Seabed Identification Surveys in HYPACK®

By Judy Bragg

Seabed Identification (Seabed ID) surveys have long been supported in the standard HYPACK® package. They require a specialized echosounder to record the data required to determine the bottom types and, although most routines used to process the data are centered in the SEABED STATISTICS program, some are less obvious.

The SeabedID device driver refers to a user-defined table of E1-E2 ranges and bottom classifications—the Seabed ID Square— to assign a Seabed ID number for each sounding record during SURVEY. The E1 and E2 values are time tagged saved with the Seabed ID number to an ROX record in the raw data file. If this driver is used to paint the matrix, SURVEY will fill the matrix using Seabed ID colors based on the Seabed Square created in SEABED STATISTICS for your survey area and designated in the driver setup. (You can also create a seabed matrix in post-processing using the SEABED MAPPER program.)

You may use Seabed ID colors to display your seabed matrix, soundings and track lines in HYPLOT. A TIN Model drawn with an XYZid file will draw to the screen using Seabed ID colors. You may also export your soundings in limited formats.

Seabed ID Systems

Certain echosounders record two echo return values (E1 and E2) in addition to the depth. These values vary according to the roughness and hardness of the bottom composition. This enables you to define various bottom types by a specific range of E1 and E2 values from the echosounder.

To do all of this requires a little preparation:

1. **Do your bottom truthing** in your survey area to determine the echo return values that correspond with each bottom type in your area.
2. **Use SEABED STATISTICS to create a Seabed ID Square**. This (*.SIX) file contains the classifications for your project area and their corresponding E1 and E2 ranges.
3. **Use the SeabedID device driver (SeabedID.dll) in your Hardware Setup**, specifying your Seabed ID Square (*.SIX) in the Driver Setup dialog.

Note You can log data with no SIX file specified in the driver setup, but no Seabed IDs will be logged in the RAW data. (Obviously, you can not display them in SURVEY either.) In this case, when you *do* have a SIX file, you can assign the Seabed IDs in either the RAW or edited ALL format files using the SEABED STATISTICS program.

SEABED STATISTICS

SEABED STATISTICS includes most routines used in Seabed ID surveys:

- **Generate the Seabed ID Square:** You can define a set of classifications for your project area in a Seabed ID Square and generate statistical data from the logged data. The Seabed ID Square includes:
  - A list of bottom types
  - Their corresponding E1 and E2 ranges from the echosounder data. (You have to have a Seabed ID system.)
  - A Seabed Identification color and number for each bottom type.

  All of the data is saved to your project in an *.SIX file. The Seabed ID device driver uses the Seabed ID Square during SURVEY to apply classification numbers for each sounding record according to the E1-E2 range in which it falls. You can use these Seabed ID numbers to color your matrix in SURVEY or HYPACK®, or plot your soundings and track lines in HYPLOT. A TIN Model drawn with an XYZid file will draw to the screen using Seabed ID colors. You may also export your soundings in limited formats.
- **Reassigning Seabed IDs:** SEABED STATISTICS can read your logged data and assign new Seabed ID numbers according to a SIX file other than the one named in the SeabedID driver setup during logging. Use this routine if you logged without a SIX file named in the driver or if you need to correct the data logged with an incorrect SIX file.
- **Statistical Reporting:** SEABED STATISTICS reads All format data containing Seabed ID information (the E1 and E2 data), and graph the distribution of each set of data. The graph also indicates the return ranges within which 68% and 95% of the returns fall.
- **Export related files** for use outside of SEABED STATISTICS.
  - **A HYPACK® Colors file** (*.HCF) with your Seabed ID colors. You will need such a file to properly display your data using Seabed ID colors.
  - **A Color Bar graphic** with your Seabed IDs and colors for use in HYPLOT.
  - **Text files** containing a selection of user-defined position coordinates and E1/E2 values.

CREATING A SEABED SQUARE IN SEABED STATISTICS

Before you can define the square, you must collect some sample data in various parts of your survey area where the bottom compositions differ to determine what bottom types exist and what their corresponding E1 and E2 ranges are. The number of readings necessary will vary depending on how much your survey area varies.

