ACT Government

2020 Monitoring of Two-spined Blackfish (*Gadopsis bispinosus*) in relation to Environmental Flows

Matthew Beitzel,
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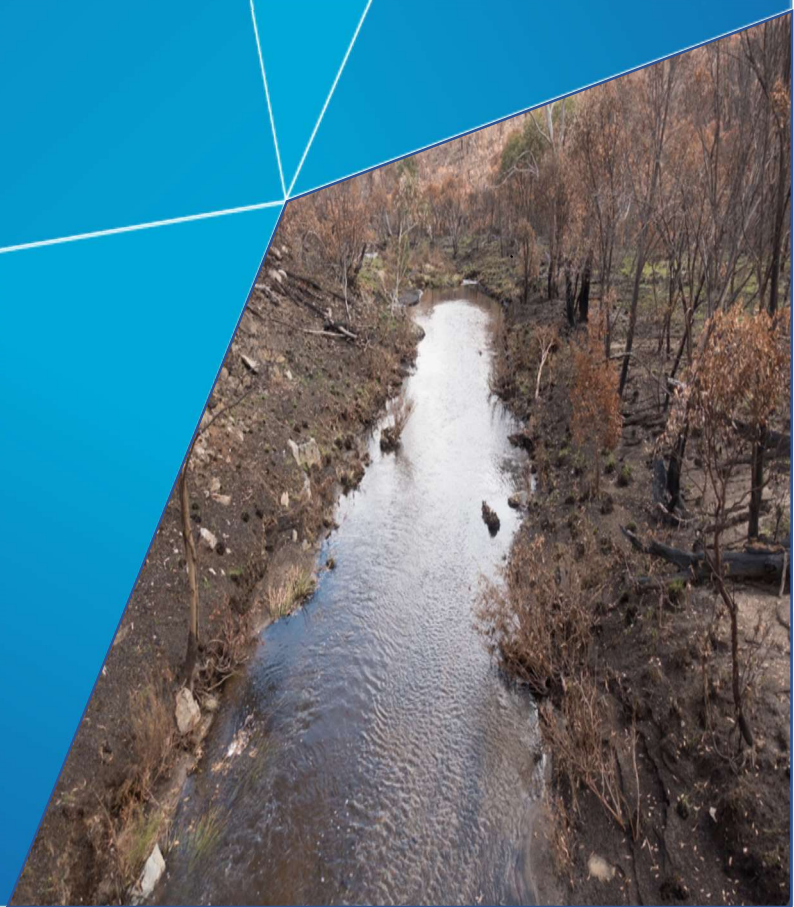
Conservation Research Report to Icon Water



Report prepared for:

Icon Water

We acknowledge the Ngunnawal people, Traditional Custodians of land upon which this project was undertaken.

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Ethics approval:

Ethics approval for this project was granted through the University of Canberra Ethics Committee for the project title 'Survey and monitoring of fish populations in the Canberra region' CEAE06-18. Researchers on this project also have individual approval.

Why is it done?

Under Icon Water's Licence to Take Water WU67, issued under the Water Resources ACT 2007, Icon Water is required to develop an Environmental Monitoring Plan (EMP) which includes assessing the effectiveness of the provision of environmental flows. The Cotter River system is provided with environmental flows from Corin, Bendora and Cotter Dams to ensure the sustainability of the aquatic ecosystem and support populations of listed threatened fish species Macquarie Perch (*Macquaria australasica*), Two-spined Blackfish (*Gadopsis bispinosus*) and Trout Cod (*Maccullochella macquariensis*) (ACT Nature Conservation Act 2014 (hereafter NC Act)).

This report focusses on the monitoring of Two-spined Blackfish in the Cotter River above Cotter reservoir in 2020. Two-spined Blackfish (hereafter Blackfish) are listed as vulnerable under the NC Act and are restricted in the ACT to the Cotter River. They require areas with abundant instream cover, especially cobble and boulders with interstitial spaces (**Error! Reference source not found.**)(Koehn 1990; Sanger 1990; Lintermans 2000). These spaces provide protection from predators and are also vital for nesting sites (O'Connor & Zampatti 2006). The species is a seasonal breeder with females above two years of age depositing 80 to 420 eggs from November, dependent upon water temperature (Lintermans 1998). Threats to this species include smothering of eggs and spawning sites by sediment, predation and competition pressures from alien species such as Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*), and cold water pollution (ACT Government 2007, 2018). Flow alteration, fire and drought are also key threats to this species. Appropriate delivery of environmental flows can help to mitigate or manage many of these threats, such as sedimentation, cold water pollution and drought in areas where the natural hydrograph has been altered by water abstraction or dams. This report will examine the status of the Blackfish population in the Cotter River above Cotter reservoir in relation to the provision of environmental flows.

The EMP associated with Licence WU67 specifies the ecological objectives and indicators to maintain populations of Blackfish in three reaches of the Cotter River, and Bendora Dam. The reaches for this project are:

- Bendora to Cotter reach which receives environmental flow from Bendora Reservoir;
- Corin to Bendora reach which receives environmental flow from Corin Reservoir;
- Above Corin is an unregulated reach which has no alteration to the natural hydrograph; and
- Bendora Reservoir which receives and provides water for both environmental flow and extraction.

In the reaches that receive environmental flows, the indicators are:

- Blackfish less than 120 mm total length (YOY and 1+ aged fish) comprise >30 % of the catch in a reach; and
- Greater than 60% of the survey shots in a reach record more than 2 Blackfish per 30 m transect of backpack electrofishing in at least one year over the last two years (As Icon Water only fund surveys every second year this metric utilises ACT government survey in intervening years, where available).

In Bendora Reservoir the indicator is:

- Two or more post-juvenile Blackfish per fyke net-night.

These indicators have been developed from the review of the environmental flow guidelines for the ACT to conserve a sustainable population over a large proportion of their existing distribution. They have also been adopted into the Draft ACT Conservation Effectiveness Monitoring Plan for Aquatic and Riparian Ecosystems(Malam et al. 2020).

