



# The 'Sea to Hume' Fishways Program 2009/2010 Update

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MRFA Tri-State Team  
(DPI NSW; ARI Vic; SARDI SA)

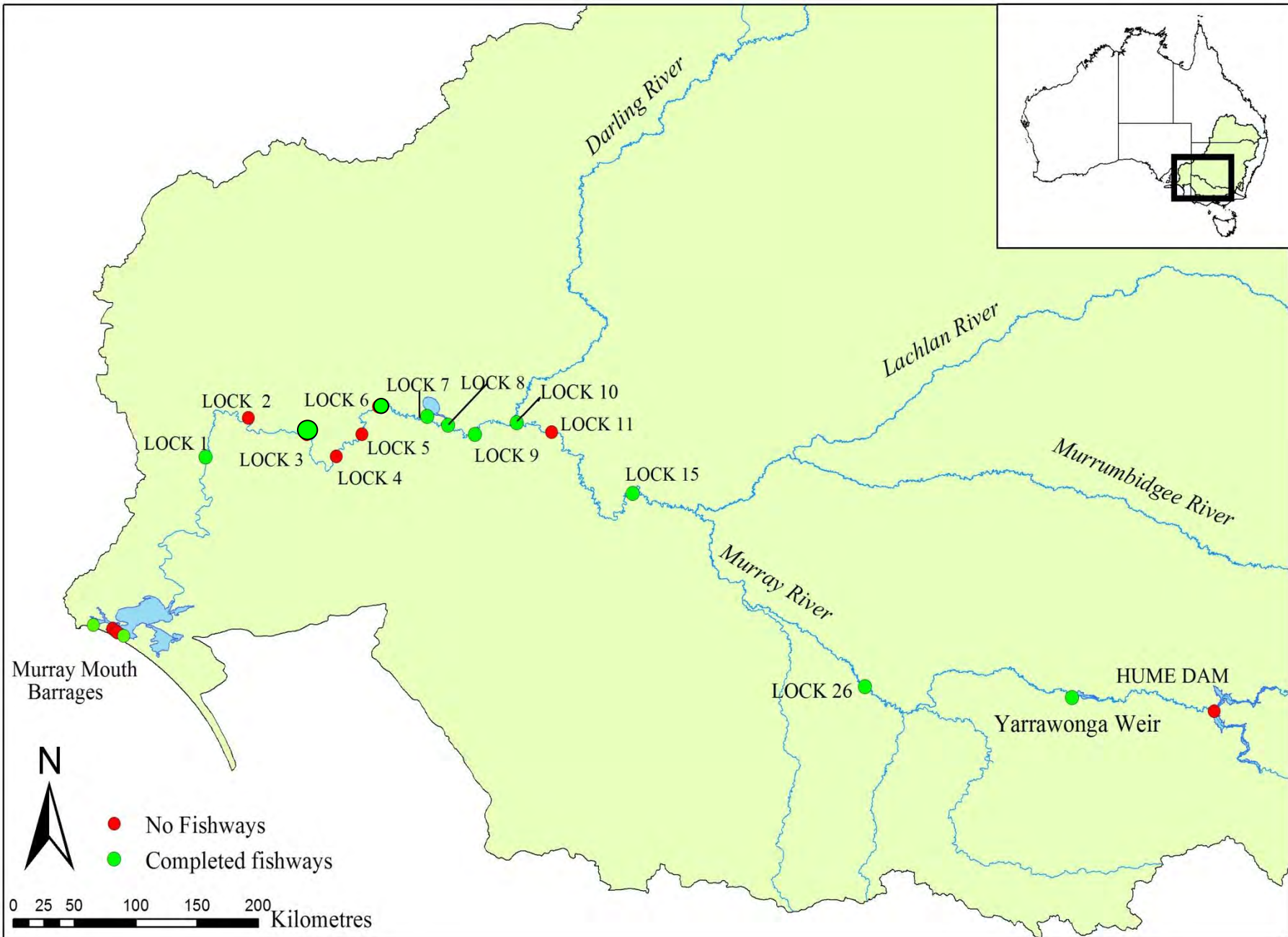


# Content

1. Background
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3. Fish movements: PIT telemetry
4. Fish community: Lock 1-3 model
5. Summary
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# 1. Background

- Improve fish passage >2,000km of the Murray River
- MDBC/MDBA initiated fishway construction between the sea and Hume dam; and
- Monitoring and assessment program started by tri-state team (NSW DPI; ARI VIC, SARDI) in 2001.



# Project Objectives

1. Are the fishways allowing passage of a full range of size classes and species of fish?
2. Are the fishways performing to design specifications in terms of hydraulics and fish passage?
3. Are the fishways reducing accumulations downstream of barriers?
4. Are the fishways contributing to positive changes in the abundance and diversity of native fish in the river?

