Talk Wild Trout 2019

Conference Proceedings

Saturday 23 November 2019
Mansfield Performing Arts Centre, Mansfield, Victoria

Target One Million
More Victorians fishing, more often

Your fishing licence fees at work

Victorian Fisheries Authority

Aboriginal acknowledgement

The Victorian Government proudly acknowledges Victoria's Aboriginal community and their rich culture and pays respect to their Elders past, present and emerging.

We acknowledge Aboriginal people as Australia's first peoples, and as the Traditional Owners and custodians of the land on which we work and live.

We recognise the strength of Aboriginal people and communities and value the ongoing contribution of Aboriginal people and communities to Victorian life, through their daily work and at key events, and how this enriches us all.

We recognise all Aboriginal cultures and communities are diverse, and should be celebrated.

We acknowledge that the land and water is of spiritual, cultural and economic importance to Aboriginal people. We embrace the spirit of reconciliation: guaranteeing equality of outcomes and ensuring an equal voice.

We have distinct legislative obligations to Traditional Land Owner groups that are paramount in our responsibilities in managing Victoria's resources.

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Preferred way to cite this publication: 'Douglas, J., Forster, A., & Hunt, T.L., (eds) 2019, Talk Wild Trout 2019: Conference Proceedings, Victorian Fisheries Authority.'

Acknowledgements: The Victorian Trout Fisher Reference Group, Victorian Recreational Fishing Grants Working Group, VRFish, Mansfield and District Fly Fishers, Australian Trout Foundation, The Council of Victorian Fly Fishing Clubs, Arthur Rylah Institute, Vicki Griffin, David Anderson for the cover shot and theme pictures and especially thanks to Julie Morgan for all her work and organising skills in booking venues, organising catering, running the booking system and a myriad of other behind the scenes activities to draw everything together.

Authorised by the Victorian Government, Victorian Fisheries Authority (VFA),
1 Spring Street Melbourne Victoria 3000. November 2019

ISBN 978-1-76090-216-2 (print)
ISBN 978-1-76090-217-9 (pdf/online/MS word)

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Foreword

Going fishing is a wonderful way to explore Victoria's rich and diverse waterways - to take time to de-stress and be nourished by nature. Trout fishers thrive in this wilderness experience as they wade through crystal clear alpine streams surrounded by mountains and pristine rain forests.

I've spoken to many trout fishers and, I've been impressed by their passion for trout fishing and their advocacy for protecting trout streams. Special mention goes to the **Australian Trout Foundation** for all their hard work in uniting trout fishers and, for volunteering their time and effort toward river health restoration projects.

In supporting trout fishing, the Andrew's government has been busy over the last 12 months:

- ✓ Hosted another very successful Talk Trout Conference,
- ✓ Stocked around 80 family friendly waters with ready to catch rainbow trout for the school holidays,
- ✓ Stocked a record one million trout,
- ✓ Proposed changes to fisheries regulations to open-up more South West rivers to year-round trout fishing,
- ✓ Improved trout fishing stream access,
- ✓ Supported the Australian Trout Foundations fish habitat enhancement projects,
- ✓ Supported the Australian Trout Foundation's development of a Wild Trout Strategy,
- ✓ Delivered the Angler Riparian Partnership Program with $1 million over 4 years,
- ✓ Delivered six Vic Fish Kids events throughout Victoria,
- ✓ Expanded trout breeding incubator trials into Macalister River,
- ✓ Expanded the trout opening festival at Eildon,
- ✓ Stocked 2,000 'Stonker' rainbow trout in the Goulburn River for the biggest trout opening in 50 years,
- ✓ Expanded the **Women in Recreational Fishing Network** to more than 1,600 members.

After five-successful years of the Victorian Government's delivery of the ***Talk Trout***, these conferences are now recognised as the premier annual national trout fishery forum. It's a credit to all involved, that this partnership between trout fishers and government agencies continues to reach new heights.

Recreational fishing in Victoria is in a great place. With the Andrew's Government record $35 million-dollar investment in ***Target One Million (Phase 2)***, we think, it will only get better.

I hope your ***Talk Trout*** conference goes well and you take the time this spring, to get out and about and throw a line, whether that be a fly, lure or bait.

The Hon. Jaala Pulford MP
Minister for Boating and Fishing

Conference program — Saturday 23 November 2019

9.30 am	Arrival & morning refreshments	Delegates
10.00 am	Conference opens - housekeeping	John Douglas Victorian Fisheries Authority
10.05 am	Welcome to Country	Taungurung Representative
10.15 am	Conference welcome	Travis Dowling, CEO, Victorian Fisheries Authority
10.25 am	Reflecting on five years of Talk Wild Trout	Anthony Forster, Victorian Fisheries Authority
10.40 am	The Adventure of Fly Fishing	Hilary Hutcheson, USA
11.00 am	Morning Tea Break	

Theme 1 – Trout management

11.30 am	Recovering trout populations: Instream egg incubators trial updates	John Douglas, Victorian Fisheries Authority and Matt Byrne, Australian Trout Foundation
11.45 pm	Health cards for six wild trout streams 2019	Brett Ingram, Victorian Fisheries Authority
12.00 pm	Trees for Fish: Angler Riparian Partnerships Program	Renae Ayres, Arthur Rylah Institute, DELWP and Terry George, Australian Trout Foundation
12.15 pm	Dare to be wild	Greg French
12:25 pm	Lunch	

Theme 2 – Trout fishing

1.30 pm	The fun of wild trout-Victorian context	Robbie Alexander
1.45 pm	Off the beaten track: Time to find new water?	Martin Auldist
2.00 pm	Forging new paths: Increasing angler access	Anthony McGrath, Victorian Fisheries Authority
2.15 pm	Wild Trout Strategy	Paul Stoltz Australian Trout Foundation and Taylor Hunt, Victorian Fisheries Authority

Trout Q&A

2.30 pm	Panel questions and answers	

Conference wrap up

3.00 pm	What I got out of the conference	TBA
3.05 pm	Afternoon Tea Break	
4.10 pm	Close of conference	Travis Dowling

Victorian Fisheries Authority

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VR FISH

Arthur Rylah Institute

VFFA

Overview of Wild Trout Fisheries Management Plan

The **Wild Trout Fisheries Management Program** (Phase 1) was a collection of nine projects undertaken over three years that aimed to deliver:

- A clearer understanding of the cause(s) of the decline in wild trout fisheries,
- A better understanding of priority trout populations' health and status,
- Improved engagement with fishers to share our understanding of trout fisheries management, science and factors that drive the fishery,
- More responsive management of wild trout recreational fishing in Victoria, and
- Improved fishing opportunities for wild trout in Victoria.

The high levels of angler concern about the status of river trout fishing in North East rivers and the social and economic contribution that trout fishing makes to the regional economy warranted further attention. The Victorian Fisheries Authority initiated a research and management program to address the key questions raised at the public meetings to better understand how the trout fishery is performing and what, if any, management interventions may be appropriate.

The Wild Trout Fisheries Management Program addressed the following key questions:

Are summer temperatures adversely impacting our river trout fisheries?

Trout are a cold water fish and high summer water temperatures can reduce feeding and increase mortality. A trout tracking study used acoustic tags and listening stations in the Delatite River to determine how river trout respond to changes in water temperatures to answer the questions like, if trout move when water temperatures increase, where do they go and at what temperature do they move?

Is there a decline in wild trout populations and breeding?

Wild trout populations in rivers rely on natural breeding to spawn young fish. Monitoring trout populations will help us assess annual breeding performance and predict the strength of the next year class of trout. This project conducted annual fish population surveys in up to twelve priority rivers annually (3–4 sites in each) to provide a 'report card'. This can be compared to historical trout population information in some of these rivers given substantial prior research in many Victorian waters. The project also considered whether predation and competition from other species was adversely affecting trout populations in rivers. During the survey work, scientists recorded information about carp, their size and abundance, along with other possible predators of trout such as cormorants.

Is fishing pressure adversely impacting trout populations and the quality of the trout fishery?

Excessive angler harvest of fish can impact trout populations by decreasing the number of reproductively mature fish. In turn, this can reduce the number of young fish produced in a system. Angler surveys and a 'tag return' program in the Howqua River helped us understand more about catch and harvest levels. It is prudent to regularly test catch limits, closed seasons and equipment restrictions to confirm they are still appropriate. The project looked for evidence that fishing pressure is impacting the fishery, and if there was need to reconsider fishing regulations including size and bag limits, the closed season or permitted equipment.

Are research results well understood by fishers?

Annual conferences with trout fishers and community groups help everyone stay informed about the progress and key outcomes of each project from the Wild Trout Fisheries Management Plan. Interested groups can thus better understand the factors at play and consider the best options for maintaining and improving our wild trout fisheries.

The conferences provide an opportunity for fishers to hear about the very latest trout fishing developments, from local and international trout experts.

How can we reliably track changes in the angling performance of our trout fisheries?

There are many angling clubs that record their catches with great diligence. If this information can be shared for use in fisheries management, it may be a cost-effective way to get an indication of fishery performance over time and a means of assessing the impacts from interventions such as stocking and habitat restoration. A trial program using angling club records in fisheries monitoring was include the wild trout fisheries in Victoria.

Is reduced trout stocking into Lake Eildon impacting the trout fisheries in its inflowing rivers?

Fisheries managers are keen to better understand the contribution that trout stocking in Lake Eildon makes to the inflowing river trout populations. Similarly, to better understand the proportion of river fish which return to the lake for some period of their life stage.
A study was done to determine more cost effective and accurate methods of marking stocked trout and in future allow a better understanding of the relationship between trout populations in Lake Eildon and its feeder rivers.

Have there been changes to bankside vegetation along our rivers? If so, have they affected water temperatures?

River water temperature is strongly influenced by the nature and extent of stream-side (riparian) shading. Major changes to bankside vegetation (e.g. bushfires and flooding, clearing and replanting) may adversely impact wild trout fisheries. This project investigated the changes to riparian shading and the scope to rehabilitate streamside vegetation if warranted.

Does trout stocking help wild brown trout river fisheries recover?

Past research on wild trout fisheries in Victoria and worldwide suggest stocking on top of existing self-sustaining populations is an ineffective strategy to improve the quality of fishing in the long-term. However anglers have a strong affinity with stocking and it's perceived benefits. This project trialed the stocking of two-rivers (Howqua and Upper Goulburn Rivers) with tagged trout to re-assess the effectiveness of this intervention to assist recovery and enhance wild trout fisheries.

The Wild Trout Fisheries Management Program (Phase 2)

Based on the success of the Phase 1, The Wild Trout Fishery Management Program (Phase 2), funded through Recreational Fishing Licence Trust Fund for two years including 2017/18 and 2018/19, focusses on three key strategies to improve wild trout fishing outcomes:

1. Building trout fishing sector understanding of the environmental drivers that dictate the performance of the trout fishery and, adjusting fishing approaches and expectations in the face of a changing climate,

2. Help trout fishers catch more trout by identifying where trout abundance is highest and how trout fishers can adjust their methods to catch trout in warmer water conditions,

3. Explore the efficacy of incubator boxes as a potential intervention strategy to accelerate recovery of seasonally impacted wild trout fisheries.

Key objectives include:

- Monitor and assess the performance (abundance and year class strength) of priority Victorian wild trout recreational fisheries in the face of challenging climatic trends.
- Share key information with anglers about the performance of our highly value wild trout fisheries to inform trout fishing choices (where to fish) and improve fishing outcomes (through better targeted fishing).
- Evaluate the effectiveness of the Scotty Jordan incubators as a recovery strategy to enhance depleted wild trout fisheries.

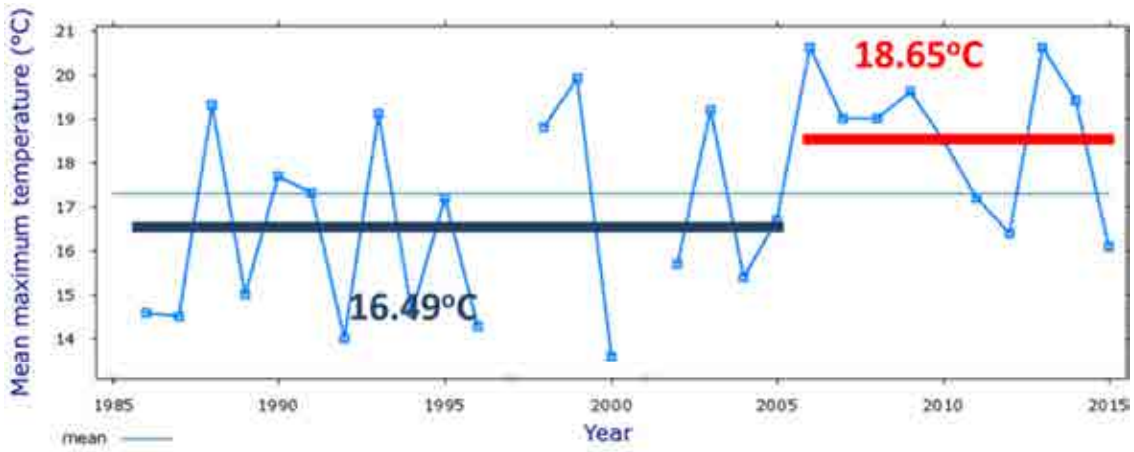
Reflecting on five years of Talk Wild Trout

Anthony Forster
Manager, Inland Fisheries, Victorian Fisheries Authority

One warm evening in early April 2014, John Douglas and I presented at a community meeting in Mansfield to talk about the status of our wild trout fisheries. We arrived to a concerned crowd of 70 people; anglers, local community representatives, shop owners and politicians and their advisors. The crowd were desperate to understand why trout fishing had collapsed in many of their iconic trout streams. More importantly they wanted solutions to the problem. Some offered their explanations for the "Trout drought" including; increase in predatory pressure from cormorants, increase in carp numbers, hot summer, removal of willows etc. Others suggested we "just stock trout, like we did in the 1960's and it will recover".

At this meeting, we presented the survey results of four trout streams: King, Jamieson, Howqua and Upper Goulburn Rivers. The results showed trout populations in the lower reaches of these rivers were low in abundance however, abundance increased at the higher elevations. We also revealed water temperatures in some of these streams were well above the temperature threshold for trout. *In some cases, river water temperatures exceeded 23 degrees at 8 am with temperatures rising further through the day*. The summer of 2013/14 was one of the warmest on record.

This meeting bought home the need to better understand the key issues affecting trout populations and, if anything, what could we do about it. Out of this meeting was born the **Wild Trout Fishery Management Plan**.

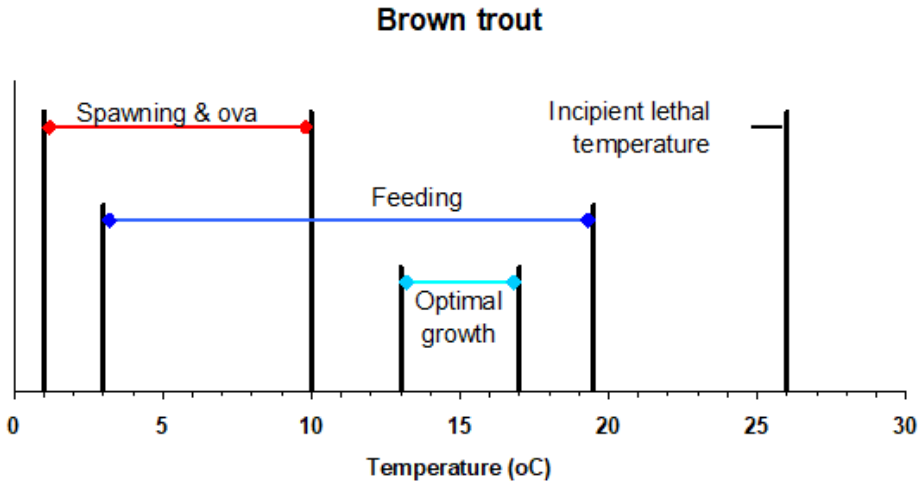


Extract from Talk Trout Proceedings 2015 showing a step change in mean maximum temperature at Mt Buller in the 2005 to 2015 decade.

Five years on, by working closely with trout fishers and researchers, we now have a better idea of what's driving the performance of our wild trout fisheries:

- Hot summers, low stream flows and poor stream side shading compromise the wild trout fishery,
- Angler fishing pressure is unlikely to be a significant cause of low trout abundance,
- Trout are typically more abundant in higher altitudes particularly in hot summers,

- Brown trout feeding is likely to stop at 20 degrees Celsius and they can die at 25 degrees Celsius and above.
- Larger trout tend to move to shaded areas when water temperature exceeds 22 degrees,
- Optimum temperatures for trout growth of Victorian streams is limited to spring and autumn periods,
- Trout are very good at breeding and their populations are generally resilient,
- Yearling stocking of brown trout in self-sustaining trout streams gives a poor return,
- Shading is a critically important to moderate water stream water temperatures,
- The range of wild trout is likely to contract (upstream) by up to 50% over the next few decades.



Extract from Mansfield public meeting presentation showing trout temperature tolerance to warm stream water.

More importantly we are focussing on the things that will help the trout fishery recover;

- Identify and restore streamside shading on trout streams,
- Encourage anglers to fish higher the rivers when conditions are warm / hot,
- Install instream structures to provide complex fish habitat for trout and other species,
- Investigate the use of Jordan Scotty incubators as a recovery tool for trout,

Five years on from the Mansfield community meeting, we are in a better place. We have a strong partnership outlook with trout fishers, we are focusing on the right things that will make a difference and, we are supporting efforts to increase stream shading and improve river health.

