River Blackfish in Rodwell Creek, 2012-13 update

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June 2013

Report to the Goolwa to Wellington LAP and South Australian Murray-Darling Basin NRM Board

Citation

Whiterod, N, & Hammer, M (2013) River Blackfish in Rodwell Creek, 2012-13 update. Report to the Goolwa to Wellington LAP and South Australian Murray-Darling Basin NRM Board. Aquasave Consultants, Adelaide. 15 p.

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Cover photos Changes in the condition of the main pool on Rodwell Creek between October 2012 (top) and March 2013 (bottom).

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1.0 Introduction

The River Blackfish (*Gadopsis marmoratus*) is a threatened nocturnal species endemic to south eastern Australia (Lintermans 2007). The species was once widespread across the Eastern Mount Lofty Ranges (EMLR) in South Australian section of the MDB, but has undergone significant (and continuing) decline in distribution and is now considered locally endangered (Lloyd and Walker 1986; Hammer *et al.* 2009). The species now persist as four distinct sub-populations in large spring-fed pools in separate catchments (Hammer 2004; Hammer *et al.* 2009). In the Bremer Catchment, the species survives in pools along a 500m section of Rodwell Creek, having been rediscovered in 2004 following over 50 years of no records (Hammer 2006; Hammer 2010).

This section of Rodwell Creek was historically perennial (due to refilling from ground water through springs), but catchment water abstraction has resulted in these pools now receiving only intermittent surface water flow. This is most apparent in dry years, and over the last five years there have been critical water shortages with receding water levels over summer and autumn seasonally threatening the remnant River Blackfish population. Indeed during summer and autumn of dry years (referred to as the 'critical period'), water levels drop to decrease habitat area and disconnect from emergent vegetation, and dissolved oxygen concentrations diminish considerably (Hammer 2010). Extreme drought over 2007 and 2008 led to severe water stress in the catchment and there were no seasonal surface water flows in the creek. The lack of flow resulted in declining water level and deteriorating water quality (e.g. increasing salinity, declining dissolved oxygen concentrations) and it was predicted that the creek section would dry completely toward the end of the 2007-08 critical period. Emergency invention was initiated as part of the Drought Action Plan for Lower Murray Freshwater Fish (DAP), a collaborative project between multiple agencies lead by the SA DENR (Hall *et al.* 2009; Hammer 2010).

Since autumn 2008 a variety of management interventions have occurred in an attempt to maintain suitable conditions for River Blackfish in the main pool (as well as other known pools), which was the last pool to dry in the creek section and has good structural integrity and shade from rock and cliffs :

- **Regular monitoring**: assess status of population and evaluate the condition of pools environmental (alarm and critical) thresholds to inform management,
- **Environmental water**: deliver water to maintain pool height and dilution of salinity and low dissolved oxygen,
- **Aeration**: oxygenate the main pool as watering alone was not sufficient to maintain dissolved oxygen above critical thresholds or combat dramatic impact of cumulative build up of organic matter, and
- **Fish transfer**: relocate fish to either captive holding facilities or surrogate locations as a safeguard in the medium-term survival of the species.

Long-term monitoring data indicates River Blackfish have been persisting at Rodwell Creek with steady low recruitment observed as the presence of successive 1+ fish cohorts most years

(Hammer 2009; Bice *et al.* 2010; Hammer 2010; Bice *et al.* 2011). The population is dynamic - restricted to pools that hold water (in 2007 and 2008 only the main pool) during dry years, but expanding throughout the section during wet years. In 2010, above average rainfall across the EMLR lead to increased flow and improved habitat condition and lead to significant recruitment and expansion in population size and distribution (to six pools) within Rodwell Creek (Hammer 2009; Hammer 2010). Yet, by the end of the 2011-2012 critical period it the species was present in only three of these pools (as other three had dried over summer) and these populations were dominated by mid- to large-sized individuals and only limited recruitment was evident (Whiterod and Hammer 2012). In 2011-12, a permanent water refuge location was established but regular monitoring is necessary to assess the status of this population evident (Whiterod and Hammer 2012).

At the beginning of the 2012-13 period there was little doubt that the management interventions remained necessary ensure the survival of this significant population of River Blackfish.

1.1 Project objectives

The 2012-13 project sort to assist the medium-term management of species by:

- assessing the status of River Blackfish in known pools,
- continuing active management of known pools, through regular water quality monitoring and the provision of environmental watering and aeration,
- range mapping by sampling additional downstream pools, and
- providing an updated status of the population in the creek.

The 2012-13 project was jointly funded by the Goolwa to Wellington LAP and the South Australian MDB NRM Board.

