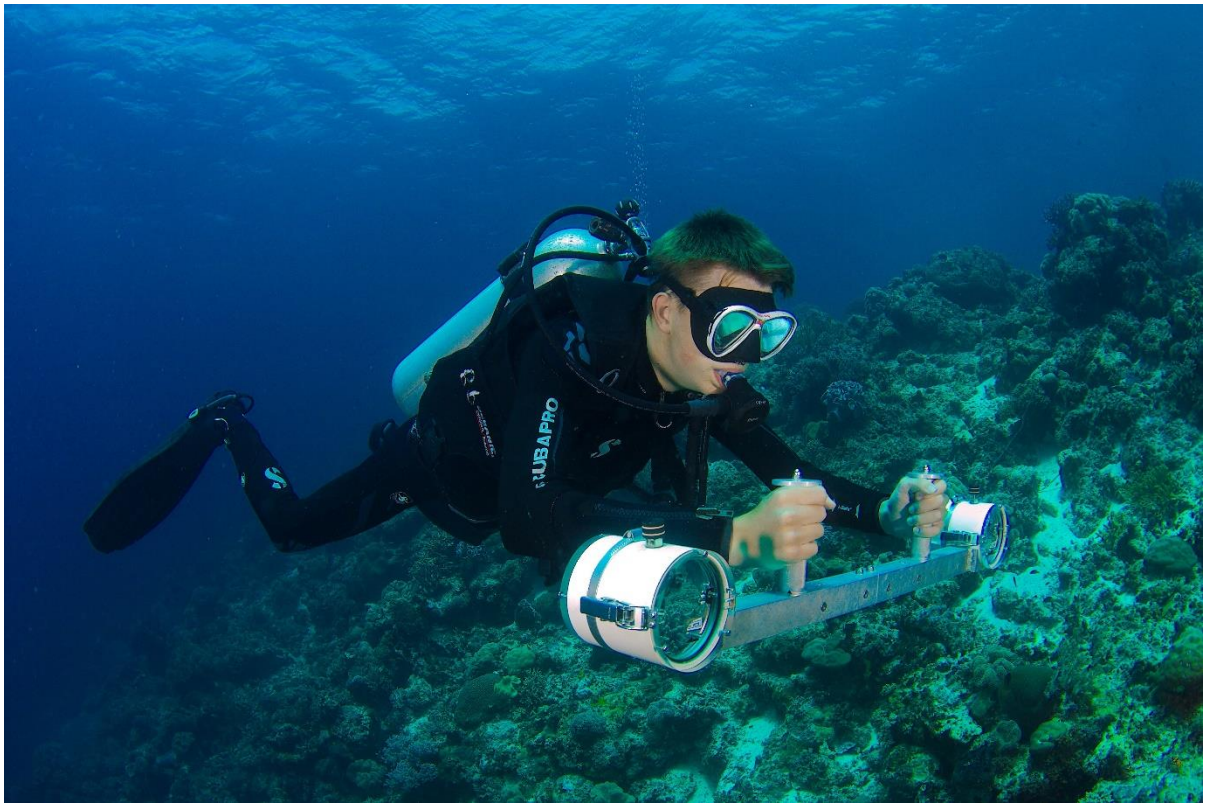

Stereo-Video-System (SVS) User Manual

Part III: Data Analysis

Before you begin

Part III of this manual provides instructions on how to analyse video transects in EventMeasure. Further details can be found in the official user guides provided by SeaGIS, go to: Start | SeaGIS | EventMeasure User Manual (after the software has been installed).

Before you begin, several steps must be taken to ensure all software and hardware requirements have been met prior to any practical application.

i. Download the Software

At the beginning of the field season, it is essential to download the latest version of CAL, regardless of what version is currently installed. This can be accessed using the following link and password:

- https://www.seagis.com.au/download.php
- seagis_sd10

ii. Update the License Key

EventMeasure software can only be accessed with the use of a license key. These can be in the form of a USB, or as a series of codes to applied directly to the computer you are using.