If you are working in the same general area of the world where the geological conditions are similar, it may be possible to use the same square for several projects. However, if the bottom types are significantly different, you will have to create a seabed ID square appropriate to each project area. (You wouldn't use the same square file in the Mississippi delta as you would on the rocky coast of Maine.)

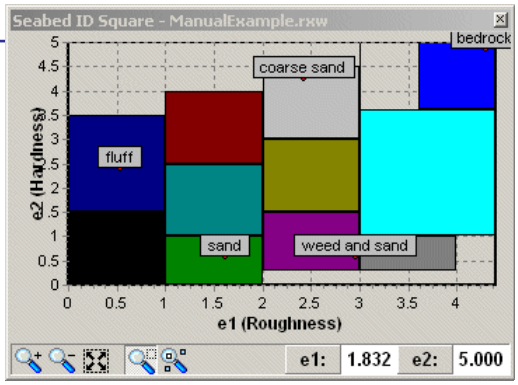
Once you have gathered this information, you are ready to build your Seabed ID Square.

1. **Launch the SEABED STATISTICS** by selecting UTILITIES- SEABED -SEABED ID.

The Seabed ID window displays five resizable windows that can be toggled on and off through the View menu.

2. **Select FILE-NEW SEABED ID SQUARE**. The screen will clear, ready for the new information.
3. **Load calibration data (optional).** You can load your data files or just representative "calibration points" from each bottom type area to guide you.
4. **Define your bottom types with their corresponding E1 and E2 ranges**. You can load your data files or just a representative "calibration point" from each bottom type area to guide you.

FIGURE 1. Seabed ID Square in Seabed Statistics



5. **Modify the seabed identification colors (optional).** SEABED STATISTICS automatically assigns colors to each color range, but you can change them by double-clicking on the sample color to the left of each range description. A color dialog will appear for you to select your desired color.
6. **Save the square** by selecting FILE-SAVE SEABED ID SQUARE and naming the file. The file will be saved with a SIX extension in the project directory.

Note: You can also save the same colors and ranges to the project's HYPACK® Color File (*HCF) which will allow you to display your data using your seabed identification colors.

Loading Calibration Data to Seabed Statistics

You can enter your sample data files, or manually enter information derived from them, to be displayed in the Seabed ID Square window. This data is useful to guide you while you define your E1 and E2 ranges for each bottom type.

Loading Data Files to Seabed Statistics

Select FILE-ADD MATERIAL then the Raw or All format files from the file selection dialog. When you do this the files are listed on the tree view file list at the left of the main window and displayed in the Seabed ID Square window.

Ideally, there would be one file for each bottom type. Whether you load them individually or using a LOG file, each file will display in a different color (up to 15) in the Seabed ID Square window.

To assign colors manually to each file or to all of the files in the catalog:

1. **Right-click** on **the file or catalog** in the tree view.
2. **Select 'Choose Color' and select your color** from the color dialog.

If you have right-click on a catalog, all files contained in the catalog will all be assigned the same color.

FIGURE 2. *Tree View File List*

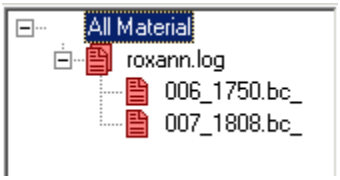
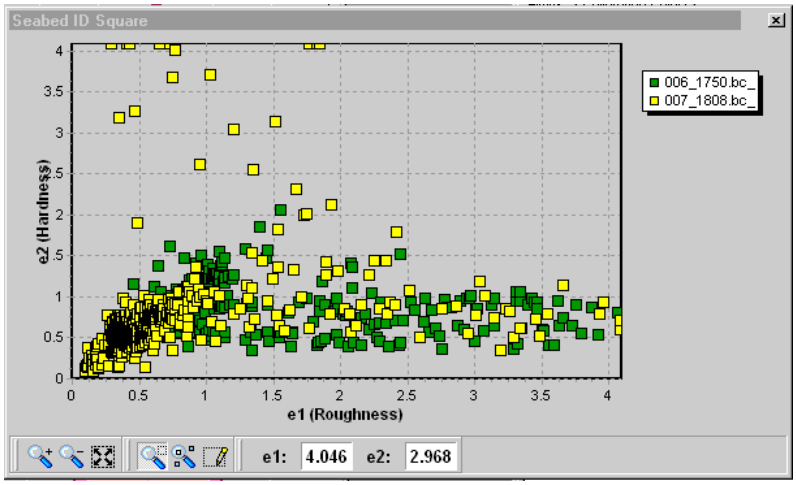


FIGURE 3. *Viewing Sample Data*



If some of your data files overlap, you can bring one set forward in the display by right clicking on the name in the tree view and selecting the "Highlight" option.