2.0 Methods

2.1 Study region

Rodwell Creek occurs within the Bremer catchment within the Eastern Mt Lofty Ranges (EMLR) (Figure 1). The creek is a small (5-10m wide), shallow (1-2m deep) stream, rising east of the Bugle Ranges and flowing in a south-easterly direction through a small catchment area to the Bremer River near Woodchester. The main land use in the catchment is livestock grazing, along with some horticulture, dairying and urban development. The creek is considered to be in poor condition with the input of high nutrient loads and fine sediments from adjacent agricultural land and the severely affected riparian zone (South Australian EPA 2008). The catchment (as part of EMLR region) experiences a Mediterranean type climate with mild to warm and dry summers and cool wet winters (Figure 2a); overall it has relatively high rainfall (e.g. average annual rainfall for nearby Mount Barker from1860-2012 is 763mm, Bureau of Meteorology, *unpublished data*).

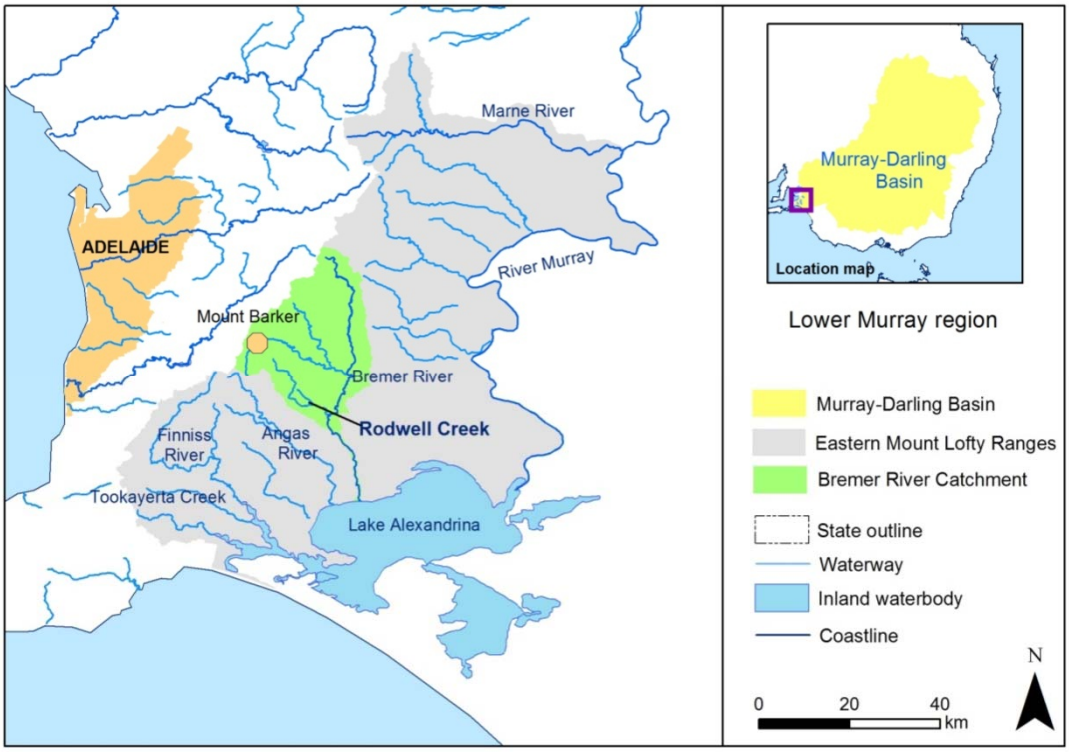

Figure 1 Location of Rodwell Creek in Eastern Mt Lofty Ranges.

Despite above average annual rainfall occurring in 2012, monthly rainfall was considerably below average from July 2012 to June 2013 (Bureau of Meteorology, *unpublished data*)(Figure 2b).

