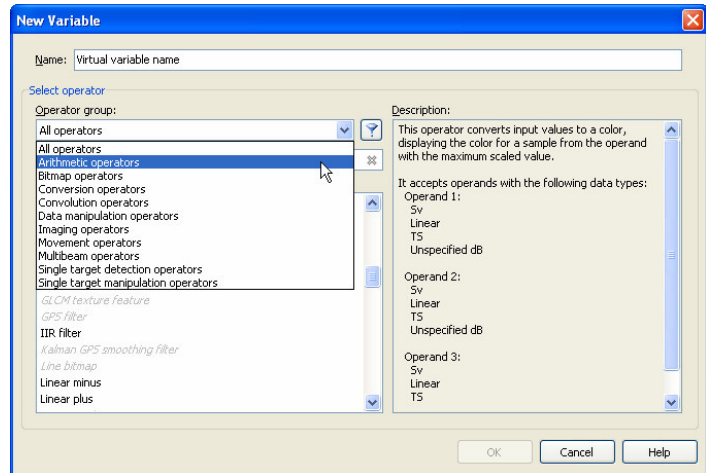
Figure 84.   New Variable dialog box. Enter the virtual variable name and select an operator.

Virtual variable properties

Select input operands, operator settings and other settings on the pages of the Variable Properties dialog box for the virtual variable.
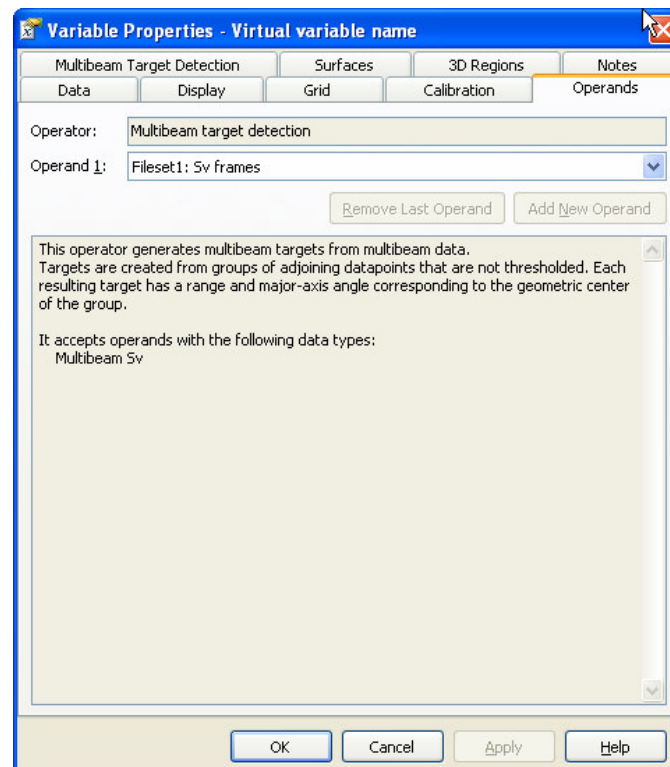
Figure 85.   A Multibeam target detection variable properties dialog box.

Virtual variable echogram

To view a virtual echogram, double-click the virtual variable or select Echogram on the Shortcut menu.
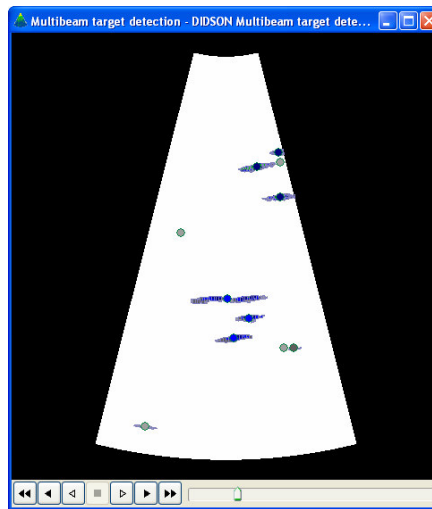
Figure 86.   Multibeam target detection echogram.

