FISH BIOMASS VALIDATION METHODS

SONAR BASED DATA COLLECTION AND REVIEW

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ABOUT US

Infofish Australia has been operating for 30 years in the recreational fishing and natural resource management sectors. We are the country's leading operator of BioSonics Inc. scientific echo sounders. BioSonics is a company in Seattle WA, who, for over 30 years have been developing this technology. The DT-X Extreme echo sounder is able to detect and count fish in real time via their Auto Track software package. Infofish Australia has taken the work of BioSonics even further and brings leading edge habitat, fish stocks and behavior assessment to Australia, incorporating advanced data analysis, modelling and machine learning techniques. A key component of any fish biomass survey is validation, which occurs during and post surveys.

BIOMASS RESULTS VALIDATION

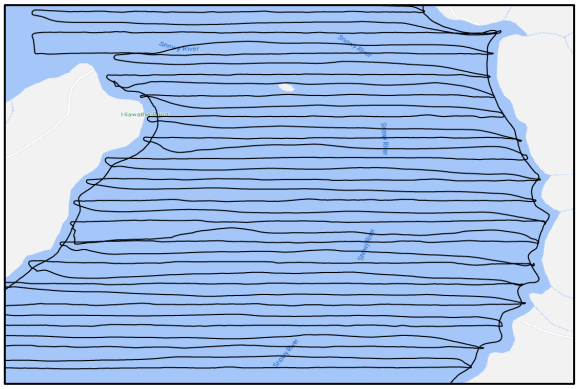
To both scrutinize and support the fish biomass data outputs, two sonar technologies are used to validate the results:

- traditional two-dimensional (2D) sonar recording review, and
- live scanning sonar.

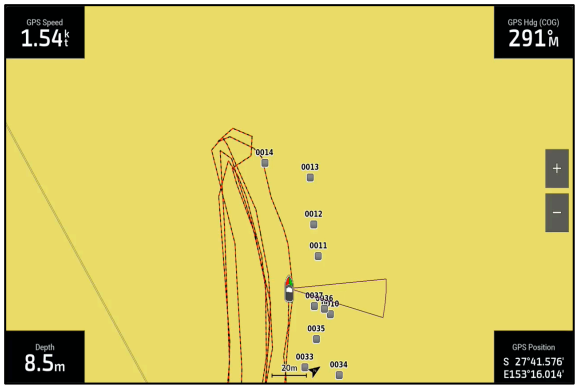
The 2D data is recorded directly beneath the vessel, during habitat and fish biomass surveys, along each transect (Figure 1, a). The 2D sonar provides information on the presence / absence or distribution of fish, submerged timber and rock, directly beneath the vessel.

The live scanning sonar is used to sweep an area of interest with the vessel in motion or drifting with transducer pointed perpendicular to the vessel (Figure 1, b) or to scan an area of interest from a point, with the vessel stationary. The transducer is rigged to a pole that can swivel 360 degrees around the vessel and can be set to one of three configurations.

The information provided by each is mostly qualitative however, can be used to gps mark objects of interest during surveys.



a) typical 2D sonar coverage recorded during a survey



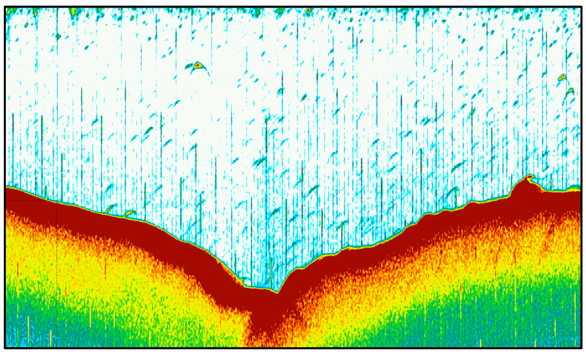
b) typical sweep (shooting from vessel to bank) of a survey site with vessel in motion

Figure 1. Fish biomass survey transect along which, 2D sonar is recorded and live sonar sweep of a discreet survey site.