# Project Phases

Stage I - Pilot Study

Stage II - Refinement of an experimental design

Stage III - Fishway assessment and fish community sampling (present)

### 3. Fish passage solutions

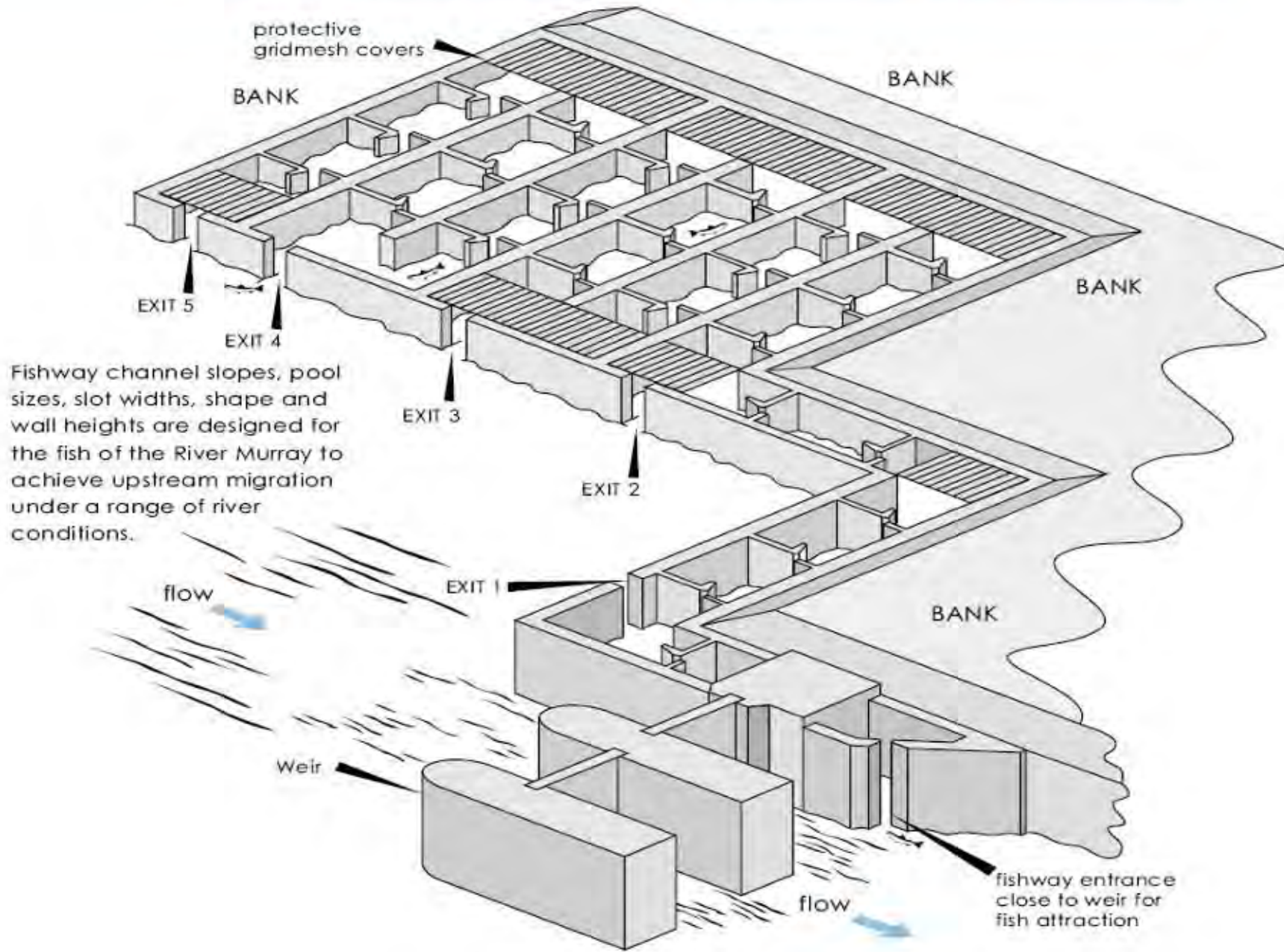
**...to enable fish passage across all**  
barriers between the sea and Hume  
dam.

# 3. Fish passage solutions

- Initially:
  - 40 to 1000 mm length via low slope vertical-slot fishways (mostly 1:32).
- Combined approach:
  - High gradient vertical-slot fishway (1:18) for larger fish (>100 mm), and
  - Automated fishlock for smaller-sized fish (<100 mm).

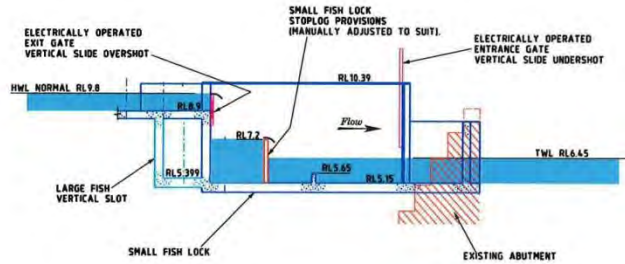


# Vertical-slot fishway



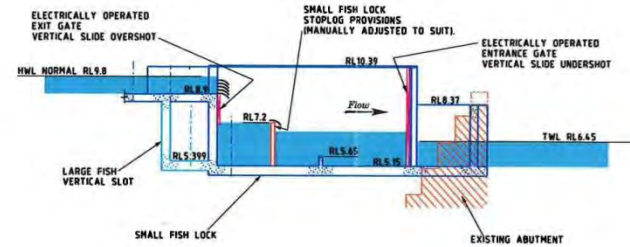
# Automated fishlock

## 1. ATTRACTION PHASE



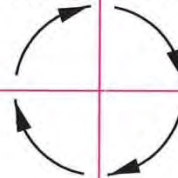
ENTRANCE GATE FULLY OPENED.  
EXIT GATE IS OPENED SLIGHTLY  
(TO PROVIDE AN ATTRACTION FLOW THROUGH THE ENTRANCE)

## 2. FILLING PHASE

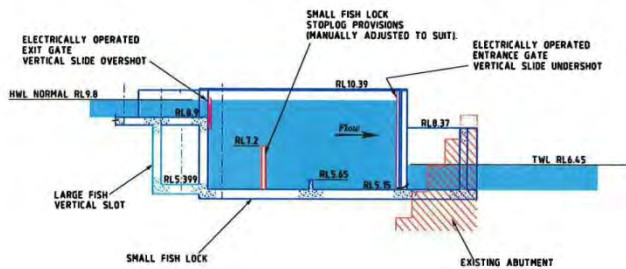


DURING THIS PHASE THE ENTRANCE GATE IS CLOSED.  
EXIT GATE IS FULLY OPENED, SLOWLY.

