# AQUATIC HABITAT SURVEY METHODS

## HABITAT MAPPING AND CLASSIFICATION

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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. Habitat and fish targets can be classified, GPS located and size graded (fish only). Surveys are completed using a combination of side-looking and down-looking techniques, depending on the aims of the survey, and can be completed from distances of up to 200m away. In addition, Infofish incorporates side scan imaging to provide the best possible picture of the underwater environment.

# SURVEY DESIGN

The common question(s) that typically prompt a habitat survey are:

- Where is the submerged habitat in a waterbody?
- What types of habitat are available in the waterbody?
- Is the available habitat likely to hold fish?

The waterbody is commonly a riverine environment or enclosed waters e.g., dam / impoundment and the survey approach can vary slightly between the two. Survey reaches in a riverine environment are typically as long as achievable in two directions e.g., upstream and downstream in a day (especially in tidal affected areas) however, the length can vary as necessary. Survey zones in enclosed waters typically cover the whole of the waterbody. Once a survey reach (riverine) or zone (impoundment) has been defined, the survey methods for each are as follows:

Riverine (Figure 1):

- two longitudinal transects (one upstream and one downstream) with the vessel travelling parallel to the bank, and
- additional longitudinal transects along the centre of a channel with the vessel travelling parallel to the bank to fill in any wider sections, where required.

Enclosed waters / impoundment (Figure 2):

- a shoreline / edge survey of the entire waterbody, and
- a number of transects across the waterbody, spaced 100m apart. Note: transect orientation varies between waterbodies, however, are typically aligned to run perpendicular to the orientation of the waterbody.