To unload data files from SEABED STATISTICS, right click on the name in the tree view and select the "Remove" option.

Entering Field Samples to Seabed Statistics

To enter a list of field samples, open the Calibration Points tab of Spreadsheet window and enter your bottom types with approximate E1 and E2 values. In this spreadsheet, the Notes field names the sample; it is not the seabed identification.

FIGURE 4. *Entering Calibration Points*

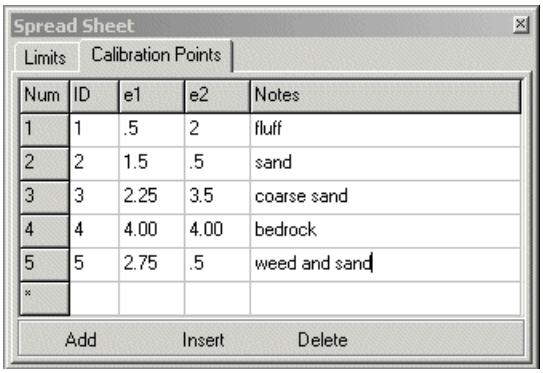
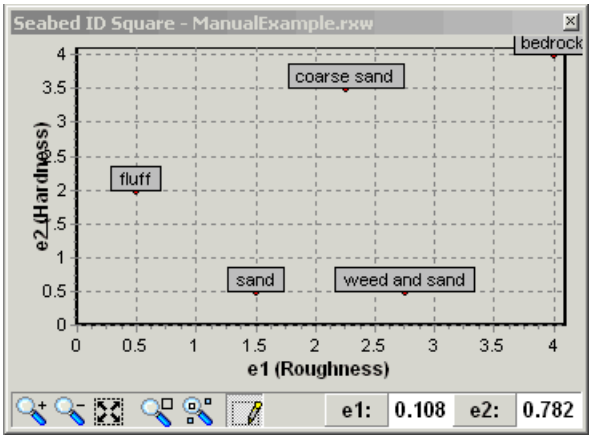


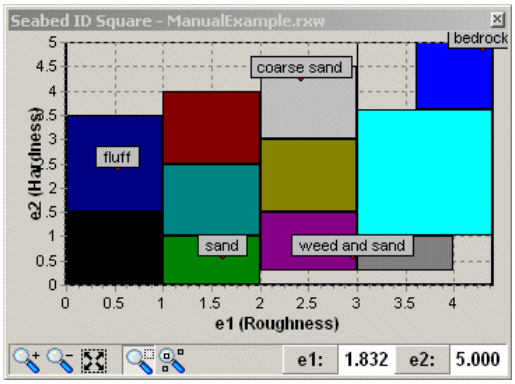
FIGURE 5. *A blank Seabed ID Square with Calibration Points displayed*



ENTERING SEABED CLASSIFICATION RANGES IN SEABED STATISTICS

In the previous versions of Seabed Statistics, the defined ranges for the roughness (e1) and hardness (e2) identification were rectangular.

FIGURE 6. *Seabed ID Square in Seabed Statistics*



Because the scatter from the roughness and hardness readings on a particular surface are not square, we now support “polygon” ranges to better “fit” the scatter areas.

You can define the ranges using one or both of the following methods.

- **Manually type the information to the Limits tab of the Spreadsheet window**.
  a. **Create a new range name** by pressing the “Add” button on the *left* side of the Spreadsheet window and typing the name into the space created in the spreadsheet.
  b. **Define your range** by pressing the “Add” button on the *right* side of the window, once for each point needed to define your range, then manually entering the hardness/ roughness (e1/e2) levels that define the range.