DIRECTION OF CYCLES

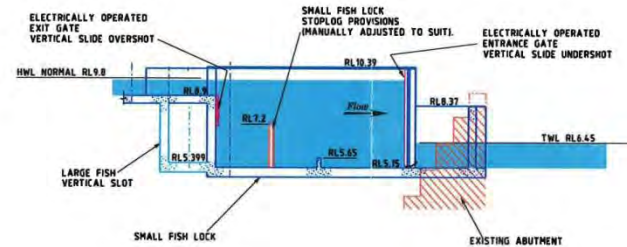


## 4. TRANSITION PHASE



GATES ARE RESET FOR THE ATTRACTION PHASE TO COMMENCE.

## 3. EXIT PHASE



ENTRANCE GATE IS OPEN SLIGHTLY  
(TO CREATE FLOW-STIMULATES FISH MOVEMENT TOWARDS THE EXIT).  
EXIT GATE REMAINS FULLY OPENED.

**LOCK AND WEIR 3  
FISHLOCK PHASE CYCLES**

# Assessment

## **Vertical-slot Fishway assessment**

**Aim:** To assess the effectiveness of the vertical-slot fishway for upstream passage of the expected size-range ( $>100\text{mm}$ ) of fish.

## **Fishlock assessment**

**Aim:** To assess the effectiveness of the fishlock for upstream passage of small-bodied fishes ( $<100\text{mm}$ ).

# Sampling

- Traps at 4 locations:
  - Fishlock Entrance,
  - Fishlock Exit,
  - VS Fishway Entrance &
  - VS Fishway Exit
- 2 x 24 hour sets per week at each trap location per month (up to 5 weeks total)
- **2010/11: Assessments at Lock 3, 4, 5, 6, and 11**

# Preliminary data from Lock 3

		Species	Number of fish	Length			
				Mean	S.E.	Min	Max
Fishlock Entrance	Small bodied species	Smelt	2896	39	0.7	31	52
		Carp gudgeon					
		Flathead Gudgeon					
	Large bodied species	Bony Herring	9	206	43.3	129	279
		Golden Perch Carp <i>Total catch</i>	2905				
Fishlock Exit	Small bodied species	Smelt	4430	38	0.8	28	54
		Carp gudgeon	37	37	1.6	27	44
		Flathead Gudgeon	177	59	2.7	42	75
	Large bodied species	Bony Herring	1	80	0.0	80	80
		Golden Perch Carp <i>Total catch</i>	4645				
Vertical_Slot Fishway Entrance	Small bodied species	Smelt					
		Carp gudgeon					
		Flathead Gudgeon					
	Large bodied species	Bony Herring					
		Golden Perch Carp <i>Total catch</i>	2	369	11.0	358	380
		2					
Vertical_Slot Fishway Exit	Small bodied species	Smelt					
		Carp gudgeon					
		Flathead Gudgeon					
	Large bodied species	Bony Herring	2				
		Golden Perch Carp <i>Total catch</i>	3	471	39.7	388	586
			5				
		10					