It should be noted that this survey has been undertaken following the severe drought through 2019 and 2020 Orroral Valley Fire, which burnt the catchment above Corin reservoir and had some impact in the catchment below Corin (see

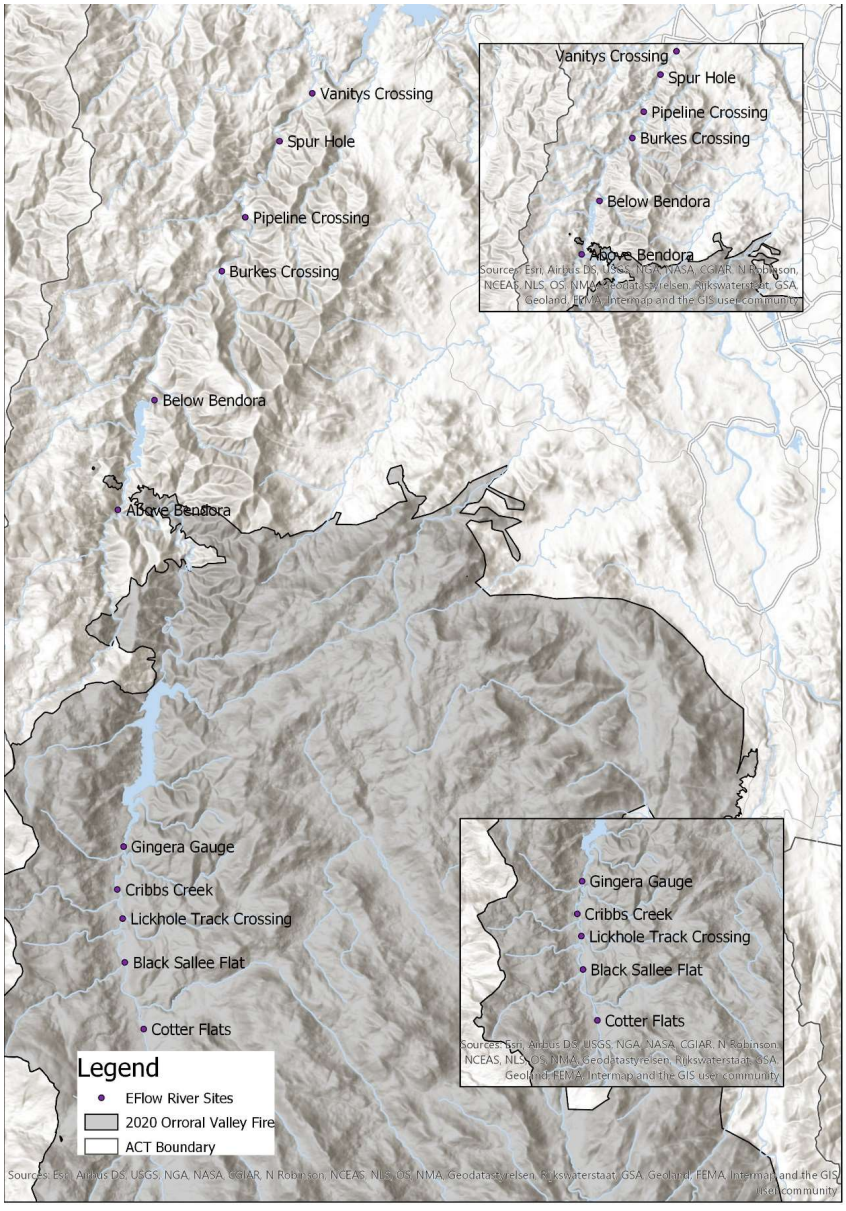

Figure 1).

What was done?

In 2020, 11 river sites and one reservoir site were surveyed once, between late February 2020 early April 2020 (Table 1 and

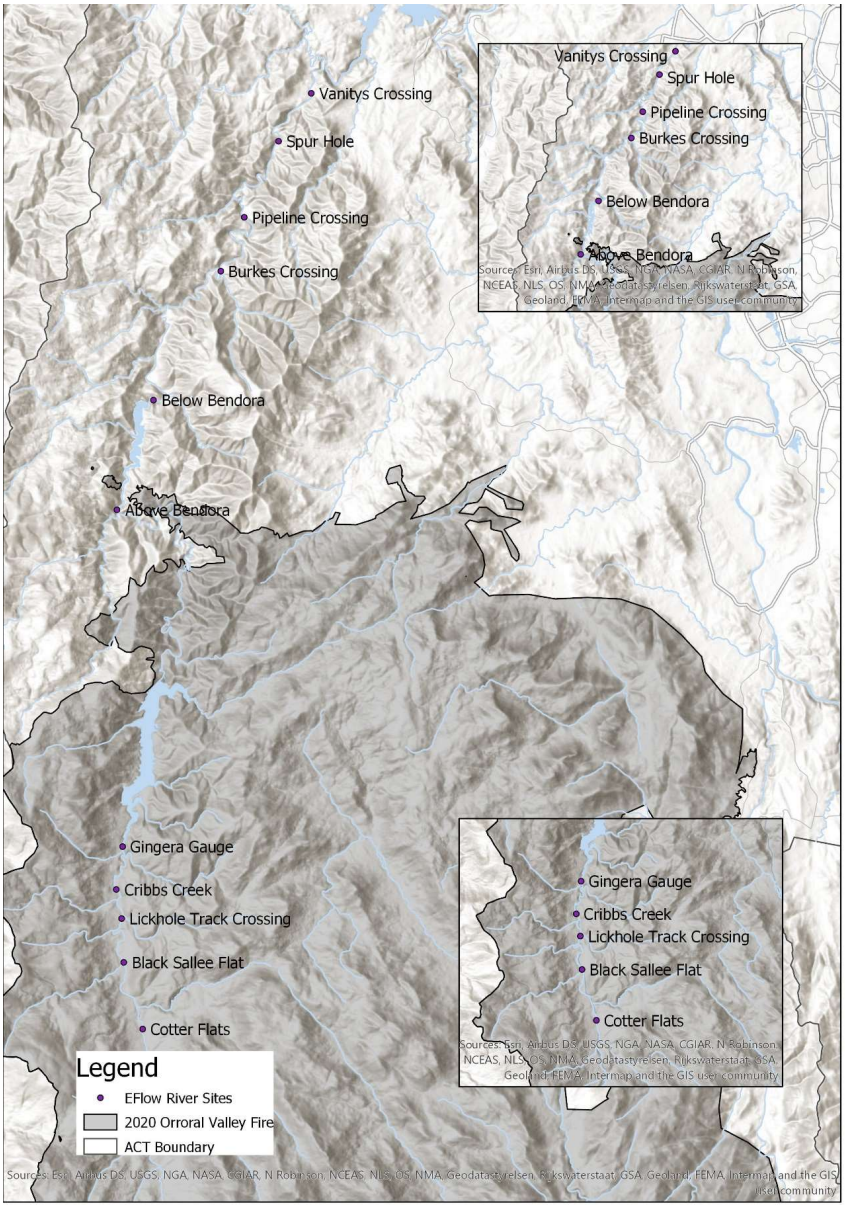

Figure 1). This was immediately after the 2020 Orroral Valley Fire. Five sites are located above Corin, in the unregulated reach and five in the Bendora to Cotter environmental flows reach. Only one site is surveyed in the Corin to Bendora environmental flows reach, and the only reservoir on the Cotter River that is sampled is Bendora Reservoir.