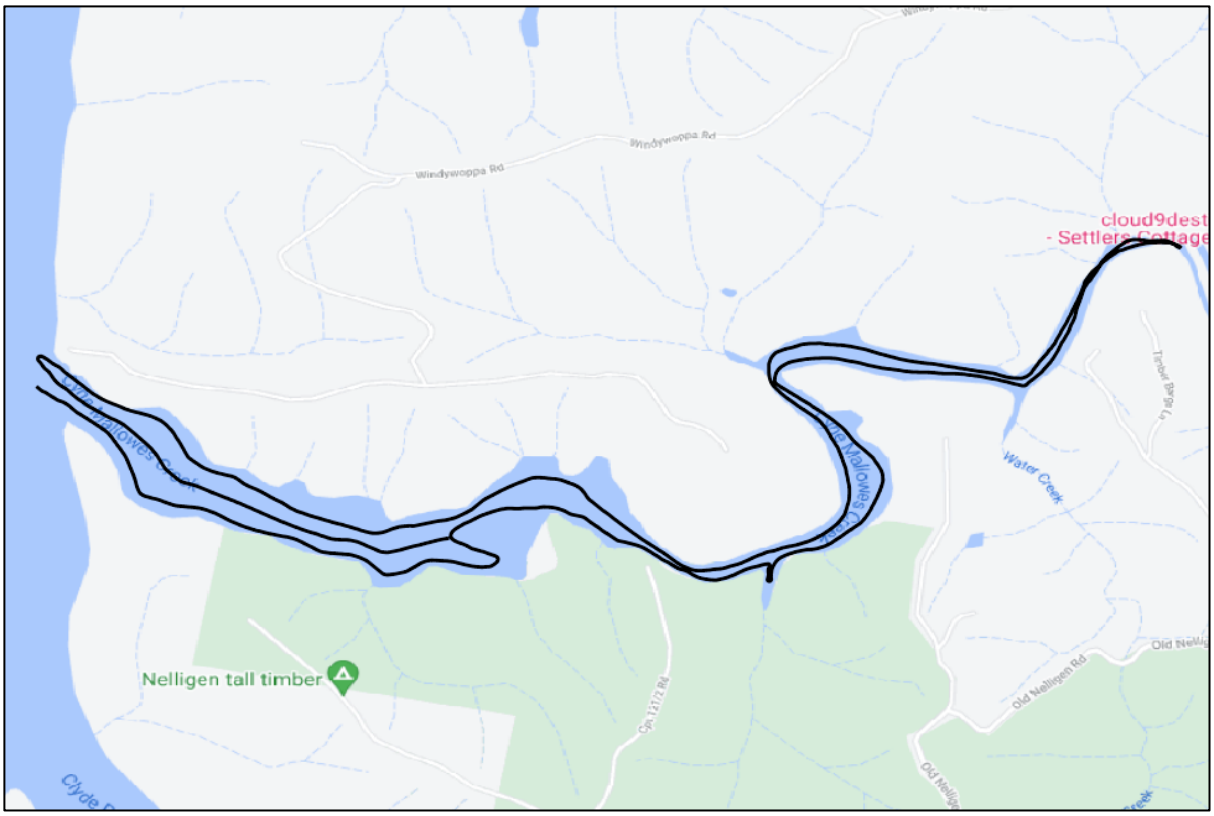



Figure 1. Typical longitudinal riverine and creek survey being edge runs and filling the centre of wider channels.

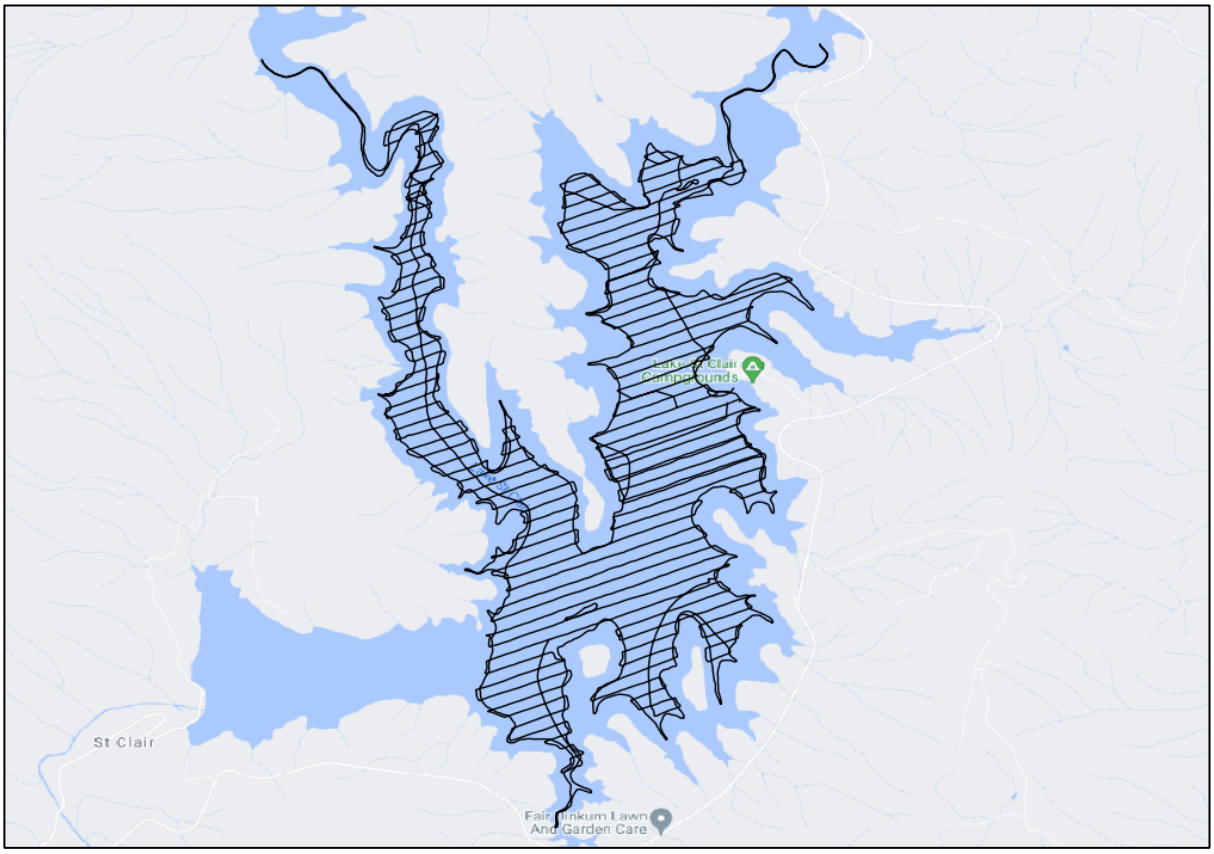
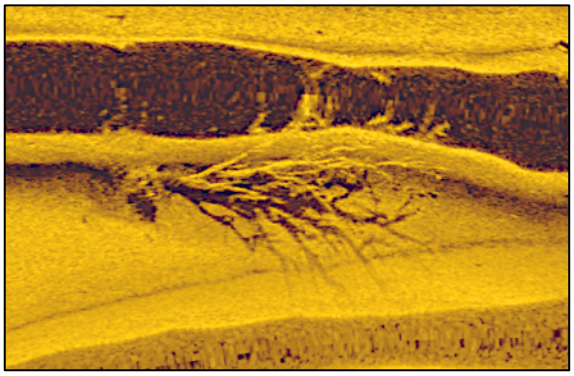