...suggests the expected size-range of fishes are using the fishway/-lock

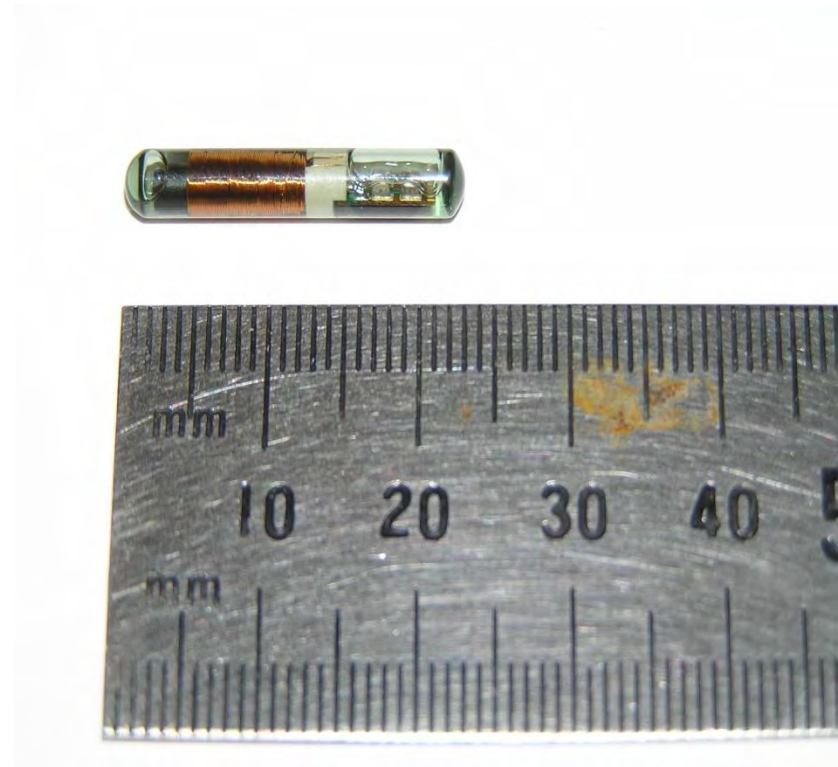
### 3. Fish Movement: PIT telemetry

**... to gain insight into movement behaviours  
of fish.**

# PIT Technology: PIT tag

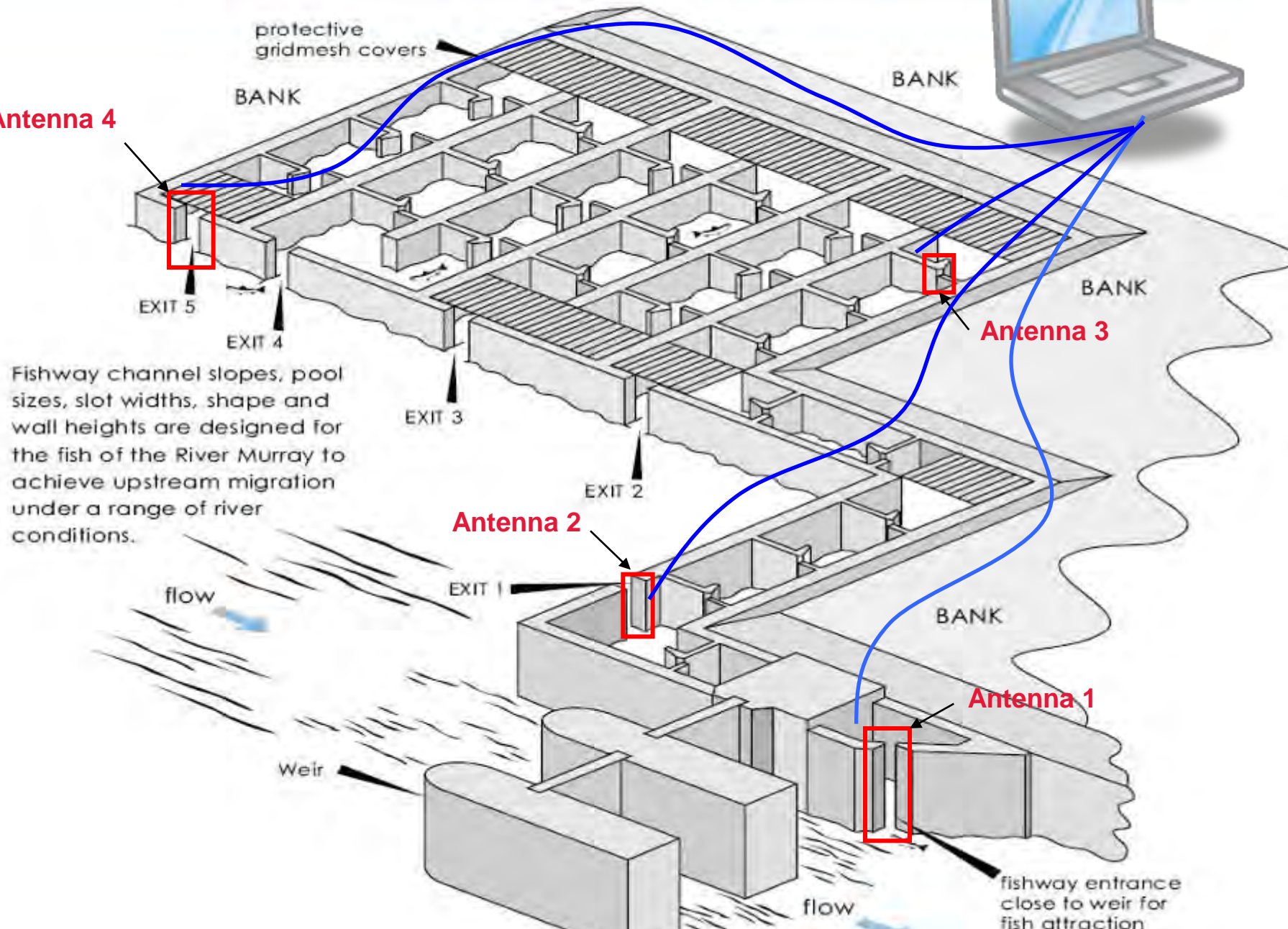
PIT = Passive integrated transponder.

- Also called microchips, similar to those used in pets.
- Fish equipped with PIT tag.
- Individually coded.
- Infinite life (no battery).
- Low cost ( $\approx$  \$2 each).



# Antenna locations in a vertical-slot fishway

**Antenna 4**



BANK

BANK

BANK

**Antenna 3**

**Antenna 2**

BANK

**Antenna 1**

fishway entrance close to weir for fish attraction

Fishway channel slopes, pool sizes, slot widths, shape and wall heights are designed for the fish of the River Murray to achieve upstream migration under a range of river conditions.