If you have a USB license key

- Plug the key into a USB port and open EventMeasure.
- Navigate to: Computer |C: | Program files | SeaGIS | EventMeasure | Executables | hasprus.
- In the pop-up window, highlight the 'Collect Key Status Information' tab and click 'Collect information'.
- Rename this file with its unique alphanumeric code (e.g., HON6.c2v) and save it to the desktop.
- Email the file to info@seagis.com.au as an attachment. In the email give your name, request an EventMeasure license, and state the number of days you wish for the license to run for – typically this will be the length of the field season. **N.B.** the minimum license for EventMeasure is **7 days**.
- SeaGIS will respond with a new file (e.g., HON6.v2c) - save this to the desktop.
- Reopen hasprus (as above) and highlight the 'Apply License Update' tab.
- Browse to the newly provided v2c file, open and click 'Apply Update'.
- After you apply the update, the license will automatically expire after the requested number of weeks. Please do not do this until the day you need to start using EventMeasure.

If you do not have a USB license key

- Open EventMeasure. A dialogue box will pop up to tell you there is an 'Error with software license'. This error message will be automatically copied to your clipboard when it pops up – this is what you need to obtain a license.
- Paste the error message text into an email (please **do not** screenshot it) and send to info@seagis.com.au. In the email give your name and note that you are working with Operation Wallacea. Request an EventMeasure license and state the dates for which you want the license to be active (e.g., 1st June – 15th August). **N.B.** the minimum license is **7 days**.
- Run the software and copy and paste the keys as prompted. If there is an 'Options' key included, in EventMeasure go to About | Install Options and copy and paste the supplied options key.

Ordering Files

i. Establish a Filing Structure

Before using EventMeasure to take fish length measurements, it is important to establish a robust labelling and filing structure and ensure everyone on the team knows exactly how to use it. At the beginning of the field season, you will be provided with a hard drive to store all videos and data. Within this hard drive:

- Create a folder for SVS data for the current year (e.g., Utila 2020).
- Within this folder, create a folder for each survey site (e.g., Utila 2020 > Coral View).

When saving videos to a site folder they must be labelled appropriately and precisely:

- Videos should be labelled using the following naming structure: Site-Depth-Transect-Date-Left/Right.
- For example, the first transect completed at 10m of Coral View on 1st June 2020 would produce two videos: CV-10-1-01-06-20-L and CV-10-1-01-06-20-R.

Please back-up this hard drive as frequently as possible to avoid unnecessary loss of data.

ii. Assemble the Analysis Files

A few additional files are required to analyse transect videos:

- Create a new folder within this year's data folder named 'Species and Calibration Files'. Within it, save the following files:
- **Species List.** This is a text delimited document, which is effectively a numbered list of all fish species identified at your survey location. In EventMeasure, it allows us to choose species from a drop-down list, rather than entering them manually. This list should be provided at the beginning of the field season.
- **Calibration Files.** For accurate analysis, EventMeasure requires the calibration information generated in CAL (see Part I: Calibration). During this process, two '.Cam' files were generated (e.g., 'Utila Calibration 01-06-20 LEFT.Cam' and 'Utila Calibration 01-06-20 Right.Cam').

Using EventMeasure

i. EventMeasure Setup

At the beginning of each new transect analysis, a series of steps are required to set up EventMeasure, load the required files and record the transect information.

Create a New Measurement File:

- Open EventMeasure. If you are using it for the first time, ensure 'Toggle View' is enabled so there are two pairs of stepping arrows – one each for the left and right videos.
- Measurement |New Measurement File.

Load the Calibration Files:

- Stereo | Cameras | Left | Load Camera File… Select the Left 'Cam' file.
- Stereo | Cameras | Right | Load Camera File… Select the right 'Cam' file.

Load the Species List:

- Measurement | Attributes | Edit/Load Species File. Navigate to calibration folder and select the Species File.

Set the Picture Directory:

- Picture | Set Picture Directory. Navigate to the correct folder (where the transect videos are saved). Once set, you can only load videos specifically from this folder.

Load the Transect Videos (this is slightly different for left and right):

- Picture | Load Picture. Select the left transect video.
- A 'Movie Sequence Configuration' dialogue box will open. In the top-right corner, change 'Time format' to HH:MM:SS.ss - click OK to close. **N.B.** longer transect videos may be split over several files - additional videos can be added and ordered within this dialogue box if required.
- Load the right video: **Stereo** | Load Picture. Select the right transect video and close the dialogue box.