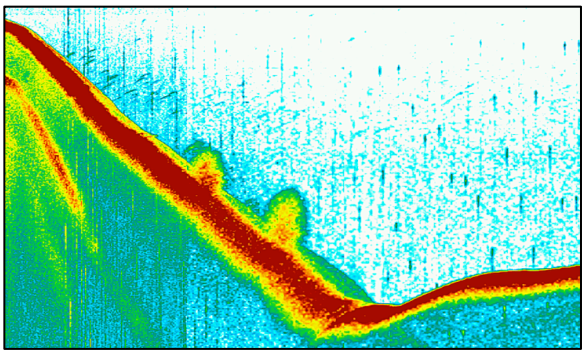
DATA COLLECTION

2D Sonar

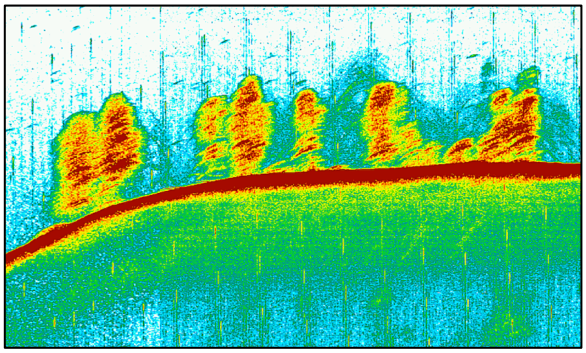
Two-dimensional sonar data is collected using the Humminbird Helix 10 Mega Side Imaging GPS fish finder (Helix) or the Solix 12 Chirp Mega Side Imaging GPS fish finder (Solix). The 2D data is recorded directly beneath the vessel, during habitat and fish biomass surveys, along each transect and saved to an SD card. The data is collected at the full spectrum setting (150-220 kHz) which provides the widest coverage beneath the vessel and most sonar returns. Examples of fish, submerged trees and an algal bloom are displayed in Figure 2.



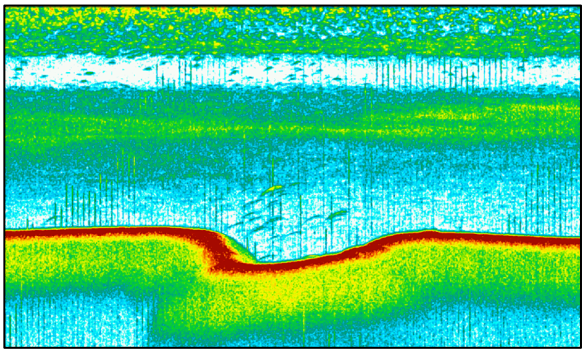
a) fish sitting through the water column above a submerged channel



b) submerged trees on a submerged valley with a small school of fish sitting higher up the bank



c) numerous submerged trees on a flat with a small number of fish sitting above them

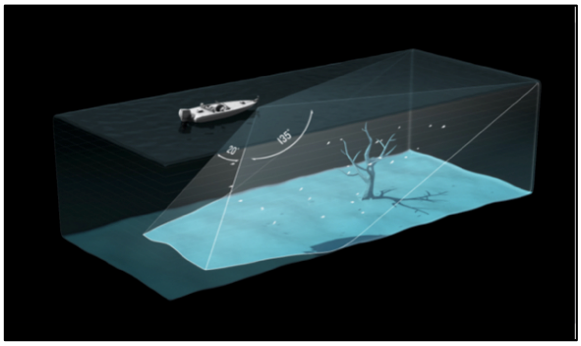


d) algal bloom at surface and another environmental anomaly at depth, with smaller fish sitting between the two layers and larger fish sitting in and above the submerged river channel

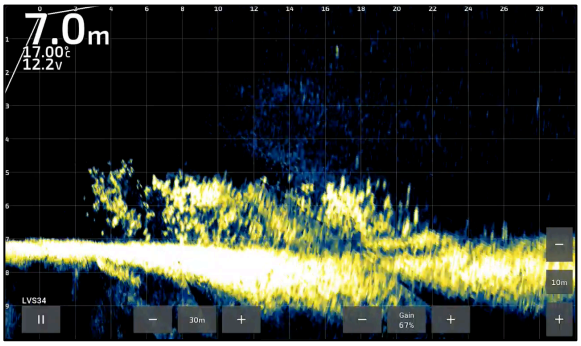
Figure 2. Example stills from 2D sonar recordings showing commonly observed fish, trees and algae.