Figure 2. Typical enclosed waters survey including edge run and cross-transects.

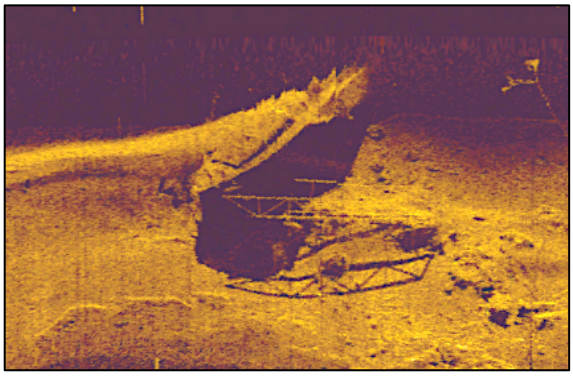
# DATA COLLECTION AND ANALYSIS

## RAW HABITAT DATA

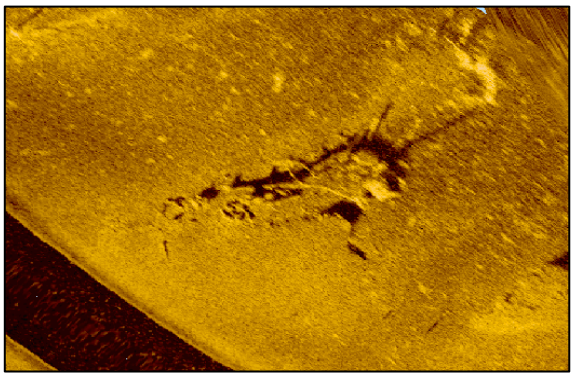
Raw aquatic habitat data is collected using the Humminbird Helix 10 Mega Side Imaging GPS fish finder (Helix) or the Solix 12 Chirp Mega Side Imaging GPS fish finder (Solix). The sidescan imaging data from a unit is recorded along each transect and saved to an SD card. The data is collected at the highest resolution possible for the type of waterbody being surveyed. In shallow (<10m) river or creek settings, the data is collected at 1.2 kHz (mega) producing high resolution imaging, while in large / deeper bodies of water, the data is best collected at lower frequencies (455 or 800 kHz) to gain greater coverage either side of the boat. Examples of habitat and anthropogenic structures side scanned at high and lower resolution are displayed in Figure 3. The raw sidescan imaging provides qualitative information on the types and locations of habitats (wood / snags, seagrass beds, freshwater aquatic plant beds, natural and anthropogenic structures, etc.) in a surveyed area.



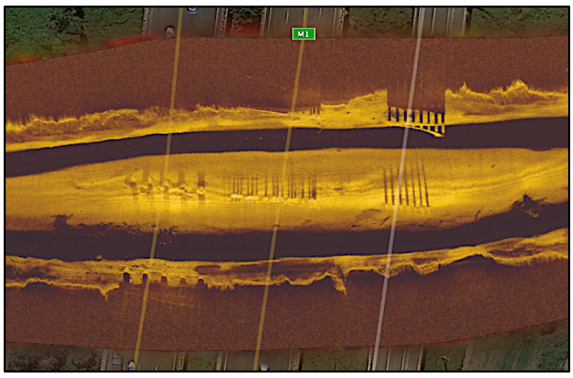
a) whole tree side scanned at high resolution



b) sunken boat and pontoon walkway side scanned at high resolution



c) part tree side scanned at lower resolution



d) highway bridge pilings side scanned at lower resolution

Figure 3. Examples of tree and anthropogenic structures side scanned at high and lower resolution.