Complete Information Fields:

- Measurement | Information Fields | Edit Field Values. Complete the three top rows:
- OpCode: give the measurement file a name that corresponds with the transect video labels (e.g., CV-10-1-01-06-20).
- TapeReader: this is the name of the person taking the measurements – add your name.
- Depth: record the depth of the transect (e.g., 10m)

Set Transect Rules:

- This step defines the specific boundaries of the transect and is very important as it ensures that the survey area and accuracy of measurements are standardised across all transects.
- Stereo | Length/3D rules. A dialogue box will open in which you can edit the transect rules. **Figure 1** demonstrates how these rules should be set:

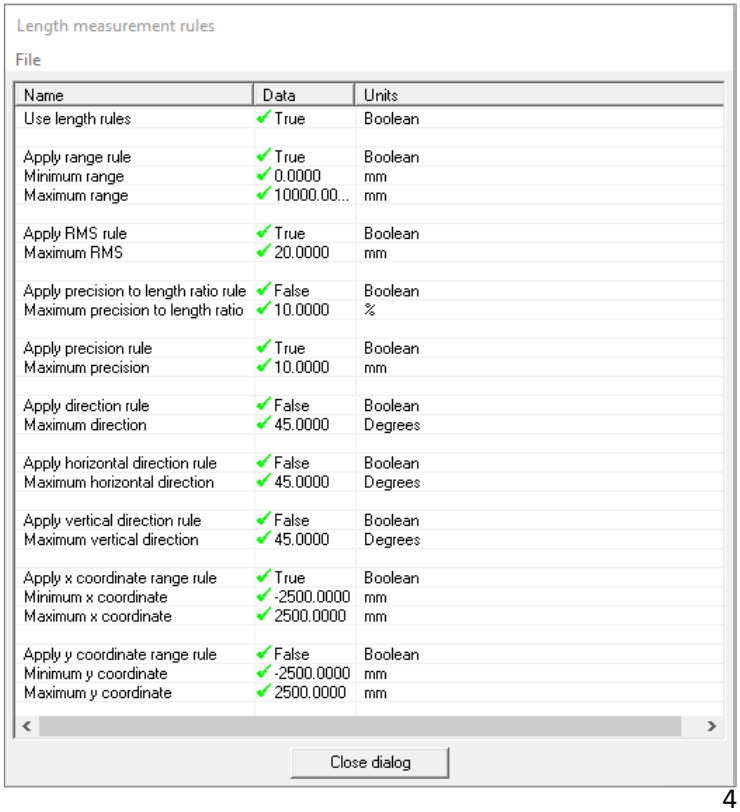

Figure 1. EventMeasure transect rules set correctly prior to analysis:

- Use length rules = True
- Apply range rule = True
  Min = 0mm, Max = 10000mm
- Apply RMS rule = True
  Max = 20mm
- Apply precision rule = True
  Max = 10mm
- Apply x coordinate range = True
  Min = -2500mm, Max = 2500mm

All other rules are set as False.

ii. Synchronising the Videos

Before proceeding with the calibration, we must first ensure that both videos are synchronised i.e., the left and right cameras are locked on the same frame and will play at the same rate. This is done in exactly the same way as in CAL, using the torch flashes recorded at the beginning of the calibration video and matching the frame in which the light comes on in both videos.

- In EventMeasure, ensure the 'lock' checkbox is unchecked.
- Select 'Play movie' above the left-hand video. A dialogue box will appear asking whether you want to 'Disable sound for ALL movie playback in this session?'. Click Yes.
- A movie player will appear where you can play and pause the left-hand video, or step through it frame by frame. Play the video until you reach the first frame in which the torch light appears. Look closely for this – the cameras are filming from different angles so the light may appear fainter on one side. Close player and update position.
- Repeat the process for the right-hand image.
- Check that both videos are aligned by using the arrows directly above each (left and right) to step through the frames one by one. When confident they are aligned (i.e., both showing the frame in which the torch comes on for the first time - Figure 2), check the 'lock' box to ensure they will remain synchronised for the rest of the calibration process.
- Use the arrows to the left of the 'lock' box to skip the images through the second and third torch flashes, ensuring that the light appears and disappears in both videos simultaneously each time.
- N.B. The calibration will not work if the synchronisation is not perfect, so spend some extra time here.