From Virtual variables training exercises
Exercise 10: Calculating Calibration Constants in Echoview

In this exercise you will calculate and apply a TS calibration constant. This represents one of the key stages in calibrating echosounder data and ensures the TS values of logged data are accurate. We examine TS from raw power data logged by a Simrad EK60 echosounder using a -35.00 dB calibration sphere. The objective is to tune the TS calibration constant (TS gain) such that the TS of calibration sphere measurements is equal to the known value of -35.00 dB. Echoview applies a default value but you must change this to properly calibrate your echosounder.

The exercise will teach you how to use Echoview, rather than the theory of calibration techniques. Specific values used in this exercise are illustrative only and may not be recommended or applicable to your work. For further information about calibration techniques you are referred to the scientific literature.

You will complete this exercise in the following stages:

▶ Open the EV file (which contains the soundings taken from a calibration sphere)

▶ Calibrate all variables (Calibration and Calibration 2 pages) and the transducer

▶ Create exclusion lines above and below the calibration sphere

▶ Create a single target variable containing only on-axis single targets representing the calibration sphere

▶ Display the measured TS mean of the on-axis single targets

▶ Calculate the change required to the TS calibration constant

▶ Apply the change to the TS calibration constant

Data folder:
C:\Myriax\Echoview\Echoview4\Echoview manual\10 Appendices\Appendix H data

Open the prepared EV file

- Open the file Virtual Variables (Calibration).EV
  This EV file contains calibration data recorded from a Simrad ES60

- Check calibration of the raw variables!
  All calibration values that are known at this time should be entered (check the Details dialog box).

  For this exercise you will need to initially calibrate all variables using the setting *From first ping* (see note below), fill out the Calibration 2 pages and calibrate the

Transducer. Later on you will need to use the *Manually* setting to apply your calculated Transducer gain which is needed to calibrate the TS mean to -35.00dB.

Note: To read calibration values from any Ex60 data files (.raw, .ek6 or .ek60), select the option *From first ping* of the setting *Apply calibration settings* on the Calibration page of the Variable Properties dialog box and then select *Apply* to apply those settings to the echogram. For new EV files this is set by default. That is, the calibration settings will be read directly from the first ping stored in the first data file which contributes to a variable and is used to populate the Calibration page of the Variable Properties dialog box. The Calibration 2 page of the Variable Properties dialog box needs be used also.

For each variable, you will need to select a setting for *Apply calibration settings* on the Calibration page of the Variable Properties dialog box. When Manually is selected, every calibration value should be assessed and corrected (if required).

Transducer calibration follows a separate path. Transducer calibration can be accessed on the Variables and Geometry window (F7) or via the button on the Calibration page of the Variable properties dialog box.

Create exclusion lines above and below the calibration sphere

You must create these lines so the single target variable you create contains only single target detections representing the calibration sphere.

- Display the TS Raw Pings T1 echogram and locate the samples representing the calibration sphere.
  Hint: The echoes from the calibration sphere are at approximately 19m. Increase the color display minimum (press F12) to -60dB to see the clear trace it has left.

- Create the upper exclusion line
  Click the Line draw tool then click **New Editable Line**
  Select *Fixed depth*
  Fixed depth = 17.75
  Create a new line = Above cal sphere
  Click **OK**

- Create the lower exclusion line
  Click the Line draw tool then click **New Editable Line**
  Select *Fixed depth*
  Fixed depth = 21
  Create a new line = Below cal sphere
  Click **OK**

- Close TS Raw Pings T1 echogram

Create a single target variable containing only on-axis single targets representing the calibration sphere

- Open the Variables and Geometry window (F7)
  Click the Variables and Geometry tool on the tool bar, or the click **Variables and Geometry** on the **View** menu

- Open the New Variable dialog box
  Object > New > Variable
  or, **Shortcut menu: New > Variable**

- Create the variable
  Name = On axis single targets
  Operator Group = Single target detection operators
  Operator = Single target detection - split beam (method 2)
  Click **OK**
  Operand 1: Fileset1: TS raw pings T1
  Operand 2: Fileset1: Angular position raw pings T1
  Click the Single target detection tab
  Minimum normalized pulse length: 0.6
  Maximum normalized pulse length: 1.2
  Exclude targets above line: Above cal sphere
  Exclude targets below line: Below cal sphere

- Display an echogram of the On axis single targets variable
  The variable currently displays single targets representing the calibration sphere. At this stage it contains all single targets which met the detection criteria (represent the calibration sphere) regardless of whether or not they lie on the beam axis.