flow

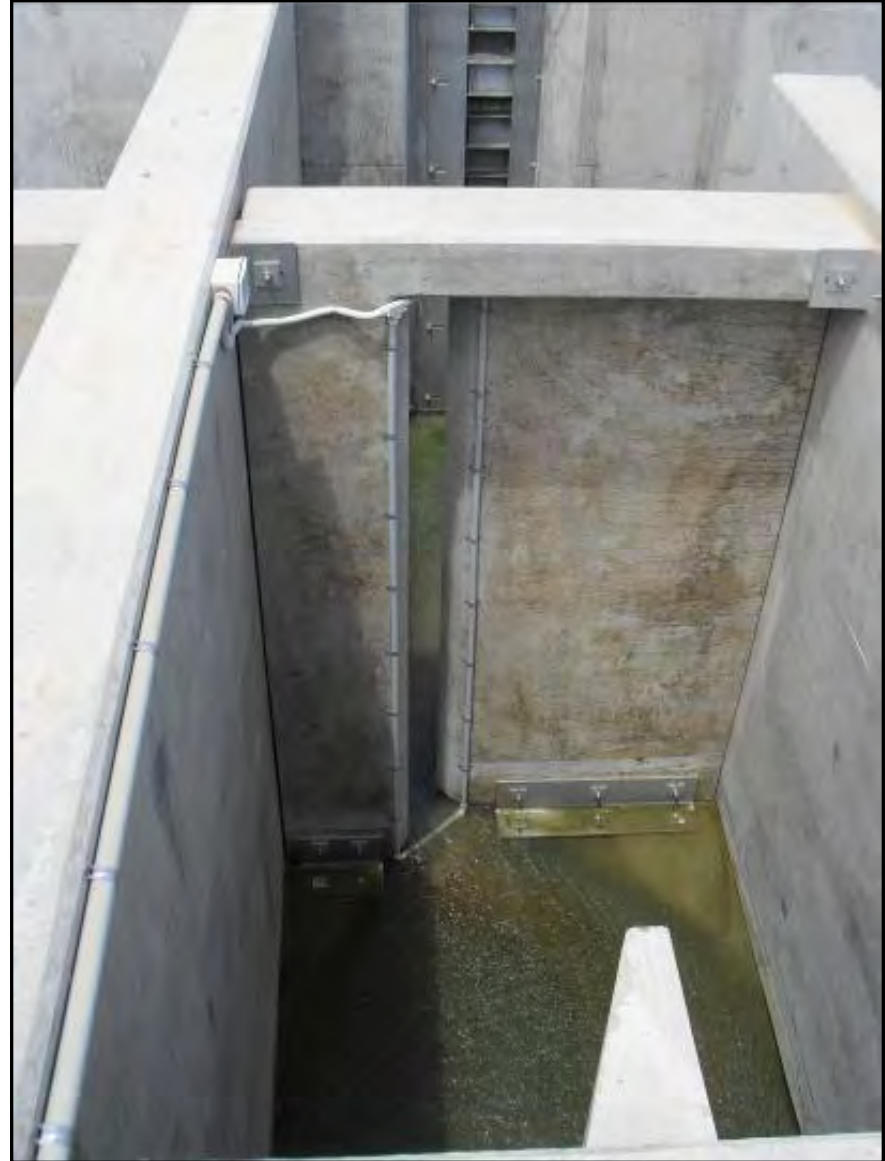
Weir

flow





# PIT technology: antenna



# PIT technology: reader system



# PIT technology: database

The screenshot shows a web browser window titled "Fishways Monitoring SystemHome - Microsoft Internet Explorer". The address bar contains the URL: <http://fishtrack.dse.vic.gov.au/fishways-web/pages/login.xhtml?sessionId=D41905483D00CC75CDC73D3A4A726D5B>. The page features the "fishways monitoring system" logo, the Australian Government crest, and the Murray-Darling Basin Authority logo. A navigation menu includes "Home", "Search", "Ascents/Descents of Fishways", "Times Between Fishways", "Multi-Lock Journeys", "Fish History", and "Unprocessed Fish". The main content area displays a "Welcome to the Fishways Monitoring System" message and a search box with the following results:

- [Search Ascents/Descents of Fishways](#)
- [Stream Journey Times](#)
- [Search Multi-Lock Journeys](#)
- [Search Individual Fish History](#)
- [List of Unprocessed Fish](#)

At the bottom of the page, there is a copyright notice: "© Copyright Rubicon Systems Australia Pty Ltd". The Windows taskbar at the bottom shows the Start button, several application icons, and the system tray with the time 2:52 PM.