Live Scanning Sonar

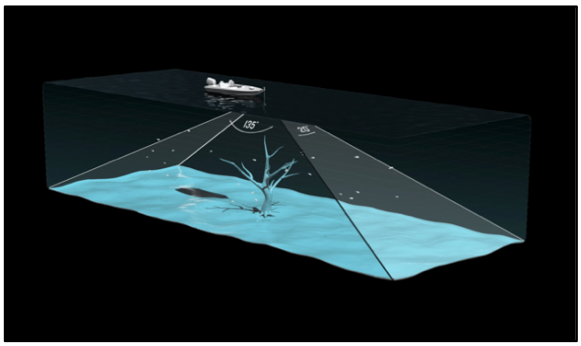
Live scanning sonar is done with the Garmin LiveScope transducer (LVS32 or LVS34), attached to a Garmin GPSMAP 8410xsv chart plotter. The transducer is mounted to a pole which sits vertically in the water, over the side of the vessel and the transducer can be set to either forward looking, down looking or perspective mode (top down). Each mode provides a different view through the water within a 120-degree arc. Examples of transducer configuration from the Garmin[1] website and stills from in house testing for each configuration are displayed in Figure 3.



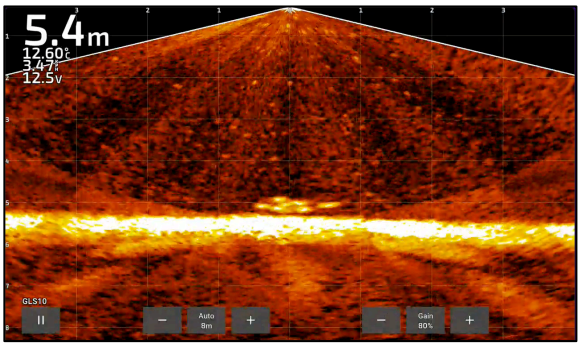
a) forward mode



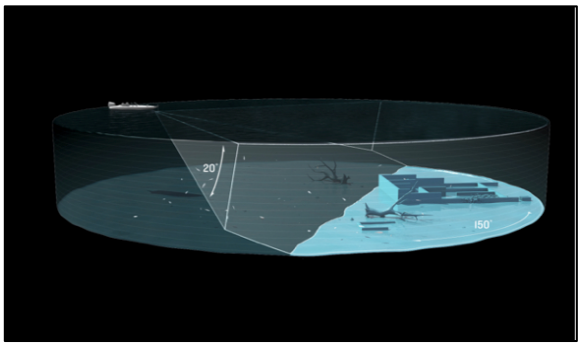
b) forward mode test showing schooling fish sitting in the lower water column over open ground



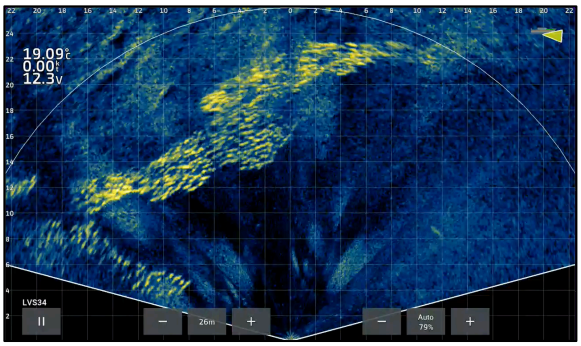
c) down mode



d) down mode test showing seven fish from a larger school



e) perspective mode

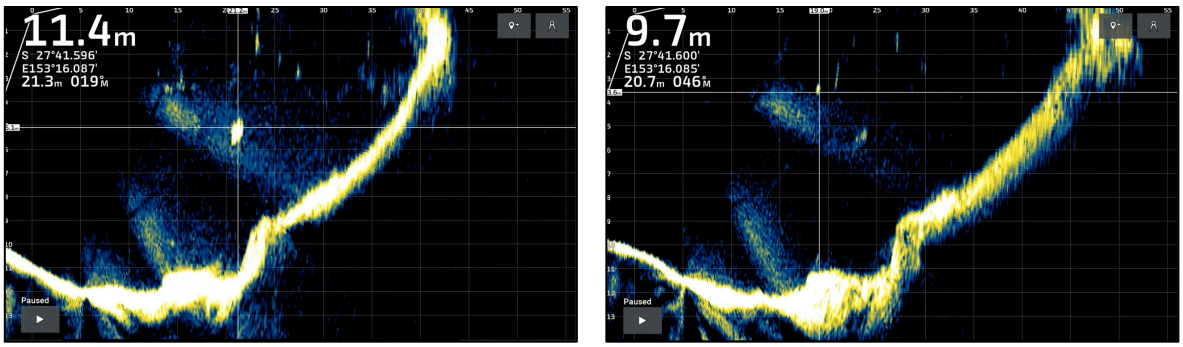


f) perspective mode test showing large school of fish passing in front of the transducer

Figure 3. Live scanning sonar transducer configurations and resulting views through the water column.