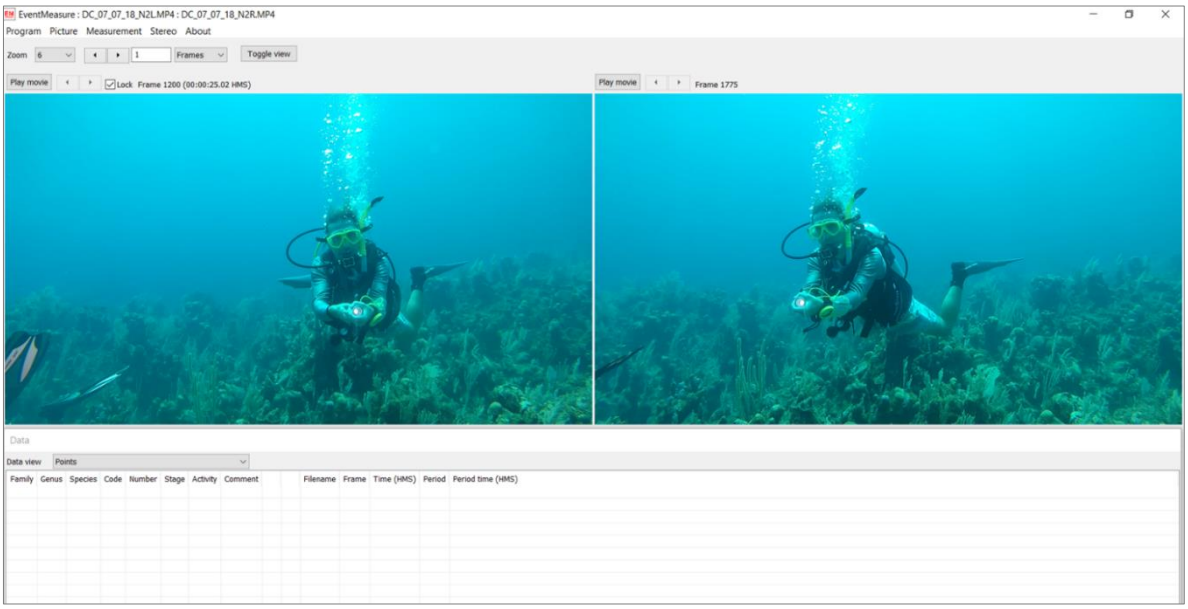

Figure 2. Screenshot from EventMeasure showing left and right videos which have been synchronised using the appearance of light from a torch.

Troubleshooting: If you are having trouble synchronising the videos, for example you can synchronise the first flash but not the second or third, this tells us there may have been an issue during filming. In this case, double check the camera settings are correct and that the cameras are stored in the correct side of the SVS. Re-film if necessary.

iii. Setting Period Definitions

Once the videos are synchronised, the final thing to be done before you start measuring fish is to set the period (i.e., the start- and endpoints of the transect). We do this for a couple of reasons: 1. It's a good opportunity to watch the

entire transect through from start to finish, ensuring the video quality is good and that there are no glaring errors; and 2. It prevents us from having to synchronise the videos again if we need to complete our analysis later down the line.

- Go back to the start of the movie and play through until the point where the transect starts - this is when the cameras are lifted from the benthos to face forwards. Click 'Close player and update position'.
- Right-click on the left-hand image | Period definitions | Add new period start.
- This will cause a dialogue box to appear – you can name this '1'.
- Play the movie through until the point where the transect starts - this is when the cameras are pointed back down towards the benthos. Click 'Close player and update position'.
- Right-click on the left-hand image | Period definitions | Add new period end.
- A dialogue box will appear with a dropdown menu with only be one option, i.e., '1'. Select this value and click OK.

iv. Saving and Autosave

By this point you have already invested quite a lot of time in setting up the transect, so it is important to save your work.

- Measurement | Save
- This will bring up your working directory. Save the project with the same title as your transect label and OpCode, e.g., CV-10-1-01-06-20. By default this will be saved as an EventMeasure observation file ('EMObs').

EventMeasure also has an automatic backup system that will regularly autosave on your behalf. In your working directory you will find two 'EMObs' files - the one that you have saved manually, and another with '_AUTO' after the file name. This is the automatically saved file that updates every five minutes or so. To access the file, you must first rename it by deleting the '_AUTO' suffix before the file can be opened in EventMeasure.