Lastly, the VFA appreciate the extent to which the **Australian Trout Foundation's** (ATF) have embraced the Wild Trout Fishery Management Plan. They have worked closely with Catchment Management Authorities and the VFA to others to build productive partnerships. The ATF are now leading with development of a **Wild Trout Strategy** with input from the VFA.

The Adventure of Fly Fishing

Hilary Hutcheson, USA

Hilary Hutcheson started her fly-fishing career as a teenaged guide in West Glacier, Montana. She guided through college, then took her journalism degree to Portland, Oregon where she worked as a television news anchor and reporter. She eventually returned to Montana to co-own and operate Outside Media and Trout TV for nearly a decade.

Today, Hilary's still guiding on the Flathead River and the Middle Fork of the Salmon River and owns and runs a fly shop called Lary's Fly & Supply in her hometown of Columbia Falls, Montana.

She volunteers as a fly fishing instructor for Casting for Recovery, serves as a national board member of Backcountry Hunters and Anglers, is a climate activist with Protect Our Winters and writes for a number of outdoor industry publications.

Hilary is a devoted mother and loves hanging out with her two teen daughters, especially when they volunteer on the oars!

She's a steward of the wild, her love of the outdoors is infectious, and she is passionate about sharing her love of angling and helping others to have a really great experience and fun on the river.

Her journey and accomplishments in fishing are inspirational.

"I love fishing and working in the fishing industry, but I don't like the feeling of using the resource and not doing enough to give back. I want to have a part in keeping the river healthy for my children's children, and it can be stressful to be aware that my time on Earth is likely spent doing too much enjoying and not enough protecting."

Theme 1 - Trout management

Recovering populations: Instream egg incubator update

John Douglas[1], Brett Ingram[1], Terry George[2] and Matt Byrne[2]
[1]Victorian Fisheries Authority, [2]Australian Trout Foundation

Background

The biggest influences impacting and limiting established trout populations are the environmental conditions within the catchment. Some events such as drought, bushfire or floods, are acute and the populations can decline significantly and quite quickly. Other factors such as climate variability are chronic and may impact on the population in more subtle ways. However, it is very rare that a river population of trout is completely wiped out by these impacts and trout populations quickly recover when suitable conditions return.

When the trout populations are low, many anglers fear the worst for the trout and call for action and request some sort of intervention to restore the fishery. While it is well known trout populations are extremely variable and trout numbers fluctuate greatly both between seasons, and within seasons it is still worth exploring options to assist recover after acute impacts. In most cases the population will recover naturally, and without any assistance but the question is "can that recovery be enhanced and is there anything that can be done to see the populations restore back to acceptable levels, and to do this as quickly as possible?"

Stocking and why instream egg incubator trials

Stocking is often suggested as an action to restore depressed riverine trout populations. The practice of stocking yearlings to assist recovery in established populations of wild river trout has been well studied and proven ineffective. The trout do not survive well once released.

One possibility for this low post-stocking survival is linked to the fish behaviour. Hatchery grown fish have selection pressures that favour bold and competitive behaviours, but such traits are not necessarily suitable once are the fish are released into the stream.

Stocked hatchery fish which have grown their whole lives in a hatchery, an relatively artificial environment, behave quite differently to wild fish and subsequently have much less chance of survival in the wild, a natural environment, after release.

Victorian egg stocking trial — Jordan Scotty Incubators

The Australian Trout Foundation (ATF) raised queries regarding what strategies or interventions could be applied to assist recovery of wild trout populations that had declined after acute events. The intention was not to reinstate a stream trout stocking program but to investigate other management tool(s) that could be applied to facilitate, or kick start wild trout population recovery, if necessary.

The ATF proposed investigating stocking of eggs and with support of the VFA the Jordan Scotty trials were started. Stocking eyed eggs means the fish do not develop any traits from the hatchery environment, and therefore may have better survival in the stream. Instream egg incubators may therfore reduce the impact of hatchery imprinted learning on stocked trout and potentially result in increased post-stocking survival.

Egg stocking has been used for stockings species of the genus *Salmo* for more than a century but the effectiveness of the method to assist recovery in populations has not been well studied (Barlaup and Moen 2001). There are studies that indicate the method is successful, but these studies generally define success as a high hatch rate or high emergence, and very few studies have followed through the actual survival of the egg stocked trout and the actual contribution these fish make to the overall adult population or indeed, the recreational fishery.

A long-term large-scale study of egg stocking (that ran for 10 years in multiple rivers in Finland) reported hatch rates from incubators do not necessarily result in fish surviving to contribute to the fishery (Syrjänen *et al*. 2015). This study found that while survival of young trout stocked as eggs may be high, many of these fish do not make it to their second year and therefore do not contribute to the overall population. Whether the same would happen in Victorian streams was unknown and the Jordan Scotty trial was set up to investigate this question.

The trial of Jordan Scotty boxes in Victoria is now into the 3rd year.

What will success look like?

The trial has been running for three years and it is important to articulate what the trials are trying to achieve and to report on assessment against this aim.

The initial aim is to assess the effectiveness of the of the Jordan Scotty boxes as intervention to kick start depressed trout population recovery and shorten the time for the population to recover.

Therefore, success for this project is defined as the stocked fish persisting to reach adulthood and contributing a high proportion of the adult breeding population. i.e. 2 and 3-year-old fish.

The step to success for this aim are:

- Step 1, a high hatch rate from the incubators.
- Step 2, a large proportion of stocked fish collected as fingerlings and yearlings.
- Step 3, the stocked fish make up a significant proportion of the mature fish in the population and are capable of spawning and assisting in further population recovery.

Progress to date

Instream egg incubators were deployed at streams where trout populations were depressed. Fish obtained from subsequent sampling near the sites were identified as either wild or hatchery origin.

The identification was done through DNA. DNA samples taken from the fish captured from the later surveys was compared to the DNA samples taken from the parents of the stocked eggs.

There have been a few setbacks, but the trials are providing valuable information and learnings.

Step 1

The Jordan Scotty incubators have proven very good at incubating eggs. Hatch rates from the incubators has been high and mostly above the 90%. The first step to success has been reached.

Step 2

In the first year's trial the DNA could not be extracted sufficiently from the samples for parentage analysis and therefore young of year trout samples could not be assigned to as either wild or hatchery. While this was disappointing, the nature of using of DNA for fish discrimination can be used irrespective of age, so DNA from any older fish captured from subsequent sampling can still be identified as wild or stocked. This learning meant that larger fin clips were taken from young of year fish and clips will also be taken from any larger fish sampled in the coming surveys.

The second year's batch of eggs was deployed in winter 2018 and sampled in autumn 2019, the third years deployment has occurred in winter 2019. The 2019 stocking was a slightly modified with the introduction of a new river and the stocking of 'first feeding fry' instead of eggs in a two of the streams. The Macalister River was introduced into the mix due to better water security than the Traralgon Creek. The eggs that were to go into the Dargo and Jameson rivers were replaced with 'first feeding fry'. These were fish that were incubated at the hatchery but as they had only stared to feed, the influence of the hatchery would not be so great.

Sampling results and comments for Step 2 for the individual rivers.

King River

Two small streams that flow into the King River were stocked with eggs. The streams mimic natal stream and allowed any fish hatched from the Jordan Scotty incubators to develop in the smaller waters and then potentially move into the larger main stream of the King River. Stony Creek was stocked about 400 meters upstream of its junction with the King River confluence. The creek dried due to low flows and subsequently had low winter flows in subsequent year so was unsuitable and had to be removed from the trials. The Queens Creek is an anabranch of the King River and has all year flows. Queens Creek supports a trout population and there have been relatively good numbers of trout sampled from the creek including wild and fish derived from the Jordan Scotty incubators. While fish are present in the Queens Creek anabranch very few trout have been sampled from the main stem of the King River. The trout do not appear to move out of the Queens Creek into the main stream. There has been no sign of recovery in the King River either from the Jordan Scotty incubator or wild fish.

Traralgon Creek

The Traralgon Creek has been on the trials for two years. However, very low flows in the Traralgon Creek last year prompted early sampling as the creek was becoming extremely low and was likely to cease to flow. The samples yielded good numbers of young-of-year fish including hatchery sourced individuals but given the low flows and dry conditions the on-going survival of these fish in the creek was not assured. The issues with poor water security meant the site was taken off future trials and the trials moved to the Macalister River. Sampling will be conducted in the creek in Autumn 2020 to examine if there is any on-going trout survival in the creek and the source of any surviving fish. This work will be a useful to investigate if the fish have survived/recovered from the very poor conditions, and if there has been recovery, to see what proportion of fish are from the Jordan Scotty incubators. The recurring low water flows indicates that Traralgon Creek is becoming increasingly marginal for trout, but the stream will be sampled again in 2020 to monitor the potential resilience of trout populations and persistence of Jordan Scotty fish.

Jamieson River

The Jamison River has been stocked with eggs for two years. Survey results captured some young of the year trout from the vicinity of the Jordan Scotty incubators in the first sampling round, but the DNA could not confirm the source of these fish. The second round of sampling in 2019 did not return many (any) trout from the vicinity. The stream was stocked winter 2019 with first-feeding fry, as part of the fry stocking trial in conjunction with the Dargo River. Very few trout have been sampled over the past two seasons and there has been no sign of recovery in the lower Jamieson River, either from the Jordan Scotty incubator or wild fish.

Dargo River

Then Dargo was stocked with eggs in winter 2018 and sampled in autumn 2019. Only three young of year trout were sampled from the area and trout numbers remain very low. No large trout were captured. The Dargo was stocked in winter 2019 with first feeding fry to trial stocking in conjunction with the Jamieson River. The river has only been sampled once since trials began but few trout were sampled from the river and at this time there is no sign of recovery in the Dargo River either from the Jordan Scotty incubator or wild fish.

Macalister River

The Macalister River was added to the stocking trial list as a replacement for the Traralgon Creek as the river offers better water security. The Macalister River was stoked with eggs in winter 2019.

The detection of Jordan Scotty derived trout in the sample indicates post hatching survival to at least several months (young of the year). The lack of fish derived from the 2017 stockings in the 2019 samples could indicate low survival of the fingerling into their first year. The second step to success is inconclusive and requires further sampling.

No yearling fish derived from Jordan Scotty incubators from hatching in 2018 have been identified later in the vicinity of incubation sites as 2019 samples.

Step 3

Work in progress. Assessment of the Jordan Scotty incubators is on-going.

Observations to date

Results of the parentage analysis combined with the fish surveys indicate that trout populations at most of the study sites remain depressed and there is no indication of any recovery in these populations (see report cards these proceedings).

At locations where egg incubator sourced fish have been recovered, wild derived trout stocks are present and dominate the samples. Natural recruitment has occurred.

There have been high hatch rates from the incubators.

There is no evidence that trout derived from eggs incubated in the Jordan Scotty incubators in 2017 are persisting in the population into yearlings where surveyed in the vicinity of the incubation sites of 2019.

Sampling has recorded few trout at many of the sites as either young of year, yearlings or older fish. The lack of wild trout in the areas would suggest that the environmental conditions in late summer at the time of sampling are not suitable for any trout, regardless of their source and this is likely the main driver influencing the results.

Looking forward

The trial will continue but will be modified slightly to include the release of first feeding fry and eggs from wild fish. Wild Salmo genes may be paramount in the survival link between alevin to beyond parr age.

ATF have always wanted to use wild sourced eggs however practicalities in obtaining such eggs meant the project used hatchery sourced eggs from Snobs Creek. The use of other eggs will be considered in future.

The trial is still on-going with another round of sampling scheduled at the stocked sites in 2020. These future results may well tell a different story. At best the results to date while not promising, without physically surveying many kilometres of streams over many years, are far from conclusive.

Volunteerism burnout is common when the good will of volunteers is pushed to the limit with high involvement expectations. The Jordan Scotty work has seen a fantastic response by recreational anglers all keen to be involved and learn by doing. Inclusion of anglers in research is important so that anglers are engaged, understand the methods, have input in the projects, are informed of how it is being assessed and, most importantly, are aware of the findings. The relationship between ATF and Government is a solid one and built on many previous collaborative activities in assisting in numerous habitat restoration projects. As previously stated, the Jordan Scotty incubator project was initiated by the ATF, and like these previous projects, has again been a catalyst for bringing new anglers, researchers and fisheries managers together, to work collaboratively on issues affecting trout and trout population recovery. The strong relationships built continue to enable conversations between these groups that go far beyond the Jordan Scotty project.

The loading and deployment of the Jordan Scotty incubators requires a lot of volunteer assistance and a high commitment for volunteers to travel to Eildon (to load) and then to the release site to deploy. The practicality of the incubators is questionable given the need for a high level of ongoing volunteer commitment and the risk of volunteer burnout. Therefore, the latest trials introduced the release of 'first feeding fry. These fish have been incubated at the hatchery but had only recently started feeding and therefore have limited exposure to any associated selection processes in the hatchery environment. The use of fry also assists in an ease of release of these fish. Fry stocking means a lot less pressure on the volunteers to travel to Snobs Creek to load and then travel to the various rivers to deploy the Jordan Scotty incubators.

Stocking—Summary

Table 1 Overview of streams stocked in the trials.

Stream Stocked	Year One (2017)	Year Two (2018)	Year Three (2019)
Traralgon Creek	Eggs	Eggs	
King River			
Queens Creek	Eggs	Eggs	Eggs
Stony Creek	Eggs		
Jamieson River	Eggs	Eggs	Fry
Dargo River		Eggs	Fry
Macalister River			Eggs

Fish sampling—Summary

Table 2 Sampling overview

Stream Sampled	2018	2019	2020
Traralgon Creek	Yes	Yes	
King River	Yes	Yes	
Queens Creek	Yes	Yes	
Stony Creek	Yes		
Jamieson River	Yes	Yes	
Dargo River		Yes	

Fish source—Summary.

Table 3 Fish source. Total number of fish sampled at Jordan scotty sites with hatchery sourced fish in brackets

Stream Sampled	2018	2019	% wild fish in 2019 samples
Traralgon Creek	51 (1*)	39** (12)	69%
King River (including Queens and Stony creeks)	44 (0)	42 (11)	74%
Jamieson River	13 (3*)	1	100%
Dargo River		4	100%

** NB issues with genotyping samples in 2018 (see Byrne et al 2018)*

*** includes two sampling events. Traralgon Creek flow was severely decreased and potentially could cease to flow so was sampled in November 2018 (32 fish) and March 2019 (7 fish).*

Acknowledgements

The incubator trials have involved many people and the ATF and VFA would like to thank the volunteers who assisted in the delicate task of loading the eggs at Snobs Creek, and the subsequent installation of the incubators into the streams.

The great bunch of volunteers, more than 100 counting all tasks, in the main were representing the following clubs and organizations:

Australian Trout Foundation; Native Fish Australia; Mansfield and District Fly Fishing Club; Victorian Fly Fishing Association ; Council of Victorian Fly Fishing Clubs; Yarra Valley Fly Fishing Club; Southern Fly Fishing Club; Harrietville Angling Club; Alpine Fly Fishing Club; Kiewa Valley Angling Club; Bairnsdale Fly Fishing Club; Latrobe Fly Fishing Club; Sale Fly Fishing Club; Wangaratta Fly Fishing Club; Northern Fly Fishing Club; Goulburn Murray Fly Fishing Club; Undera Angling Club & VRFish.

Lots of hard work mingled with lots of fun and laughter.

All Recreational anglers and clubs are welcome to be involved and to assist in the Jordan Scotty trials; please feel free to register your interest today with ATF or visit www.atfonline.com.au.

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Health cards for 6 wild trout streams 2019

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[1]Victorian Fisheries Authority, [2]Arthur Rylah Institute, DELWP

Aim

Produce health cards for each of our monitored streams to give fishers and managers a better understanding of the past and current health of our wild trout streams.

Overview

The information in these *Health cards* is aimed to give the reader a better understanding of the health of trout streams now and into the future. It is hoped the health cards will also provide some information useful for your future trout fishing adventures. These *Health cards* add to those for selected trout streams published in previous proceedings (Hunt and Lieschke 2015, Hunt and Lieschke 2016, Ingram *et al.* 2017, Ingram and Lieschke 2018).

The information provided on the *Health cards* is based on recent and past survey information collected using electro-fishing methods. Electro-fishing is an effective sampling tool for providing a snapshot of the presence and abundance of fish present in a stream. However, electro-fishing is not perfect and does not catch all the fish present. For example, some studies suggest electro-fishing catches around 28% of trout present at a site, and not all habit is fished (or fishable), particularly in larger streams, such as the Goulburn River tailrace. Often fish are observed but cannot not caught. Therefore, the numbers of fish presented in the *Health cards* should be considered an underestimate. ***There are likely to be many more fish in the system available to fishers, than just those recorded in the surveys!***

It is also important to remember that trout are resilient species and population size and structure vary widely. Some streams support large populations and others support small populations, depending on the carrying capacity of the stream. Some streams have lots of small fish and others have few big fish. Fluctuation is normal in fish populations and trout are particularly good at responding to their environment and so streams that fished poorly last year may fish well the next season, or vice versa. Consequently, these *Health cards* provide a snapshot insight only into the current health of a variety of trout populations in Victoria.

What we did

Between mid-March and early April 2019, six trout streams (Table 1, Figure 1) were surveyed using electro-fishing methods, which are described by Lieschke *et al* (Lieschke *et al.* 2015). Briefly, sites in smaller streams were surveyed with a backpack electrofisher for approximately 90 minutes, while sites in larger streams were surveyed with an electrofishing boat for about 60 minutes. A combination of both boat and backpack electrofishers were used in some streams, depending on site conditions. Two to four sites were surveyed in each stream, and 60 - 390 m of stream was surveyed at each site (0.5 – 2.21 km per stream). The length of trout caught were measured and their abundance (number of trout caught per 100 m of stream) was estimated. These results were compared with surveys conducted in previous years as part of the *Wild Trout Wild Trout Fisheries Management Program* (Hunt and Lieschke 2015, Hunt and Lieschke 2016, Ingram *et al.* 2017, Ingram and Lieschke 2018) (Appendix I), and historic electro-fishing surveys of the streams conducted by fisheries scientists This information was then summarised into a *Health card* for each stream, and key health indicators assessed.