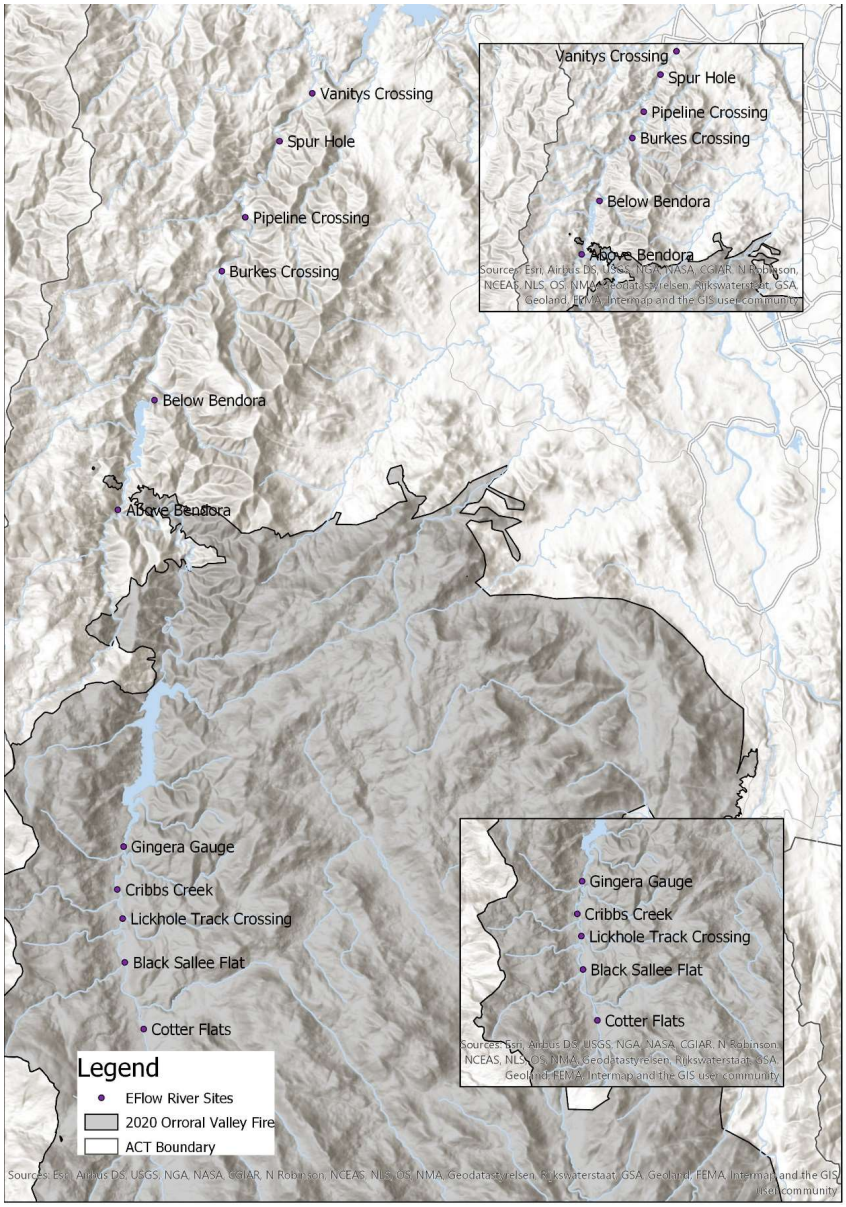

Figure 1. Survey sites for the 2020 Eflows Survey and the area burnt by the 2020 Orroral Valley Fire (dark grey).

At each river site, five 30 m backpack electrofishing shots were undertaken (Beitzel et al. 2016; Hale & Treadwell 2017). In Bendora reservoir, 10 single wing fyke nets (constructed of 5 mm stretched mesh) were set overnight for Blackfish. Each net is set from the bank with a 150 mm float in the cod end of the net to prevent mortalities in bycatch of air-breathing animals. Fish collected by these methods were identified to species and measured for length.

Table 1. Reaches and number of sites for 2020 survey.

Reach	No of sites	Type
Above Corin	5	Unregulated
Corin to Bendora	1	Environmental flow
Bendora to Cotter	5	Environmental flow
Bendora Reservoir	1	Reservoir

In order to assess the 2020 catch against the EMP indicators the following analysis was undertaken. The proportion of shots with two or more Blackfish was calculated within each reach which provided an indication of the overall health of the population in that reach. The percentage of Blackfish caught within each reach that was less than 120 mm total length (TL) (juvenile fish) overall was calculated. This indicates breeding success and survival over the previous two years. This less than 120 mm TL group comprises Young-of-Year (YOY), spawned in late spring 2019 (less than 80 mm TL), and 1 year olds (80-120 mm TL), which would have been spawned in late spring 2018. The percentage of the total catch of Blackfish in a reach, less than 80 mm TL is also calculated to provide an indication of breeding success of this season (2019/20).

What was recorded?

In 2020, 193 Blackfish were captured in the three river reaches (Table 1) by backpack electrofishing and one in Bendora Reservoir in a fyke net (Table 2). Additionally, 12 Macquarie Perch were recorded in the Bendora to Cotter Reach and two Trout Cod were recorded in Bendora Reservoir (Table 2). A total of 21 Rainbow trout were recorded across all three river reaches, with no Rainbow trout recorded in Bendora Reservoir (Table 2).

Table 2. Summary of fish recorded from the 2020 environmental flows monitoring program using five 30 m backpack electrofishing for each river reaches and 10 fyke nets for Bendora Reservoir.

