

**Standard Operating Procedures for *Fish Movement***  
**Version 1.1**

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## Introduction

The Standard Operating Procedure (SOP) for Fish Movement describes the purpose of the tagging and acoustic monitoring of fish movement assessments in the lower Goulburn River, how the monitoring will be conducted, who is responsible for specific tasks and how the collected data will be analysed and reported. The document is intended to be taken in the field during when fish are fitted with the tagging devices and when data are downloaded from the acoustic receiving stations and should be updated throughout the life of the Long Term Intervention Monitoring Program to reflect any agreed changes to method or procedure.

## Objectives and hypotheses

This monitoring protocol for Fish Movement addresses the following Basin scale evaluation questions:

### **Long-term (five year) questions:**

- What did Commonwealth environmental water contribute to native fish populations?

### **Short-term (one year) questions:**

- What did Commonwealth environmental water contribute to native fish dispersal?

The Area Specific evaluation questions to consider are:

### **Long-term (five year) questions:**

- What did Commonwealth environmental water contribute to the recruitment of Golden Perch in the adult population in the lower Goulburn River?

### **Short-term (one year) questions:**

- What did CEW contribute to the movement of Golden Perch in the lower Goulburn River and where did those fish move to?
- What did CEW contribute to Golden Perch spawning and spawning-related movements and in particular what magnitude, timing and duration of flow is required to trigger spawning-related movements?

The Standard Methods for Fish Movement assessments for the LTIM require M&E Providers to tag and monitor Golden Perch and/or Murray Cod as a minimum. The Fish Movement component of the LTIM for the lower Goulburn River Selected Area will focus only on Golden Perch because spring and summer freshes in the lower Goulburn River specifically aim to trigger spawning and spawning-related movements for Golden Perch. If successful, this spawning and movement may result in a broader range of age classes in the population (currently the Golden Perch population comprises only large, old fish) and an increase in abundance.

## Indicators

Fish Movement is a Category II monitoring indicator for the LTIM Program in the lower Goulburn River. It requires monitoring of fish movement in each nominated zone. The monitoring will use an existing acoustic telemetry array established in the lower Goulburn and mid-Murray rivers. Fish collected will be tagged with V-13 acoustic transmitters to allow their movement past established telemetry sites to be recorded. The data will be used to answer questions such as do fish move to specific areas to spawn and what flow magnitude triggers movement.

Fish movement will also be measured in the Edward-Wakool, Murrumbidgee and Lower Murray Selected Areas using the method described in this SOP, which has been specified by the M&E Advisor. Fish Larvae surveys will complement Fish Movement assessments because they should indicate whether spawning occurs immediately or shortly after significant movement events. The Fish River surveys will also complement this indicator because they will measure successful recruitment (young-of-year fish) following any spawning-related movement.



## Locations for monitoring

Acoustic receivers will be installed at all of the adult fish monitoring sites in Zone 2 (Shepparton to Murray Junction) to provide a comprehensive assessment of fish movement through that zone. Six of the sites already have acoustic receivers, which were deployed as part of a separate, ongoing project conducted by the Arthur Rylah Institute. Therefore new receivers will only need to be installed at four additional sites.

Three sites in Zone 1 (Goulburn Weir to Shepparton) also have working acoustic receivers and although the LTIM will not focus on Zone 1 and no fish will be tagged in that zone, data collected from the existing receivers will be used to evaluate how far and under what circumstances, tagged fish move from Zone 2 into Zone 1. The proposed sites for acoustic receivers are shown in Table 1.

**Table 1: Name and location of proposed fish movement monitoring sites for the lower Goulburn River. Most of the sites have existing receivers as shown.**

Zone	Site	Lat	Long	Existing ARI site	New site
1	Cable Hole	-36.690	145.230	✓	
1	Cemetary Bend	-36.516	145.322	✓	
1	Pyke Road	-36.427	145.357	✓	
2	Shepparton	-36.354	145.353	✓	
2	Zeerust	-36.254	145.353		✓
2	Loch Garry	-36.242	145.287	✓	
2	Pogues Road Undera	-36.203	145.268		✓
2	Kotupna	-36.164	145.222	✓	
2	McCoys Bridge	-36.177	145.123	✓	
2	Murrumbidgee Road Pederick	-36.156	145.035		✓
2	Yambuna	-36.131	145.003	✓	
2	Murphy Road/Sun Valley Road Kanyapella	-36.095	144.925	✓	
2	Stewarts Bridge	-36.103	144.850		✓