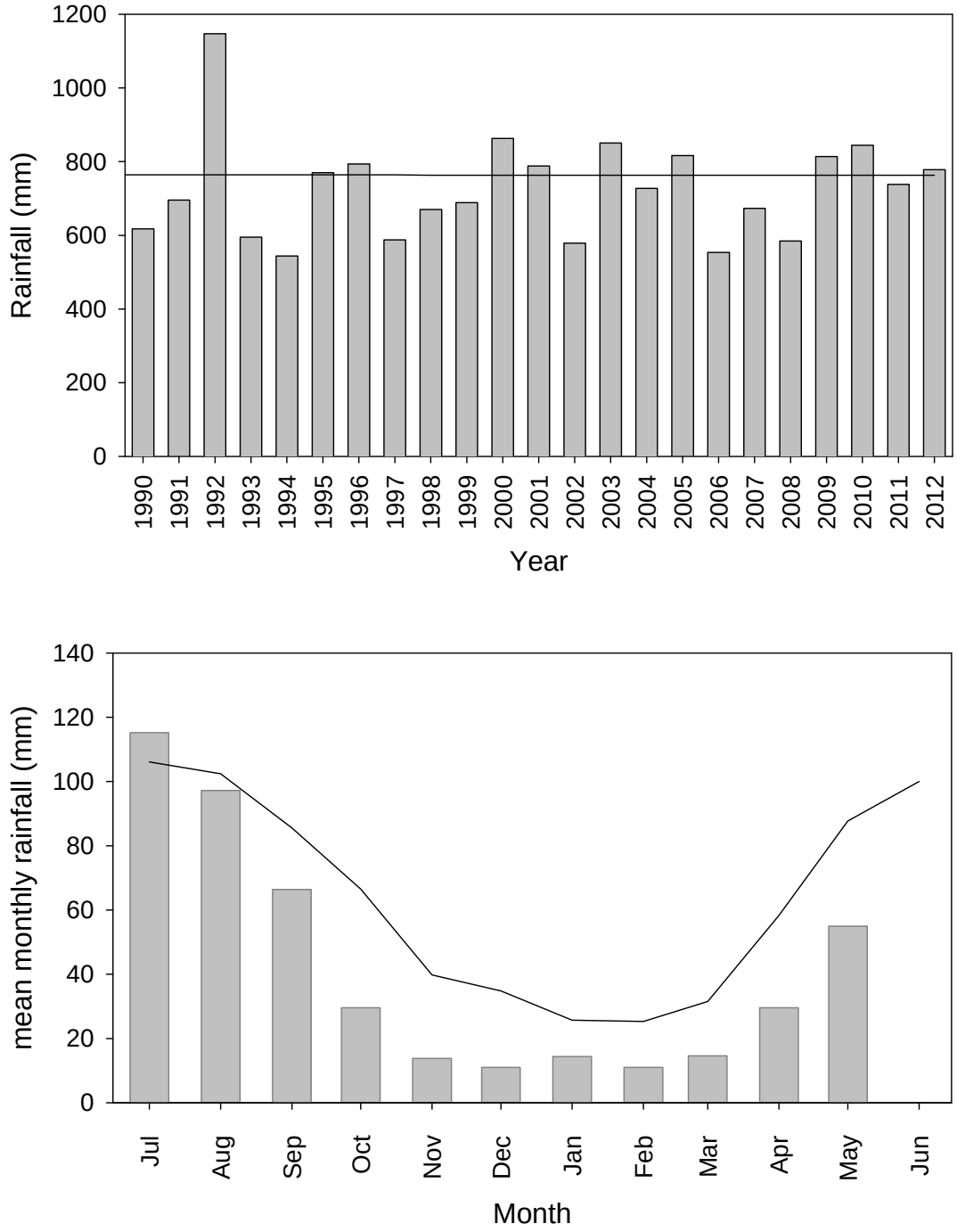

Figure 2 Representative rainfall data at Mount Barker (a) between 1990-2012 with long-term average, 1860-2012 (black line) and (b) from July 2012 to May 2013 (Bureau of Meterology, *unpublished data*).

2.2 Fish monitoring

Fish monitoring was conducted on several occasions between January and May 2013 under a *Section 115 permit* in accordance with the *Fisheries Management Act 2007* (PIRSA Fisheries No. 9902527). Monitoring of the six known pools occurred during January 2013 and the long-term sites (as part of EMLR annual condition monitoring) and additional pools were sampled in April-May 2013 as part of EMLR annual condition monitoring (Figure 3 and Table 1). Sampling was designed to determine if the species remains in known pools (presence), map distribution in additional habitats (population extent) and provide information on the demographic structure of

sampled populations. Specific sampling methods and effort matched prevailing environmental conditions at each site (see Appendix 2 for sampling effort). Sampling utilised the following:

- Large fyke net: single 6m wing, D shaped entrance (0.7m wide x 0.7m high), 3 compartments and 6mm half mesh.
- Small fyke net: single 3m wing, D entrance, 2 compartments and 4mm stretch mesh.
- Bait trap: rectangular 0.5m long x 0.25m square, 60mm entrance and 1mm mesh.

All sampled fish were identified to species, counted and observed to obtain general biological information (size range, reproductive condition and external disease or parasites). Length-frequency information (as Total Length, TL) was gathered for River Blackfish. Records of other fauna sampled opportunistically were maintained. At each sampled site, environmental descriptors, covering differing aspects of underwater cover, edge vegetation, pool condition, flow and water quality (see full details in Appendix 1), were recorded to aid the interpretation of results and assist with broader stream condition assessment.