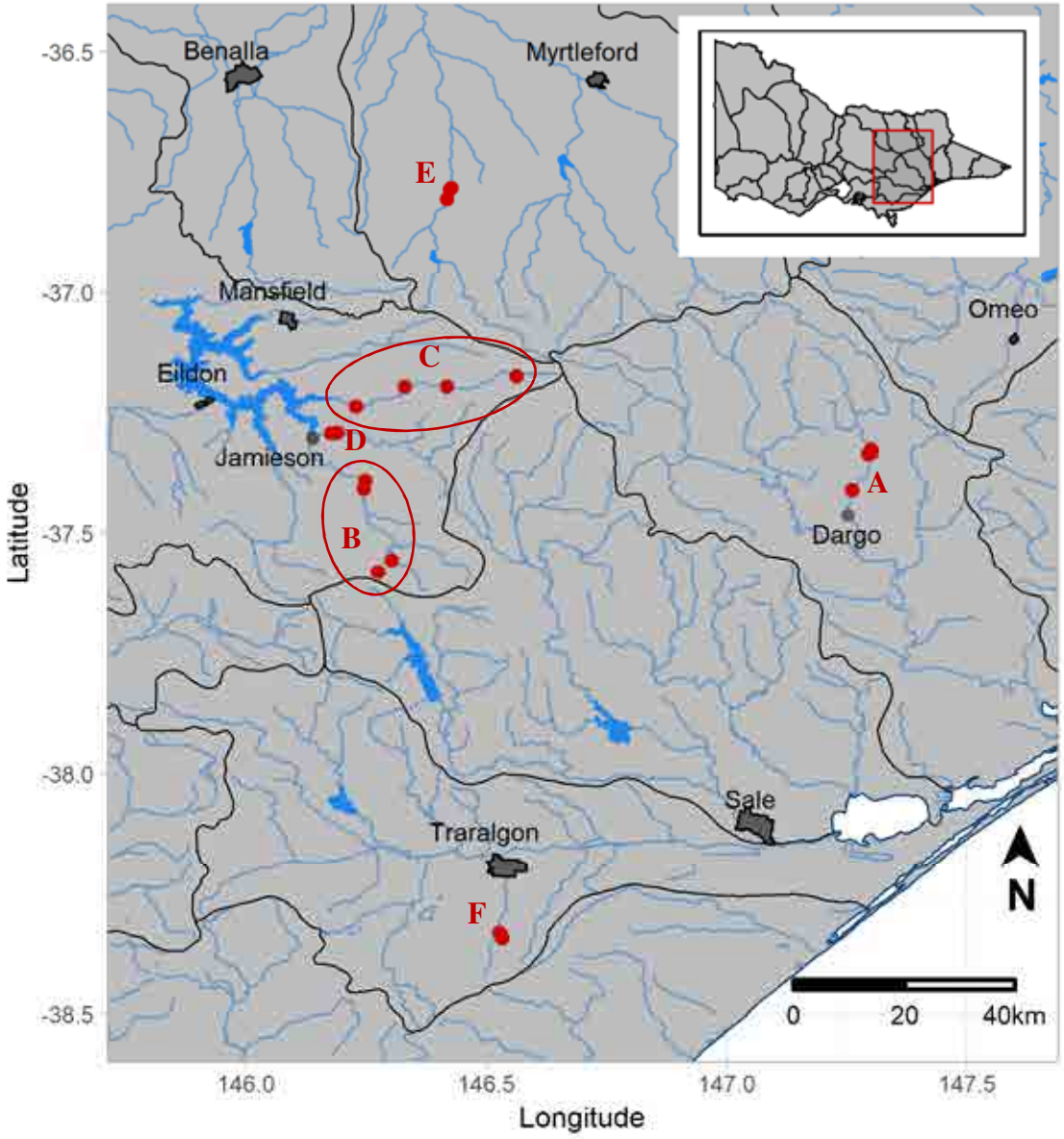

Figure 1. Location of streams surveyed in 2019. A. Dargo River, B. Upper Goulburn River, C. Howqua River, D. Jamieson River, E. King River system, F. Traralgon Creek.

How to read the *Health cards*

The **Key Health Indicators** (green box) provides an easy to read overall evaluation of key health attributes of the trout population in the stream and an overall rating, which are:

Abundance (fish/100 m)	⇧	Up compared to historic records collected over at least three years.
	⇩	Down compared to historic records collected over at least three years.
	⇔	Stable compared to historic records collected over at least three years.
	?	Insufficient information.
Recent recruitment	✓	Good numbers of small trout < 12 cm (5 inches)[1] present, indicating that trout have spawned recently (last 12 months) (or that a stocking event has recently occurred).
	Some	Some small trout < 12 cm (5 inches) present.
	✘	No small trout present
Multiple size classes	✓	Wide range of fish sizes present indicating multiple year classes present in the stream.
	Some	Some size classes present.
	✘	Very few size classes present.
Mature fish	✓	Trout > 30 cm (12 inches)[2] present, indicating mature fish capable of spawning are present in the stream.
	Some	Some trout > 30 cm (12 inches) present.
	✘	No trout > 30 cm (12 inches) present.
Overall rating	**Low**	**Moderate** **Good** **Very good** **Excellent**

1. Indicative size only as growth of juvenile trout may vary between streams and years.
2. Indicative size only as size at maturity varies between species, streams and years.

The **Monitoring Results** (grey box) provides a summary of the fish surveys conducted in the stream, including the number of brown trout and rainbow trout caught and their abundance (fish per 100 m), the size of the largest trout caught, the percentage of trout that were over 20 cm in total length (defined as catchable), and the abundance and average size of trout over 20 cm in total length. All abundance estimates for current and historic data were derived from fish caught only, and excludes fish that were observed but not caught.

The map shows the locations of each survey site in the stream.

The second page of the health card provides important information about the shape of the population (size structure) of the trout population in the stream and the relative abundance (fish per 100 m) compared with previous surveys. The size range of trout caught in 2019 is presented as a graph of the number of fish caught for different size (length) categories. The abundance of trout caught is graphed along with abundance estimates from surveys conducted in the same stream in previous years. In addition, the long-term average (*LTA*) abundance for both brown trout (*LTA-BT*) and rainbow trout (*LTA-RT*) are presented on the abundance graph. These values indicate the average abundance calculated from all available records (current and historic) for the stream.

Information is also presented on recent stocking events in the streams surveyed.

Finally, a simple overview summary statement of the *Health card* report is provided.

What we found

A total of 439 brown trout and 206 rainbow trout were caught during surveys of 6 wild trout streams. Brown trout were caught in all streams surveyed, but rainbow trout were caught in the upper Goulburn and Howqua rivers only.

A summary of the key health indicators for the 6 wild trout streams surveyed in 2019 and overall ratings for these streams from earlier surveys are provided in Table 1. In 2019, two streams (upper Goulburn River and King River system) had an overall rating of *Excellent*. The Howqua River rating dropped from *Excellent* over the previous three years to *Good* due to a lower abundance compared to previous years. The rating for both the Jamieson River and Traralgon Creek dropped from *Good* to *Low*. Just one fish was caught from the Jamieson River in 2019 whereas 26 trout were caught in 2018. In the Traralgon Creek, the abundance was down on previous years and there were few mature fish capable of spawning present. The Dargo River was also rated as *Low* due to low abundance and absence of mature fish capable of spawning.

Trout abundance

Since 1997, the average annual abundance of trout estimated from electrofishing surveys conducted in Victorian trout streams as part of the Trout Fisheries Management Program has ranged from 1.3 – 22.6 trout/ 100m (Figure 2). Despite there being considerable variation in average trout abundance from one year to the next over the past 23 years, the long-term trend in abundance has been relatively flat (Figure 2). Although the average trout abundance for 2019 (11.9 trout/ 100m) was down slightly on the average for 2018 (14.2 trout/ 100 m), this value was *on par* with the long -term average of 11.8 trout/ 100m.

Abundance estimates for surveys conducted in 2019 are provided in Figure 3. The streams surveyed in 2019 supported low to excellent populations of trout. The highest abundance (47 trout/ 100m) was recorded in the upper Goulburn River where many brown trout and rainbow trout (< 10 cm) were caught (Figure 3). The presence of these fish indicates good natural recruitment of both species from spawnings in the winter of 2018. The next highest abundance was observed in the Howqua River (8 trout/ 100m). The lowest abundance was recorded in the Jamieson River (<1 trout/100m). Compared to historic records trout abundance estimates were up for the upper Goulburn River and the King River system (below Lake William Hovell) (Table 1), and values in these rivers were generally above the long-term averages (LTA). Abundance estimates were down in all other streams.

Due to concerns regarding reducing flow rates approaching summer, the Traralgon Creek was surveyed in late November 2018 to capture brown trout and collect DNA tissue samples to assess outcomes from the Jordan-Scotty Trial (see Jordan Scotty Update, these proceedings). At this time brown trout abundance was 3.4 trout/ 100m, which was slightly higher than for the 2.4 trout/ 100 m recorded in March 2019, when the survey was repeated at the same time of year as previous surveys.

In streams where both species occurred, abundance of brown trout was higher than for rainbow trout in the upper Goulburn River, but were similar in the Howqua River.

A summary of trout abundance records (trout per 100 m) for all sites surveyed in streams as part of the *Wild Trout Wild Trout Fisheries Management Program* (2015-2019), along with historic records back to 1997 for these streams, is presented in Appendix II. Abundances range from <1 trout/ 100m to 198 trout/ 100m, with few records (7.5%) being >20 trout/ 100m.

Table 1. Summary of key health indicators for six wild trout streams surveyed in 2019, and overall ratings for these streams from 2015 to 2018 surveys.

Stream	2019 Results					2018	2017	2016	2015
	Abundance	Recent recruitment	Multiple year classes	Mature fish	Overall rating	Overall rating	Overall rating	Overall rating	Overall rating
Dargo River	⇩	✓	**Some**	✘	Low	NS	NS	Good	Moderate
Upper Goulburn River	⇧	✓	✓	✓	Excellent	Excellent	Good	Moderate	Good
Howqua River	⇩	✓	✓	✓	Good	Excellent	Excellent	Excellent	Very good
Jamieson River	⇩	✘	✘	✘	Low	Good	Good	Low	Moderate
King River system	⇧	✓	✓	✓	Excellent	Very good	NS	NA*	NA*
Traralgon Creek	⇩	✓	**Some**	**Some**	Low	Good	Excellent	NS	NS

* NA. Not applicable because different areas and sites were surveyed.
NS – Not surveyed.

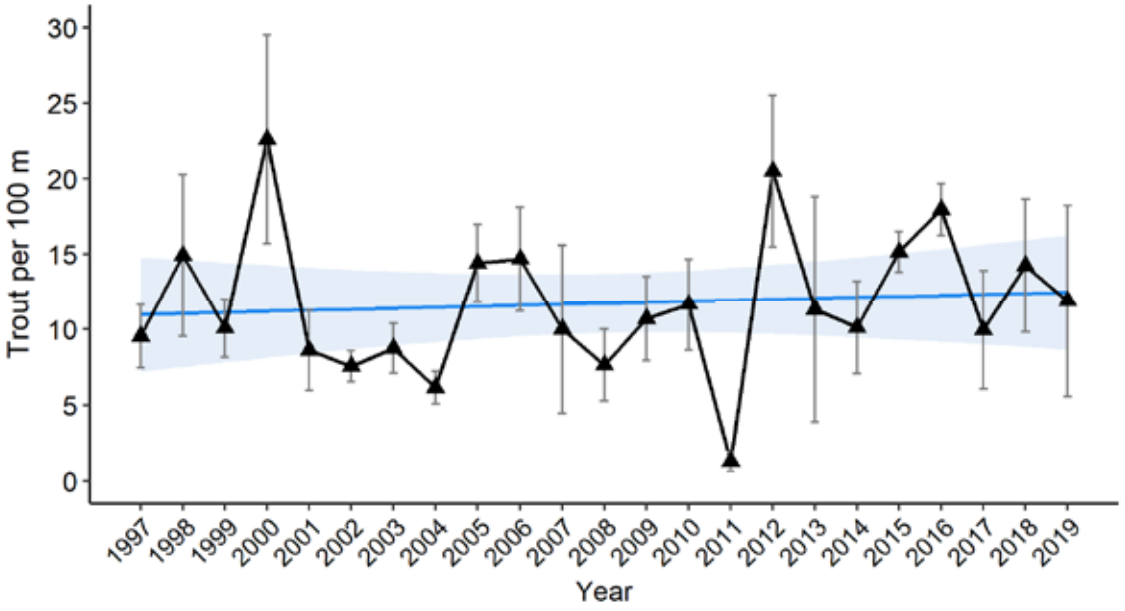

Figure 2. Annual changes in abundance of trout from Victorian trout streams surveyed as part of the Wild Trout Fisheries Management Program. (Black line = average value and standard error bar for all streams surveyed each year. Blue line = long term trend line calculated using the generalized additive model (GAM) with the shaded blue area representing the 95% confidence interval of the GAM).

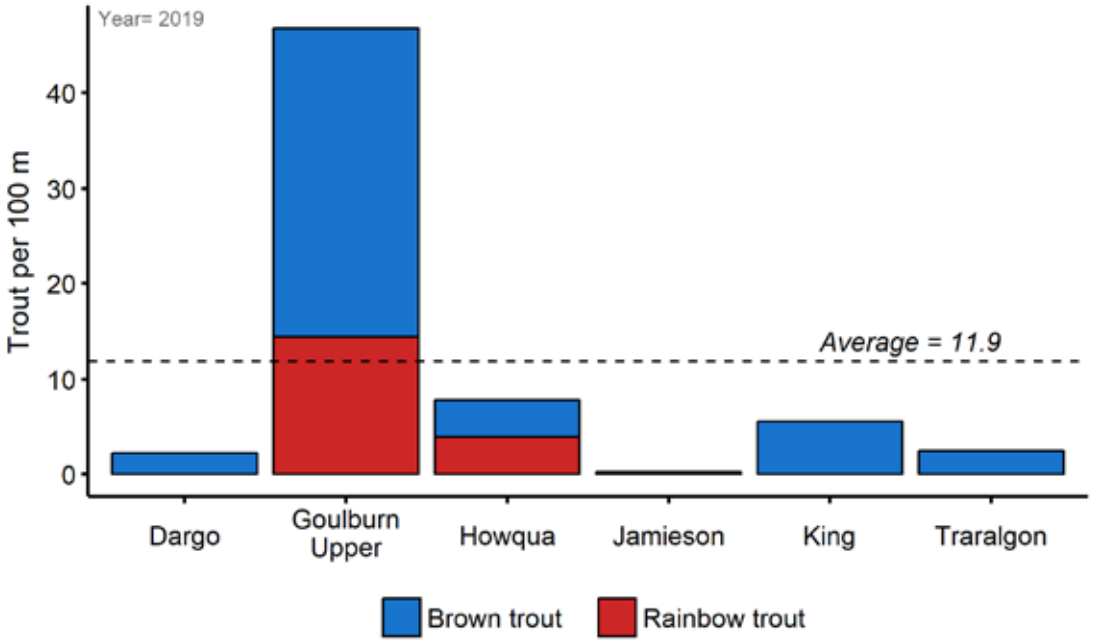

Figure 3. Abundance estimates of brown trout and rainbow trout caught during surveys of six wild trout streams. (Bars = average abundance. Dots = abundance estimates for each site surveyed in each stream).

Trout size range

The size range of brown trout and rainbow trout measured during electrofishing surveys of streams conducted as part of the *Wild Trout Wild Trout Fisheries Management Program* in 2019 and the previous four years are presented in Appendix III. Overall, in 2019 there were good signs that trout had spawned recently (last 12 months) as indicated by presence of large numbers of both small trout < 12 cm (5 inches). Mature trout capable of spawning (> 30 cm, >12 inches) were also present.

The size (length) of brown trout and rainbow trout caught during surveys conducted in 2019 is provided in Figure 4.

The highest average length of brown trout was observed in the Howqua River (17 cm, 7 inches) (ignoring the one 25 cm brown trout caught in the Jamieson River), followed by the King River (14.4 cm, 6 inches) (Figure 4). The largest brown trout measured (47 cm, 18.5 inches) was caught in the King River system. The highest average length of rainbow trout was observed in the upper Goulburn River (13 cm, 5 inches), and the largest measured (34 cm, 13.5 inches) was also from in the upper Goulburn River (Figure 4).

The highest abundance of trout over 20 cm (8 inches) was recorded in the upper Goulburn River (5.7 trout/ 100m). These trout, which represented 12% of the catch, averaged 25 cm (10 inches) (Figure 5). However, the highest average size of trout over 20 cm was recorded in the King River (30 cm, 12 inches) (Figure 5c).

Length weight relationships for brown trout and rainbow trout are provided in Appendix IV.