Taking Measurements in EventMeasure

i. Playing the transect video (and some useful shortcuts)

Now that EventMeasure is up and running, it's time to start identifying and measuring all fish that are present on the transect. At the most basic level we do this by playing the video, pausing it each time a new fish appears, measuring its length in the left and right images, and populating a drop-down list with its species information. While this is all very simple in theory, it can be quite fiddly, at least to begin with. However, there are a few tips, tricks and shortcuts that will make the process easier and ensure you are extracting good quality data.

Playing the Transect Video

- Before you begin, ensure the 'Lock' box is checked on the main screen to avoid undoing the synchronisation.
- Select 'Play movie' above the left-hand image and play the transect video until a fish enters the view.
- The rate of playback can be increased or decreased using the upward and downward arrows (▲▼).
- The video can also be viewed frame by frame using the left and right frame stepping buttons (◄►).

Ensuring the target fish is in the right position

- To take an accurate measurement of a fish, it's important that its entire length is in view (i.e., the fish is 'side on' to the camera) in both the left and right images, and that the fish is fairly central in both images.

- It can be useful to watch the movement of the fish across the screen before choosing when to pause the video; the frame stepping buttons can also be useful here for more precision. When you are happy with the fish's position, select 'Close player and update position'.
- Check the position of the fish on the main screen, ensuring it is visible and 'side-on' to the camera in both left and right images. Use the frame stepping buttons (◄►) to move both images at once.

Zooming

- Often fish on the transect are too small to identify and to take accurate measurements, so zooming is essential.
- In the top left corner of the main screen, there is a Zoom function with a drop-down menu. From this, you can select required level of magnification – 4 or 6 will typically work best.
- To Zoom, move the mouse to hover over the fish or area of the image you want to view. Hold down **Ctrl** and move the mouse lightly. This should zoom in to the location of your cursor.
- While in Zoom mode, you may wish to manoeuvre the fish into a more optimal position. To do so, hold down **Z** and use the frame stepping buttons to skip frame by frame.
- It is far too easy to Zoom in to the wrong part of the image and lose sight of the target fish. When this happens, hold down **Q** to pan the image while zoomed, or **A** to pan both images simultaneously.

Improving Clarity of the Image

- Sometimes the water visibility or quality of the image can make it difficult to differentiate one end of the fish from the other and take accurate measurements.
- Picture | Histogram options. This will open a list of options for editing the colour and contrast of the image.
- Picture | Restore original image will undo any changes made.

Epipolar Lines

- Epipolar lines are a useful feature in EventMeasure that estimate the position of a fish in the right image, after it has been identified in the left.
- To test this, click on a fish in the left-hand image. A red line will automatically appear on the right – this should indicate the position of the same fish in the right-hand image.

Troubleshooting: Epipolar lines will appear on the screen whenever you click on the images, whether you mean to or not. When this happens accidentally, simply click anywhere on the image until an error message appears. This will say 'Invalid length measurement sequence' – click OK to close and the epipolar lines will have disappeared – you are now ready to proceed with taking measurements.

ii. Measuring Fish Lengths (3D Measurements)

To fully utilise EventMeasure's features and collect accurate fish abundance, species richness, and biomass data, the best practice is to measure every fish on the transect and identify it to species level.

- Select the frame in which the target fish is central to the cameras,and presenting a side-on view in both the right and left images. Zoom in.
- In the left image, click on the tip of the fish's snout, followed by the end of the caudal (tail) fin.
- Repeat this in the right image, using epipolar lines to locate the correct fish if necessary.
- When all four points are placed, two dialogue boxes will appear titled '3D information' and 'Attributes - Length'
- The 3D information box provides information about the measurement - check this over to ensure the measurement is ok:

- The RMS must be less than 20mm (and ideally less than 10mm).
- The precision must be less than 10mm.
- The Range (distance from the camera) should not exceed 5 metres.
- The length should appear sensible for the fish measured (use common sense here – there are no 50cm damselfish that we know of!)

- The Attributes box is where we can add species information by populating the Family, Genus and Species information. The 'Stage' and 'Activity' boxes can be ignored unless specified by the senior scientist.
- N.B. You can save time here by typing the species name into the appropriate field - this will auto-populate the Genus and Family fields or, if there are multiple species with the same name, generate a reduced list of options.