As each classification is defined, the corresponding area will be drawn in the Seabed ID Square window.

FIGURE 7. *The Edit Ranges Spreadsheet*

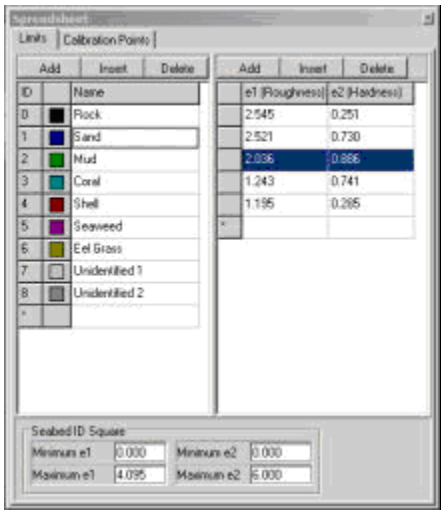
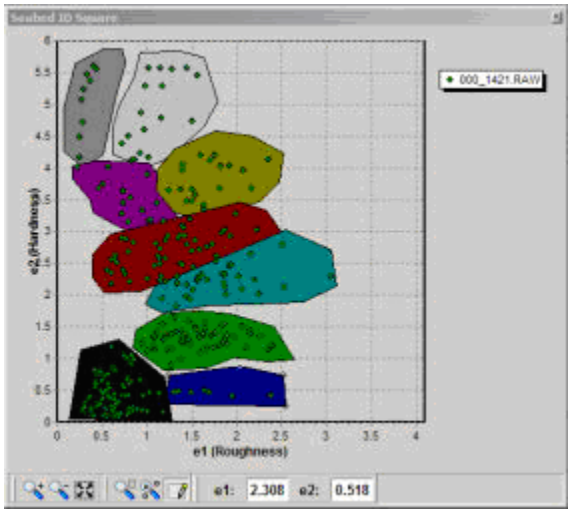


FIGURE 8. *The resulting Seabed ID Square*



- **Use the cursor to draw the ranges** in the Seabed ID Square window.
  a. **Click the Range Edit Icon** on the bottom of the Seabed ID Square window. This will change the cursor to the Range Edit cursor.

  b. **Define the polygon**.

i. **Press the "Shift" button**. When you press the Shift button the cursor changes to let you know you are adding points. *Keep it pressed as you click all the points in the range perimeter*.

ii. **Click the points around the perimeter of your polygon**. As you click on the screen the polygon will be built.

iii. **Close the polygon** by releasing the Shift key.

To create another new range, press the Shift button again and click the points for the new range.

Editing Seabed Squar es

As you are developing the Seabed Square for your project area, you may need to modify your settings or add new ranges.

1. **Load the seabed square into SEABED STATISTICS** by selecting FILE-OPEN and choosing the SIX file you wish to edit.
2. **Modify your square**.
   - Define additional ranges.
   - Change your current range settings. You can enter new values in the spreadsheet or use the cursor in the Seabed ID Square window.

To change existing range settings:

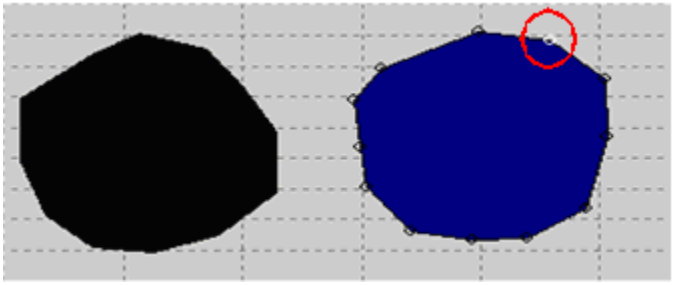
1. Select the range.
2. When a range is selected, you can add nodes to the border or move the existing nodes.

Selecting a Seabed Range

1. **Enter Range Edit Mode.** (Press the Range Edit Icon.) As you move over an unselected range with the mouse you will see a Range Select cursor.

2. **Click on any range in the Seabed ID Square window.** The cursor will change to the Node Edit Cursor while it is within the selected range and the nodes defining the selected range will be displayed (shown below).