[1] https://www.garmin.com/en-NZ/marine/live-sonar/livescope/

Fur survey, the transducer is calibrated to know which direction it is pointing and fish targets or other points of interest within the beam are gps marked with latitude, longitude and depth information being captured. It is impossible to mark all fish observed with live sonar however, it provides an opportunity to assess what should be expected from the processed biomass survey results. Figure 4 shows the marking of fish in the live sonar beam in forward mode and Figure 5 shows the chart view of the vessel heading north-west, the calibrated live sonar beam direction and fish targets marked as waypoints.



a) bait ball being gps marked during survey

b) single fish being marked during survey

Figure 4. Fish targets being gps marked during a general survey in forward mode.

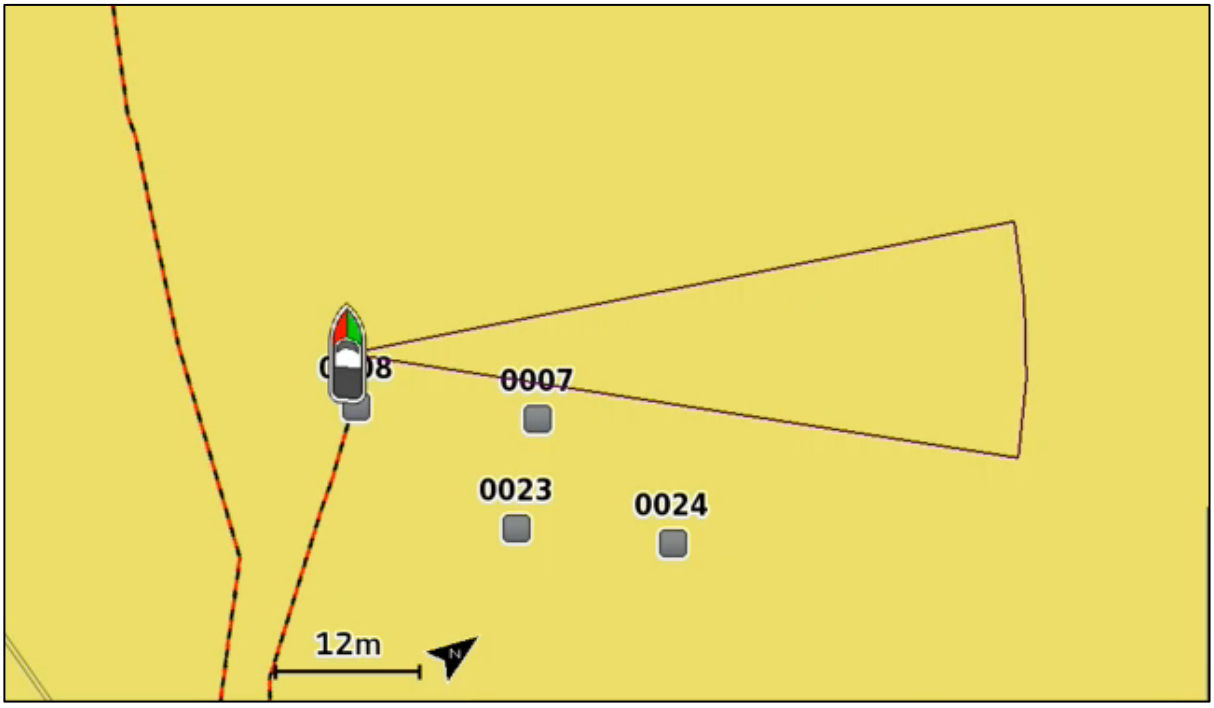


Figure 5. Fish targets being gps marked while within the beam of the calibrated transducer (chart view).

The live sonar doesn't give an indication of fish size however, single small fish are discernible from medium and large fish and tight schools of fish are discernible from individual fish. Screen recordings in .MP4 format can be made through the Garmin Active Captain app, installed on a phone or tablet. The vessel track and target waypoints are saved in .GPX file format and exported to SD card. The live sonar and target marking feature is used to meet the aims of the survey e.g. detection of schooling large fish, for example.