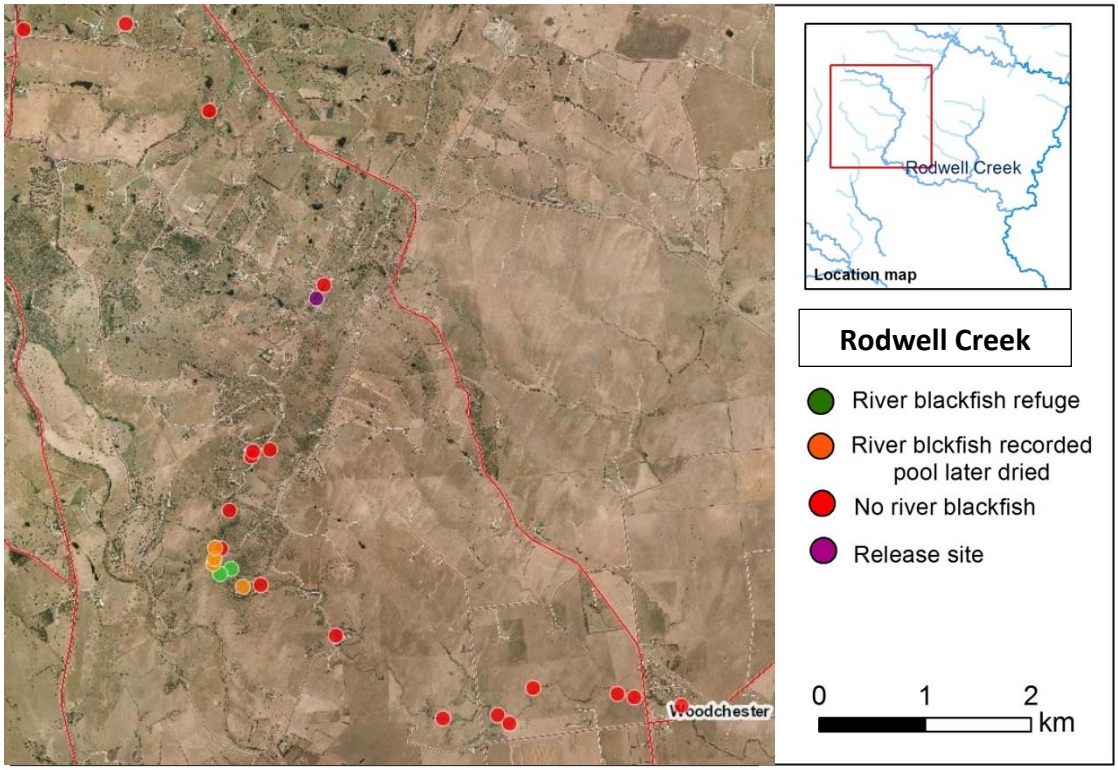

Figure 3 Fish monitoring sites on Rodwell Creek, location permanent refuge pools (green), pools known to dry annually (brown), the 2012 release dam (purple) and sites were River blackfish have not been recorded (red) as of autumn 2013.

Table 1 Summary of fish monitoring sites on Rodwell Creek in 2013.

Sampling focus	Site Code	Date	Waterway	Location	Easting	Northing
Pool monitoring	ML13-01	10-Jan-13	Rodwell Creek	Pool 1 (house pool)	310137	6103954
Pool monitoring	ML13-02	10-Jan-13	Rodwell Creek	Pool 2 (main pool)	310003	6104156
Pool monitoring	ML13-03	10-Jan-13	Rodwell Creek	Pool 3	309881	6104103
Pool monitoring	ML13-04	10-Jan-13	Rodwell Creek	Pool 4	309820	6104394
Pool monitoring	ML13-61	29-Apr-13	Rodwell Creek	Highland Valley (a)	310006	6104154
Pool monitoring	ML13-62	29-Apr-13	Rodwell Creek	Pool 2 (main pool)	310340	6103956
Pool monitoring	ML13-63	29-Apr-13	Rodwell Creek	Fitton property	310930	6107265
Range mapping	ML13-64	30-Apr-13	Rodwell Creek	Burgess property	312404	6102463
Range mapping	ML13-65	30-Apr-13	Rodwell Creek	Schofield 1	313030	6102499
Range mapping	ML13-66	30-Apr-13	Rodwell Creek	Schofield 2	313430	6102808
Range mapping	ML13-67	30-Apr-13	Rodwell Creek	Schofield 3	314383	6102744
Range mapping	ML13-68	30-Apr-13	Rodwell Creek	Schofield 4	314580	6102704
Range mapping	ML13-69	01-May-13	Rodwell Creek	Marsh property	313162	6102401
Range mapping	ML13-70	01-May-13	Rodwell Creek	The Lagoon	315111	6102606