Row Labels	Reach	Two-spined Blackfish	Macquarie Perch	Rainbow Trout	Trout Cod
Gingera Gauge	Above Corin	1		4	
Cribbs Creek	Above Corin	14		2	
Lick Hole Track	Above Corin	8			
Black Sallee Flat	Above Corin	4		2	
Cotter Flat	Above Corin	10		4	
Above Bendora	Corin to Bendora	20		1	
Vanitys Crossing	Bendora to Cotter	6	1	1	
Spur Hole	Bendora to Cotter	18	2	1	
Pipeline Crossing	Bendora to Cotter	51	7	2	
Burkes Crossing	Bendora to Cotter	31	2		
Below Bendora	Bendora to Cotter	1		4	
Bendora Reservoir	Reservoir	1			2

Table 3. Environmental Flows Monitoring Plan indicators for the three river reaches for 2020 (indicator acceptance level)

Reach	Percentage of shots with > 2 Blackfish *(> 60 %)*	Percentage of YOY and 1+ (< 120 mm) *(> 30 %)*	Percentage of YOY (< 80 mm)
Above Corin	32	10.8	0
Corin - Bendora	80	45	25
Bendora - Cotter	66.6	55.9	4.4

Comparing this year's results for catch (greater than 2 Blackfish per shot) against the programs long term performance showed 2020 was lower than the mean in all reaches and the lowest recorded in the Above Corin unregulated reach (Figure 2).

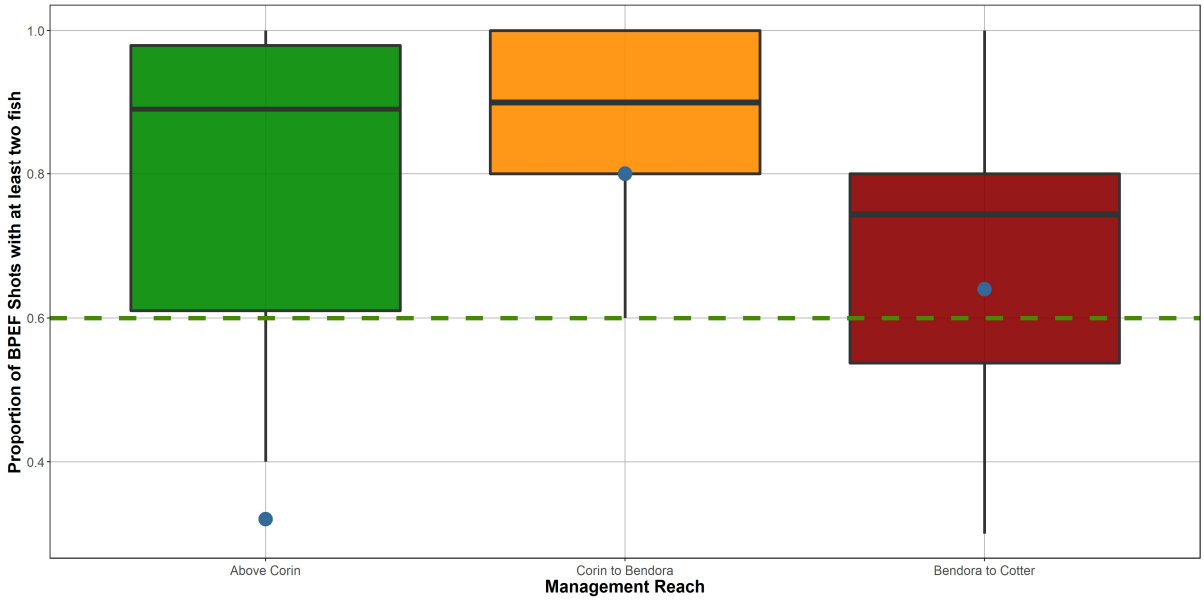

Figure 2. Proportion of Backpack electrofishing (BPEF) shots in a reach with 2 or more Blackfish 2009-2020 (Icon and ACT gov data combined). Blue dots are the 2020 value for each reach, compared to a box and whisker plot of 2009-2019. Green dashed line is the 60% of shots indicator and the grey line within the box is the long-term mean.

The mean annual catch of Blackfish in fyke nets in Bendora Dam is shown as number of fish per net-night (Figure 3). The lack of variation compared to previous years is because only one fish was caught.

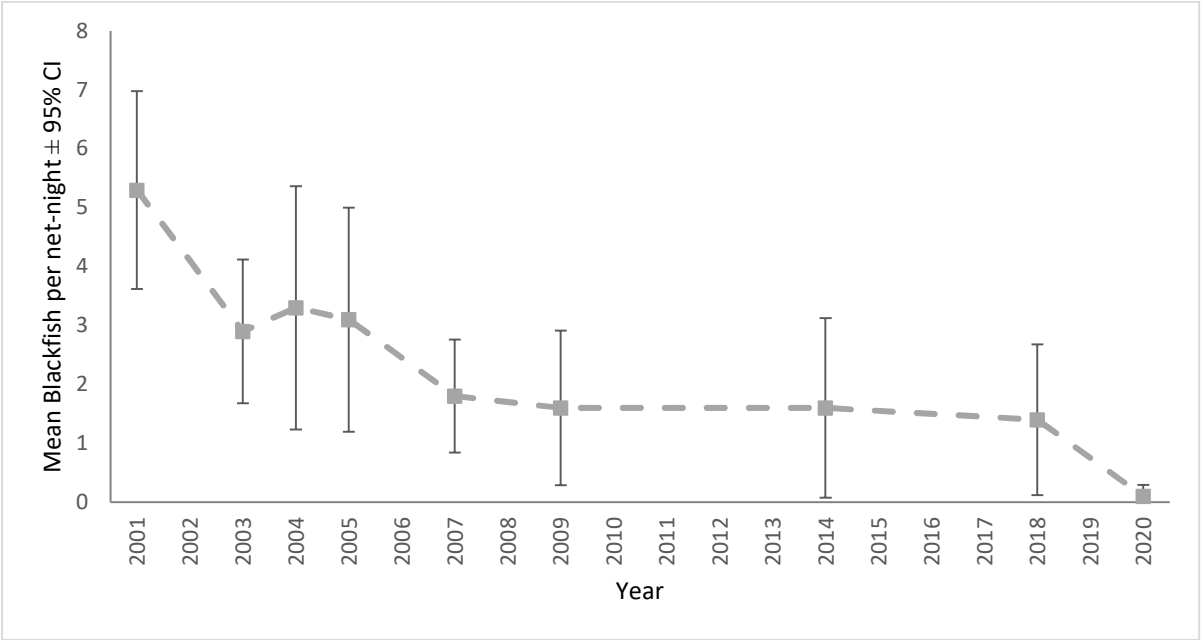

Figure 3.Mean Blackfish per net-night ± 95 % Confidence Interval for the fyke net catch, Bendora Reservoir 2001-2020 (Icon and ACT gov data combined)

Additional data including length frequency and mean catch per shot over time for all Blackfish and Young-of-Year (< 80 mm), is provided in Appendix 1.