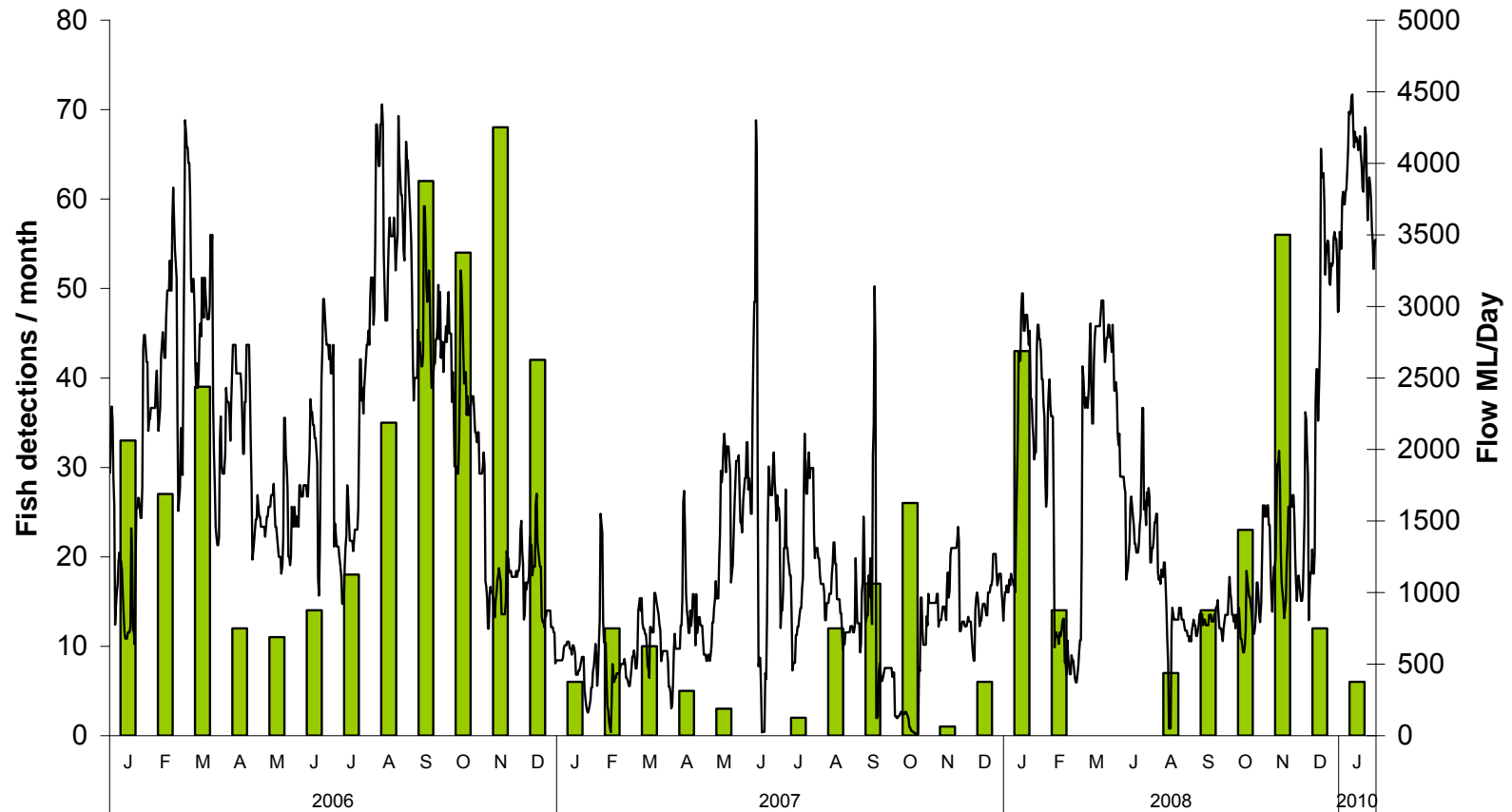
# PIT tagged fishes

Common Name	L1	L2	L3	L5	L6	L7	L8	L9	L10	L11	L26	Mull Creek	French Creek	Darl River	Rufus River	Total
<i>Native Fish</i>																
Golden perch	1,030	329	350	101	95	1,703	2,187	921	1,016	46	11	43	14	13	195	8,054
Murray cod	60	11	5	2	4	144	277	8	21	5	9	9	0	2	21	578
Silver Perch	69	88	80	20	6	40	89	29	19	12	0	3	0	0	10	465
Bony herring	20	1	20	0	1	13	39	22	41	1	0	0	1	7	2	168
Freshwater catfish	4	2	2	5	3	0	1	0	0	0	0	0	0	0	0	17
																0
<i>Alien Fish</i>																
																0
Carp	3,380	1,339	1,073	232	192	703	1,147	417	306	41	1	14	50	15	132	9,042
Goldfish	12	3	2	0	0	1	17	1	6	5	0	0	3	0	3	53
Redfin perch	9	8	1	0	0	0	10	2	0	0	0	0	0	0	4	34
																0
<b>Grand Total</b>	4,584	1,781	1,533	360	301	2,604	3,767	1,400	1,409	110	21	69	68	37	367	18,411

# General Data outputs

1. Fish movement in relation to flow;
2. Investigations of distance travelled;
3. Multi-lock journeys;
4. Site specific movement;
5. Movements of individual fish;
6. Directionality (upstream or downstream); and
7. Migratory demographics (i.e. species, sizes, seasons, etc).

# Example: Cues for migration



Fish movement in relation to flow presented for all fish species detections at Lock 9 since the fishway came online in 2006.

## 4. Fish community: Lock 1–3 Model

... to demonstrate that active fishways reduce accumulations of fish downstream of barriers and contribute to positive changes in fish community.



## 4. Fish community: Lock 1–3 Model

- 4 sites; below Locks 1, 2, 3 and control
- Monthly electrofishing (18 x 90 sec) between Sep and Feb since 2003 (30 trips in total).
- Randomised sampling strategy among sites & sampling period (daylight/night).





# Electrofishing results (All pooled)

Common name	Lock 1: 0km	Lock 1: 5km	Lock 2: 0km	Lock 3: 0km	Total
<i>Native</i>					
Australian smelt	5,517	5,240	2,285	2129	15,171
Bony herring	43,341	13,742	18,911	12,804	88,798
Silver perch	100	5	188	161	454
Short-headed lamprey	7	0	0	0	7
Flat-headed gudgeon	817	94	413	228	1,552
Golden perch	1,042	894	703	491	3,130
Murray cod	8	63	14	7	92
Rainbowfish	170	47	194	200	611
Un-specked hardyhead	2,021	758	1,734	768	5,281
Carp gudgeon	591	66	267	394	1,318
Freshwater catfish	1	0	4	0	5
Sandy sprat	1	0	0	0	1
<i>Alien</i>					
Eastern gambusia	9	1	7	14	31
Carp	33,008	4,350	7,293	3,226	47,877
Redfin perch	275	106	130	65	576
Goldfish	589	257	842	725	2,413
<b>Grand Total</b>	87,497	25,623	32,985	21,212	<b>167,317</b>