## HABITAT MOSAIC CREATION

All raw sidescan imaging is uploaded to ReefMaster[1]. A habitat mosaic is made up of an edge or shoreline scan of a lake and numerous cross-transects, spaced 50 or 100m apart, depending on the transducer frequency setting being used. The recordings are edited to keep only the best sections of imagery and remove the sweeping / distorted imagery that occurs during vessel turns. All accepted imagery is then compiled into a single map and blended to provide the clearest image possible. Completed mosaics are exported in .MBTiles format and used in habitat / structure classification review. See Figure 4 for an example raw sidescan mosaic.

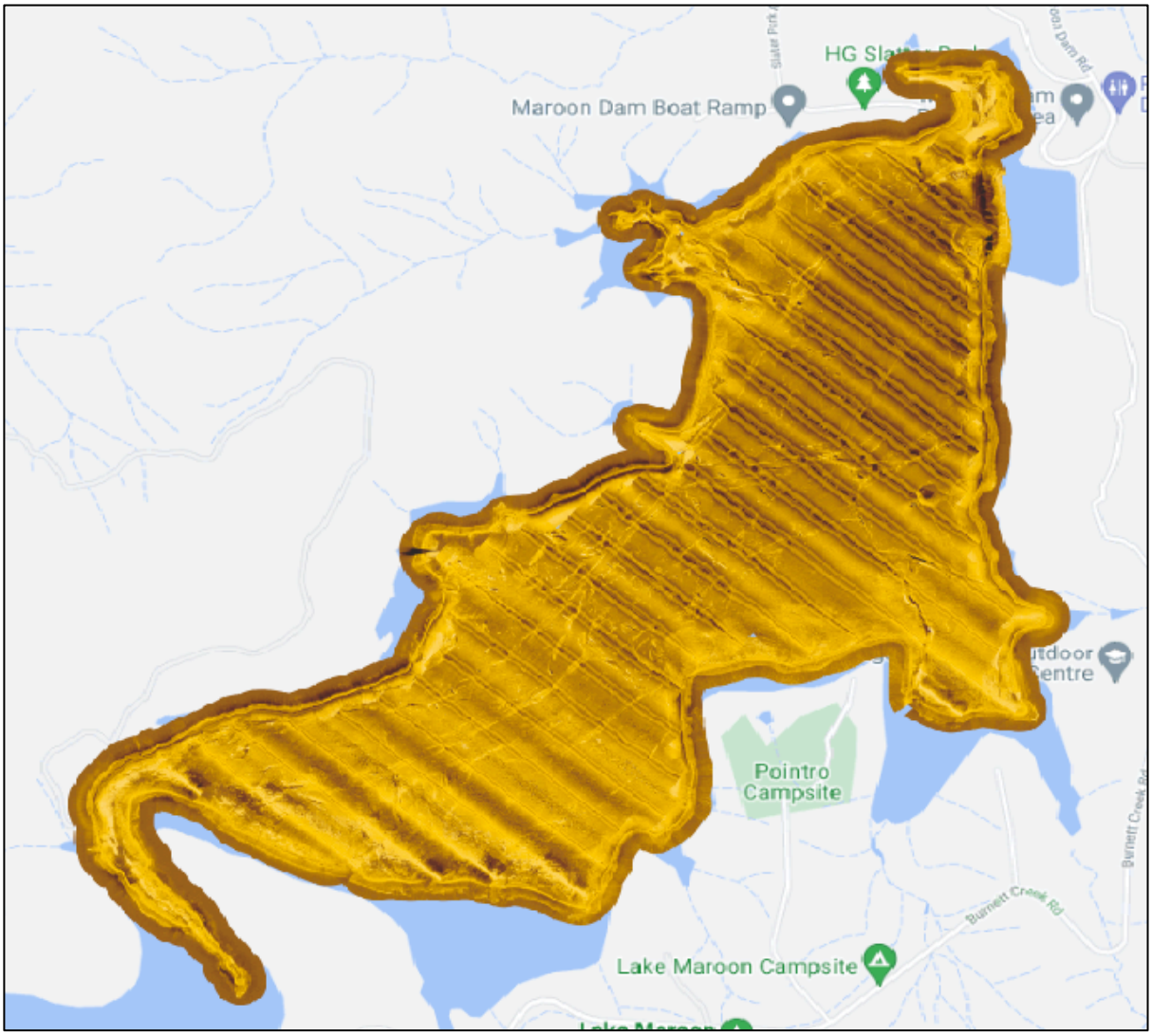



Figure 4. Sidescan mosaic of Lake Maroon in Queensland.