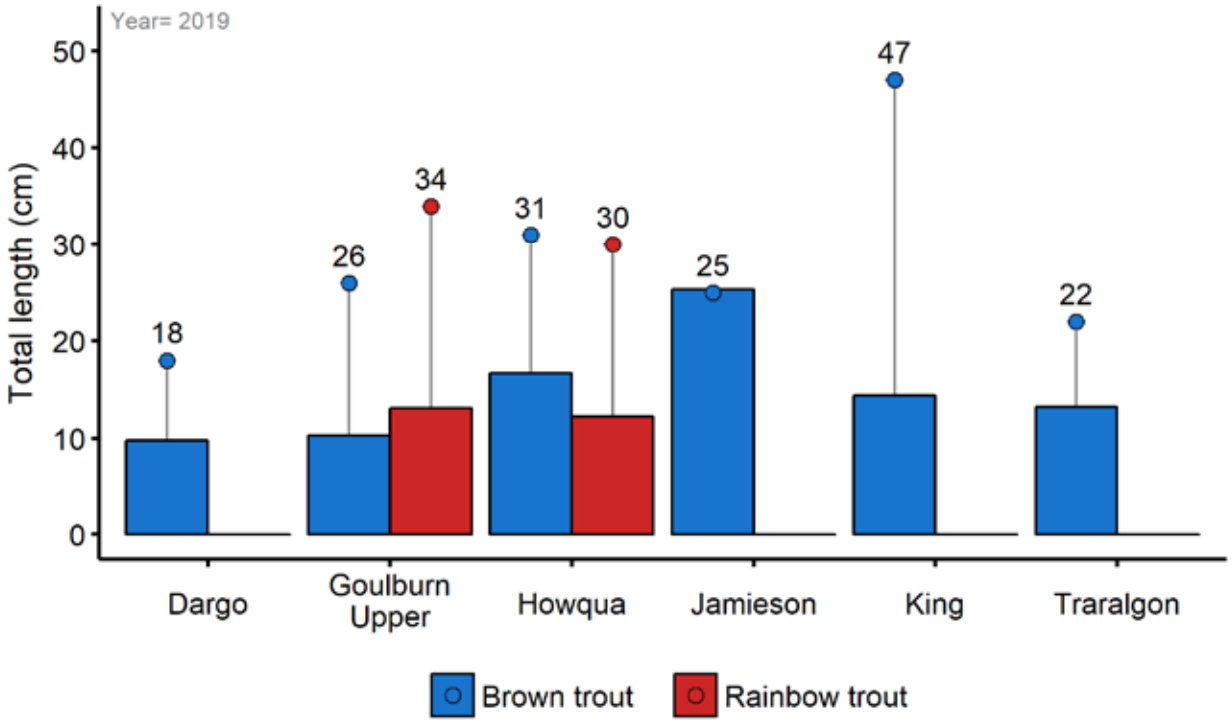

Figure 4. Length of brown trout and rainbow trout caught during surveys of six wild trout streams. (Bars = average length. Dots = Maximum length measured).

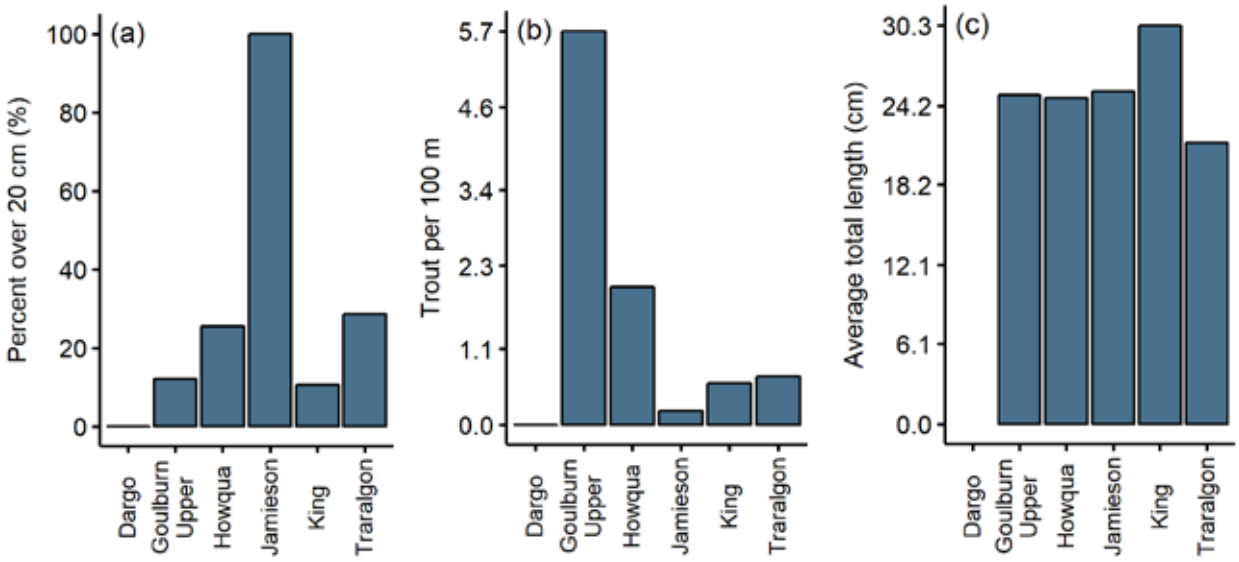

Figure 5. Trout over 20 cm (8 inches). (a) Percent of trout caught.
(b) Abundance of trout over 20 cm (trout/ 100m). (c) Average total length of trout over 20 cm

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Location: Dargo River (including Two Mile Creek)

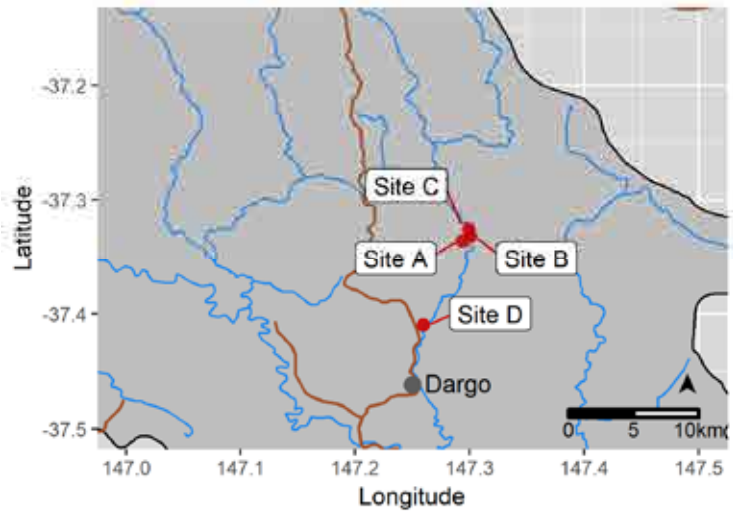
Surveyed: 2-4 April 2019

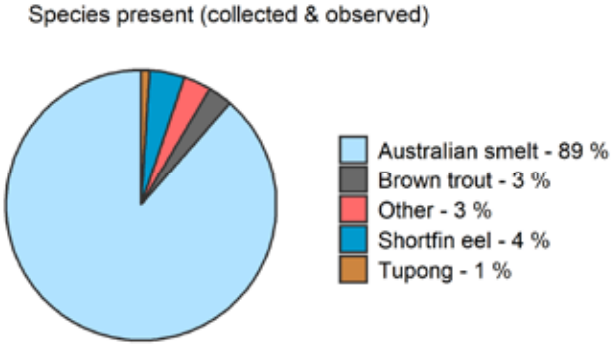
Site A: Upper Dargo Road Site 1 (140 m stretch)
Site B: Upper Dargo Road Site 2 (200 m stretch)
Site C: Upper Dargo Road Site 3 (Harrisons Cut) (390 m stretch)
Site D: Two Mile Creek Junction (160 m stretch)

Key health indicators

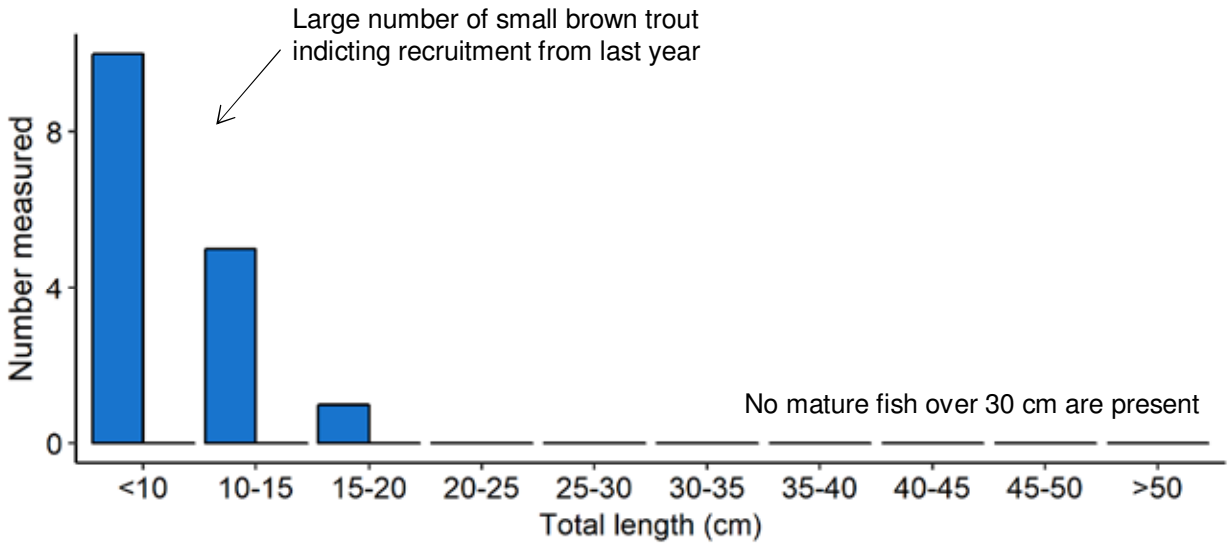
Abundance	⇩
Recent recruitment	✓
Multiple size classes	Some
Mature fish	✘
Overall rating	Low

Monitoring results		Brown trout	Rainbow trout	ALL TROUT
Total number of fish caught in 890 m of river		16	0	16
Mean fish abundance (fish per 100 m)		2.2	-	2.2
Largest fish	Weight	0.08 kg (0.2 lb)	-	0.08 kg (0.2 lb)
	Length	18 cm (7 “)	-	18 cm (7 “)
% of catchable (20 cm +) fish		0 %	-	0 %
Average size of catchable fish (20 cm +)		-	-	-
Abundance of catchable fish per 100 m		-		-
Other species present:	Australian grayling, Australian smelt, galaxiid minnows, longfin eel, river blackfish, shortfin eel and tupong.			

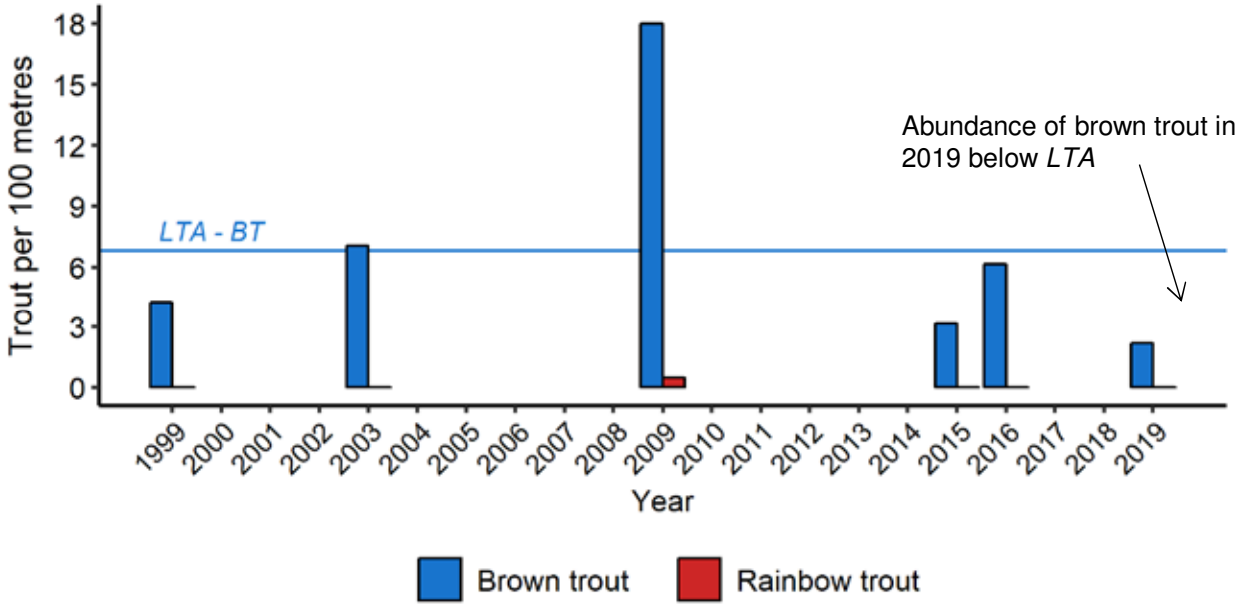




Dargo River trout size range in 2019



Dargo River abundance



The 2019 survey suggests the Dargo River supports moderate numbers brown trout and no rainbow trout. There are juvenile brown trout present, indicting recruitment from last year's spawnings. Brown trout abundance is below estimates from surveys in recent years and is below the long-term average (LTM). Jordan-Scotty incubator boxes containing brown trout eggs were placed in the Dargo River at the survey sites in 2018. However, the low number of fish caught in 2019 suggests these eggs have made negligible contribution to the population (see Jordan Scotty Update, these proceedings).

Location: Upper Goulburn River (above Lake Eildon)

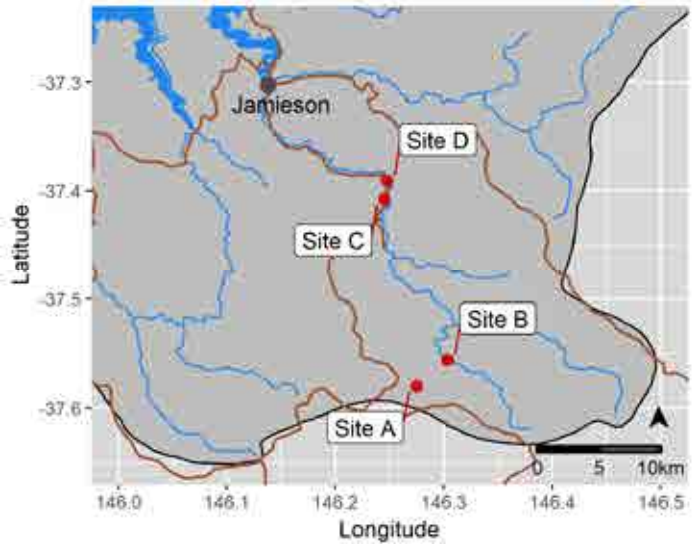
Surveyed: 13 Mar. - 5 Apr. 2019

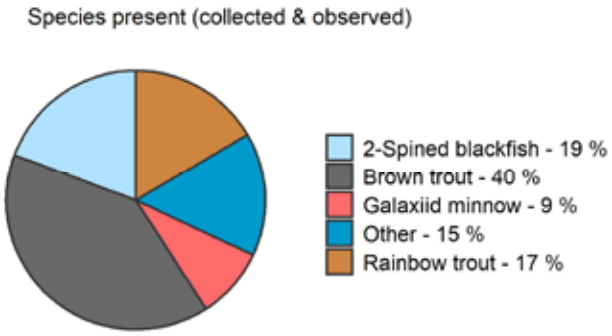
Site A: Johnson Hill Track (160 m stretch)
Site B: Clarke Spur Track (240 m stretch)
Site C: Picnic Point (200 m stretch)
Site D: Blue Hole (300 m stretch)

Key health indicators

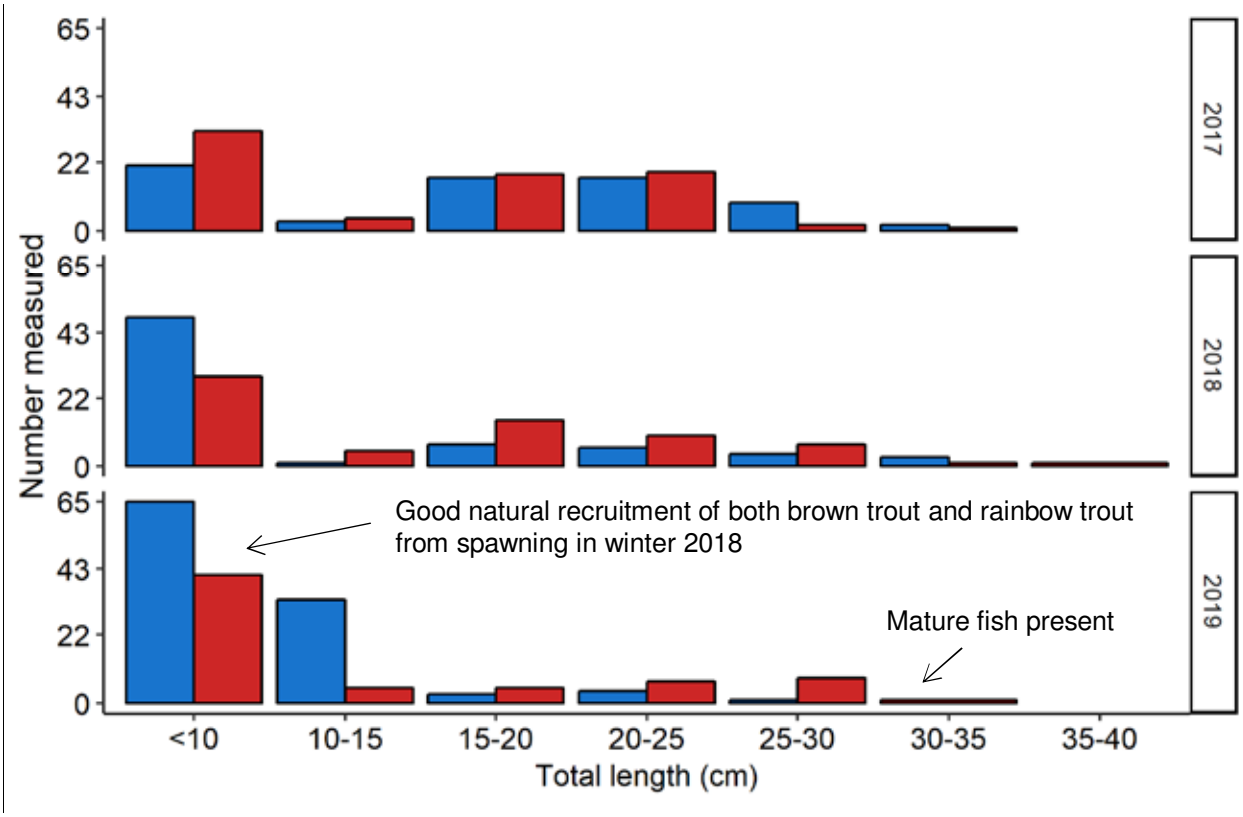
Abundance	⇧
Recent recruitment	✓
Multiple size classes	✓
Mature fish	✓
Overall rating	**Excellent**

Monitoring results		Brown trout	Rainbow trout	ALL TROUT
Total number of fish caught in 900 m of river		275	111	386
Mean fish abundance (fish per 100 m)		32	14	47
Largest fish	Weight	0.2 kg (0.4 lb)	0.3 kg (0.6 lb)	0.3 kg (0.6 lb)
	Length	26 cm (10 “)	34 cm (13.5 “)	34 cm (13.5 “)
% of catchable (20 cm +) fish		5 %	24 %	12 %
Average size of catchable fish (20 cm +)		23 cm (9 “)	25 cm (10 “)	25 cm (10 “)
Abundance of catchable fish per 100 m		1.5	3.4	5.7
Other species present:	2-spined blackfish, common carp, galaxiid minnows, Murray spiny crayfish, redfin perch and roach.			