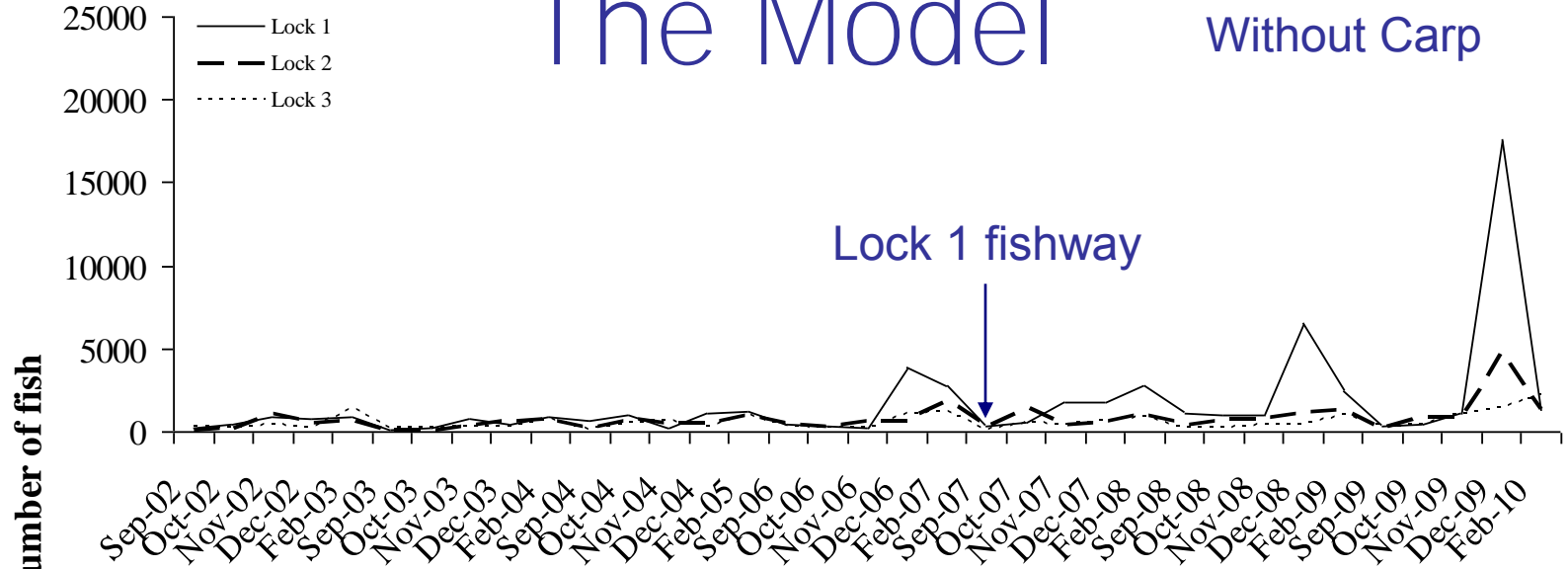
# Electrofishing results (2009/10)

Common name	Lock 1: 0km	Lock 1: 5km	Lock 2: 0km	Lock 3: 0km	Total
<i>Native</i>					
Australian smelt	608	604	310	344	1,866
Bony herring	19,279	2,312	6,989	4,672	33,252
Silver perch	12	2	55	47	116
Flat-headed gudgeon	231	50	180	74	535
Golden perch	189	95	164	114	562
Murray cod	0	6	3	2	11
Rainbowfish	2	9	12	19	42
Un-specked hardyhead	178	52	301	188	719
Carp gudgeon	113	17	58	53	241
Freshwater catfish	0	0	4	0	4
<i>Alien</i>					
Eastern gambusia	0	0	1	3	4
Carp	11,910	1,127	1,941	555	15,533
Redfin perch	13	2	1	5	21
Goldfish	61	34	53	105	253
<b>Grand Total</b>	32,596	4,310	10,072	6,181	<b>53,159</b>