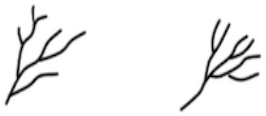
[1] ReefMaster, 2018. ReefMaster Software Limited, V2.0.

## HABITAT CLASSIFICATION

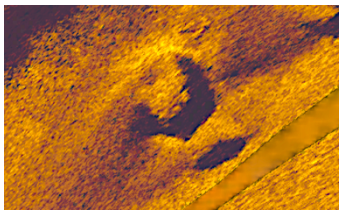
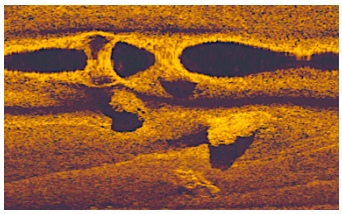
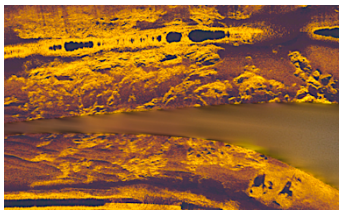
The raw sidescan image mosaic is displayed in QGIS[2]. A classification shapefile layer is created and where a habitat element type is observed on the habitat mosaic, is marked with a GPS point and classified. The most commonly observed and classified habitat elements range from naturally occurring wood and rock, to anthropogenic structures like sunken boats to pontoons. The level to which classification occurs is typically project specific. The common habitat types and their classifications are presented in Table 1.

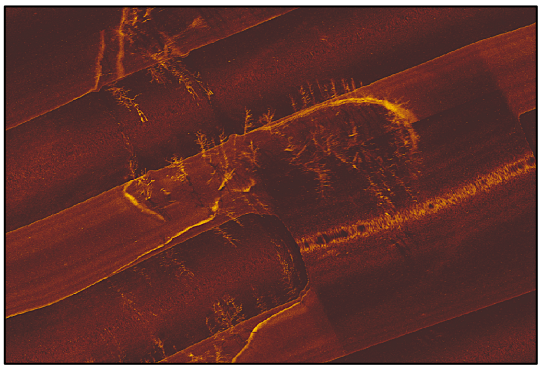
Where habitat elements are extensive or too numerous to mark individually, habitat type specific polygons are used to delineate these areas. See Figure 5 a) and b) for an example habitat polygon delineating a submerged tree line along a creek.

Table 1. Wood and rock complexity descriptions and classifications.

| Description | Example | Classification |
|---|---|---|
| Wood | | |
| A single trunk or branch: a root mass or small part of a branch may be present. |  | W1 |
| Double trunk or branch or single trunk with one level of branching for most of the length. |  | W2 |
| Trunk with multiple branches for most of length, with 2nd level of branching present. |  | W3 |
| Complete tree with extensive branching or an accumulation of large wood in which individual pieces could not be resolved. |  | W4 |
| Rock | | |

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

| | | |
|---|---|---|
| A single large (>0.5m) rock protruding from the bed or bank. |  | R1 |
| Numerous individual large (>0.5m) scattered rocks on bed or bank. |  | R2 |
| A rock bar protruding from bed or bank. |  | R3 |



a) standing submerged trees lining old creek

b) habitat polygon delineating the tree lines

Figure 5. Example habitat polygon.

# DATA OUTPUTS

## HABITAT MOSAICS

Habitat mosaics are the base level of qualitative information and presented in web-based mapping platforms like Mapbox Studio[3]. In the post processed data review process, the mosaics are viewed in tandem with fish biomass spatial data. They are a key part of this process, particularly in dams or areas of dams that contain extensive submerged tree lines or fields of felled trees, rock bars / gravel beds etc. The review confirms that a sufficient number of signals has been rejected by the data processor in these areas, which can erroneously inflate fish biomass estimates. The mosaics presented in Mapbox Studio are interactive and made available to clients and stakeholders where necessary. Links to existing interactive habitat mosaics can be provided upon request.

## CLASSIFIED HABITAT

Classified habitat provides information on the locations and complexity of habitat present in a surveyed area. This information is used in fish distribution mapping and habitat association investigations. It is also displayed as an interactive layer in the Infofish Explorer mobile phone application.