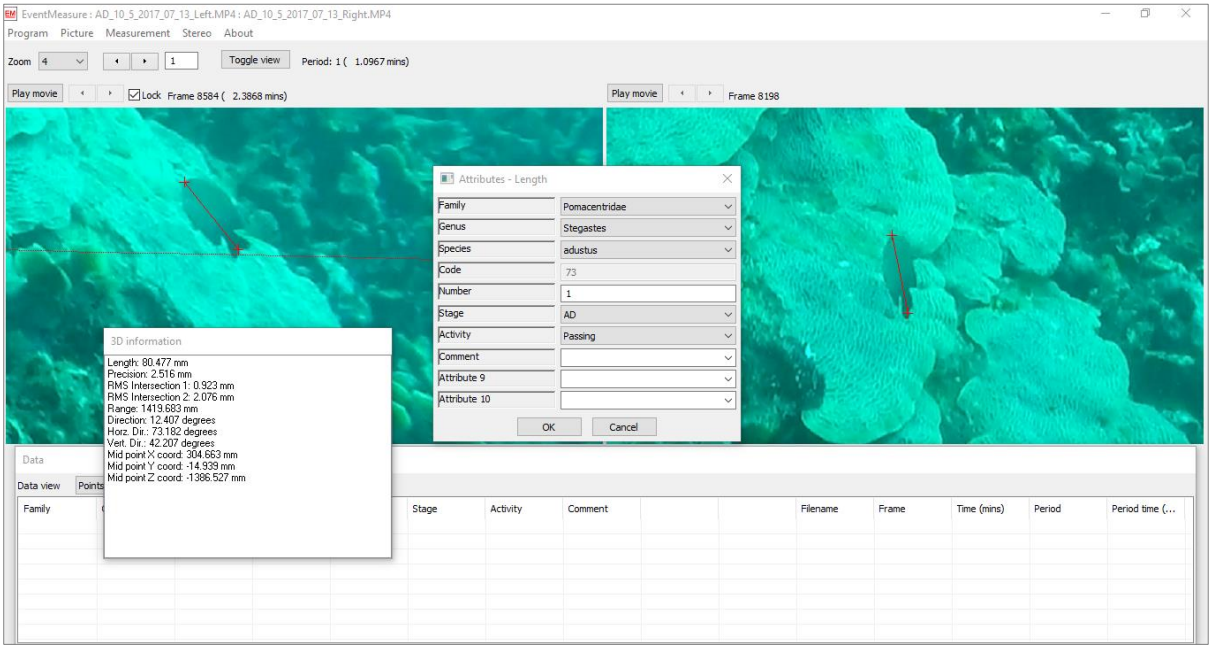

Figure 3. Screenshot from EventMeasure showing a successfully measured fish. The 3D Information shows the measurement is accurate and the fish is within range. The Attributes box has been populated with species information.

iii. Submitting Incomplete Fish ID's

There will inevitably be occasions where you are unable to identify a fish because it is uncommon to the area, or because the image is not clear enough to get a good view.

- Any unidentifiable fish species should be measured as normal and identified to the lowest possible taxonomic resolution.
- If the same unidentifiable fish appears multiple times in the same or different transects, it is useful to record this information – this can be done using species numbers.
- Identify the fish Family and Genus, if possible. In the Species field, select 'sp1'.
- If the fish is identified later in the field season, all fish listed as 'sp1' can then be easily renamed.

iv. Adding 3D Points

Sometimes the fish just don't play the game - no matter how much you search for the perfect frame; it isn't always possible to get a good angle for measuring the full length of every individual. This happens most often with smaller fish. In these cases, instead of measuring the fish we can add a 3D point:

- Click once on the fish in the left image, then once on the fish in the right.
- A dialogue box will appear titled '3D point info' – this provides us with coordinate information.
- Right click anywhere on the left image and select 'Add 3D point' – this will open the attributes box which can be populated with species information as normal.