FIGURE 9. *The range on the right is selected (active/current range).*



A range can also be selected by clicking on it in the Spreadsheet window.

Adding a Node to the Selected Range

A new node must be added on an existing edge.

1. **Press the Shift key**. (Remember, new points can only be added with the Shift button pressed.)
2. **Move the cursor** (with the Shift key pressed) over an edge of the selected range. You will notice the Node Addition cursor.
3. **Click on the point where you want to add a node on that edge**.

Nodes can also be added by using the Spreadsheet window.

Moving a Node on the Selected Range

To move a node:

- **In the Seabed Square**, move the cursor over a node point on the selected range. When the cursor changes to the Node cursor, click and drag the node to the new position.
- **In the Spreadsheet** by changing the roughness/hardness (e1/e2) values for that node in the Spreadsheet window. When you select a node either by the Node tool or the spreadsheet window, that node is drawn in white (circled in the previous image) on the Seabed ID Square window.

Creating Seabed Statistics

The second function of SEABED STATISTICS is to read and analyze the E1 and E2 values in the survey data you have loaded to the program, then present statistical information about it. **Four windows display the data statistics.**

When you load survey data to SEABED STATISTICS:

- **The file names are listed in the tree view on the left.**
- **The statistics are automatically calculated and displayed.**

Beware! If you have loaded data files that should not be included in the statistical analysis, you must omit them from your display and statistical calculations by right clicking on the name in the tree view and clearing the "Enable" option.

- **E1 Distribution and E2 Distribution windows:** The distribution of the E1 and E2 values are graphed in the two distribution windows.

FIGURE 10. *E1 Distribution Graph*

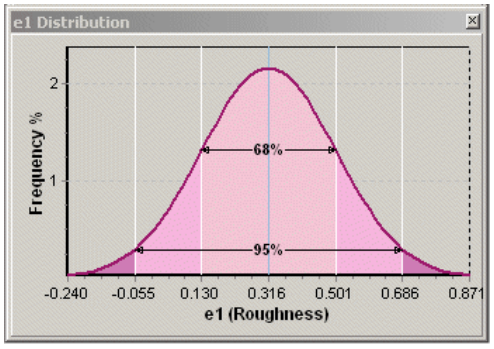
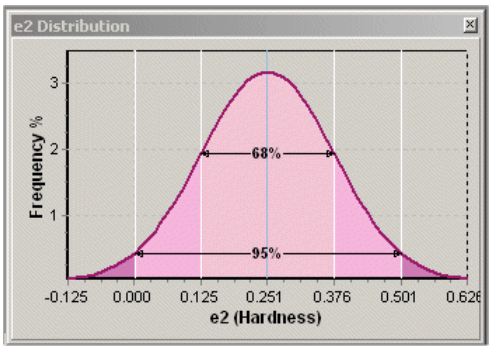


FIGURE 11. E2 Distribution Graph



- The **Material Statistics** display presents the same data in numeric form.

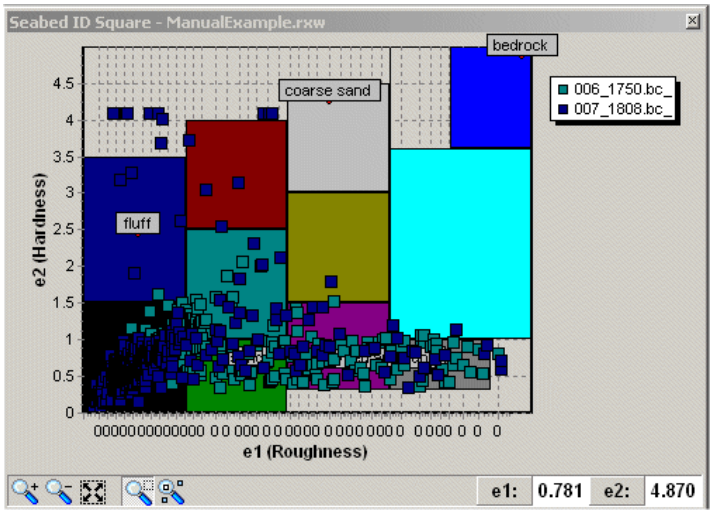
FIGURE 12. Material Statistics

Material Statistics

	Points	Min	Max	Sigma	-2 Sigma	-1 Sigma	Mean	+1 Sigma	+2 Sigma
e1	1395	0.100	4.090	0.734	-0.741	-0.007	0.727	1.461	2.195
e2	1395	0.090	4.090	0.418	-0.145	0.273	0.691	1.109	1.528

- The **Seabed ID Square** overlays the E1 and E2 data on the classification squares.