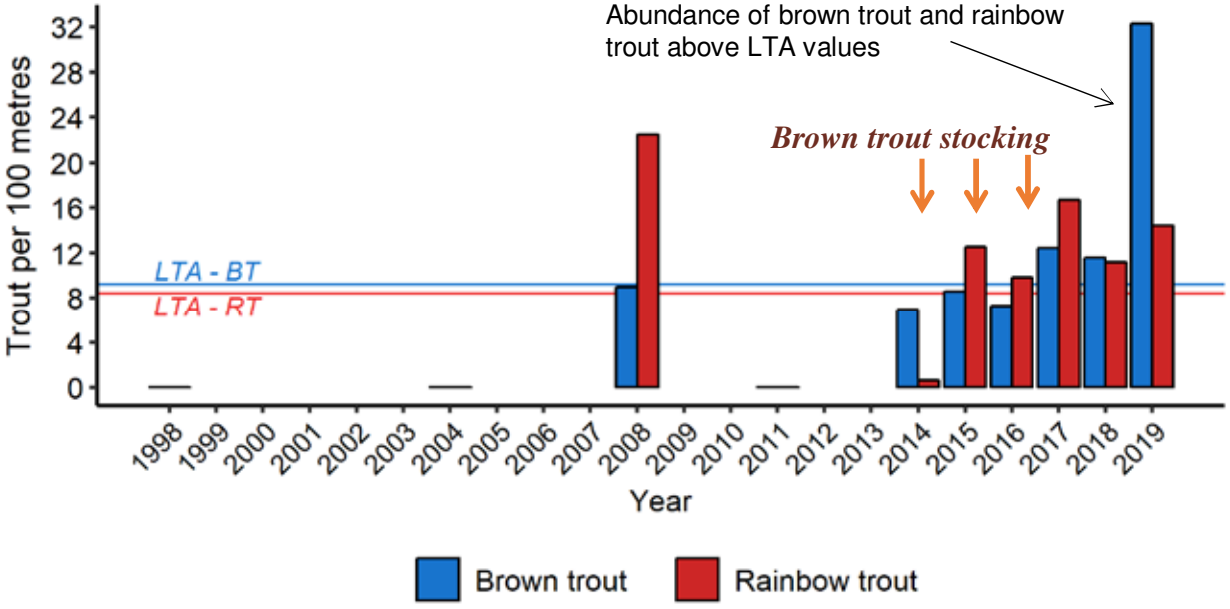




Upper Goulburn River size range over last three years



Upper Goulburn River abundance



The 2019 survey indicates the upper Goulburn River supports excellent numbers of small to medium sized brown trout and good numbers of small rainbow trout. There is good evidence of recent natural recruitment and mature fish are present. Trout abundance is above long-term average values.

Location: Howqua River

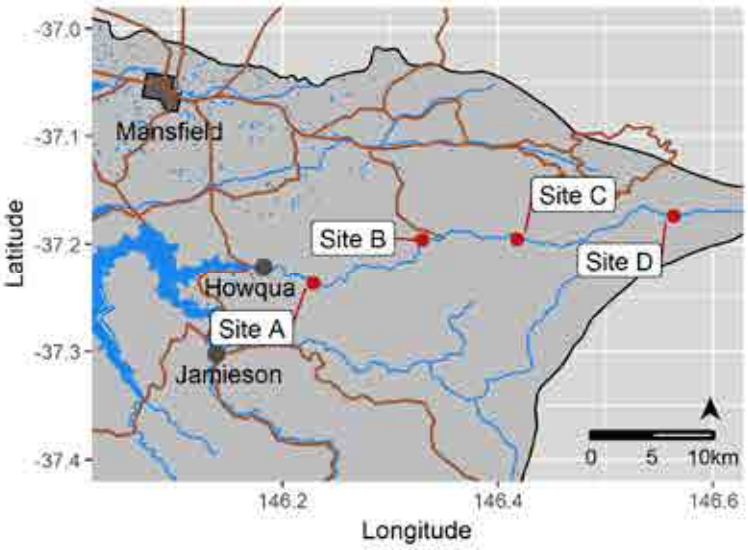
Surveyed: 18 – 19 Mar. 2019

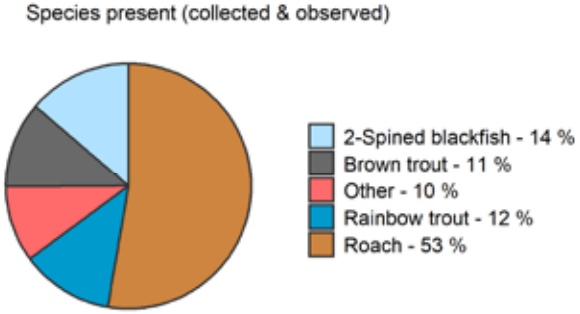
Site A: Running Creek (190 m stretch)
Site B: Frys Hut on the Howqua River (220 m stretch)
Site C: Seven Mile Flats on the Howqua River (200 m stretch)
Site D: Bindaree on the Howqua River (1.6 km stretch)

Key health indicators

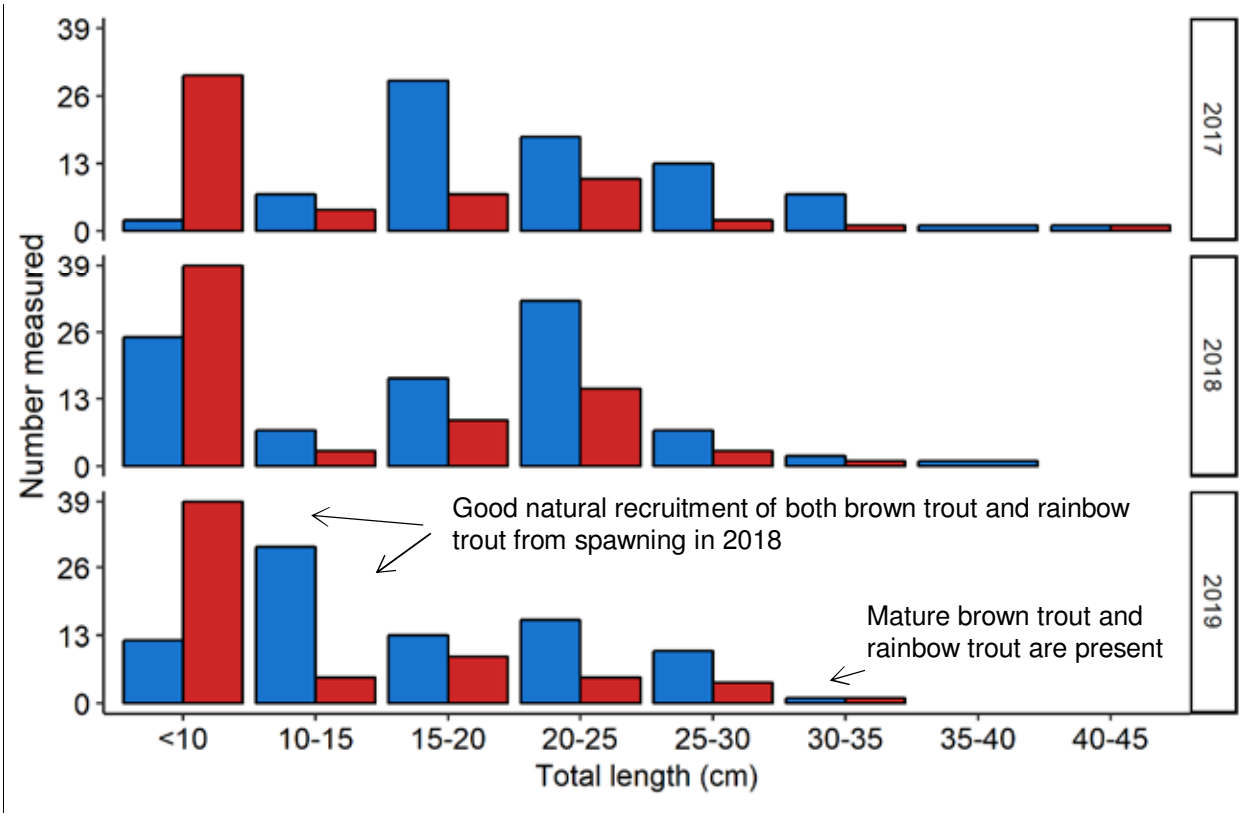
Abundance	⇩
Recent recruitment	✓
Multiple size classes	✓
Mature fish	✓
Overall rating	Good

Monitoring results		Brown trout	Rainbow trout	ALL TROUT
Total number of fish caught in 2.21 km of river		93	95	188
Mean fish abundance (fish per 100 m)		4	4	8
Largest fish	Weight	0.3 kg (0.6 lb)	0.6 kg (1.3 lb)	0.3 kg (0.6 lb)
	Length	31 cm (12 “)	30.5 cm (12 “)	31 cm (12 “)
% of catchable (20 cm +) fish		33 %	16 %	26 %
Average size of catchable fish (20 cm +)		25 cm (10 “)	25 cm (10 “)	25 cm (10 “)
Abundance of catchable fish per 100 m		1.3	0.6	2
Other species present:	2-spined blackfish, common carp, galaxiid minnows, Murray spiny crayfish, redfin perch, roach and yabbies.			



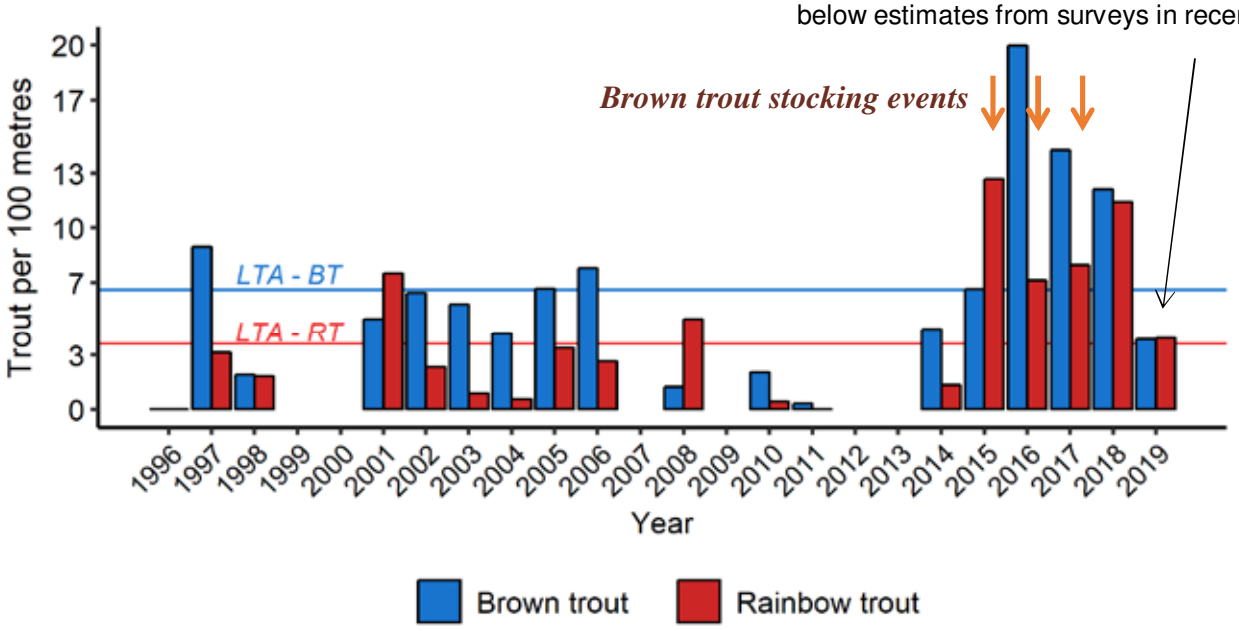


Howqua River size range over last three years



Howqua River abundance

Abundance of brown trout and rainbow trout below estimates from surveys in recent years



The 2019 survey suggests the Howqua River supports moderate numbers of small and medium sized brown trout and rainbow trout. Abundance of brown trout and rainbow trout are below estimates from surveys in recent years, and the abundance of brown trout is below the long-term average (LTA). There is good evidence of recent natural recruitment of rainbow trout, and mature fish capable of spawning are present.

Location: Jamieson River

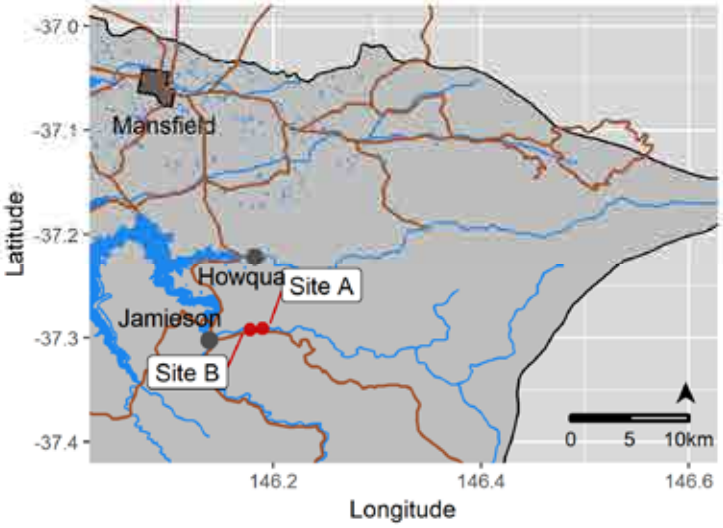
Surveyed: 20 Mar. 2019

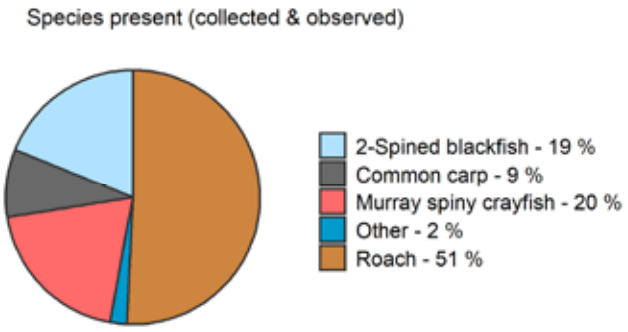
Site A: Jamieson Valley Retreat (250 m stretch)
Site B: Bosnans Track Site 2 (270 m stretch)

Key health indicators

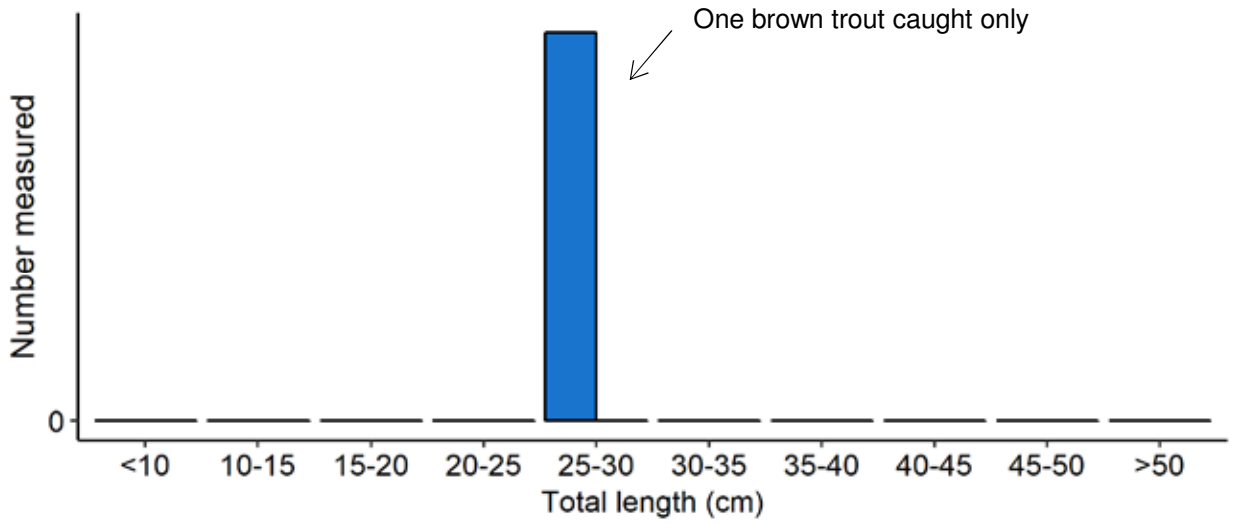
Abundance	⇩
Recent recruitment	✘
Multiple size classes	✘
Mature fish	✘
Overall rating	Low

Monitoring results		Brown trout	Rainbow trout	ALL TROUT
Total number of fish caught in 520 m of river		1	0	1
Mean fish abundance (fish per 100 m)		0.2	-	0.2
Largest fish	Weight	0.2 kg (0.4 lb)	-	0.2 kg (0.4 lb)
	Length	25 cm (10 “)	-	25 cm (10 “)
% of catchable (20 cm +) fish		100 %	-	100 %
Average size of catchable fish (20 cm +)		25 cm (10 “)	-	25 cm (10 “)
Abundance of catchable fish per 100 m		0.2	-	0.2
Other species present:	2-spined blackfish, common carp, Murray spiny crayfish, redfin perch and roach.			