DATA REVIEW

2D Sonar

Once the processed fish biomass pointsource data is available, it is displayed in QGIS[2], over the bathymetry data and habitat mosaic for the survey location. Fish are represented by dots and are typically classified by size and depth for review. Figure 6 shows the processed large (yellow dots) and medium (green dots) fish point source data displayed over the bathymetry data for the site. Figure 7 shows the same accepted large and medium fish signals and the rejected signals (red dots). Rejected signals are either from the bottom, submerged structure (trees, rocks, debris) or poorly constructed tracks in the Visual Acquisition[3] software. There is a small degree of error in what is accepted and rejected e.g. some fish may be rejected or a non-fish track accepted however, most of this is resolved during review and data reprocessing. The biomass data is reviewed in conjunction with the 2D sonar recording across all sites and surveys. Figure 8 shows the finalised biomass dataset, post review, and the corresponding 2D sonar data (inset), with a small number of larger fish sitting on the inside of the bend at the site, in both. Some medium and small (<200mm) fish are visible in both as well.

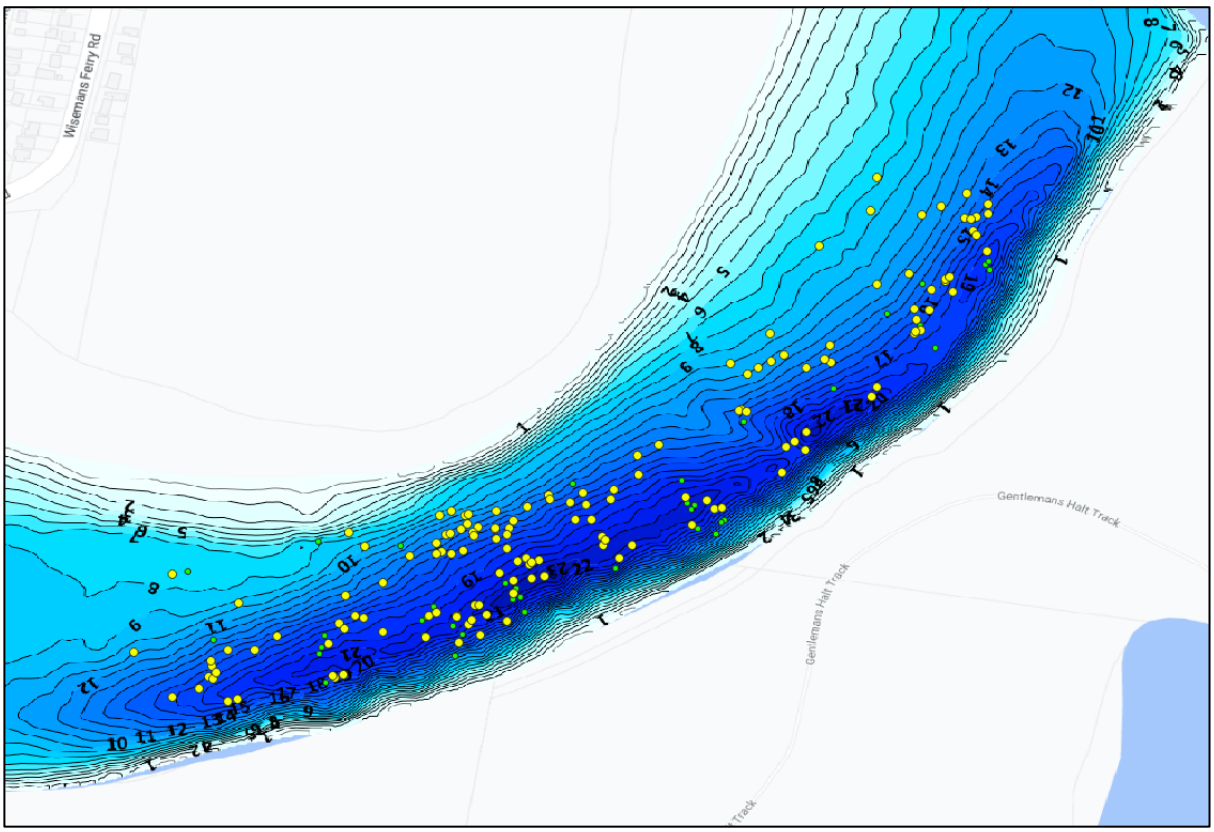


Figure 6. First cut processed fish biomass data from a site showing large fish (>400mm) in yellow and medium fish (200-400mm) in green.

[2] QGIS, 2019. Version 3.8 (Zanzibar).

[3] BioSonics Inc., 2017. Visual Acquisition - Real Time Data Acquisition, Storage and Playback Software for BioSonics Echosounder Systems, v6.3.1.10980.

