

Sampling fish communities using electrofishers

1 Purpose and scope

This document provides the procedure that can be used across the different forms of electrofishing (e.g. backpack, shore-based and boat-mounted units). It broadly describes checking equipment, preparation for sampling and the basic steps of electrofishing. Due to the variation in electrofishing equipment and purposes, it is important to refer to the manufacturer's manual, *Australian Code of Electrofishing Practice* and relevant background information for specific details on the use of electrofishing equipment.

2 Associated documents

Sampling design and preparation:

- *Permits and approvals*
- *Record keeping, including taking field photographs and videos*

Biological Assessment:

- *Background to fish sampling and index calculation*
- *Fish holding, identification and measurement of length and weight*

3 Health and safety

Before following the methods contained in this document, a detailed risk management process (identification, assessment, control and review of the hazards and risks) must be undertaken. All work carried out must comply with the *Australian Code of Electrofishing Practice* (NSW Fisheries 1997) (hereafter the Code), and Queensland Work Health and Safety legislative obligations.

4 Permits and approvals

Any staff member involved in electrofishing must have the approval of their manager, who should ensure the electrofishing operations are compliant with relevant legislation.

A general fisheries permit is required for all work that involves 'fish' as defined in the *Fisheries Act 1994*. Note that early life stages such as eggs, spat or spawn of fish are considered as fish under the Act. Under the *Animal Care and Protection Act 2001*, prior approval in writing from an Animal Ethics Committee is required for the use of animals for scientific purposes. All work carried out must comply with Australian Code for the Care and Use of Animals for Scientific Purposes (National Health and Medical Research Council 2013).

If a boat is to be used for research and/or commercial purposes, consideration must be given as to whether a Certificate of Survey or Marine Safety (Scientific research and educational activities) Exemption is required.

Permits and approvals may be required to conduct activities involving animals, plants and/or in protected areas (for example National Park/Regional Park, State Forest or State Marine Park).

See *Permits and approvals* document for more information on requirements.

5 Skills, training and experience

All staff involved in electrofishing must have (as a minimum standard) skills to electrofish safely.

Electrofishing team leaders must meet the standard of a Senior Operator with respect to the type of electrofishing equipment to be used, as defined in the Code. This includes the requirement of 50 hours of 'supervised electrofishing' to qualify as a Senior Operator. 'Supervised electrofishing' is based on active fishing time, i.e. excluding preparation and travel time. Note that the qualification time must be fully documented.

No person is to operate electrofishing equipment unless they meet the standard for a Senior Operator, or, for training purposes, work under the direct close supervision of a Senior Operator. For boat-based electrofishing, there must be one Senior Operator on the boat. Any other team members on board can be in training.

It is highly recommended that Senior Operators undertake theoretical training with an authoritative external organisation such as the US Fish and Wildlife Service (<http://nctc.fws.gov/courses/csp/csp2c01/resources/>) and/or Smith-Root Inc. as part of their initial training. It is also recommended that Senior Operators take time to periodically refresh their theoretical knowledge and/or practical skills, especially if they have not electrofished for a period of six months or more.

Staff members assisting the team leader need to complete:

- a detailed briefing on dry land with the electrofishing team leader, who must demonstrate operation of equipment and provide safety information
- a "wet induction" with the electrofishing team leader that involves active fishing solely for demonstration (as opposed to data collection) purposes and highlights safety requirements.

All staff involved in electrofishing must hold a current Senior First-aid Certificate or equivalent, including CPR, and have written approval from a medical doctor that states that they are fit for electrofishing. This may include an ECG report.

If a boat is to be used, the skipper must be sufficiently experienced with the size of the boat being used and the prevailing river or lake conditions. It is recommended that the skipper holds a current Queensland Recreational Shipmaster's Licence.

At least one staff member must have the ability to identify local fish to species level.

6 Equipment

Equipment will depend upon the type of electrofishing to be undertaken. See Appendix 1 for an example equipment checklist.

7 Procedure

7.1 Determine fishing protocol

There are many fishing protocols that could be used, and these depend upon the aim of the sampling, site characteristics and electrofishing equipment used. Some considerations are outlined below when determining your electrofishing protocol.