## Timing and frequency of sampling

Fish will be collected for tagging as part of the Fish River surveys in Zone 2. The adult fish surveys will be conducted annually between March-May at each site in Zone 2 over the five year program, but fish will only be tagged in the first two years of the program. The transmitters that will be used for the study have an operating life of approximately three years and therefore tags fitted in fish during the first two years of the program should provide good data over the duration of the LTIM. It is better to collect data on individual fish over as many years and flow events as possible and therefore fitting tags in the first two years of the program is considered better than the first year and the third or fourth year. The timing of sampling/tagging will be chosen to coincide with relatively low river flows and low turbidity to maximise sampling efficiency. High flows (e.g. due to rainfall or environmental water releases) will be avoided, where possible, as these may increase turbidity and reduce sampling efficiency. Data recorded on the acoustic receivers will be downloaded quarterly throughout the five year program to reduce the loss of data due to potential equipment damage.

## Responsibilities – identifying key staff

### Field program

Wayne Koster and David Dawson from the Arthur Rylah Institute will be responsible for overseeing the planned monitoring, conducting the field surveys, tagging and data downloads and any relevant training, and preparing safety plans. Other experienced staff from ARI may also participate in the surveys at times where needed. CMA staff will assist staff from ARI in downloading data from the receivers. Angus Webb from



Melbourne University will conduct data analysis. Wayne Koster and David Dawson will be responsible for collating, checking and uploading collected data.

### Laboratory requirements (if any)

- N/A

### Procedure for transferring knowledge to new team members

The discipline lead (Wayne Koster) will be responsible for ensuring new team members have a sound understanding of the program and are able to competently undertake required tasks. The discipline lead will undertake the following steps to facilitate this process

1. Discuss the overall program to the new staff member and introduce to team members.
2. Outline and document the roles and responsibilities of the new staff member
3. Explain and provide access to relevant program documents
4. Explain and discuss the standard operating procedure
5. Explain and discuss the project risk assessment and the required safety measures
6. Demonstrate sampling methods to staff in the field and supervise staff undertaking these methods until satisfactory competency is demonstrated.
7. Explain and demonstrate data collation, analysis, uploading procedures and assist staff in performing these tasks as required

Fish tagging - No formal accreditation is required to undertake tagging. However, any inexperienced staff involved in tagging will only work with other staff who have at least 2-3 years' experience.

Fish surveys - Any new staff undertaking electrofishing will be required to complete the U.S. Fish and Wildlife Service's Principles and Techniques of Electrofishing Program. No formal accreditation is required to undertake fyke net surveys. However, any inexperienced staff involved in fyke net surveys will only work with other staff who have at least 2-3 years' experience. Staff must hold a valid Victorian drivers licence and a coxswains certificate. Staff must also have completed accredited 4WD training and First Aid (Level 2) training. David Dawson will be the senior field technical officer within the field team. David will liaise regularly with Wayne Koster and will train any new staff required throughout the duration of the project. Wayne Koster will convene (face to face) regular debriefs with the field team after field trips to identify any issues of concern. Scheduled debriefings will occur after each field trip for the duration of the project. Any significant matters will be dealt with immediately rather than waiting for a scheduled debrief.

## Monitoring methods

### Field methods

#### Equipment

Electrofishing boat  
Double wing fine (2 mm) mesh fyke nets, chains and floats  
GPS  
Measuring boards  
Scales  
Datasheets and/or field computer  
VR2W receivers  
Vemco tags  
Laptop with Vemco software installed  
Surgery kit (scalpels, sutures, scissors, betadine, ethanol)



## Sample placement within sites

### Sampling protocol

#### Tagging

About 30 Golden Perch, greater than 500 grams will be tagged, in both year 1 and 2 (making a total of approximately 60 tagged fish). Most fish will be collected and tagged in zone 2 as part of the Fish River surveys. However, sites within zone 1 (e.g. Cable Hole, Pyke Road, Cemetery Bend) that are known to support large populations of Golden perch may also be targeted if insufficient numbers are collected in zone 2. The minimum weight of 500 grams is specified to ensure the transmitter is less than 2% of the fish body mass and therefore doesn't impede its movement.