- Note down the number of single targets
  Click the Horizontal band tool (4).
  Make a selection that covers all single targets
  On the **Shortcut** (right-click) menu, click **Define Region**
  Name: Cal sphere single targets
  Type: Analysis
  Click the close button
  On the **Shortcut** menu, click **Analyze Region**
  Note down the number of single targets

No. of Single Targets	

  Click **OK**

- Filter out off-axis single targets
  Note: For this purpose you can filter targets using beam compensation or angular position in the beam. In this exercise you will use the beam compensation.
  Open the Variable Properties dialog box (F8)
  Click the Single Target Detection tab

Maximum beam compensation: 0.5

Click **OK**

Note: The off-axis targets are removed from the echogram in real time when live viewing data with Echoview. This makes it possible to continue a calibration sounding for as long as necessary to generate enough data for calibration by monitoring the quality of the data as it arrives.

- Note down the number of on-axis single targets
  Click the **Cal sphere single targets** region
  On the **Shortcut** menu, click **Analyze Region**
  Note down the number of single targets

No. of Single Targets	

How many off-axis single targets has Echoview filtered out? What is the likely impact of this on the calibration results?

Display the measured TS mean of the on-axis single targets

- Click the **Cal sphere single targets** region (if not already selected)
  On the **Shortcut** menu, click **Analyze Region**

- Note down the TS mean

TS mean	

Calculate the change required to the TS calibration constant

In this step you will calculate the change that is required to the current TS calibration constant to make the measured TS mean of the calibration sphere equal to the theoretical TS value of the calibration sphere. This data was generated using a -35.00 dB calibration sphere so we should measure a mean TS of -35.00 dB in Echoview. We adjust the calibration constant to achieve that result.

Use the following equation:

$$\Delta C = \frac{TS_m - TS_t}{2}$$

where:

C = TS calibration constant

TS_m = measured TS mean

TS_t = theoretical TS value of calibration sphere (-35.00dB for this exercise).

Change to TS calibration constant	

Note: This equation is valid for raw data logged by the Simrad Ex60 series of echosounders – it may not apply to your echosounder. You will need to know how Echoview calculates TS values from the data stored in the data files you have logged. This is documented in the Echoview help file (Reference>Algorithms>Echosounder Algorithms>...) or you can contact Echoview support for details.

Apply the change to the TS calibration constant

- Display the Fileset1 : TS raw pings T1 echogram

- Display the Variable properties dialog box
  Click the Variable properties tool

- Change the TS calibration constant
  Click the Calibration tab
  Select the Apply calibration settings option Manually
  Transducer gain: Add the change you calculated in the previous step to the value in the text field
  Click **OK**
  Note: The name of the TS calibration constant setting may be different for variables derived from different echosounders. This exercise assumes all other settings on this dialog box are accurate and represent the conditions during sounding. In practice, before determining the calibration constant you must determine the absorption coefficient, sound speed, transmitted power and pulse length and enter them here.

- Display the Fileset1: Sv raw pings T1 echogram and apply the change to the TS calibration constant.
  Note: Sv data needs a further calibration to account for uncertainties in the beam volume. In this example this is the Sa correction term you see on the Calibration page of the Variable Properties dialog box.

Check your results

- Display an echogram of On axis single targets variable

- Analyze the Cal sphere single targets region
  On the **Shortcut** menu, click **Analyze Region**
  Note down the TS mean

TS mean	

The TS mean should be equal to the theoretical TS value of the calibration sphere, i.e. -35.00 dB. If it isn't, try to work out why by reviewing the exercise steps and/or comparing your EV file to Virtual Variables (Calibration) Solution.EV.

- Apply the TS calibration constant to **all** variables for which it is used

Calibrate the Sv variable

This exercise has thus far calibrated TS data – that is determined the appropriate echosounder constant (TS gain value) to convert the logged raw power data to the correct TS values. We leave it to you to apply a comparable technique to the Sv data. You will need to combine elements of the technique above and techniques you used in a previous exercise (Exercise 9: Removing Pings With No Single Targets from Sv Variable).

Exercise 9 is a part of the Echoview training materials for the Virtual Variables exercise set. Please contact the Echoview support team (support@echoview.com) if you need advice in pursing the Sv calculations.