2.3 Condition monitoring & management of pools

The condition of the six known River Blackfish pools was monitored from 17 September 2012 to 29 May 2013. Monitoring predominately focused on the main pool (16 trips) with regular checking of the remaining five pools. Monitoring of the main pool involved measurement of select environmental descriptors - water level (using existing depth stake), water quality (EC, pH, temperature, dissolved oxygen) and an assessment of aquatic habitat (see Appendix 1). The condition of pools was evaluated against ***alarm*** and ***critical*** thresholds linked to the tolerances of the species (Hall *et al.* 2009; Hammer 2010):

- **Water level** - above alarm (1.5m) and critical (1m) thresholds to maintain sufficient aquatic cover and buffer against high air temperatures.
- **Temperature** - below alarm (20°C) and critical (24°C) thresholds to limit direct (survival) and indirect (dissolved oxygen concentrations) impacts to species.
- **Salinity** - below alarm (5000µScm^{-1}) and critical (7500µScm^{-1}) thresholds to limit direct (survival) and indirect (sub-lethal growth and conditioning or stress) impacts to species.
- **Dissolved oxygen** - above alarm (4 mgL^{-1}) and critical (2 mgL^{-1}) thresholds to limit direct (survival) and indirect (sub-lethal growth and conditioning or stress) impacts to species.

Management invention of the main pool was initiated when prevailing conditions reached alarm thresholds and involved aeration and environmental watering using pre-existing infrastructure (Hammer 2010). Environmental water is gravity fed from two rainwater tanks (total volume 30000L) via a spray bar at the top of the pool to reduce velocity and increase aeration. A water tanker delivers bore water with suitable water chemistry (low salinity, sulphides, and trace metals) to the rainwater tanks via a commercial supply. An aeration system was developed via a commercial pond aerator (Pond One 12000, 6600L hour^{-1}) located at the property residence and piped to the pool some 400m through 12mm poly pipe carefully trenched and configured to avoid damage during property maintenance and by natural means. Delivery to the pond was to three large airstones at 0.5m depth tide to star pickets.

3.0 Results

3.1 Fish monitoring

Status of populations in known pools

In January 2013, low numbers of River Blackfish were present in three of the known pools (Table 2). Fish monitoring in April 2013 indicated that the species remained present in the main pool and also that the species has persisted in the upstream refuge location (Fitton property). Insufficient individuals were sampled to investigate the population structure in these pools.

Table 2. Catch summary of fish species recorded during pool monitoring in Rodwell Creek. Alien species in red.

Site Code	Date	Location	Carp gudgeons	Gambusia	River Blackfish	Yabby	Freshwater shrimp	Freshwater prawn
ML13-01	10-Jan-13	Pool 1 (house pool)	3	123		x		
ML13-02	10-Jan-13	Pool 2 (main pool)	3		4	x		
ML13-03	10-Jan-13	Pool 3	17		1	x		x
ML13-04	10-Jan-13	Pool 4	2		1	x		
ML13-61	29-Apr-13	Pool 2 (main pool)	1		1	x	x	
ML13-62	29-Apr-13	Highland Valley (b)		21		x		
ML13-63	29-Apr-13	Fitton property		5680	3	x	x	x

Range mapping

A total of seven additional pools – located downstream of the known pools - were sampled as part of range mapping during April-May 2013 (Table 3). River blackfish were not detected in any of these locations. Carp Gudgeon were recorded in moderate numbers across the majority of the sites and Gambusia numbers were high in two of the pools.

Table 3. Catch summary of fish species recorded during range mapping in Rodwell (in downstream to upstream order). Alien species in red.

Site Code	Date	Location	Carp gudgeons	Congolli	Flathead gudgeon	Gambusia	River Blackfish	Yabby	Freshwater shrimp	Freshwater prawn
ML13-64	30-Apr-13	Burgess property	119		1	4				
ML13-65	30-Apr-13	Schofield 1	350			6		x	x	
ML13-66	30-Apr-13	Schofield 2	146	1		700		x	x	
ML13-67	30-Apr-13	Schofield 3				17		x	x	
ML13-68	30-Apr-13	Schofield 4			2	200				
ML13-69	01-May-13	Marsh property	429	1				x	x	
ML13-70	01-May-13	The Lagoon	18					x		

Encouragingly, two threatened congolli (listed as vulnerable in SA action plan) was recorded at two of the sites. This species is diadromous with females migrating downstream from freshwater environments (such as Rodwell Creek) to spawn in estuarine and marine environments before juveniles migrating back upstream. The sampled congolli must have migrated upstream from the Murray estuary and Lower Lakes through the Bremer River to reach the lower Rodwell Creek (as juveniles). Their size (187-235mm total length, corresponding to 2-3 years old) indicates they were mature females that undertook upstream migration during unimpeded connectivity created by the 2010-11 high flows in the region. As these fish are mature individuals they now need similar levels of connectivity to migrate downstream to spawn. Clearly, maintenance of regular connectivity for diadromous species through the lower Rodwell Creek and the Bremer River is an important management consideration.