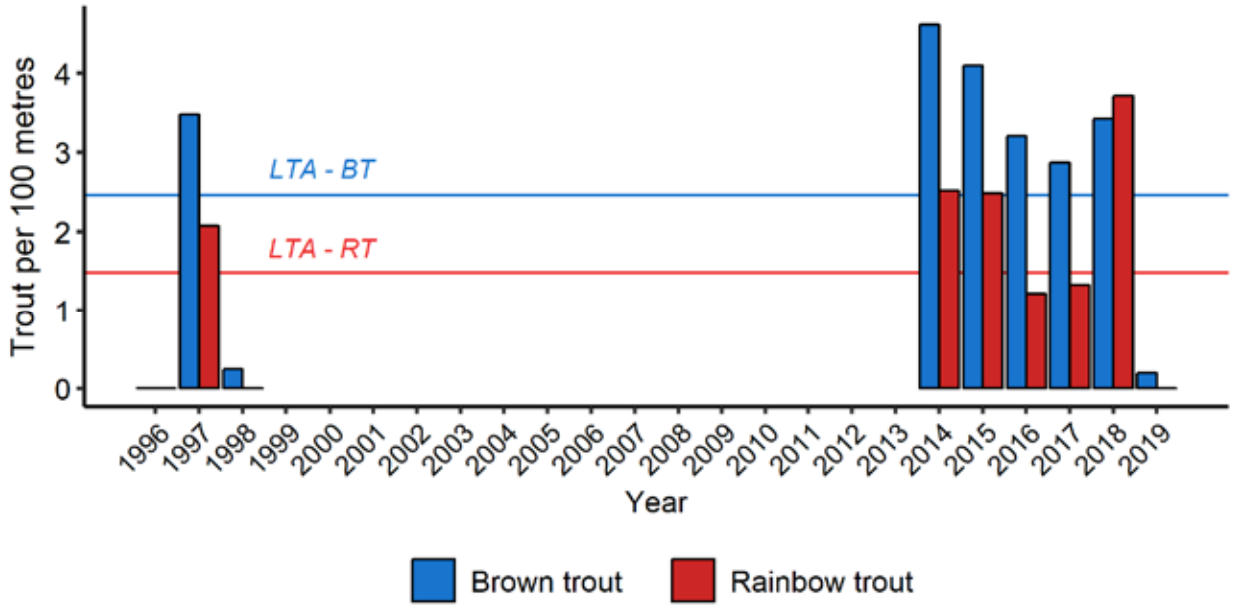




Jamieson River size range in 2019



Jamieson River abundance



The 2019 survey suggests the Jamieson River supports low numbers of brown trout only. Just one brown trout and no rainbow trout were caught during the survey. Abundance of brown trout was well below long-term average (LTA). There was no evidence of recent recruitment. Jordan Scotty incubator boxes containing brown trout eggs were placed in the Jamieson in 2017 and 2018. Some fish from the boxes were identified during the 2018 survey only. However, the low number of fish caught in 2019 suggests these eggs have made negligible contribution to the population (see Jordan Scotty Update, these proceedings).

Location: King River system (below Lake William Hovell)

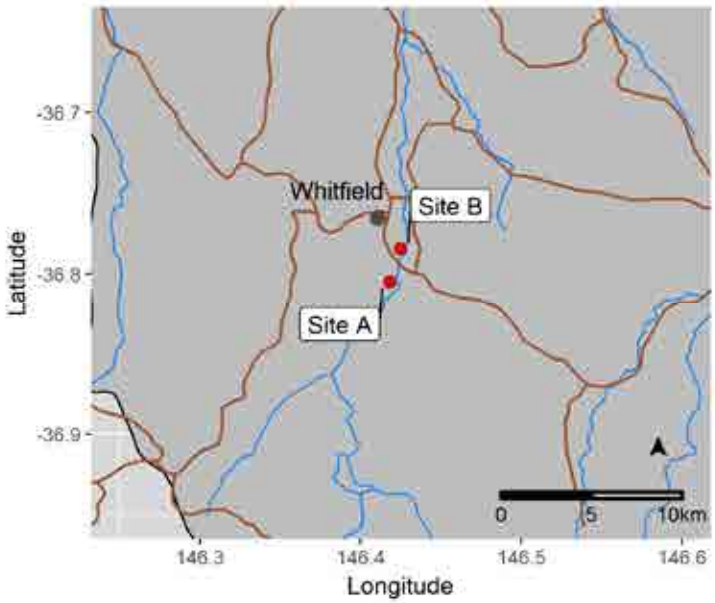
Surveyed: 21 Mar. 2019

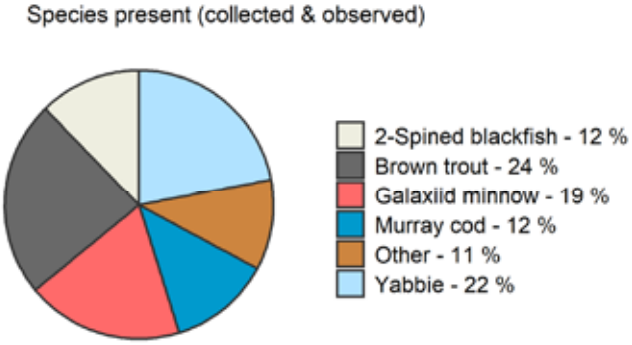
Site A: Hardy's Lane, Queens Creek (210 m stretch)
Site B: King River below Queens Creek Junction (290 m stretch)

Key health indicators

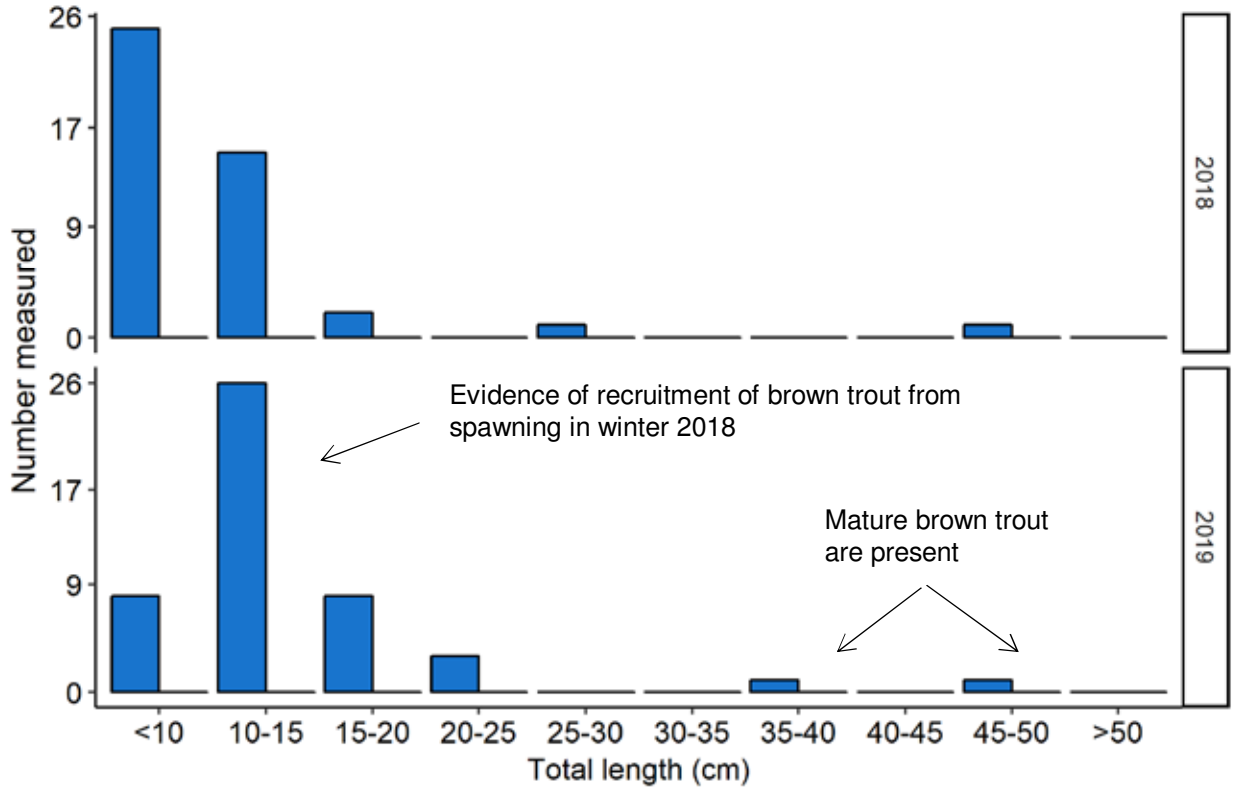
Abundance	⇧
Recent recruitment	✓
Multiple size classes	✓
Mature fish	✓
Overall rating	**Excellent**

Monitoring results		Brown trout	Rainbow trout	ALL TROUT
Total number of fish caught in 500 m of river		47	0	44
Mean fish abundance (fish per 100 m)		5.6	-	5.6
Largest fish	Weight	0.6 kg (1.3 lb)	-	0.6 kg (1.3 lb)
	Length	47 cm (18.5 ")	-	47 cm (18.5 ")
% of catchable (20 cm +) fish		11 %	-	11 %
Average size of catchable fish (20 cm +)		30 cm (12 ")	-	30 cm (12 ")
Abundance of catchable fish per 100 m		0.6	-	0.6
Other species present:	2-spined blackfish, common carp, galaxiid minnows, gambusia, Murray cod, Murray spiny crayfish, river blackfish, southern pygmy perch and yabbies.			

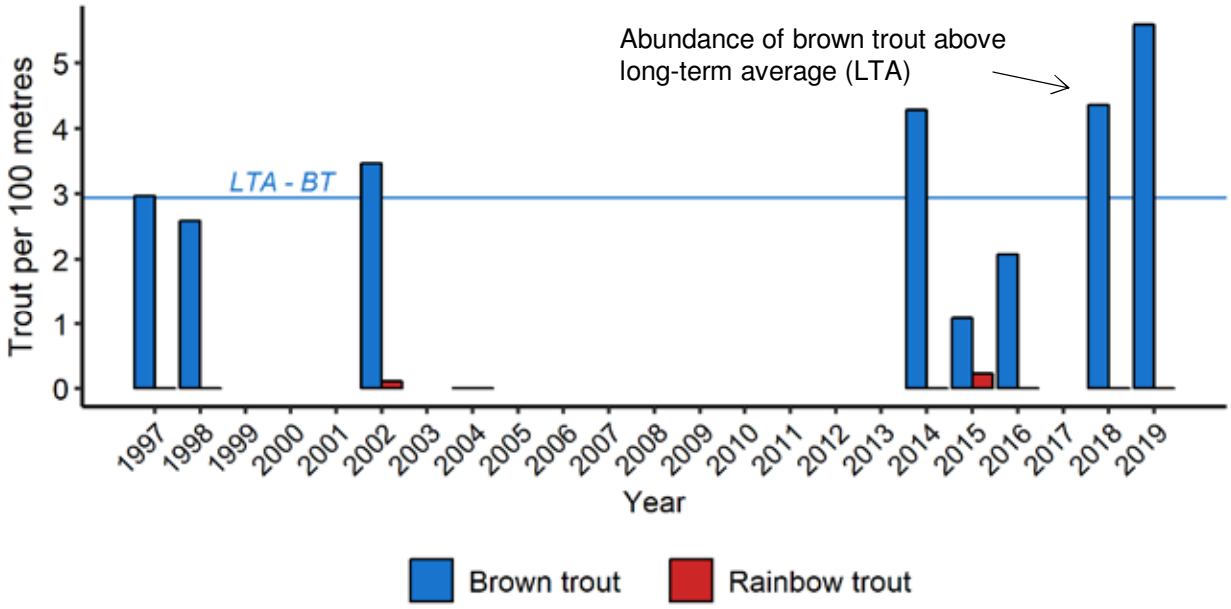




King River system size range over last two years



King River system abundance



The 2019 survey suggests the King River system below Lake William Hovell supports good numbers of small to medium sized brown trout. Brown trout were collected in Queens Creek only. No rainbow trout were collected. Abundance of brown trout in 2019 is above the long-term average (LTM). There is evidence of recent recruitment and mature brown trout capable of spawning are present. Jordan Scotty incubator boxes containing brown trout eggs were placed in the system in 2017, 2018 and 2019. No fish from the 2017 eggs and some fish from 2018 were detected in subsequent surveys (see Jordan Scotty Update, these proceedings).

Location: Traralgon Creek

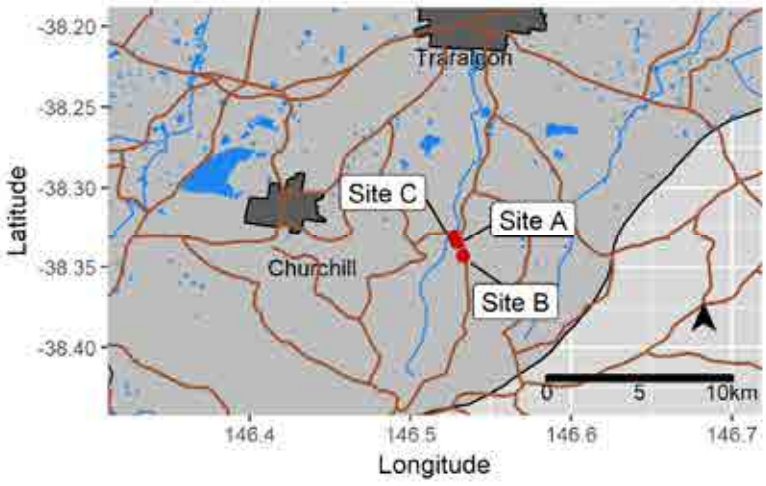
Surveyed: 13-14 Mar. 2019

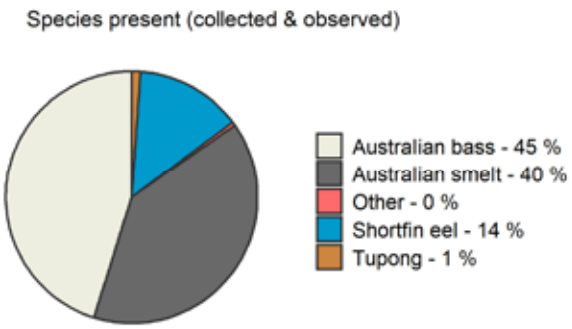
Site A: Lower Traralgon Creek Road (360 m stretch)
Site B: Koornalla Picnic Reserve (240 m stretch)
Site C: Thompsons Bridge (140 m stretch)

Key health indicators

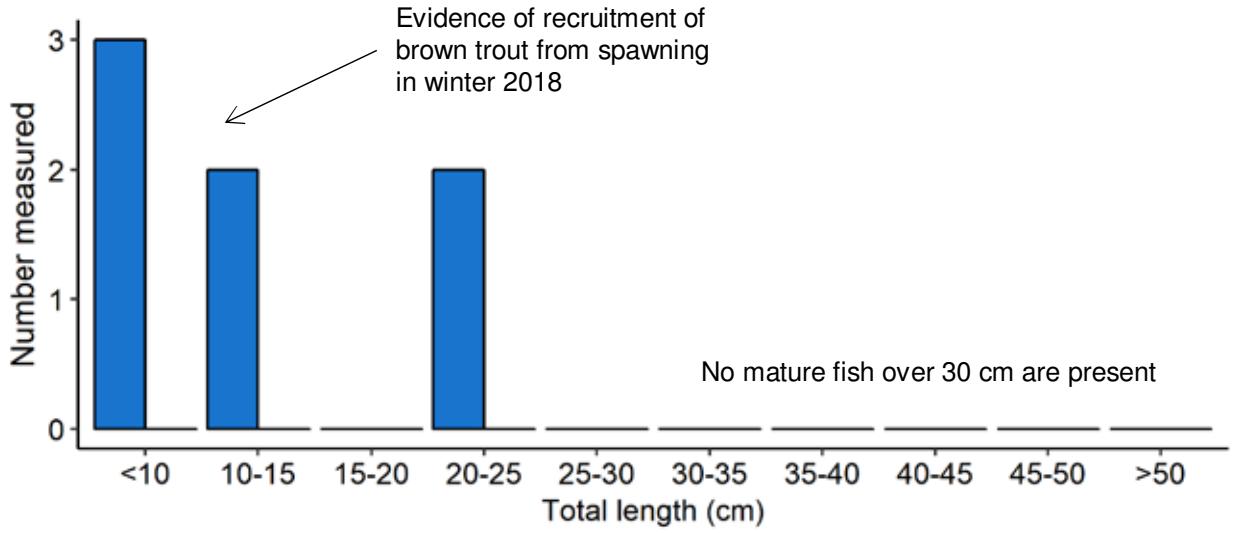
Abundance	⇩
Recent recruitment	✓
Multiple size classes	**Some**
Mature fish	✘
Overall rating	**Low**

Monitoring results		**Brown trout**	**Rainbow trout**	**ALL TROUT**
Total number of fish caught in 740 m of river		7	0	7
Mean fish abundance (fish per 100 m)		2.4	-	2.4
Largest fish	Weight	0.1 kg (0.2 lb)	-	0.1 kg (0.2 lb)
	Length	22 cm (8 “)	-	22 cm (8 “)
% of catchable (20 cm +) fish		29 %	-	29 %
Average size of catchable fish (20 cm +)		21 cm (8.5 “)	-	21 cm (8.5 “)
Abundance of catchable fish per 100 m		0.7	-	0.7
Other species present:	Australian bass, Australian smelt, shortfin eel and tupong.			