Which targets were met, and which were not?

The indicators under Icon Water's Licence were met for the environmental flow reaches, Corin to Bendora and Bendora to Cotter, in 2020. Both the reaches achieved the greater than 60 % of shots with two or more Blackfish, negating the need to assess this indicator over two years, as is allowed in the threshold (

Table 3 and Figure 2). The recruitment indicator of more than 30 % of the catch in each environmental flow reach being juveniles less than 120 mm TL was also met for both reaches.

The indicator for Bendora Dam was not met (Figure 3). The indicator for the reservoir is two Blackfish per net-night and in 2020, only 0.1 Blackfish per net-night was recorded.

The poor recruitment from the 2019/20 spawning season should be noted. Less than 5 % of the catch in the Bendora to Cotter Reach was Young-of-Year (< 80 mm TL, YOY) from the 2019/20 spawning season (

Table 3). The proportion of juveniles indictor for this reach was achieved from survival of older juveniles (80–120 mm TL i.e. 1 year olds) from 2018/19 spawning season.

The Above Corin unregulated reach is a reference reach for Icon Water's Licence and does not have any mandated indicator values as no managed flows can be delivered in this reach. This catchment was heavily fire affected in the 2020 Orroral Valley Fire and the drought prior to the fires. This reach is unregulated, does not receive any environmental flows and stopped flowing naturally for periods in 2019. However, it is useful to apply the same tests to this reach as to the environmental flow reaches to assess the population. The Above Corin unregulated reach had its lowest catch since 2009 with only 32% of shots having greater than two Blackfish and only 10.8% of the catch less than 120 mm TL.

What was the outcome?

The indicators in the environmental flow reaches were achieved in 2020, despite the preceding drought and 2020 Orroral Valley Fire. However, the lower numbers of YOY (< 80 mm TL) in the Bendora to Cotter regulated reach and the Above Corin unregulated reach are likely due to the drought from 2019–2020. In the 2019/20 season there were significant periods were the required environmental flow from Bendora and Corin was equivalent to the inflow due to the natural flow being lower than the alternative flow release of 75 % of the 80th percentile, on a monthly basis. Despite these low flow periods, YOY were recorded in both regulated reaches and good survival of the 2018/19 season was apparent, particularly in the Bendora to Cotter regulated reach. The number of shots with greater than two Blackfish, while lower than the long-term average, was above the indicator level for both regulated reaches (Figure 2). These results substantiate the provision of environmental flows to support the Blackfish population in the regulated reaches through periods of drought. However, longer droughts may result in extended periods of low recruitment that could impact the population as shown by the low number of 2019/20 season juveniles recorded.

Corin to Bendora regulated reach (only one site), received its required environmental flow through this period. However, for long periods of 2019 and early 2020 the characteristic large transfer flow of water for abstraction at Bendora (usually between 100–250 ML/day) was not discharged. The reach was also impacted by the 2020 Orroral Valley Fire, though not to the extent of the Above Corin unregulated reach, with approximately 30% of its catchment burnt (ACT Government, *unpublished data*). The reach achieved the indicators for breeding and catch but was comparatively low in Blackfish catch compared to previous surveys (Figure 2). Additional sites would be required in this

reach to understand if the breeding and response recorded in the single site surveyed is representative of the overall reach.

Bendora Reservoir's decline below one fish per net-night is concerning, as the reservoir has recorded between one and two fish per net-night since 2007 (Figure 3). There is a lack of data and knowledge around Blackfish in reservoirs. Potential threats include sedimentation or variation in water levels impacting breeding or habitat, water quality changes, predation or productivity changes. However, it is difficult to determine the validity, cause, consequence or potential mitigation of this result, without additional data. Assessing other fyke net surveys in 2020 (if undertaken by University of Canberra) and repeating the survey with replication in 2021 with inclusion of Corin Reservoir could be considered to further understand the Blackfish population in reservoirs operated by Icon Water. Noting that a significant Blackfish population have not established in the other reservoir in the Cotter Catchment the Enlarged Cotter Reservoir.

The impact of the 2020 Orroral Valley Fire in the Above Corin catchment is evident with the less than 35% of shots having two or more Blackfish, which was well below the normal catch for this reach (Figure 22). The lack of YOY in this reach could be due to the preceding drought as well as the effects of the fire. The discharge of sediment from the fireground into the river is a significant risk to the Blackfish population in this reach in the short and medium term. Fire runoff can also significantly impact water quality and this may also impact the aquatic ecology and fish population (White et al. 2006; Hall & Lombardozzi 2008; Smith et al. 2011a; Smith et al. 2011b). Significant sedimentation of the Cotter River channel above Corin reservoir has been observed. The Corin to Bendora reach's catchment was also impacted by the Orroral Valley Fire. The impact of the fire in this middle reach was not apparent in the Blackfish catch at the Above Bendora site despite evidence of fire damage to the riparian area in the vicinity. This site is at the downstream end of this reach and any sediment impacts from the larger fire ground upstream may take some time to travel downstream.

What Next?

The environmental flows from Corin and Bendora Dams have supported the Blackfish population in the river reaches through the recent drought period. Although breeding in 2019/20 was reduced in the Bendora to Cotter Reach, the survival of fish from the 2018/19 juveniles has maintained fish numbers in these reaches.

Icon Water should undertake the Blackfish monitoring for the river reaches in February–March 2022, in accordance with the EMP. The ACT Government is likely to undertake surveys in 2021 to monitor the effects of the Orroral Valley Fire. This will assist in maintaining the dataset to achieve compliance with the minimum sampling and assess the breeding success and survival post the 2019 drought and 2020 Orroral Valley Fire. Additional sites in the Corin to Bendora regulated reach are required to understand if the results from the single existing site are representative of the entire reach.

Environmental flows in the Corin to Bendora Reach and larger flows from natural rain event will assist in clearing sediment from erosion caused by the 2020 Orroral Valley Fire. It is predicted that 2020-21 will be particularly wet. However, natural rain events will be likely to deliver additional sediment from the catchment to the river until vegetation cover increases and erosion sources are ameliorated. In the upper catchment only natural flows events are available for sediment transport.

Additional investigation of Bendora Reservoir should be considered as it did not achieve its indicator level in 2020. It is recommended that a review of any other available data for this year is conducted. Additionally, one or two extra nights sampling in 2021 or 2022 could be considered, potentially with

the inclusion of Corin Reservoir as an additional site to assist in determining validity of this year's result.