River Blackfish (top) and Congolli (bottom) sampled from Rodwell Creek

3.2 Condition monitoring & management of pools

The 2012-13 critical period in Rodwell Creek was preceded by slightly above average rainfall (Jan-Jun 2012) that contributed to moderate but short, winter flows in June 2012 (Figure 4). Consistent with previous years, the creek ceased to flow in October and water levels (1.74m) receded rapidly to 21 January 2012 (1m deep) but unlike 2011-12 suitable dissolved oxygen (7.1 mgL^{-1}) and EC (4.7 $mScm^{-1}$) were maintained – in fact dissolved oxygen and EC generally remained outside the alarm threshold range for the entire critical period (Figure 5). However, as the critical pool depth threshold was triggered emergency watering (30,000L) was initiated. In response to a subsequent drop in water level and in anticipation of the impacts of period of high air temperatures, emergency watering (30,000L) was repeated on 12 March 2013 (Figure 6), which helped to stabilise water level (>1m), improved dissolved oxygen (>7mgL^{-1}) and freshening the main pool (down 2.8 $mScm^{-1}$). The pool depth and water quality remained suitable until the end of the critical period.

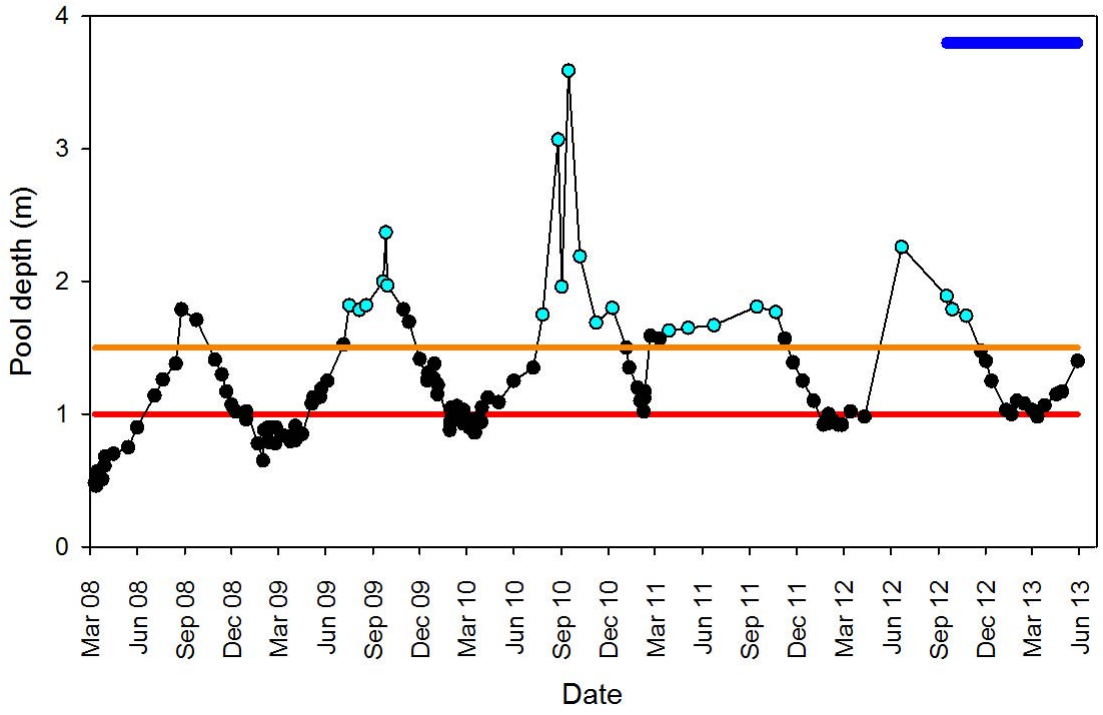

Figure 4 Pool depth at Rodwell Creek since autumn 2008 with 2012-13 sampling period (blue bar) and periods of creek flow (light blue dots).

In contrast to the main pool, the condition of the unmanaged pools (1, 3, 4, 5, 6) continued to decline over the critical period and by April 2012 conditions in pools 1, 4, 5, and 6 had collapsed. By the end of May 2013, cooler weather and periods of high rainfall, had acted to main pool depth to 1.4m and it is anticipated that the creek will begin flowing shortly.