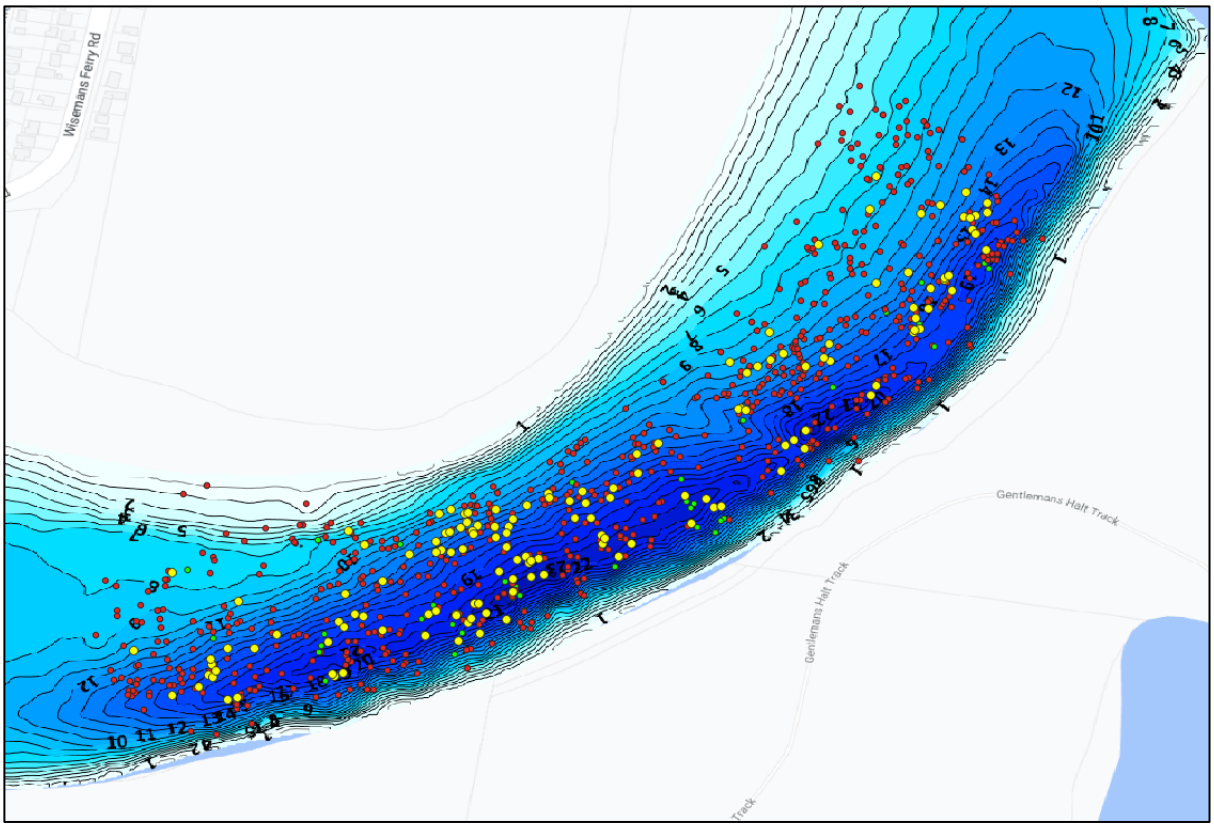


Figure 7. Objects that were rejected (red) during the processing of fish biomass data.