# The Model

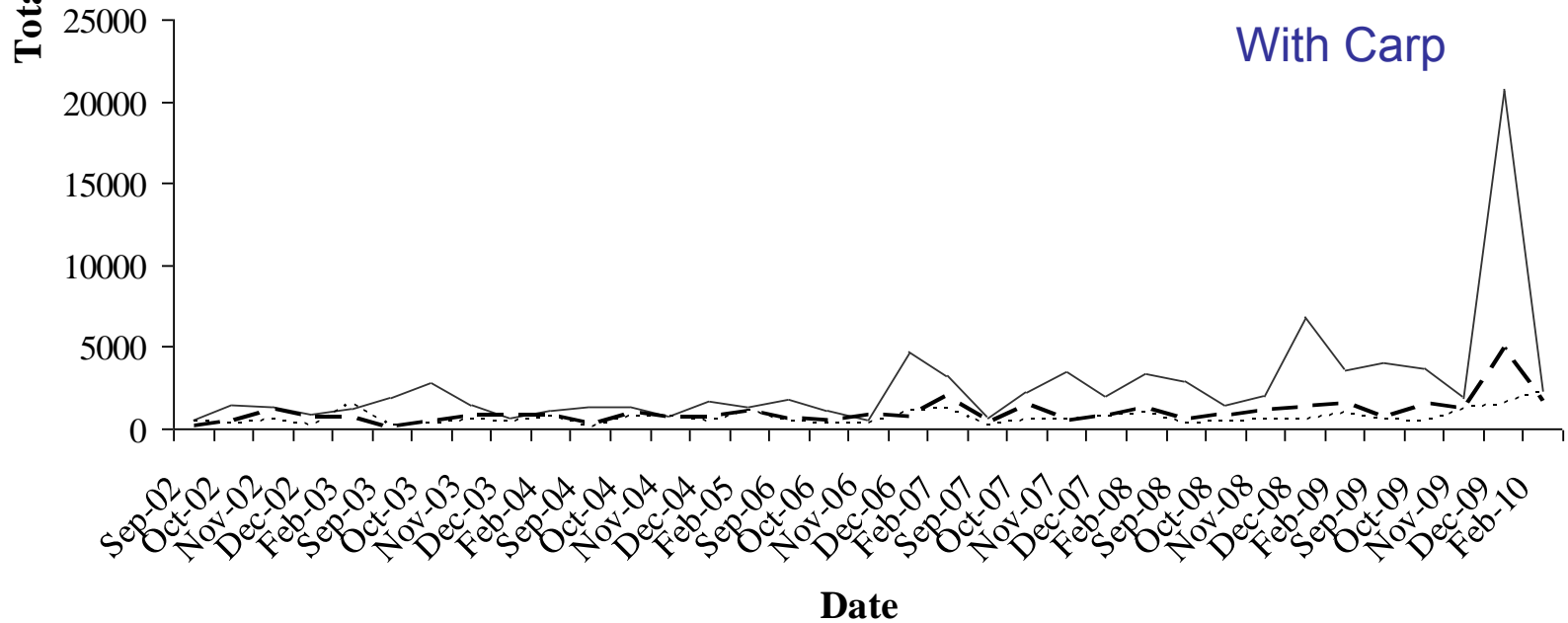
Without Carp

a)



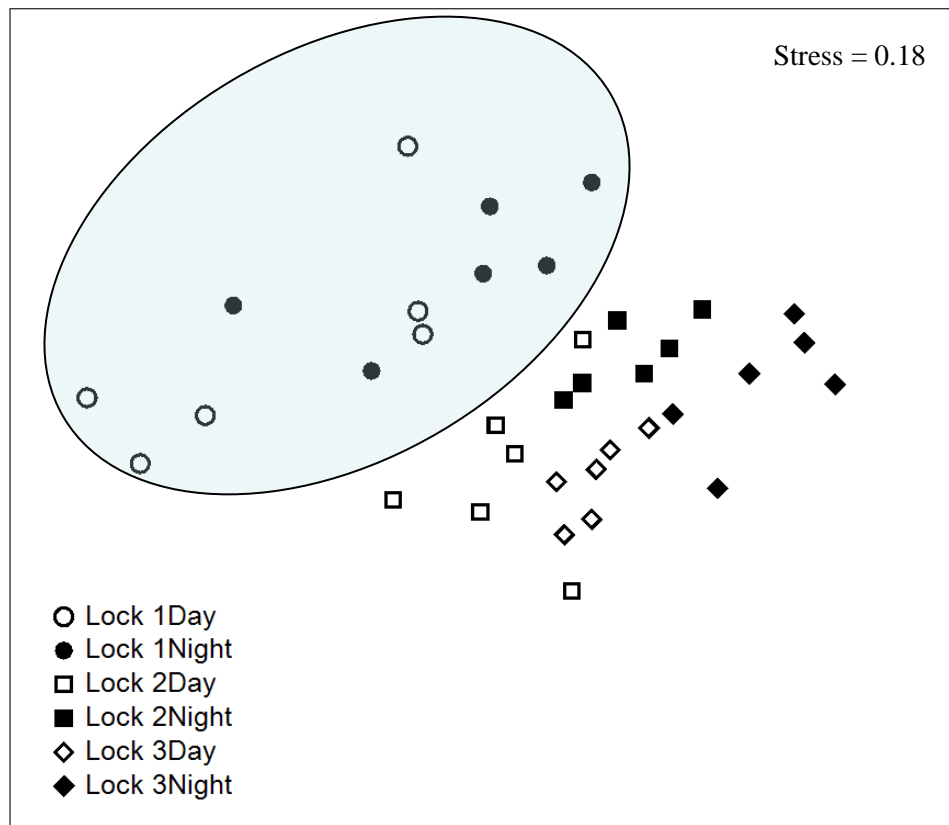
b)

With Carp



# Two-way analysis of similarity ANOSIM

...continues to statistically confirm these differences ( $R = 0.559$ ,  $p < 0.001$ ).



## **Diel Changes**

### Daylight:

More Golden perch  
& smelt.

### Night:

More bony herring  
& carp.

# 5. Summary

- New combined fishway/-lock approach yet to be assessed.
- Long-term PIT monitoring system provides important information on fish movements.
- Lock 1-3 community sampling reveals seasonal & spatial differences, and continues to fit accumulation model.
- Project provides a basis for river & habitat management.

## 6. Continued in 2010/11

- Continue PIT and Acoustic Telemetry studies
- Vslot fishway/fishlock assessments at Locks 3, 4, 5, 6, and 11
- Lock 1-3 sampling (model)
- PIT system maintenance & installation at new fishways
- PIT population maintenance
- Automated Measuring Boards
- Weir staff training

# Acknowledgments

- MDBA; TLM; NFS
- **Technical assistance:** M. Bettanin, C. Bice, F. Cory, G. Hackett, J. Hutchieson, P. Jennings, I. Magraith, J. McKenzie, J. McPherson, A. Pickworth
- All Lock staff
- SA Water