Fish will be collected using a boat-mounted electrofishing unit or fyke nets in the Fish River surveys. Upon capture, fish will be immediately transferred to an aerated 50 L holding container to which an approved anaesthetic will be added (0.03 mL AQUI-S per litre water) (AQUI-S, Lower Hutt, New Zealand). Acoustic transmitters (Vemco, model V-13) will be implanted into the peritoneal cavity through an incision of about 15 mm, adjacent to the pectoral fin extending toward the anus. Surgery equipment will be rinsed in ethanol and tags soaked in betadine prior to commencement of surgery. Time to anaesthesia (i.e. opercular rate slow, no reaction to stimuli) will be about 7–8 minutes. Once the transmitter has been implanted, the incision will be closed with 2–3 dissolvable external synthetic absorbable monofilament sutures. We will also fit a coded 't-bar' tag between the second and third dorsal spines of each fish to allow individuals to be identified if they are caught in any subsequent adult fish surveys, and a PIT tag so that they can be detected as they move through any of the fishways in Murray River system. Fish will be sexed by examination of gonads or by collecting a fin clip for later examination. The tag identification number, length, weight and site of collection for each individual will be recorded on the data sheets used for the Fish River surveys. Throughout the procedure the head and gills of fish will be immersed in aerated water containing anaesthetic levels of the AQUI-S solution.

Once the surgery is complete, each fish will be placed into an aerated 50 L recovery container. Once the fish is observed to maintain its balance and swim freely in the recovery container (usually after about 10 minutes) it will be released within 100 m of the point of capture.

We will exchange acoustic telemetry data with other M&E providers annually and by accessing the Murray Fishway PIT tag database so that fish from the lower Goulburn River can be tracked if they move into other LTIM Selected Areas and so that fish from other Selected Areas can be detected if they move into the lower Goulburn River.

#### *Schedule of data download.*

Data from the listening stations will be downloaded using wireless communication technology and a laptop computer approximately every four months during the study. Acoustic listening stations will be cleaned at each download. Hardware attaching the listening stations will be inspected for damage or signs of wear. Any listening stations malfunctioning will be replaced and sent to VEMCO for data extraction and repair. Receivers will be cleaned and repaired if needed at the end of each trip. New batteries will be installed in the receivers about every 12-15 months. Data downloads and battery replacements can only be done during low flow conditions as high flows will prevent access to the listening stations. Therefore, flow conditions are taken into account when planning the trips.

### Laboratory methods

- N/A

### Data analysis and reporting

#### Data outputs

Movement data should be reported as:



- Total longitudinal distance (TD) moved for each individual, stratified by month (sum of all distances (upstream and downstream) covered by an individual, within a receiver array)
- Total longitudinal distance (TDU) moved upstream for each individual, stratified by month (sum of all distances moved upstream made by an individual, within a receiver array).
- Total longitudinal distance (TDU) moved downstream for each individual, stratified by month (sum of all distances moved downstream made by an individual, within a receiver array).
- Net longitudinal displacement (NLD) downstream for each individual, stratified by month
- Longitudinal range (LR) for each individual, stratified by month (farthest upstream location minus the farthest downstream location, within a receiver array)

Data will be provided in an excel spreadsheet and presented in a table. This data will be uploaded to the MDMS and to the University of Melbourne using a cloud service within 1 month of collection.

An annual area evaluation report will be produced for the CEWO in accordance with section 6.3 of the final proposal. This will include an assessment of relationships between movement and flows and will focus on the magnitude, timing and duration of flow associated with spawning season movements by Golden Perch because we expect spawning-related movements of this species to be associated with high flow events. The report will also include an assessment of whether tagged fish move to other systems, and whether fish tagged in other systems move into the Goulburn River. Where relevant the report will describe modifications or revisions to existing environmental water releases in the lower Goulburn River to enhance fish movement.