7.1.1 Aim of sampling

Understanding the purpose of the sampling will assist in determining the fishing protocol and the methods to be undertaken during electrofishing sampling.

If the aim is to conduct a fish community composition survey, then fishing effort is typically timed (e.g. five minute shot time), with the number of shots depending on the size of the site. Electrofishing may be conducted across alternate banks and mid-channel to cover all habitat types, or may be divided into habitats, transects or sample reaches. For example, sampling may be conducted with runs both parallel and perpendicular to the bank to capture fish from various habitats (e.g. in the edge and mid-water). Other examples may be to sample for a fixed time per shot in homogenous habitats at each site, to assist in standardisation, or to attain full coverage of a certain section of stream, denoted by length of stream section or area fished.

If the aim is to target a particular fish species (e.g. golden perch), sampling methods will be designed to target

specific habitats for the particular fish species (e.g. snags in deep pools). More sampling effort will be placed on habitats known to be suitable for the particular species.

Recording measures of fishing effort (e.g. 'power-on' time, fishing time, size of fished area) is important for all electrofishing sampling protocols, as it allows some standardisation across sites and over time to provide accurate comparisons in community composition (e.g. catch per unit effort), or calculation of effort when targeting species.

7.1.2 Site characteristics

Knowing the site/s to be sampled will assist in determining your sampling protocol. The size of the water body, depth to be sampled, habitat types, flow of the water and approximate water conductivity will help in determining the equipment to be used, and the sampling methodology.

7.1.3 Equipment type

There are many different electrofishing units (e.g. backpack, boat-based and shore-based), each having different uses. Equipment is determined by characteristics such as depth/flow of the water and water electrical conductivity. General details for each are below. A combination of types of electrofishing equipment can be used.

Backpack electrofishing is generally used for smaller streams and lakes, typically of a depth less than the operator crotch height. Strong flows should be avoided using this technique. Backpack electrofishing can only be performed in water of low to moderate salinity (e.g. 10–1500 μ S/cm depending on unit specifications), and therefore, its use is limited in tidal and some lowland waters.

Boat-based electrofishing is used for large rivers and lakes where it is not possible to use backpack electrofishing, or where unsafe to wade (e.g. due to potential presence of crocodiles or strong flows). Boat-based electrofishing can be undertaken in low to high water salinity (e.g. 10–25,000 μ S/cm depending on unit specifications).

Shore-based electrofishing is used in wadeable waters, but has the advantage over backpack electrofishing in that it can be undertaken in waters of moderate to high salinity. However, because they have a higher power output, the safety risk is also greater than backpack-mounted equipment.

7.2 Complete pre-departure check of equipment maintenance and testing

The following steps should be undertaken prior to departing to the field.

7.2.1 Check maintenance and testing logbook

Ensure the equipment is ready for use and is not requiring any maintenance prior to use. Refer to specific manufacturer's instruction manual for further information on maintenance, and the *Australian Code of Electrofishing Practice* (NSW Fisheries 1997).

7.2.2 Conduct a bench-test of the equipment

The Senior Operator must check the electrofishing equipment (including pole, anode and cathode) to ensure it is in working order prior to field mobilisation. The Senior Operator must also check that the batteries are fully sealed and working, and ensure they are fully charged before undertaking the survey.

7.3 Preparation for electrofishing

7.3.1 Undertake staff briefing prior to entering the water

This should consist of an overview of electrofishing equipment, including safety features and personal protective equipment, and the safety protocols around electrofishing, such as not touching the water, and clear communication between the operator and the assistant/s. Use the following as a guide:

- Assess the sampling site to be fished before entering the water with the equipment. It may be helpful to mark out the fishing area (e.g. upstream and downstream extent, target habitats) prior to fishing.