Using this method, we can still identify the fish and account for it in the left and right images, therefore it will be useful for our fish abundance and species richness data, however we cannot take a length measurement. However, after the data has been extracted from EventMeasure, we can apply the average length recorded for that species and apply it to any individuals that are missing length values. We should still try to take measurements for as many fish as possible to increase the accuracy of our estimated values.

v. Adding Points

There will also be occasions where you can only see the fish in either the left OR right image. This happens when fish are very close to one camera, and not captured at all by the other. We need two images to add a 3D point, so in this case we will have to opt for a 'Point' instead.

- If the fish is visible in the left image, right-click on it and select 'Add point'.
- This will open the Attributes box, which can be populated with species information as normal.
- If the fish is in the right image, unfortunately a point cannot be added in this screen. Instead, right-click on an open space in the left image that corresponds with the fish's location in the right and select 'Add point'.
- Populate the Attributes box with species information. In the Comments field, write 'in right image' - this will allow the fish to be easily located again in future.
- Adding points can also be useful when a large shoal of fish moves across the transect. In such cases, always try to measure at least 10% of individual fish in the shoal before adding points to the rest.

vi. Common Error Messages

There are a number of error messages that will frequently appear when you start using EventMeasure. These will become less frequent when you get the hang of using the software, but it is important to understand each of them, and to be able to troubleshoot potential problems that they may be indicating.

Invalid length measurement sequence

- The points you have placed to measure a fish have been incorrectly placed (e.g., the points in the left image do not match the points in the right image, or too many points have been placed in one image).
- Click OK and start this measurement over.

Length measurement does not comply with current rules - Precision /RMS exceeds the limit

- This usually means that the accuracy of the measurement is off, and the precision or RMS have exceeded the limits set at the beginning of the transect.
- It is important that we do not ignore messages like this – those limits were set for a reason. Close the error message, reject the measurement, and manoeuvre the images so you get a better side-on view of the fish.
- Repeat the measurement until it is accepted without warning.
- If this happens repeatedly and you are unable to take measurements from fish even when they are perfectly in view, there is likely an issue with either the synchronisation or calibration.

Length measurement does not comply with current rules - Range exceeds the limit

- The range is the distance of the fish from the centre of the cameras. When this error message appears, it means that the fish we are trying to measure is outwith the transect boundaries we set at the beginning of the transect.
- We do not want to record any fish outwith the survey area. Play the video through and identify whether the fish comes into the survey area at any point. If so, retake the measurement from this location. If not, disregard the fish.

As a general rule, if you receive an error message that asks whether you want to 'Accept the measurement?' the answer is always no. Remember, if you can't get a length measurement for every fish you can always add a 3D point.

Extracting Data from EventMeasure

Once you have completed all SVS analysis fir the field season you will be left with a large number of EventMeasure (EMObs) files. The final step is to concatenate and convert the data stored in these files into a more usable spreadsheet format.

i. Gather the 'EMObs'

- Create a new folder within your SVS data folder and give it a sensible name (e.g., Final EMOBs Utila 2020).
- Go through each site folder and copy all EMObs into the newly created folder.
- N.B. Double check that files are copied and not cut, leaving the original files in their correct folders
- N.B. Ensure that the files you are copying are the full files NOT the autosave files

ii. Create New Folders for Extracted Data

- Within your final EMOBs folder, create two new folders titled 'Points' and '3D Points and Measurements' - these two types of data point must initially be extracted separately.

iii. Extracting Data from EventMeasure

- Open EventMeasure and start new measurement file: Measurement | New measurement file
- Program | Batch text file output
- A dialogue box will open titled 'Text report generation settings'. This is where we specify which type of data we want to extract – we will start with Points.
- In the dialogue box, set 'Dot Point Measurements' to True – all other fields should be set as False.
- Change the 'Input file directory' to the location where your EMObs are gathered and saved.
- Change the 'Output file directory' to the new 'Points' folder you just created.
- Click 'Process'. A new dialogue box will appear outlining how many files have been processed successfully.
- Navigate to your 'Points Folder'. You should find a text document file for each analysed transect, plus a concatenated file titled 'All dot point measurements' – this contains the combined data from all transects.
- Repeat the above steps for 3D measurements, changing 'Dot Points' to 'False' and '3D Point and Length Measurements' to 'True', and setting the 'Output file directory' to the '3D Points and Measurements' folder you created earlier. Process.

For further details and troubleshooting information, please see the official EventMeasure handbook.