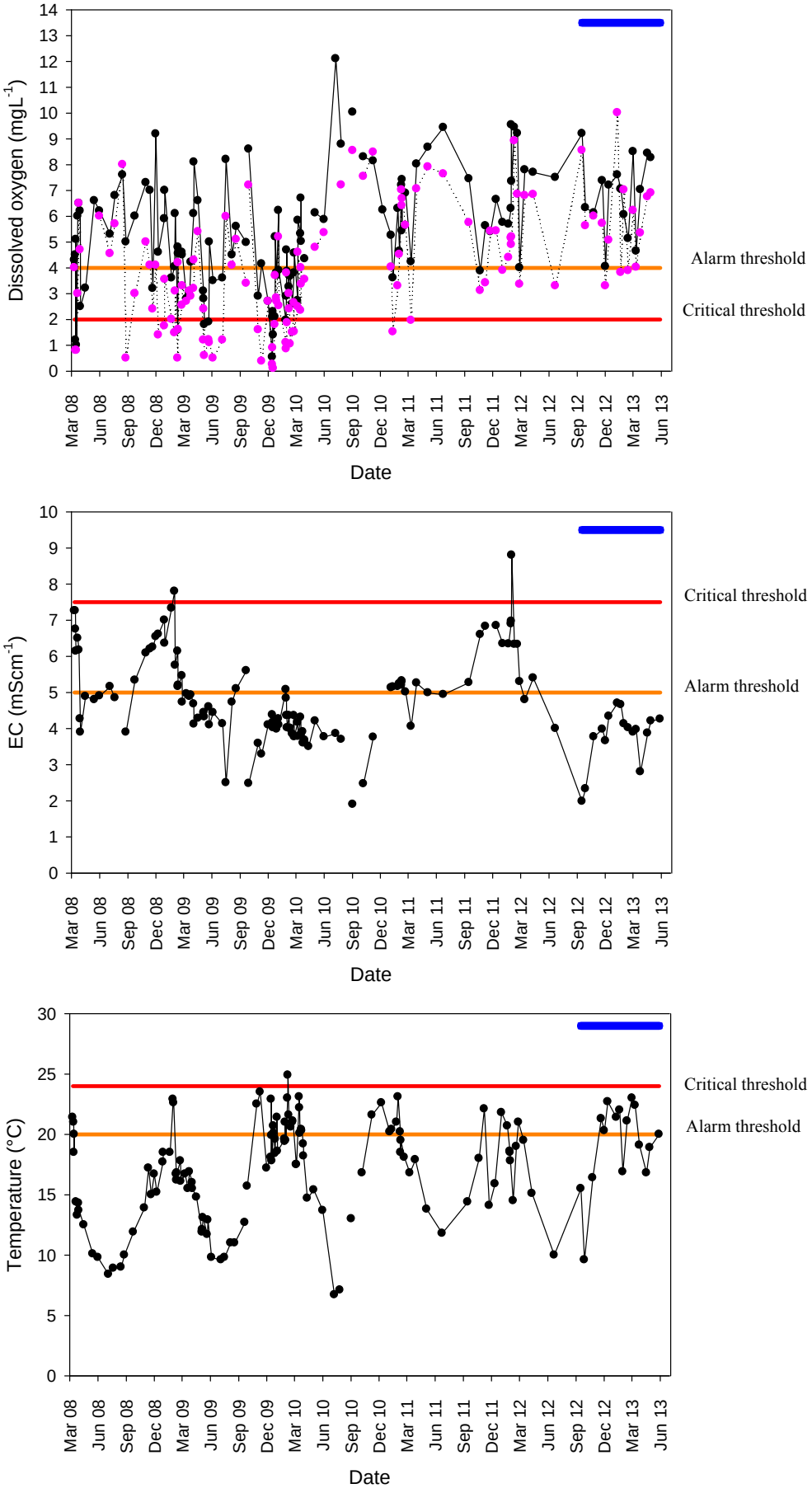

Figure 5 Dissolved oxgyen (top), EC (middle) and temperature (bottom) at Rodwell Creek since autumn 2008 with 2012-13 sampling period (blue bar) and alarm (red line) and critical (orange line) thresholds shown.