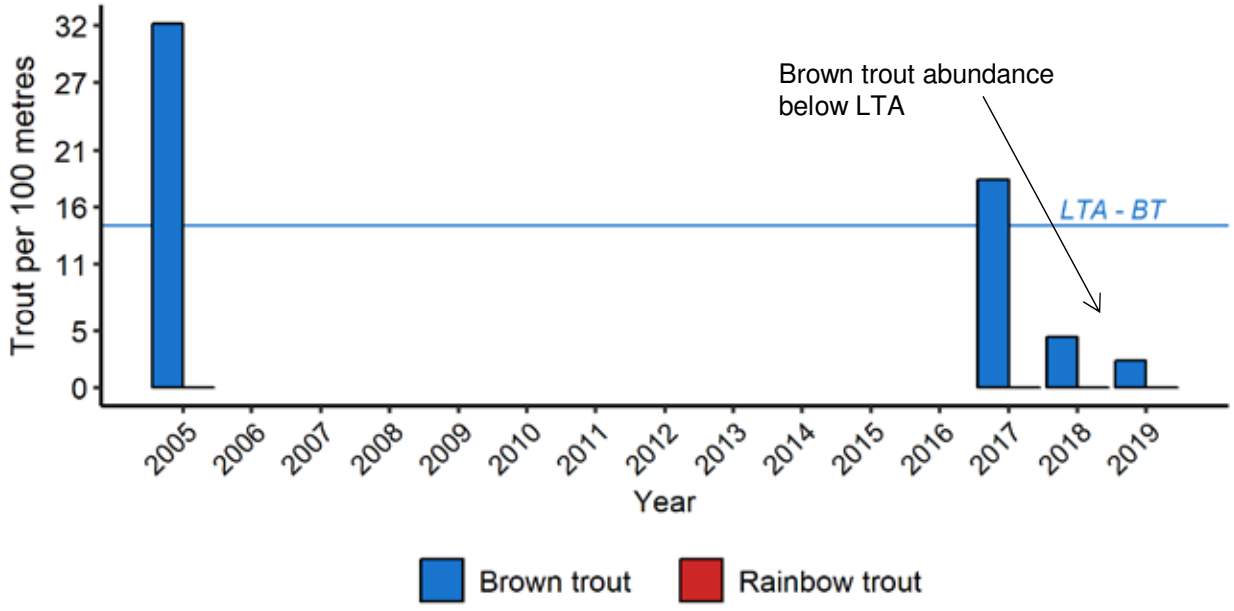




Traralgon Creek size range in 2019



Traralgon Creek abundance



The 2019 survey suggests the Traralgon Creek supports moderate numbers of brown trout. Rainbow trout are absent. There is evidence of recent recruitment as indicated by the presence of small (<10 cm) brown trout. However, mature trout capable of spawning are absent. Abundance of brown trout is below estimates from surveys in recent years and is below the long-term average (LTA). Jordan Scotty incubator boxes containing brown trout eggs were placed in the system in 2017 and 2018. No fish from the 2017 eggs and some fish from 2018 were detected in subsequent surveys (see Jordan Scotty Update, these proceedings).

Appendix I: Wild trout streams surveyed as part of the Wild Trout Fisheries Management Program

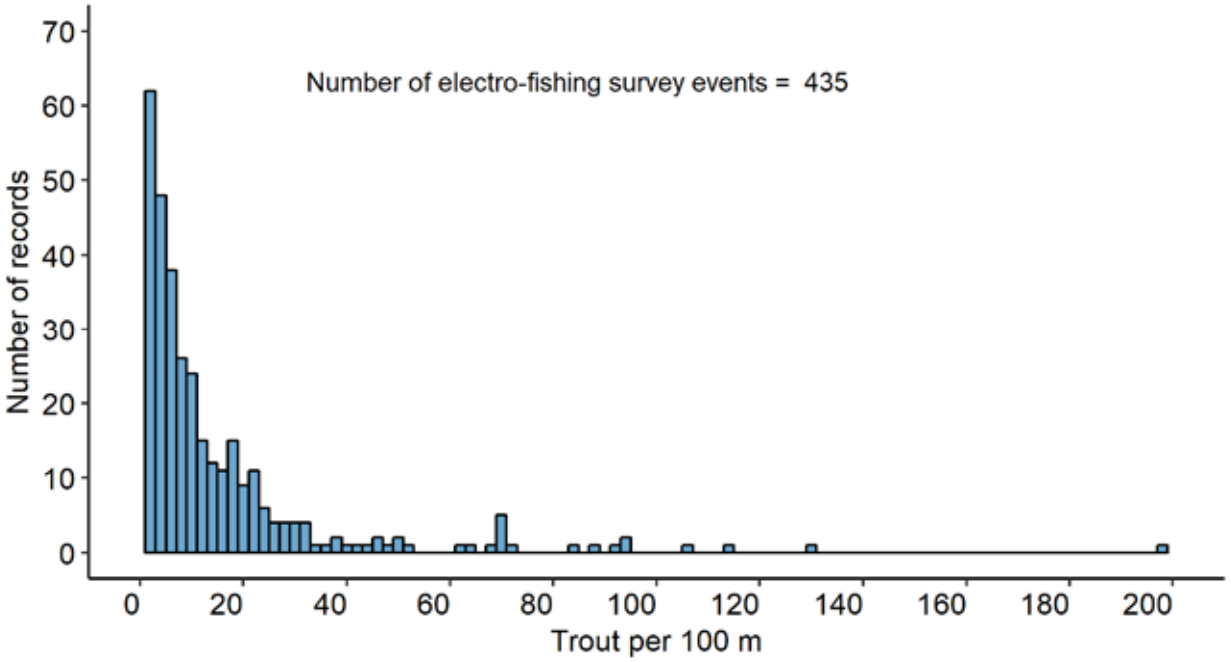
Results of surveys of selected wild trout streams conducted as part of the Wild Trout Wild Trout Fisheries Management Program. See Hunt and Lieschke (2015), Hunt and Lieschke (2016), Ingram *et al.* (2017) Ingram and Lieschke (2018) and Ingram and Lieschke (2019, this report) for further details.

Stream	Year last assessed	Abundance	Recent recruitment	Multiple year classes	Mature fish	Overall rating
Aire River	2015	Not scored	✓	✓	✓	Excellent
Barkly River	2016	Not scored	✓	✓	✓	Very good
Buckland River	2018	⇧	✓	✓	✓	Very good
Dargo River System (including Two Mile Creek)	2019	⇩	✓	Some	✘	Low
Goulburn River tailrace	2017	⇩	Some	✓	✓	Moderate
Upper Goulburn River	2019	⇧	✓	✓	✓	Excellent
Howqua River	2019	⇩	✓	✓	✓	Good
Jamieson River	2019	⇩	✘	✘	✘	Low
Kiewa River system (including Running Creek)	2016	Not scored	✓	✓	✓	Excellent
King River	2016	Not scored	✓	✓	✓	Good
King River system (below Lake William Hovell)	2019	⇧	✓	✓	✓	Excellent
Merri and Hopkins Rivers	2017	?	Some*	✓	✓	Excellent
Mitta Mitta River system (including Bundara River and Big River)	2017	⇩	✓	✓	✓	Good
Morass Creek	2016	Not scored	✓	✓	✓	Very good
Nariel Creek system (including Wheeler Creek)	2017	⇩	✘	✓	✓	Low
Ovens River system (including Buckland River)	2017	⇩	✓	✓	✓	Moderate
Tooronga River	2015	Not scored	✓	✓	✓	Excellent
Traralgon Creek	2019	⇩	✓	Some	✘	Low
Wellington River	2017	?	✘	Some	✘	Low
Yarra River	2015	Not scored	✓	✓	✓	Good

* Recruitment likely due to recent stocking.

Appendix II: Historic trout abundance

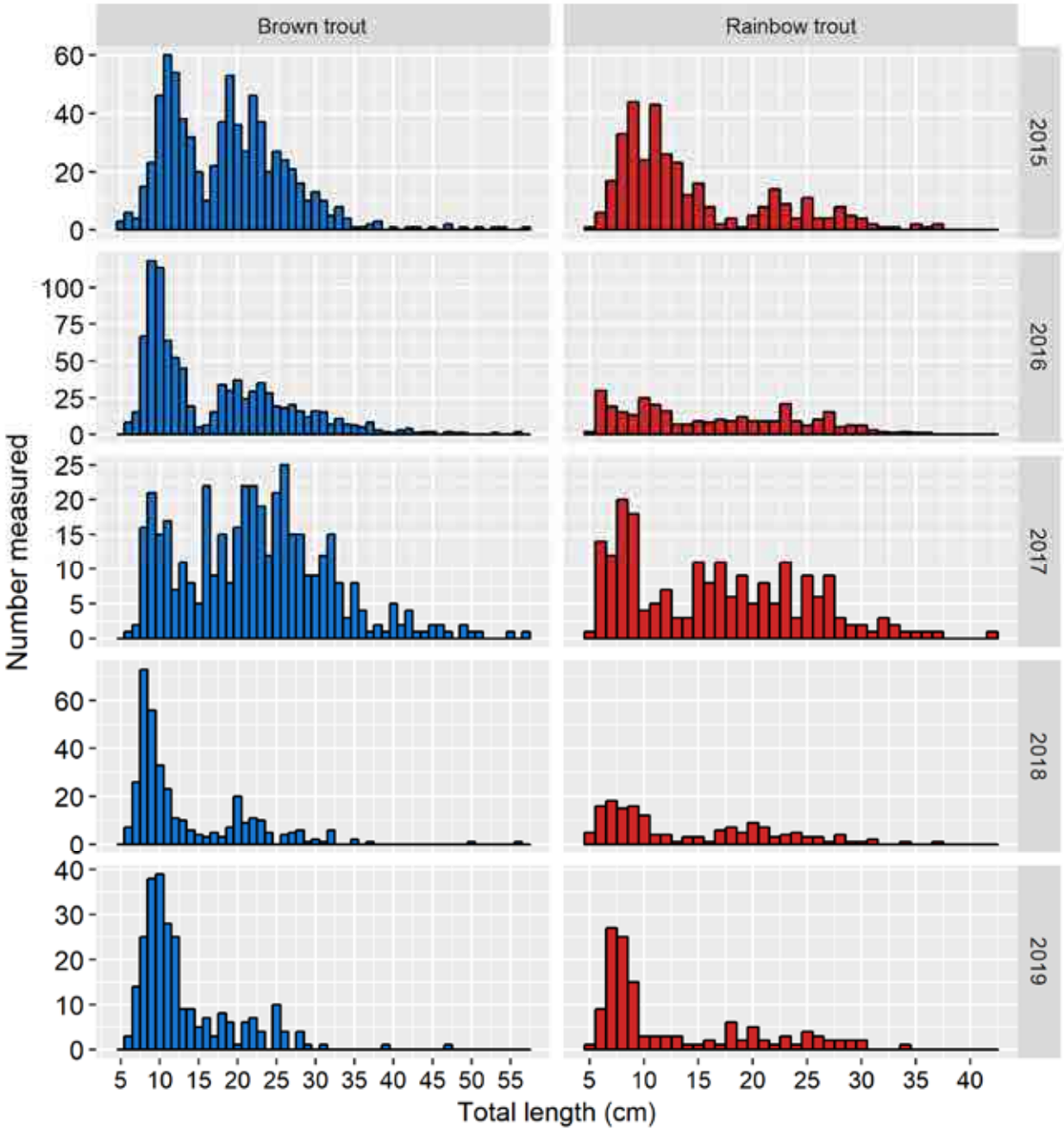
Abundance of trout (per 100 m) estimated from historic electrofishing survey data and contemporary electrofishing surveys of trout streams conducted as part of the *Wild Trout Wild Trout Fisheries Management Program* (Appendix I) (435 events).



Abundance:	Low	< 1 fish per 100 m
	Moderate	1 –5 fish per 100 m
	Good	5 – 15 fish per 100 m
	Very good	15 – 25 fish per 100 m
	Excellent	25 – 50 fish per 100 m
	Exceptional	> 50 fish per 100 m

Appendix III: Size range of trout measured over the last five years

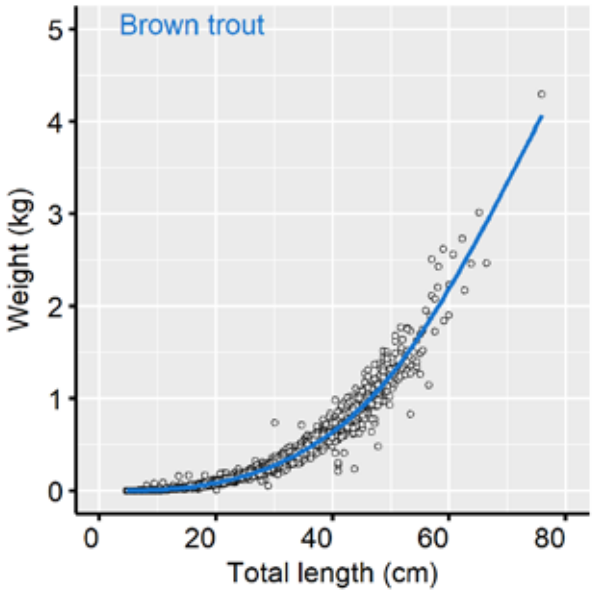
Size range of brown trout and rainbow trout measured during electrofishing surveys of streams conducted as part of the *Wild Trout Wild Trout Fisheries Management Program (Appendix I)* (data for all streams combined).

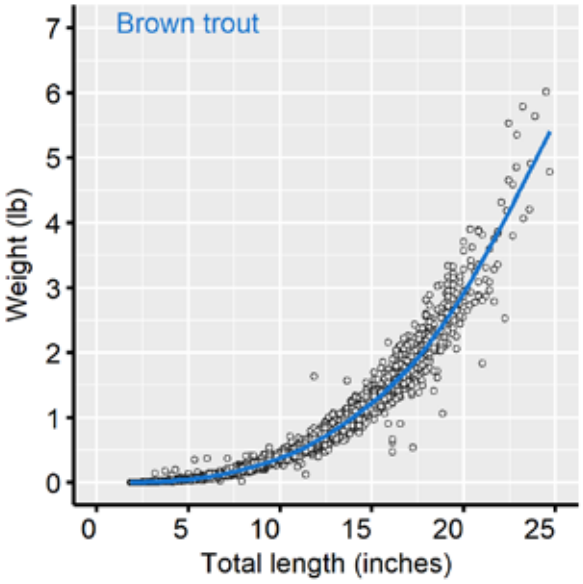


Year	Brown trout			Rainbow trout		
	Number measured	**Size range** (total length in cm)	**Percent over 20 cm**	**Number measured**	**Size range** (total length in cm)	**Percent over 20 cm**
2015	745	5 – 57	40	345	5.5 – 36.7	24
2016	931	6.1 – 56.5	34	317	5.2 – 35.6	35
2017	420	6.2 – 56.8	60	206	5.3 – 42.4	36
2018	352	6.2 - 56	21	161	4.7 – 37.5	26
2019	259	6.2 - 46.7	15	130	4.8 – 34.2	20

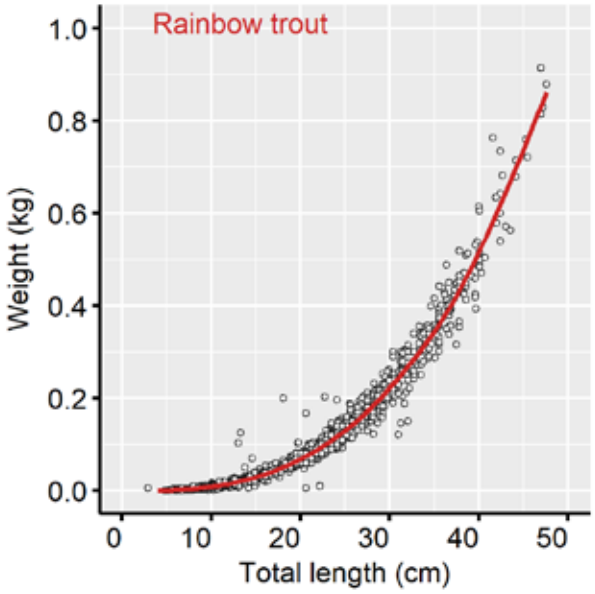
Appendix IV: Trout length – weight relationships

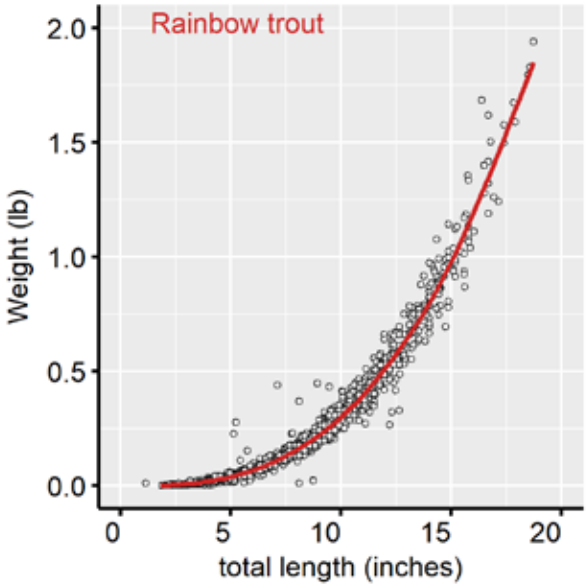
Brown trout





Rainbow trout





Howqua River trout across time

Brett Ingram and Justin Bell
Victorian Fisheries Authority

Summary of findings

The Howqua River has had a long history of being a recognised as a destination for good fishing for both brown trout and rainbow trout, which continues today.