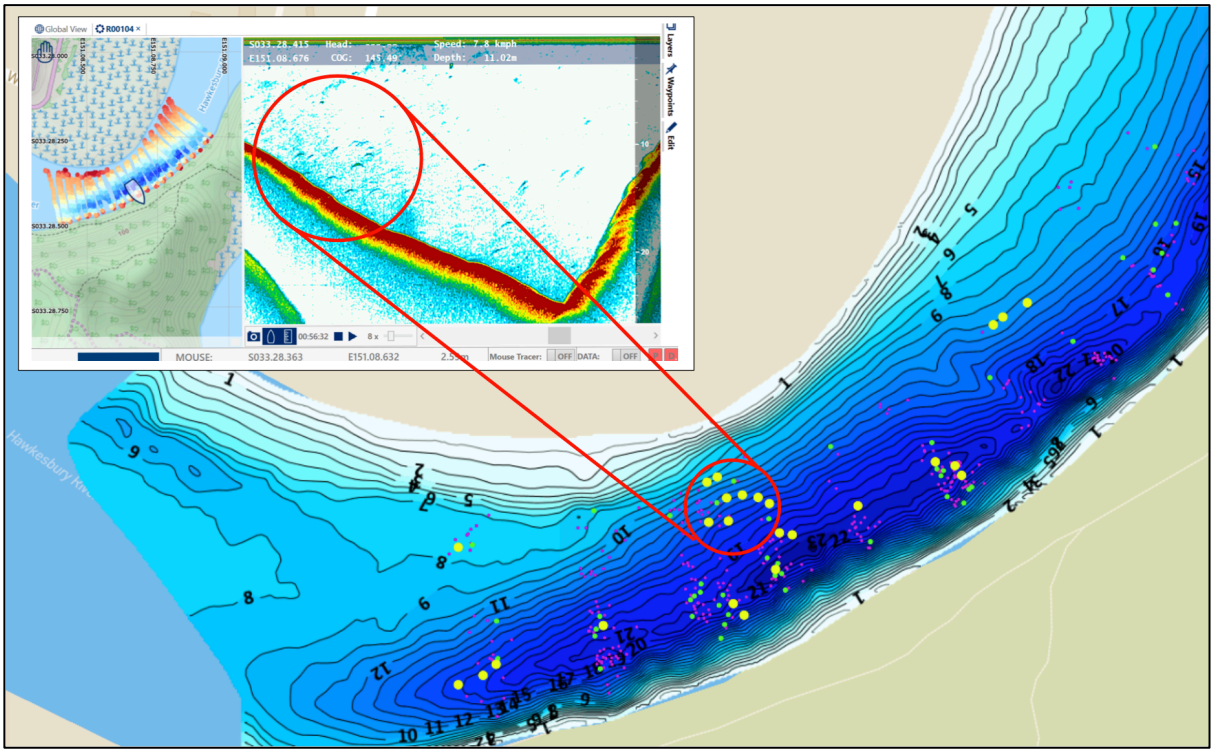
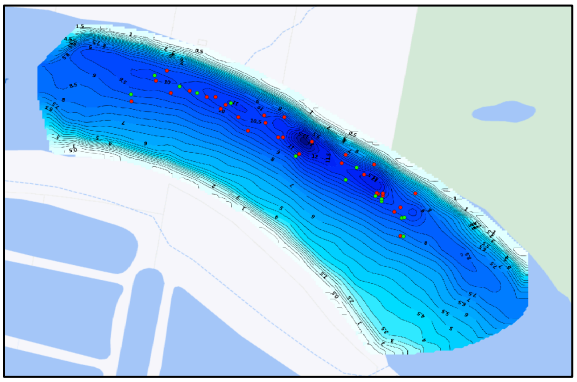


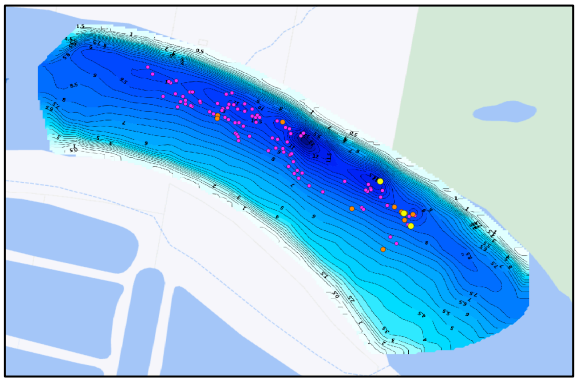
Figure 8. Final / cleaned fish biomass data set showing accepted fish across the site and the corresponding 2D sonar from a specific location that fish were observed.