### Quality Assurance/Quality Control

- Any new inexperienced staff involved in tagging will only work with other staff who have at least 2-3 years' experience.
- All persons conducting electrofishing will be required to complete the U.S. Fish and Wildlife Service's Principles and Techniques of Electrofishing Program.
- The electrofishing boat will be serviced annually by Berry Rewind Electrical (BRE). BRE is an electrical engineering, contracting and electric motor company currently employing an experienced team of industrial A grade electricians. The boat and motor will also be serviced annually by Barry Lawrence Marine. All service certificates will be stored in a filing cabinet in the maintenance department at ARI.
- Fyke nets will be checked for holes in either wing- or cod-ends prior to every field trip, and also upon completion of sampling at each site. Any net with a hole will be repaired or replaced immediately using a repair kit that is taken on site.
- The monitoring will be conducted under an existing Victorian Flora and Fauna Guarantee Permit (expires Aug 2014 but is renewed annually) and Fisheries Victoria Research Permit (expires Aug 2014 but is renewed annually) and ethics permit 13-10 (Arthur Rylah Institute Animal Ethics Committee) (expiry 31/12/2017 but will be renewed prior to expiry). Permits will be carried while sampling. Prior notification to Fisheries for any sampling will be made as per permit conditions.
- As per permit conditions, all electrofishing operations will be undertaken in accordance with the Australian Code of Electrofishing Practice. Permit reports will be lodged annually with the relevant body as per permit conditions.
- The boat and motor will also be serviced annually by Barry Lawrence Marine. All service certificates will be stored in a filing cabinet in the maintenance department at ARI.
- Data will be exported from the laptop to excel immediately upon return from the field. Filters will be used to identify false detections (i.e. code collisions) and ghost tags which will be removed from the dataset.
- All data provided for this indicator must conform to the data structure defined in the LTIM Data Standard (Brooks and Wealands 2013) and provided in Attachment 1 – Note that we will include the length and weight of each tagged fish in the database even though it is not specified for the LTIM as we think these data are important for the overall analysis of fish movement. The data standard provides a means of collating consistent data that can be managed within the LTIM Monitoring Data Management System (MDMS).
- Data will be entered into an excel spreadsheet that follows the prescribed template outlined in the standard methods. Each cell of data will be cross-checked visually against data sheets for accuracy by David Dawson. Data sheets will be stored in a filing cabinet in David Dawson's office at ARI. All data sheets will be photocopied and stored in a separate filing cabinet in Wayne Koster's office at ARI.
- Data will be stored electronically at ARI on a computer network that is backed-up daily to an external server. Data will be sent by David Dawson via email to Melbourne University to be loaded onto a central database.





## References

Brooks, S. and Wealands, S. (2013) LTIM Data Standard v0.2. Draft Report prepared for the Commonwealth Environmental Water Office by The Murray-Darling Freshwater Research Centre, MDFRC Publication 29.3/2013 November, 29pp.

## Attachment 1 LTIM Data Standard requirements

### Attachment 1.1 Standard Data format for individual fish to be submitted to the CEWO.

Variable	Description	Type	Req	Range
assessmentUnitId	The spatial extent monitored by the telemetry receiver array	string	Y	
dateStart	Start date (inclusive) that these measures were observed	dateTime	Y	
dateEnd	End date (exclusive) that these measures were observed	dateTime	Y	
speciesName	Latin name for species of fish	string	Y	Lookup List
totalLength*	Total length (in mm), where necessary	number (1 decimal)	N	[0,+]
forkLength*	Fork length (in mm), where necessary	number (1 decimal)	N	[0,+]
Weight*	Mass (in grams)	number (2 decimal)	N	[0,+]
tagNumber	Transponder identifier			
TotalDistanceMoved	The sum of all distances in m (upstream and downstream) covered by an individual within the receiver array range	integer	Y	[0,+]
totalUpstream	The sum of all distances moved upstream in m by an individual, within a receiver array range (TDU)	integer	Y	[0,+]
totalDownstream	The sum of all distances moved downstream in m by an individual within a receiver array range (TDD)	integer	Y	[0,+]

\* Variables not specified by Brooks and Wealands, but considered important for the analysis.