In summary your goal is:

▶ Create a single targets variable containing only on-axis soundings form the cal sphere

▶ Create an Sv echogram containing only pings from the on-axis single targets

▶ Display the measured Sv mean of the calibration sphere echo trace

▶ Calculate the change required to the Sv calibration constant (Sa correction)

▶ Apply the change to the Sv calibration constant

Hint: the theoretical Sv for a calibration sphere of -35.00 dB target strength can be calculated as follows:

$$S_{vt} = TS_t - 20\log(R) - 10Log(T) - \Psi$$

Where:

TS_t = Theoretical TS of the calibration sphere (-35.00 dB in this exercise)

R = Range of the calibration sphere (19m in this exercise)

T = Mean thickness (height) of the region you are integrating. This region must contain all the energy of the cal sphere and ideally only the energy of the cal sphere for an accurate calibration.

Ψ = Two-way beam angle (dB) – a property of the transducer.

Finish exercise

- Close Echoview - save a working copy of the EV file

Appendix I: Introduction to DIDSON data processing. Topic 8 Calculations and graphs

Example calculations and graphs

Exported fish track analysis data can be processed in a number of ways to reveal useful numerical information and trends about the observed fish.

This tutorial shows you one variation of calculations and graphs that can be derived from the exported data in Topic 7.

.csv file processing

The exported fish track analysis file contains valid *and* invalid fish track regions. You will need to sort the file and delete regions where Num_targets equal -1 and 1. You will then sort by Region_ID to re-order the data correctly for use in the calculations workbook.

30. With **Windows Explorer** open your export file **gt 20cm target length by cells.csv**

    C:\Myriax\Echoview\Echoview4\Echoview manual\10 Appendices\Appendix I data\gt 20cm target length by cells (Solution).csv
    - OR -
    Click the file.
    On the **Shortcut** menu click **Open**.

31. Select the whole sheet.

32. On the Excel **Data** menu click **Sort**.

33. Under the *Sort by* section:
    Select *Num_targets, Ascending*
    Click **OK**.

34. Delete all rows where Num_targets equal 1 or -1.

35. Select the whole sheet.

36. On the **Data** menu click **Sort**.

37. Under the *Sort by* section:
    Select *Region_ID, Ascending*
    Click **OK**.

38. Save the sorted file as gt 20cm target length by cells.xls

Excel workbook – Calculations and graphs

The prepared fish track data is copied to an Excel workbook that has been configured to run pivot table calculations, formulas and plot graphs.

The workbook has been set up to use prepared fish track analysis data. The prepared data must be copied to the Fish tracks worksheet.

Use the data from **gt 20cm target length by cells (Solution).xls**

39. Open
    C:\Myriax\Echoview\Echoview4\Echoview manual\10 Appendices\Appendix I data\DIDSON Tutorial Statistics and Fish Flux (Solution).xls

40. The worksheets of the workbook solution file have been protected (in a simple way). To remove the protection for each sheet do the following:
    On the **Tools** menu select **Protection >Unprotect**.

41. Examine the calculations and graphs in the workbook.

Tips and tricks

You can use the workbook as a template for fish track analysis data exports that contain different analysis variables than those specified by the Echoview DIDSON tutorial set. However you may have to reconfigure the source data for tables and graphs. The histogram graph will also need to be redrawn using the Excel Add-in **Data analysis > Histogram**.

Refer to the Echoview help file for more information regarding: "About fish track regions (Invalid fish tracks")."

Configuration

Figure 87.   The Configuration worksheet.

This worksheet defines Named worksheet variables that are used throughout the workbook.

Intermediate calculations

Figure 88.   The Intermediate calculations worksheet..

This worksheet displays intermediate calculations for fish count and fish flux. Formulae use Excel Lookup functions and Named variables.

Basic statistics and fish flux

Figure 89.   Basic statistics and fish flux worksheet.

This worksheet displays upstream and downstream calculations for:

- Fish number via a pivot table.
- Fish number/hour via a formula that sources data from the pivot table and the workbook.

Fish tracks

Figure 90.   Fish tracks worksheet.

This worksheet contains the processed fish track analysis export data.

Topic completed

You have completed this topic and should now be aware of some of the types of information you can derive from Echoview fish track analysis export data.