Live Scanning Sonar

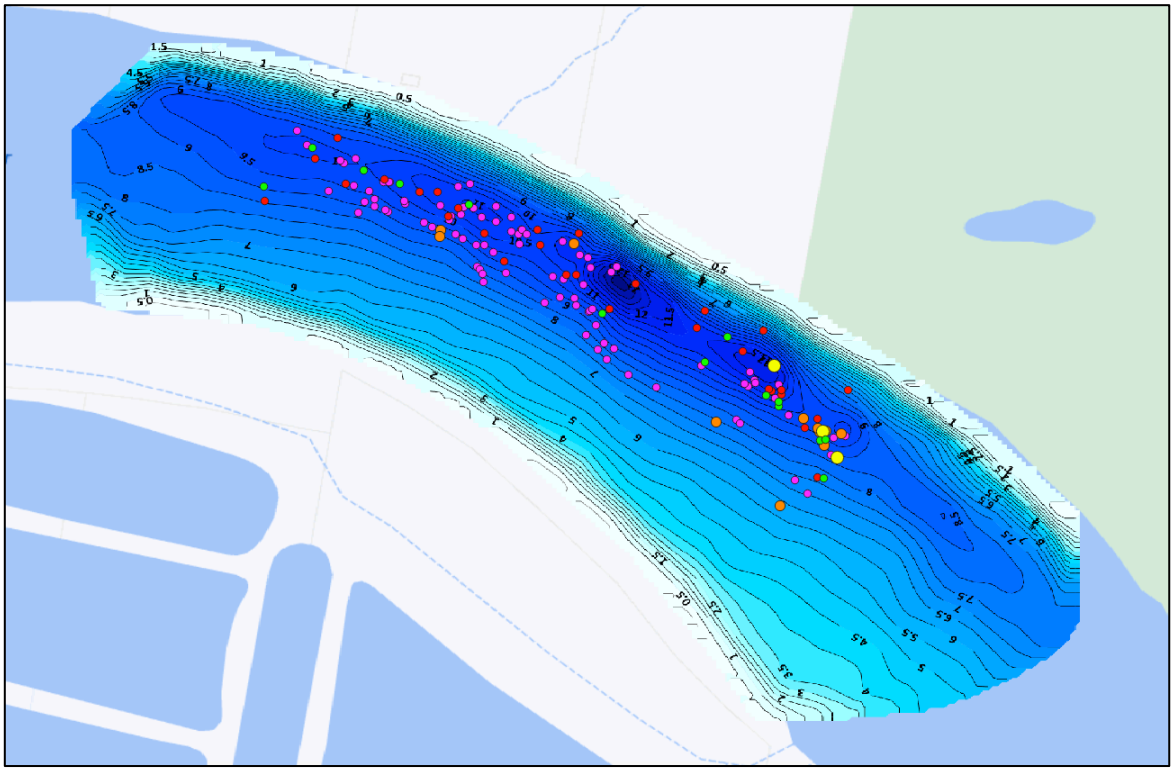
In the data collection example above, fish in a range of sizes and depths were observed with the live sonar sweep and the whole sweep was recorded as an .MP4. The most commonly observed fish were small, sitting higher in the water column, with some medium sized fish spread through the water column and very few large fish observed (Figure 9, a). The biomass survey, completed between live sonar sweep one and two at the site showed similar results (Figure 9, b). When combined, the live sonar observations and distribution of marked fish support the processed biomass results (Figure 9, c).



a) fish targets gps marked during live sonar sweeps (green, first sweep and red, second sweep)



b) biomass results showing small fish (<200mmm, pink), medium fish (200-400mm, orange) and large fish (>400mm, yellow)



c) Combined live sonar marked fish and fish biomass results.

Figure 9. Live sonar and biomass results of a small survey site.

QUALITY ASSURANCE AND SAFETY

Our team is experienced in completing scientific studies in field environments. They have the ability to assess any potential hazards prior to mobilising into the field and develop appropriate control measures. They also have the experience and authority to alter controls and procedures based on current field conditions, in order to ensure that risks are minimised on the ground. All field team members are required to be inducted into and sign all of Infofish's site safety documentation, per project.

Our survey vessels operate as non-survey domestic commercial vessels under the Australian Maritime Safety Authority (AMSA) EX02 – Marine Safety (Certificates of survey) Exemption, 2018, under the Marine Safety (Domestic Commercial Vessel) National Law Act 2012. Our survey teams hold current certification under EX38 - Marine Safety (Low complexity duties) Exemption 2017 (No. 2).

PROJECT EXPERIENCE

Infofish Australia has completed or is currently completing the following relevant projects using the survey methods stated herein:

- Fish Biomass Surveys (including habitat mapping) in lakes St Clair, Glenbawn, Copeton, Split Rock, Pindari, Tantangara, Blowering, Burrinjuck and Wyangala, NSW DPIF, 2020-2021.
- Trout Biomass Surveys in Lake Jindabyne, NSW DPIF, 2020 and 2021.
- Lake Somerset Fish Biomass Surveys in Lake Somerset, Infofish Australia, 2020.
- Logan and Albert Rivers Fish Habitat Assessment, Logan City Council, 2019.

For any queries on the above survey methodology and associated data analysis and outputs, don't hesitate to contact us at admin@info-fish.net.