FIGURE 13. E1 and E2 overlays the Seabed ID Square



The tools in the Seabed ID Square window enable you to remove any data from the statistical analysis. You can omit selected data points or entire files from your display and statistical calculations.

To omit select data points:

1. **Click on the Material Selection Icon** (right-most on the toolbar).
2. **Drag an area around the data** you want to remove with your cursor. The selected points will turn white. If you are not satisfied with the selection, you can:

- **Make a new selection** by dragging a new area.
- **Deselect the data** by selecting EDIT-CLEAR SELECTION.

3. **Select EDIT-DELETE SELECTED MATERIALS** or hit the Delete key. The Material Statistics and the E1 and E2 Distribution displays will all update accordingly.

To omit entire data files:

Right-click on the name in the tree view and clear the "Enable" option.

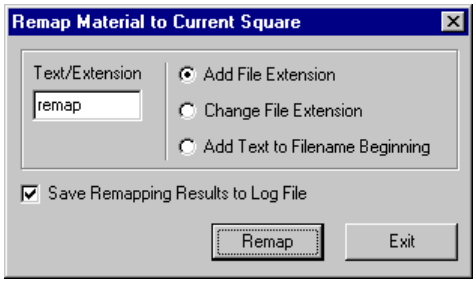
Note: This does *not* delete the data from the data files.

Reassigning Seabed Identification Values

The Seabed Square is used by the SeabedID.dll to assign Seabed Identification values to each sounding record. In SEABED STATISTICS, you can reassign these values based on a different Seabed Square. When you do this, SEABED STATISTICS creates a new set of data files with the modified identification numbers.

1. **Open the new Seabed Square** by selecting FILE-OPEN SEABED ID SQUARE.
2. **Load your sounding files by** selecting FILE-ADD MATERIAL then the Raw or All format files from the file selection dialog.
3. **Select FILE-REMAP MATERIAL**. A dialog will appear with a number of options for naming the remapped files.

FIGURE 14. Seabed Statistics Remap Dialog



- **Text Extension** sets the extension to be used in naming the files. There are three ways this text can be used. The following table describes each option. The sample names result from using "new" as the text to reassign 041_322.edt which is listed in the FirstOne.log.
  - **Add File Extension** adds a "." followed by your text to the end of your text name. Ex. 041_1322.edt.new, FirstOne.log.new.log
  - **Change File Extension** replaces the original extension with the text. Ex. 041_1322.new, FirstOne.new.log
  - **Add Text to Filename Beginning** begins each file name with your text. Ex. new041_1322.edt, newFirstOne.log
- **Save Remapping Results to Log** File creates a catalog file listing all remapped files.

4. **Enter your settings and click [Remap]**. A window will appear with a line-by-line accounting of the conversion and the converted files will be saved to the same folder as the original data files.

Exporting from Seabed Statistics

Once you have configured your seabed square and loaded your survey data to the SEABED STATISTICS program, you can export the information to formats that may be useful in other modules or outside of HYPACK®.

TABLE 1. *SEABED STATISTICS Export Formats*

Seabed Data	Output
Selected Sounding and ID data	Text
Seabed ID Colors	HYPACK® Colors File (*.HCF)
Legend	Graphic (*.BMP)

Exporting Seabed Data to a Text File

SEABED STATISTICS can reassign the seabed identification values in your survey data and export selected data to a text file. This does *not* affect the input data files.

For each record, it reads the E1 and E2 values, refers to the currently loaded Seabed Square to determine the ID number and writes the requested information to the exported XYZ file.