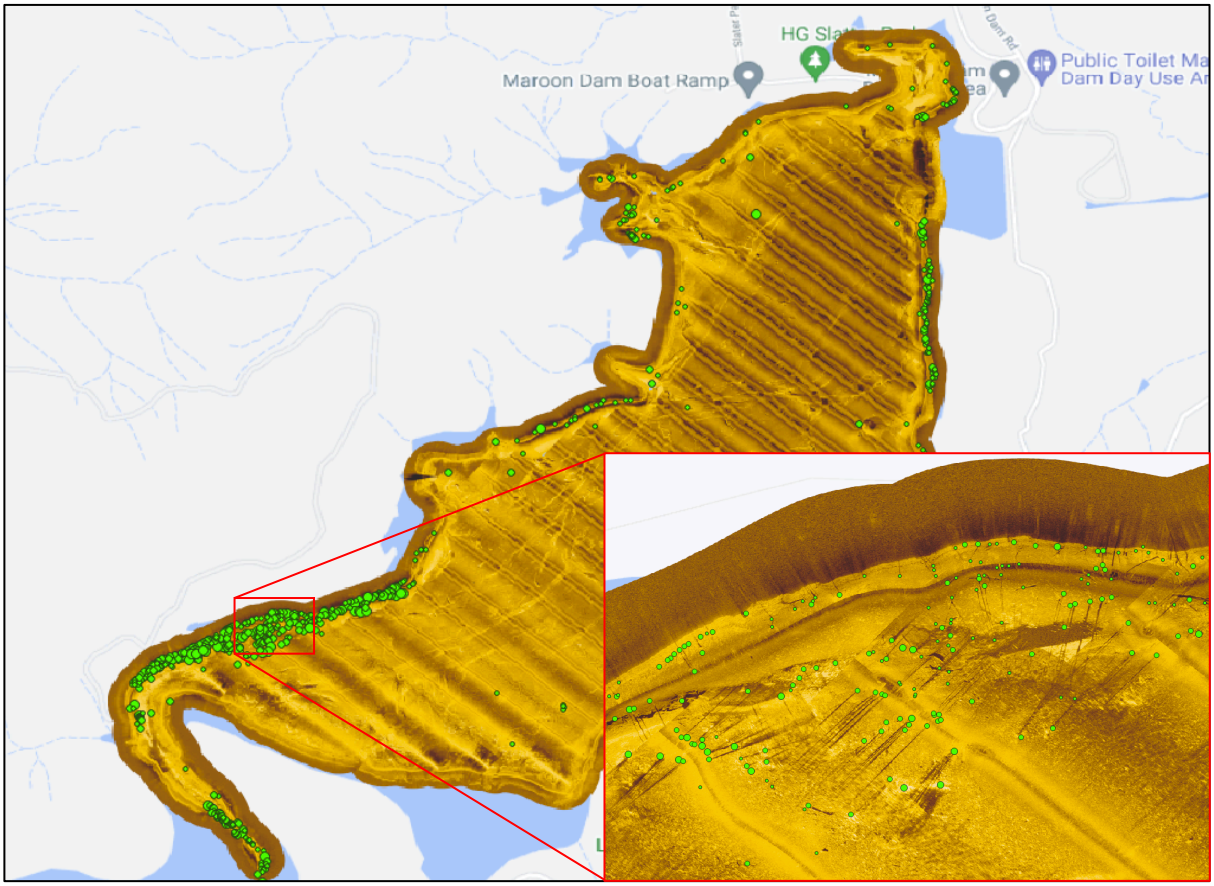



Figure 6. Classified individual woody habitat elements showing different sized points (W1-smallest to W3-largest) for varying complexity in Lake Maroon, Queensland.

[3] Mapbox Studio, 2022. Online resource - https://www.mapbox.com.

## STRUCTURE MAPPING

Structure mapping is generated during the post survey processing of data collected by the BioSonics DT-X during fish biomass surveys. The base raw data is collected to include the greatest amount of signals as possible and contains signals from fish, trees, rock, creek channel edges and any other object that returns an echo. The structure-based echoes are separated out from the fish signal analysis during machine learning based data processing. The filtered structure signals are mapped providing information on the abundance of structure in a surveyed area. Structure mapping highlights areas of high signal return and is validated by comparison with habitat mosaics. See Figure 7 for an example of structure detected and mapped.