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Appendix 1

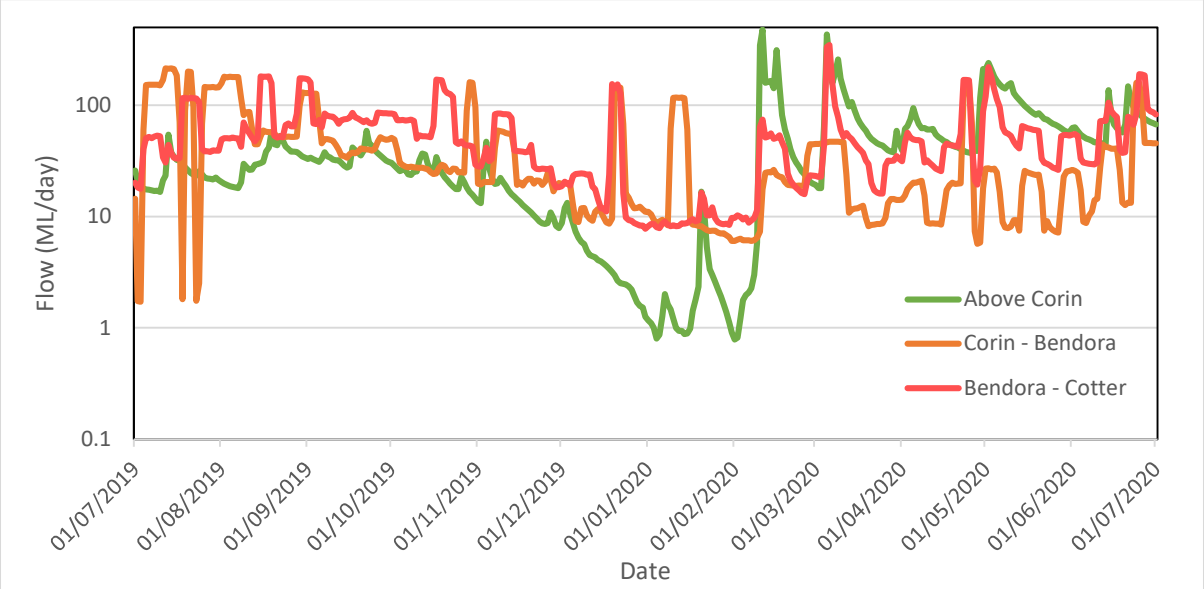

Figure 4. Flow in the Survey Reaches of the Cotter River July 2019 -July 2020. Gauges data sourced from Above Corin – 410730; Corin -Bendora – 410752; Bendora – Cotter 410725. Note the log scale on the Y axis.

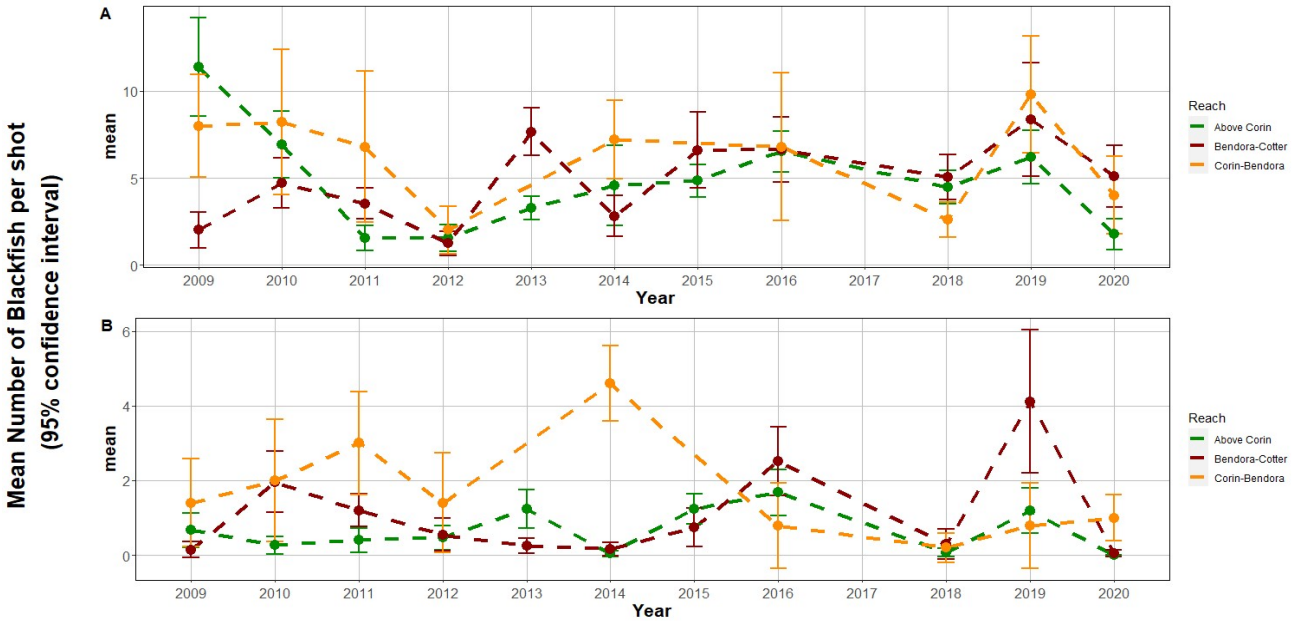

Figure 5. Mean Blackfish per shot for Eflow reaches 2009–2020 (95% Confidence Interval) (Icon and ACT gov data combined). (A) All Blackfish; (B)Young-of-Year < 80mm TL