Values available for output include the following data:

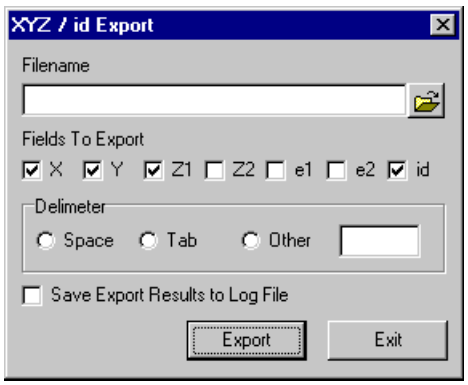
TABLE 2. *Output Options from SEABED STATISTICS*

- ID
- X
- Y
- Z1
- Z2
- E1
- E2

To export your seabed data to text:

1. **Load your seabed square.** The identification numbers exported will be based on this square.
2. **Load your edited data files.** The depths, E1 and E2 data will come from these files.
3. **Select FILE-EXPORT MATERIAL** and the XYZ/ID Export dialog will appear for you to choose your export options.

FIGURE 15. XYZ ID Export Dialog



- **Filename**: Click the File Open icon and define the path and name for the exported file.
- **Fields to Export** provides a series of check boxes, one for each type of data that may be included in the resulting text file. Check those that you wish to export along with the **Delimiter** that will separate each value.

4. **Click [Export]** and the text file will be created according to your choices.

CONVERTING SEABED IDENTIFICATION COLORS TO PROJECT COLORS

You can export your Seabed Identification colors from SEABED STATISTICS to your project colors. By doing this:

- SURVEY can color-code the matrix using Seabed ID colors.
- HYPACK® can display a seabed matrix using seabed colors.

To export your colors:

- **When you save your SIX file**, SEABED STATISTICS asks you if you would like to save the color codes to an HCF file (HYPACK® Color File) and transfer the seabed color coding to the project color settings. The new HCF file will be named *SixFileName*_six.HCF.
- **Select FILE-EXPORT ID SQUARE TO HYPACK® COLOR FILE** and naming the file.

In either case, the new HCF file will be saved to the project directory. When you exit SEABED STATISTICS, it will be implemented in the HYPACK® display.

In order to avoid confusion, a brief explanation about how this works with seabed identification data is in order.

Each cell in a matrix file actually has space in the matrix code for two depths. (This is what allows us to show the survey depth, dredge depth or the difference between the two values in dredge projects.) When you are collecting seabed identification data, the SeabedID device driver stores the seabed identification number in the first memory space, and the depth in the second.

The HCF file normally specifies the color that goes with each depth range. When SEABED STATISTICS exports the seabed colors to the HCF, it saves a range for each seabed identification number (plus and minus 0.5) with its corresponding color. Since the seabed

identification numbers are stored in the first "depth" memory, SURVEY reads it as a depth and colors the matrix accordingly.

To display a seabed matrix using Seabed ID colors in HYPACK®:

1. **Load your seabed colors HCF file to your project**.
2. **Right-click on the Matrix folder in the Project Files list and select 'Seabed ID'**.

Generating a Seabed Legend in BMP Format

The colors and bottom types defined in a seabed square may be exported to a labeled BMP file. This graphic may then be imported to HYPLOT for use as a legend in the smooth sheet plot.

Once you have loaded the seabed square to SEABED STATISTICS, select FILE-EXPORT ID SQUARE TO IMAGE (Ctrl+I) and name your output file in the dialog that appears. The file will be saved, by default, to the project directory.

Seabed ID in MAPPER

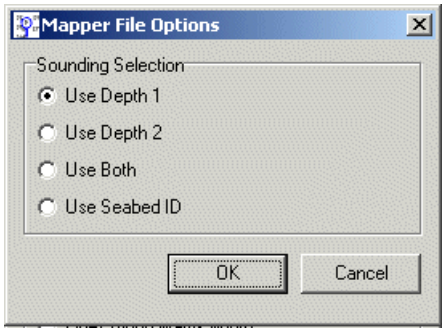
If you have an echosounder that provides seabed identification data, you can create a Seabed Identification Square in SEABED STATISTICS then use SEABED MAPPER to:

- **Map your seabed identification (seabed ID) colors into a matrix** for display in MAPPER.
- **Export an X, Y, Z, ID file**.