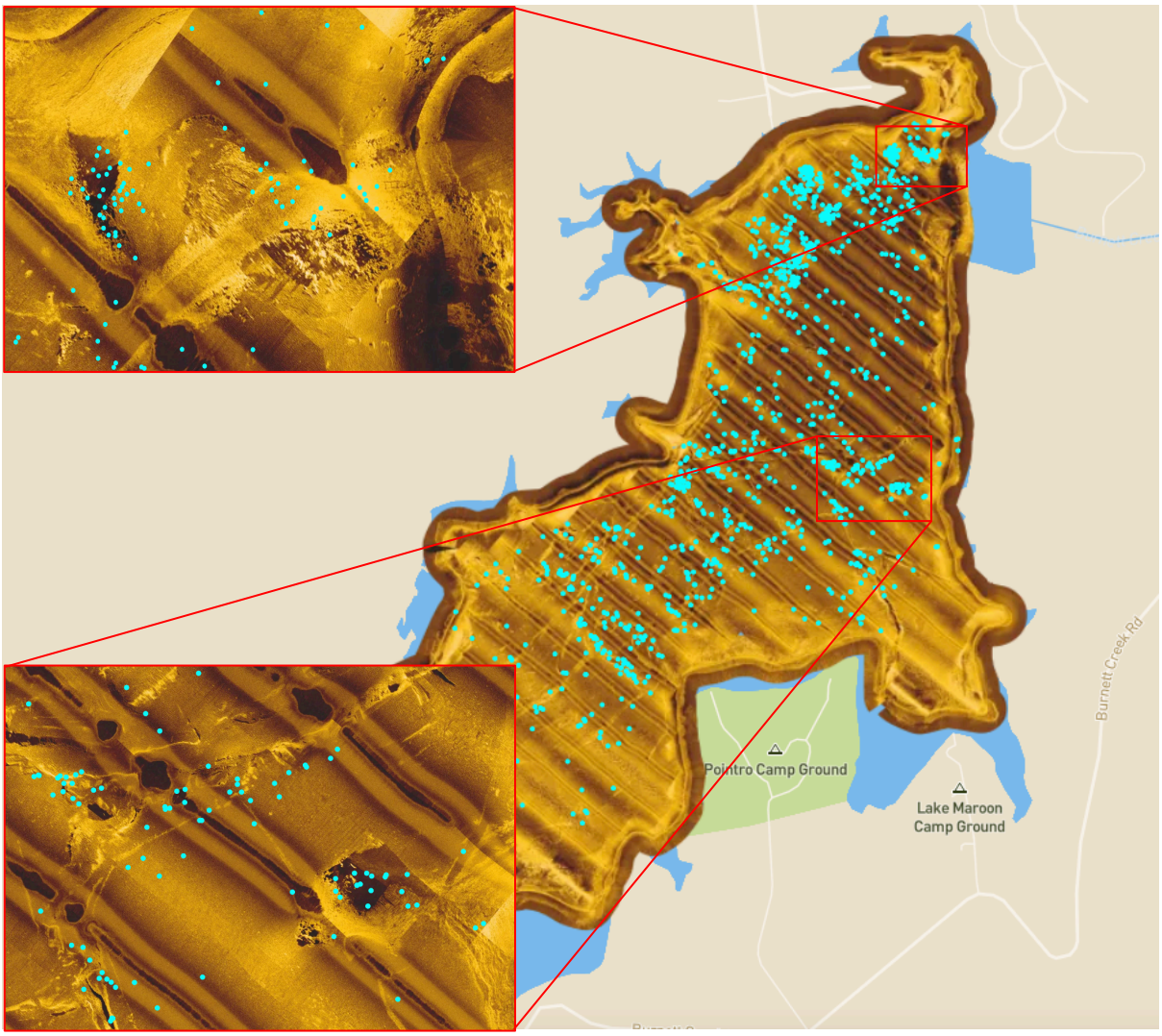



Figure 7. Structure map (predominantly rock signals) of Lake Maroon, Queensland.

## QUALITY ASSURANCE AND SAFETY

The survey team holds suitable tertiary qualifications and / or the necessary experience to undertake surveys. Our team is highly 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 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.