- If backpack electrofishing is to be undertaken, ensure water depth and flow is suitable across the fishing area (i.e. water level not above operator crotch depth, and flow safe to wade in). Similarly, ensure suitable depth is present if using boat-based electrofishing.
- Determine water conditions, such as electrical conductivity, which will affect the nature and range of the electrical field within the water. Knowing the electrical conductivity of the water will assist the Senior Operator in setting the electrofishing output.
- Set electrofisher output. This will be dependent on equipment to be used, and water conditions. The aim of setting the electrofisher output is to use the minimum power required for successful electrofishing. If the power is too low, electrofishing will be unsuccessful as it will not stun fish. If the power is too high, there is potential to harm or kill fish. Because of this, electrofishing settings and/or fishing protocol should be set to minimise harm to the fish while still allowing effective fishing. The Senior Operator must adjust the amount of power by setting the electrofisher output through the equipment controls. If the site and water conditions are well known by the Senior Operator, it may be satisfactory to set the equipment to the output settings known to be ideal. Generally, electrofishing equipment controls include:
 - voltage (V) – this will vary according to the electrical conductivity of the water, with lower conductivity requiring higher voltage (e.g. in headwaters), and higher conductivity requiring lower voltage (e.g. in lowland rivers)
 - frequency (Hz) – the number of electrical pulses (cycles) per second. In general, the larger the fish, the lower the frequency required to stun the fish
 - duty cycle (measured in %, is the ratio of on-to-off time) or pulse width (ms).
- Check safety prior to entering the water:
 - All electrofishers must have an audible alarm when in use.
 - For backpacks, recommended safety features include: a quick-release harness, a magnetic safety switch on the anode pole, a tilt switch and fully sealed dry cell batteries. Additional details can be found in the *Australian Code of Electrofishing Practice* and/or in the user manual for the specific equipment.
 - Boat mounted electrofishers must have a deadman switch requiring two or more operators to engage for power to be applied to water. If one is disengaged, the system will shut off power.
- Electrofishing has specific animal ethics requirements, which will be outlined in the Animal Ethics Approval. The following care should be taken when electrofishing:
 - Check there are no other users in the vicinity, including recreational users and animals (e.g. cattle using the water for drinking/crossing, dogs etc.).
 - Be mindful of potential for larger aquatic vertebrates (platypus, turtles, birds) in the sampling area. Use the lowest power required to successfully catch fish to minimise potential stress and injury.
 - If targeting smaller species, higher power or frequency is often required. However, be cautious as larger fish are more vulnerable to electrofishing than smaller fish. Consider other fishing methods if required (e.g. fyke nets).
 - Avoid the necessity of re-shocking fish by netting immediately and either placing in a bucket, or releasing downstream when recovered. Do not allow fish to be continuously shocked, i.e. inside dip net.

7.4 Electrofishing

The electrofishing sampling to be undertaken should be outlined in the sampling plan and will depend on equipment, purpose and specific site characteristics. General points to note for undertaking electrofishing are outlined below.

Note:

- Once fishing begins, the output settings may need to be adjusted by observing fish behaviour and recovery times to ensure the most effective settings are used.

- Nets can be set at the upper and lower ends of a stream section to prevent movement of fish out of the area.
- When using backpack or shore-based electrofishing, one person operates the electrofishing equipment, and the other person either collects specimens using a dip-net and places catch into a bucket if required, or assists operator by recording the species as they are captured. During boat-based electrofishing, the driver maintains their foot on the pedal unless unsafe, and the netter applies power to the water and nets the fish.



Figure 1: Backpack electrofishing being undertaken, with assistant carrying bucket and ready to take notes on catch

The following outlines general steps for electrofishing:

1. Carefully enter the water at the downstream extent of the sampling area (via boat or wading). Minimise disturbance to limit scaring fish and to keep turbidity to a minimum. Any other staff/observers must keep a safe distance from the water. For backpack electrofishing, the assistant should stand slightly downstream of the operator, keeping out of the way but ready to capture fish, and taking care not to stand on the cathode behind the operator. Slowly approach the desired habitat for sampling. Take care not to disrupt bed sediment while moving through the water.
2. Communicate with sampling team that fishing is about to commence. Assistants should be ready to either capture fish or record detail provided by the operator.
3. Begin electrofishing, and continue as you move through the habitat being sampled (in accordance with sampling protocol). If using a boat, the boat should approach habitats slowly, and electrofishing can continue while the boat is stationary or manoeuvring within the habitat and while the boat exits the habitat.
4. Immobilised fish should immediately be netted either by the electrofishing operator or the assistant so that the fish are isolated from the electric field.
5. Once captured, fish can either be identified and released downstream upon recovery if there is no chance of recapturing them, or placed in a holding vessel with fresh stream water for catch processing. Allow fish to recover before releasing.
6. Record measures of fishing effort (e.g. 'power-on' time, fishing time, size of fished area).
7. Ensure fishing effort is adequate for the purposes of sampling. For example, effort may be adequate if no new species has been recorded during the last 300 seconds of 'power-on' time.

7.5 Catch processing

Specific procedures used to process fish will depend upon the project objectives, and should be completed as quickly as possible to minimise stress. It may be required/possible to identify and release fish (downstream) immediately after capture, and in other instances it may be necessary to collect fish in a bucket during each 'shot', then process these at the end of the shot. Depending upon the purposes of the study, voucher photos, tissue samples/specimens and/or measurements of catch may be required prior to release.

See *Fish holding, identification and measurement of length and weight* document for further information.

7.6 Cleaning and maintenance of equipment

All gear must be thoroughly cleaned and dried following use to reduce the risk of spread of biological material between waterways.

Each electrofishing unit must have a detailed instruction manual and gear logbook, in which all maintenance of equipment (among other things) is recorded.

Regular electrical safety checks must be performed by a qualified/experienced service technician on all electrofishing units. Refer to instruction manual for additional details.

Note: no substantial repairs or modifications should be made to any electrofishing equipment unless conducted by a suitably accredited electrical/electronics specialist.

All equipment should be inspected by the Senior Operator for any equipment faults, loose wires or connections etc. following each use.

8 References and additional reading

Burkhardt, RW & Gutreuter, S 1995, Improving Electrofishing Catch Consistency by Standardizing Power, *North American Journal of Fisheries Management* 15, 375-381.

Marshall, C, Negus, P, Winning, M & Johnson, D 2004, *Fitzroy Basin Resource Operation Plan Ecological Monitoring and Assessment Program Pilot Study – Part 2 Research Project Indicator Methods*, Department of Natural Resources, Brisbane.

National Health and Medical Research Council 2013, *Australian code for the care and use of animals for scientific purposes*, 8th edition, National Health and Medical Research Council, Canberra.

New South Wales Fisheries 1997, *Australian code of electrofishing practice*, NSW Fisheries Management Publication No 1.

Pusey, B, Kennard, M & Arthington, A 2004, *Freshwater Fishes of North-Eastern Australia*, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Publishing, Collingwood, Victoria.

US Fish and Wildlife Service 2000, *Principles and Techniques of Electrofishing*, US Fish and Wildlife Service, Shepherdstown.

Appendix 1

Table 1: Equipment checklist

| Equipment | ✓ |
|---|---|
| Backpack and shore-based electrofishing: <ul style="list-style-type: none"> • 1 x backpack electrofisher or shore-based electrofisher, including anode, anode pole, cathode • 1 x Pair of long 1000V linesman gloves for each sampling team member • Waders for each sampling team member | |
| Boat electrofishing: <ul style="list-style-type: none"> • Boat with outboard motor, stable deck for netter at front of boat and three safety gates around the deck • Electrofishing equipment including generator (2.5V or 5.0V) and control box, anode, anode pole, foot switches. • Rubber boots for each sampling team member | |
| Life jackets (if water depth great than 50cm or in specific safety plan) | |
| Shallow and deep long-handled, non-conductive fish net | |
| Electrical conductivity meter | |
| Large holding containers (e.g. Nally® bins) | |
| Gloves for handling fish (optional) | |
| Polarized sunglasses | |
| Fish identification field guide | |
| Measuring board and scales (if required) | |
| Electrofisher logbook | |
| Field data sheets | |
| Waterproof marker, pens and pencils | |

Note: Equipment numbers/amount to be determined by the study design.