The interface is much the same as MAPPER, but includes the enhancements necessary for the seabed identification features.

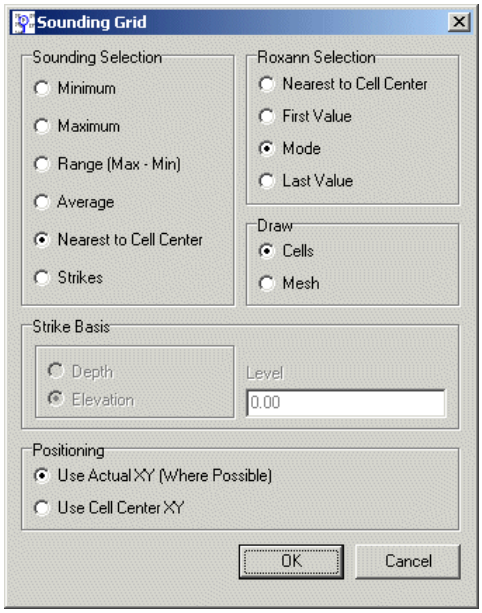
1. **Create a Seabed Identification Square** in the SEABED STATISTICS program.
2. **Launch SEABED MAPPER** by selecting UTILITIES-SEABED-SEABED MAPPER.
3. **Load the Seabed Identification Square** by selecting FILE-OPEN SEABED ID SQUARE.
4. **Open your Matrix file and, if it is a filled matrix, the data that should be included.** Set:
   - Load Soundings from Matrix = No
   - Add Soundings to Matrix = Yes and click [Update with Catalog File] to select your files that include the seabed identification information.
5. **If you have opened an empty matrix, load your soundings** by selecting FILE-LOAD SOUNDINGS and choosing your files that include the seabed identification information.
6. **Set your file options.** SEABED MAPPER includes an additional "Use Seabed ID" option. This tells the program to fill the matrix with seabed ID colors based on the seabed ID information in each record and your seabed ID square, rather than with depth data.

FIGURE 16. SEABED MAPPER File Options



7. **Set your data selection options**.

FIGURE 17. Data Selection Options



- **Nearest to Cell Center**
- **First Value** in the file positioned in each matrix cell.
- **Last Value** in the file positioned in each matrix cell.
- **Mode** colors the cell according to the Seabed ID that occurs most often within the cell.

8. **Save your results**. SEABED MAPPER can store data in two formats:
   - **Matrix files filled with seabed identification colors**. (Select FILE-SAVE SOUNDINGS-SAVE MTX FORMAT and name your file.)

     A Seabed ID matrix can be displayed in the HYPACK® window by:

     i. Enabling them in the project files list.

     i. Setting HYPACK® to display seabed identification colors.

     ii. Loading the correct seabed identification square in the Soundings Tab of the HYPACK® Control Panel.
   - **X, Y, Z, ID files: (Select FILE-SAVE SOUNDINGS-SAVE XYZID FORMAT and name your file.)**

Both of these file types can be used as the input file in TIN MODEL to model the seabed types in the terrain. and export matrix files and DXF files color-coded with seabed ID colors. TIN MODEL uses the seabed ID to color the model.

MODELING SEABED IDENTIFICATION VALUES

If you build a TIN model using an X, Y, Z, ID file or a seabed matrix, TIN MODEL will draw the model using seabed identification values..

To display your data using seabed identification colors:

1. **In SEABED STATISTICS or SEABED MAPPER, export your data to XYZId format**. (SEABED MAPPER also exports a Seabed Matrix, color-coded using the seabed ID numbers.)
2. **In SEABED STATISTICS, export the seabed ID colors to a HYPACK® Color file (*.HCF)**.
3. **In HYPACK®, load the Seabed HCF file as your project color file**.
4. **In HYPACK®, set the matrix to display either Survey Depths or Seabed ID**. Either will work.
5. **In TIN MODEL, TIN your seabed ID values by using your XYZId (or Seabed Matrix file) as the input file**.

Since you have loaded your seabed colors as your project colors, your color TIN models should draw in seabed colors. Likewise, if you export your TIN data and display it in the HYPACK® map, it will be color-coded according to your seabed colors.