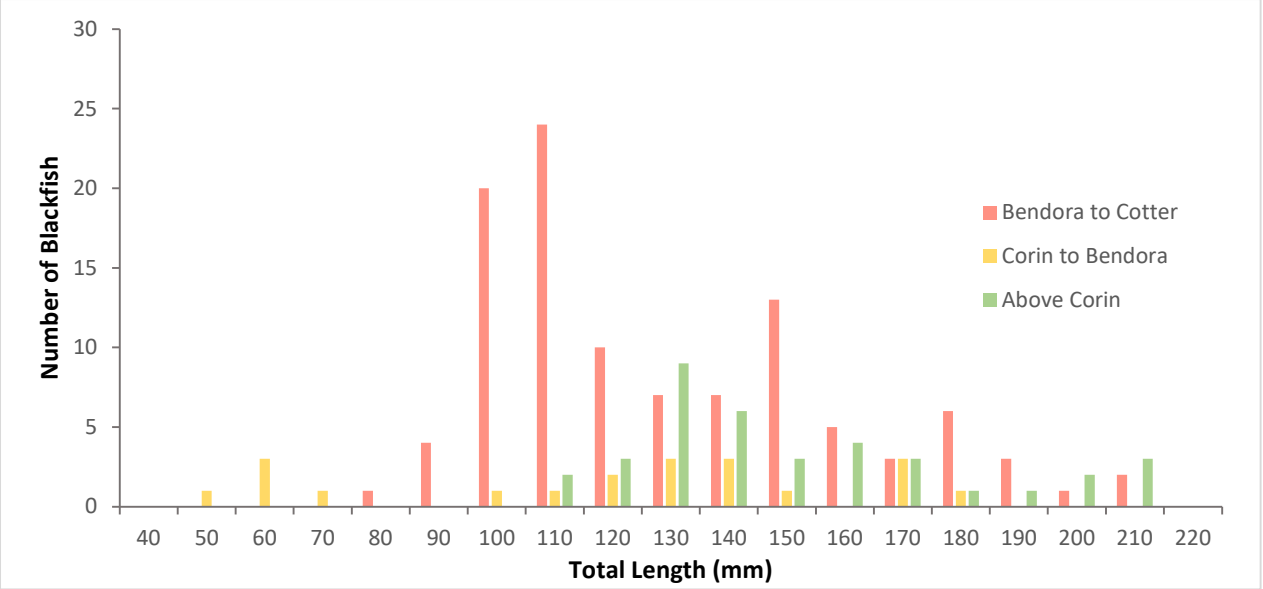

Figure 6. Length Frequency histogram of Blackfish caught by reach during the 2020 Eflows Monitoring.

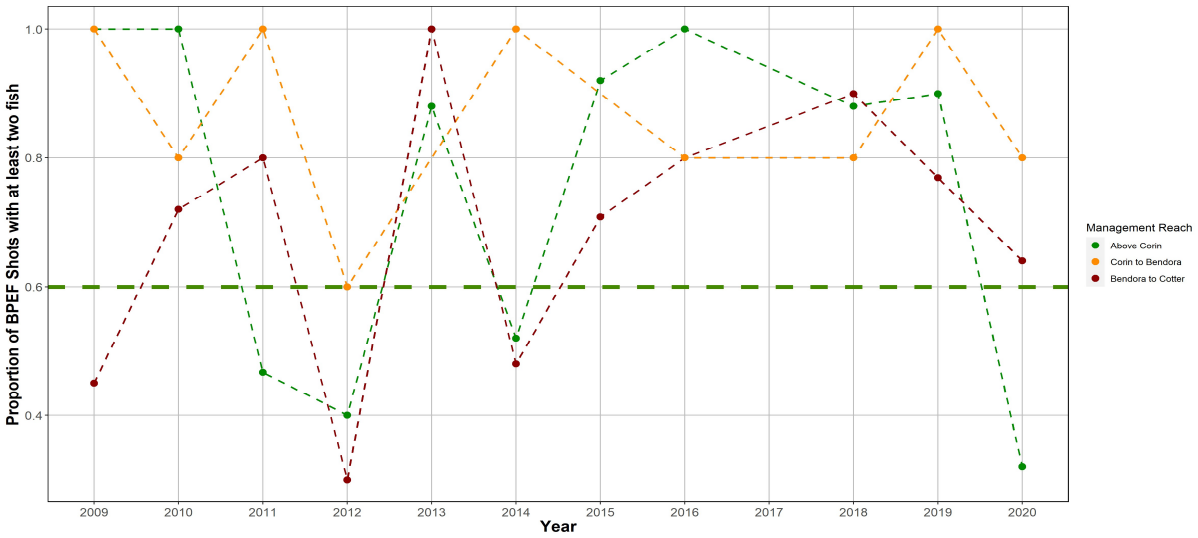

Figure 7. Proportion of Backpack electrofishing (BPEF) shots in each management reach with at least two Blackfish 2009-2020 (Icon and ACT gov data combined). Green line indicates 60% threshold from the Environmental Management Plan.

Appendix 2

2020 Monitoring of Two-spined Blackfish (*Gadopsis bispinosus*) in relation to Environmental Flows Executive Summary Storymap supplement

This project was undertaken on Ngunnawal country.

Matt Beitzel, Lisa Evans, Chris Malam and Mark Jekabsons

Two-spined Blackfish (Blackfish) are a threatened native fish growing to 30 cm long and occur in the upland regions of the southern Murray Darling Basin. In the ACT they are restricted to the Cotter River. They require cool, clean, clear cobble rivers to live and breed.

Large areas of the Cotter Catchment, particularly in the Above Corin Reach were impacted by the 2020 Orroral Valley Fire. Prior to the fire, the entire catchment was impacted by drought.

Icon Water provide environmental flows below Corin Dam and Bendora Dam to support the aquatic ecosystem, including the vulnerable Two-spined Blackfish. Specific flows are provided to flush sediment from the cobbles and maintain the habitat.

In 2019-20, environmental flow was reduced to equal to inflow to the dams for large periods due to the very low flow levels during the drought. This is compared to the normal releases, which are based on the long term monthly average flow.

To monitor Blackfish 11 river sites were surveyed in autumn 2020:

- Five sites were in the Environmental Flow Reach, Bendora to Cotter;
- One site in the Environmental Flow Reach, Corin to Bendora; and,
- Five in the Above Corin Unregulated Reach.

Bendora Reservoir was also surveyed.

At each river site, five 30 m transects (shots) were fished with a backpack electrofisher to capture Blackfish. In Bendora Reservoir, 10 fyke nets were set overnight and collected the next morning. Fish were counted and measured for length and returned to the water.

Icon Water's Environmental Management Plan has the following indicators to maintain a sustainable Blackfish population in the environmental flows reaches:

- More than 2 Blackfish per transect are recorded in 60% or greater of the survey transects; in at least one year, over the last two years.
- Blackfish under 120 mm in length (0 and 1 year old fish) comprise 30% of the catch in a reach.

There is also an indicator for Bendora Reservoir of two or more Blackfish per net-night.

In 2020 the indicator for catch was met in both Environmental Flow Reaches. The blue dot in the chart is the 2020 result for each reach, and the green dashed line the indicator level.