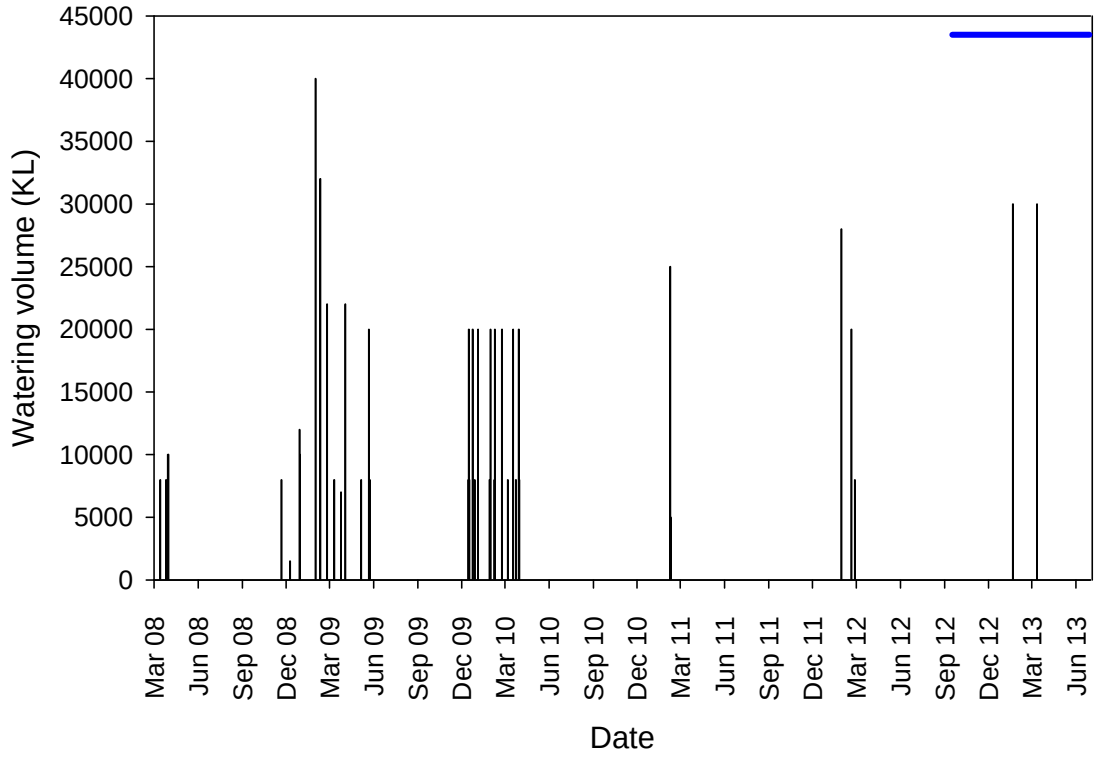

Figure 6 Environmental watering history at Rodwell Creek since autumn 2008 with 2012-13 sampling period (blue bar).

4.0 Discussion

Wide ranging management interventions are increasingly required to prevent the extirpation of freshwater ecological assets. The remnant River Blackfish population in Rodwell Creek represents a significant ecological asset in the EMLR and, more broadly, South Australia. Critical water shortages (2007-2010) would have undoubtedly lead to the loss of this population without management intervention (that has occurred since 2008). This management has been intensive with regular monitoring, environmental watering, aeration and fish transfer, and allow the ongoing persistent of River Blackfish in Rodwell Creek. A comprehensive project helped to maintain known populations and also establish a refuge locations to safeguard the medium-term survival of the species (Whiterod and Hammer 2012). In the present project focusing on the 2012-13 critical period ensured the ongoing survival of the species in three of the known pools and a recently established refuge location. The species is undoubtedly confined to this stretch of the creek as extensive monitoring has failed to detect the species in any other locations. Whilst the species persists, the observed extent of occurrence and population demographics coupled with a limited dispersal ability highlight the vulnerability of the species. Ongoing annual management is now essential to maintain River Blackfish in Rodwell Creek (see Table 3).

Table 3. Annual monitoring framework for Rodwell Creek.

Monitoring objectives (with indicator)	**Method**	**Objective**
Habitat condition (habitat)	Fortnightly (up to weekly if conditions deteriorate) monitoring of aquatic habitat, water quality and pool depth	Assess conditions against alarm and critical thresholds (with provision for management intervention)
Determining that a species remains (presence)	Annual fish survey of known pools (present - pools 2, 3, 6, refuge location). Additionally, any opportunistic sampling as part of over projects	Confirm that the species remains
Snapshot of demographic structure) for (a) assessing presence of recruits and (b) assessing longer-term survivorship through presence of older size classes (recruitment)	Length-frequency measurements (including annual survey) during spring (as part of annual survey) and autumn	Assess temporal trends in population status (e.g. recruitment, only older individuals)

Table 3 details the minimum annual monitoring requirements to provide the information necessary to manage the species. It is important to understand the extent and structure of known populations prior to the critical period each year, which should be achieved through fish surveying in spring. As the critical period approaches, regular monitoring is necessary to assess the condition of known pools (particularly the main pool) to allow management intervention to occur should conditions deteriorate. A newly installed flow gauge will hopefully provide real-time data of water level in the main pool to assist with regular monitoring. In autumn, further fish surveying should occur to confirm that the species still occurs at known pools. Ultimately, management attention should turn to the enhancement of the population through the provision of environmental water requirements as part of broader catchment-wide management.

5.0 Acknowledgements

We thank the various funding bodies for assisting with the project and we thank Sherie Bain, Kate Mason and Liz Schofield. Valuable field assistance was provided by Craig Kemp, Liz Schofield and Sherie Bain. Ongoing thanks to Beryl and Jim Belford for access and support, landholders for access during additional pool monitoring and John Jansen for water tanker delivery.

6.0 References

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