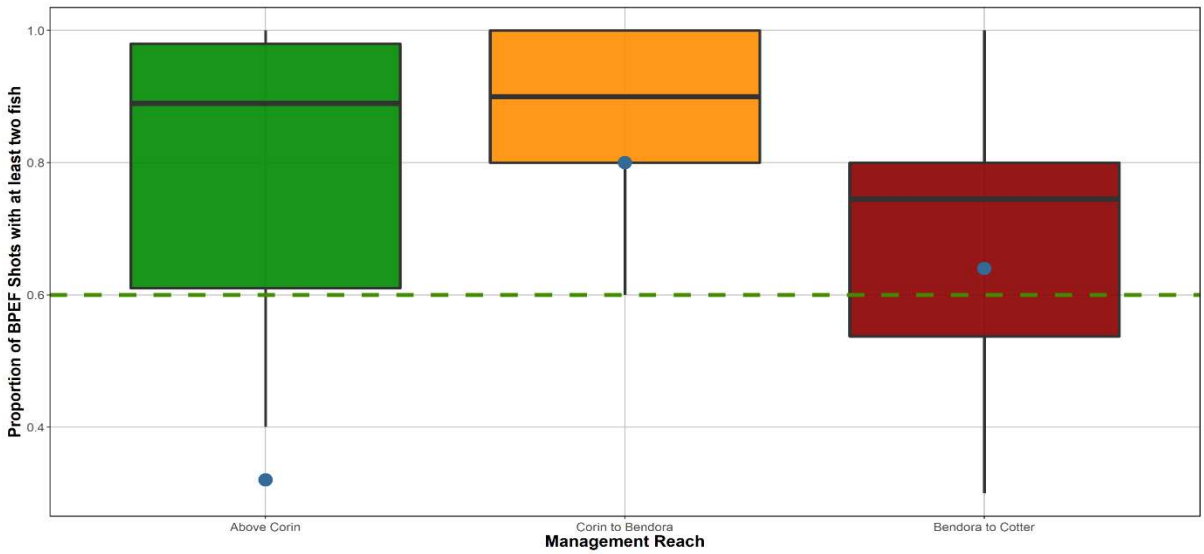

Figure 8. Proportion of Backpack electrofishing (BPEF) transect (shots) in a reach with 2 or more Blackfish 2009-2020 (Icon and ACT gov data combined). Blue dots are the 2020 value for each reach, compared to a box and whisker plot of 2009-2019. Green dashed line is the 60% of shots indicator and the grey line within the box is the long term mean.

However, the result was lower than the long-term average (indicated by the grey line) in both reaches implying a poor season in both reaches. In the unregulated reach, Above Corin, which was affected by fire, was the lowest on record (2009-2020). Both Environmental Flow Reaches also met the criteria of 30% of the catch (green dashed line) being below 120 mm in length.

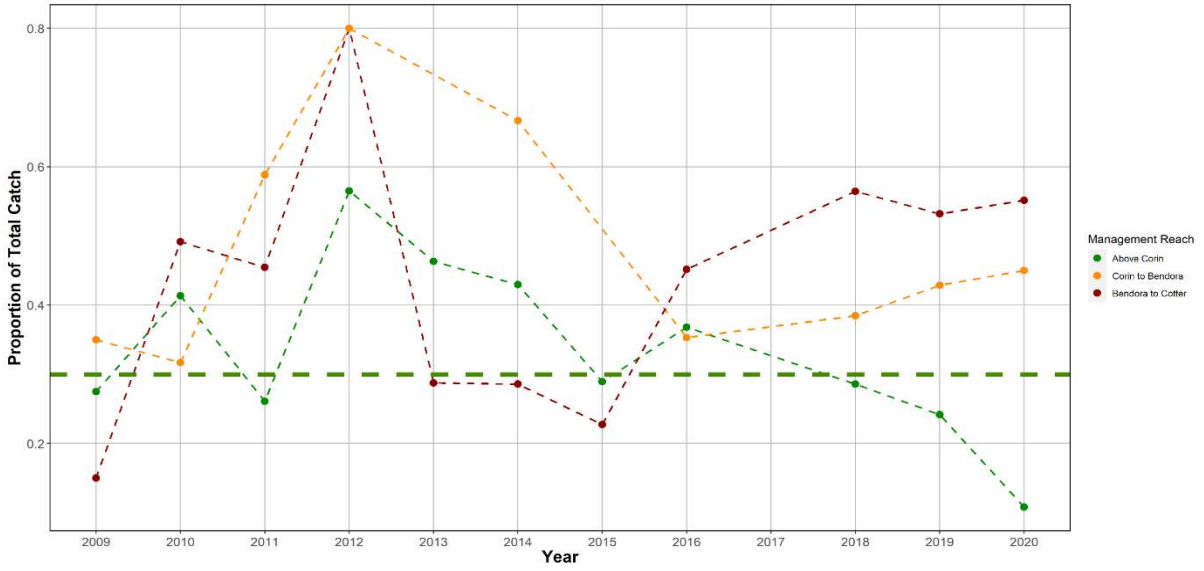

Figure 9. Proportion of the catch under 120mm (juvenile fish) in each management reach 2009-2020. Green dashed line represents the EMP guideline value of 30%.

This indicates a reasonably healthy number of juvenile fish in these reaches. In comparison, the unregulated Above Corin reach had almost no juveniles. However, the number of juveniles from the 2019 spawning season was particularly low. Only 6 of the 76 juveniles in the Bendora to Cotter reach, spawned in 2019. The indicator was achieved due to good survival of 1 year old fish from the 2018 spawning season.

Unfortunately, Bendora Reservoir did not meet the indicator with 0.1 fish per net night recorded.

Erosion from the bushfire ground upper catchment is delivering a large volume of sediment and other debris into the river and reservoirs both in the above Corin and Corin to Bendora Reachs. This is a major threat to Blackfish as it smothers the rock habitat they rely on and results in more rapid heating in summer due to the shallow water.

Figure 10 Lickhole Crossing Site in the Above Corin reach, before and after the 2020 Orroral Valley Fire.

Note the sedimentation covering the cobble substrate in the foreground post-fire. Cobble substrate is critical for Blackfish as it provides shelter, feeding and breeding habitat in the spaces under the rocks. These spaces are filled by post-fire sediment.

Figure 11. Pond Creek in the upper Cotter Catchment in 2017 and March 2020 with a large sand slug.

In 2020 flows from Corin and Bendora Reservoirs have supported the Blackfish populations in the environmental flow reaches through the drought. Additional investigation of the results from Bendora Reservoir is recommended due to the falling catch numbers.

The next scheduled environmental flow monitoring is in 2022.

Impacts from the drought are being observed, as are fire-related impacts in the unregulated catchment. These could impact on the Corin to Bendora Reach in a similar way. ACT Government sampling in 2021 will assist in monitoring the impact of the fires in the unregulated catchment.