Anecdotal angler information from historic articles dating back to the 1930s and fishery surveys conducted since 1978 indicate that population size and structure has varied widely over time. The Howqua River catchment has been impacted by several major environmental events in recent decades that have reduced trout stocks. These include the 2000-2011 Millennium drought of south-eastern Australia and the Eastern Victoria Great Divide bushfires of 2006/07.

Fishery surveys show typical year-to-year fluctuations in trout abundance. Surveys conducted in recent years conducted as part of *Wild Trout Wild Trout Fisheries Management Program* (2015-2019) have rated the Howqua River trout fishery as *Very good* in 2015, *Excellent* 2016, 2017 to 2018 and *Good* in 2019. Both the average size and maximum size of brown trout has been relatively stable over the last 4 decades. The average size of rainbow trout has declined noticeably in the last five years, but this has been due to the presence of large numbers of juveniles from very successful annual natural spawning.

Image 1. Howqua Hills 1915 (Source: Museums Victoria, https://trove.nla.gov.au).

Stocking has occurred in the Howqua River in an attempt to increase fish numbers, however, periods of stocking in the 1980s and again in recent years (2014-2016) have had little effect. Trout stocks in the river appear to be adequately sustained by natural recruitment, and perhaps immigration of fish from Lake Eildon.

Modelling available information suggested that both altitude and the Southern Oscillation Index affected trout abundance in the river, whereas more obvious factors, such as river flow and temperature, could not be fit to a model. These results suggest that there is no simple answer to the question of what affects trout

abundance in the Howqua River and that identifying key factors is complex. Factors that affect trout populations are many and varied, many of which may interact in complex ways.

Results from this review clearly demonstrate that the Howqua River trout populations (brown trout and rainbow trout) are quite resilient over time. Although fluctuations in abundance have occurred from year to year and major environment events such as bushfires and droughts have reduced abundance, the populations respond to favourable conditions through natural recruitment to sustain stocks. With good management and support from stakeholders the river should continue to support good trout fishing into the future.

Introduction

The Howqua River, a tributary of the Goulburn River system that flows into Lake Eildon, is one of Victoria's primary wild trout fisheries. "*It has a deserved reputation as a prolific trout stream and has changed little in 25 years*" (Philip Weigall) (in Various authors 1996). The river supports healthy wild populations of brown trout and rainbow trout sustained by natural recruitment. The river is a popular destination for outdoor activities and is one of the most famous rivers in the high country around Mansfield and Mt Buller, "*…the historic Howqua River is a Victorian Heritage river and a fly-fishing icon where world champions cross lines with locals*" (Fishing the High-Country Mansfield – Mt Buller, Australian trout Foundation, www.atfonline.com.au). The Howqua River has also featured in the first episode on the ABC documentary series "*A River Somewhere*" aired in 1997.

As part of the *Wild Trout Wild Trout Fisheries Management Program* the Howqua River has been surveyed annually since 2015 to obtain information for *Health cards* that give a snapshot insight into the current health of trout populations (see Ingram and Lieschke, this proceedings). The reputation of the Howqua River trout fishery has prompted a more detailed review of information about the fishery.

What we did

We provided an overview of the Howqua River trout fishery by gathering and synthesising available information, including

- Historic and contemporary published articles (books, magazines, newspapers, journals and reports)
- Historic and contemporary fishery survey and monitoring data such as,
    - Fishery surveys conducted over 42 years (1978 – 2019). Sites surveyed are shown in Figure 2.
    - Angler Diary Program records (Conron and Oliveiro 2016)
    - Recent angler surveys (2015 and 2017) (Hall and Giri 2015, Hall and Giri 2017).
- Fish stocking records.

We then attempted to identify factors influencing the abundance of trout in the Howqua River between Lake Eildon and Bindaree by analysing fishery survey data collected since 1978 together with other available information collected over the same period. These included:

- Distance of survey sites upstream from Lake Eildon, which encompassed effect of elevation.
- Average river discharge in the 12 months prior to fishery survey. River discharge information, which was obtained from the Running Creek gauge((http://www.bom.gov.au/waterdata/), encompassed effects of rainfall and river height.
- Average maximum air temperature and number of days air temperature was over 25ºC in the 12 months prior to fishery survey. Air temperature (from the Eildon Fire Tower records, http://www.bom.gov.au/climate) was used as a proxy for water temperature.
- Average Southern Oscillation Index (SOI) for the 12 months prior to fishery survey. The SOI is one of the key atmospheric indices for gauging the strength of El Niño and La Niña events and their potential impacts on Australian (http://www.bom.gov.au/climate/enso/history/ln-2010-12/SOI-what.shtml). El Niño events are associated with less rainfall, droughts and warmer days whereas La Niña events are associated with increased rainfall, floods and cooler days.
- The number of trout stocked in the 12 months prior to fishery survey.

The analysis used generalized linear mixed models (GLMMs). Akaike information criterion (AIC), an estimator of the relative fit of a statistical model, was then used to identify the "best" models, and the coefficients of these models were used to estimate how much effect the influencing factors had on trout abundance in the river.

The Howqua River

The Howqua valley was first inhabited by the Minjambuta and Tuanguarng peoples and European settlement began in the 1840s (Tent 2009). There are a number of ideas as to how the Howqua got its name but the most likely being it was named after the nickname of the merchant John "Howqua/Houqau" Hunter from the Watson and Hunter Paster Company, which established a pastoral run in area in the 1840s (Tent 2009).

In the latter half of 1800s there was both alluvial and reef gold mining in the valley. Today the valley is a popular destination for camping, fishing, hiking, four-wheel driving and white-water canoeing (https://parkweb.vic.gov.au/explore/parks/howqua-hills-h.a). Camp grounds on the river, such as at Sheepyard Flat and Frys Flat, are very popular during weekends and holidays times.

The Howqua River (Figure 2) is one of five streams (along with the Big, Upper Goulburn, Jamieson and Delatite rivers) that flow into Lake Eildon. The Howqua River is a fast-flowing river with stretches of pools riffles and rapids running through forested mountainous country, draining a catchment of 368 km^2 (State Rivers and Water Supply Commission of Victoria 1984). The river bed is mainly gravel with rock and rubble. The upper reaches pass through native forest (mixed eucalypt woodland) and riparian vegetation. Below Frys Flat the banks tend to become less vegetated and closer to Lake Eildon the river flows into cleared agricultural land. From Lake Eildon to Bindaree covers some 70 river km and rises some 570 m, from around 270 m to 840 m. Between Lake Eildon and Bindaree, nearly half of the river is inaccessible to fishing. There is a walking track along the river between Sheepyard Flat and Pikes Flat (more than 20 km) from which the river can be reached with some effort through steep bushy terrain (James 1999). As for fish, "*There are trout all the way from the base of Mt Howitt to Lake Eildon*" (Weigall 2014).

River discharge

River discharge and height is monitored at a gauge between Running Creek and Lake Eildon. Annual and monthly variation in discharge for the period from 2005 to 2018 is presented in Figure 1. Discharge patterns vary from one year to the next. The average monthly flow can range from less than 7 MegaL/day to over 3,000 MegaL/day (long-term average = 447 Megal/day). On average, discharge is greatest during August and September and lowest from January to April (Figure 1b). During the Millennium drought of the 2000s discharge was greatly reduced, particularly the peak flows in late winter to early Spring (Figure 1a). The year 2015 was also particularly dry.

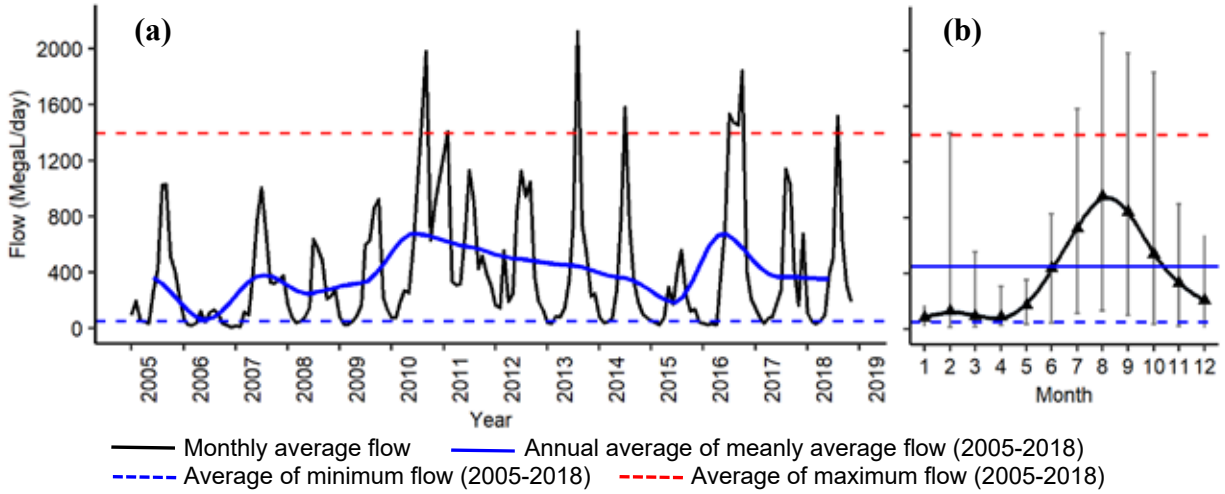


Figure 1. Water discharge (MegaL/day) in the Howqua River between 2005 and 2018. (a) Average monthly flow from 2005 to 2018. (b) Average flow per month (2005-2018) (error bars = range) (Data source: Bureau of Meteorology http://www.bom.gov.au/waterdata/. Data Owner: © Department of Environment, Land, Water and Planning).

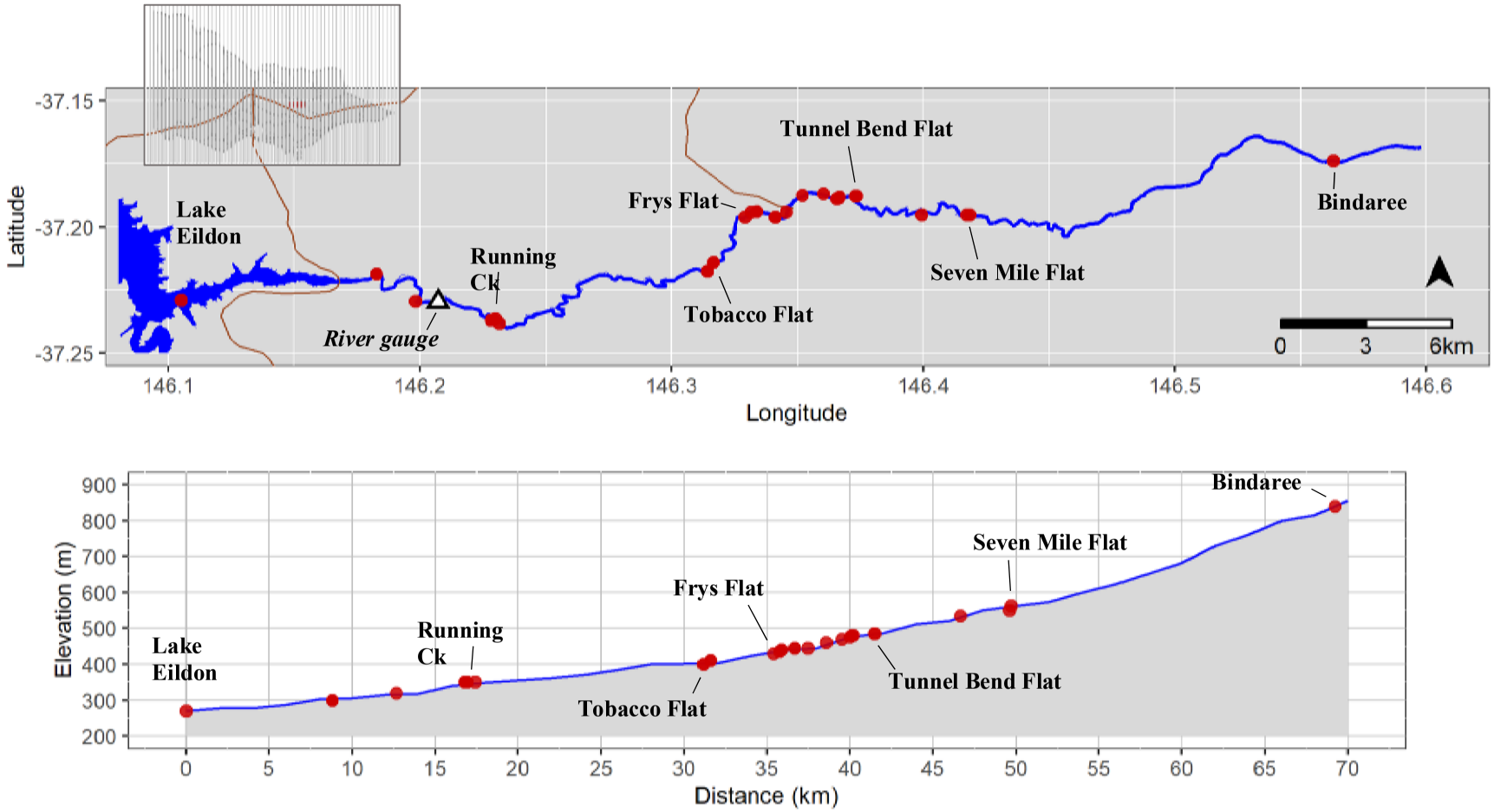


Figure 2. Map (upper) showing sites (red dots) along the Howqua River surveyed by electro-fishing between 1996 and 2019, and distance from Lake Eildon and elevation of sites (lower)

Fish Species in the Howqua

Although trout are the main species targeted by anglers fishing the Howqua River, other species are present. Along with brown trout (the most common species) and rainbow trout, two-spined blackfish, roach and redfin perch were commonly collected in surveys (Figure 3). Other species recorded from the Howqua River include galaxiid species, common carp, Australian smelt, Macquarie perch, Murray cod, Murray Spiny crayfish and yabbies.

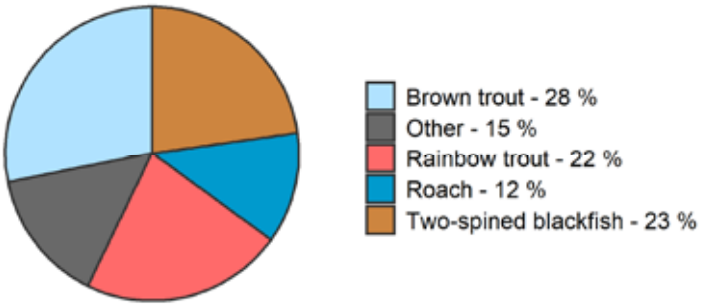


Figure 3. Species caught during fishery surveys of the Howqua River between 1978 and 2019.

Stocking history

The Howqua River was first stocked with trout some time during the late 1800s. In 1891 the Zoological and Acclimation Society distributed 14,000 fry (presumably brown trout) into a number of streams including the Jamieson, Delatite and Howqua rivers (*The Argus*, Melbourne, 7 December 1891, page 6). Stockings of trout into this area may have occurred earlier than this as the article also described "…*fine trout, a foot in length*…" had been caught in the Delatite River "…*proving that the fish placed there in former years had succeeded*".

There were irregular stockings of both brown trout and rainbow trout into the Howqua River throughout the early half of the 1900s (Figure 4). In 1932, the trout hatcheries run by Fisheries and Game were closed due to budgetary constraints. However, this did not affect trout in the Howqua River as at the time, "*The Mansfield Club had intimated that it did not want any yearlings as there were plenty of young trout in the Jamieson, Howqua Upper Goulburn and Delatite*" ("Trace" 1932). This certainly indicated that the Howqua River was being sustained by a healthy population of naturally recruiting fish.

In 1981, 5,000 rainbow trout were released into the river and between 1978 and 1990, 37,000 brown trout were released mainly into the lower reaches (Sheepyard Flat and Howquadale areas) (Figure 4). All brown trout released between 1988 and 1990 were fin-clipped to identify them as hatchery fish. A fishery survey conducted in 1991 indicted that there were good numbers of wild brown trout, but there were very few fin-clipped hatchery trout (2 fish). These results suggested that the Howqua river trout population was being sustained by natural recruitment whereas stocking made minimal contribution to the fishery. Consequently, with natural stocks available in the river no further stockings occurred (Barker 1991). Indeed, stocking in upper reaches of inflowing Eildon tributaries would not be considered when these streams supported healthy self-regulating trout populations (Department of Primary Industries 2011).

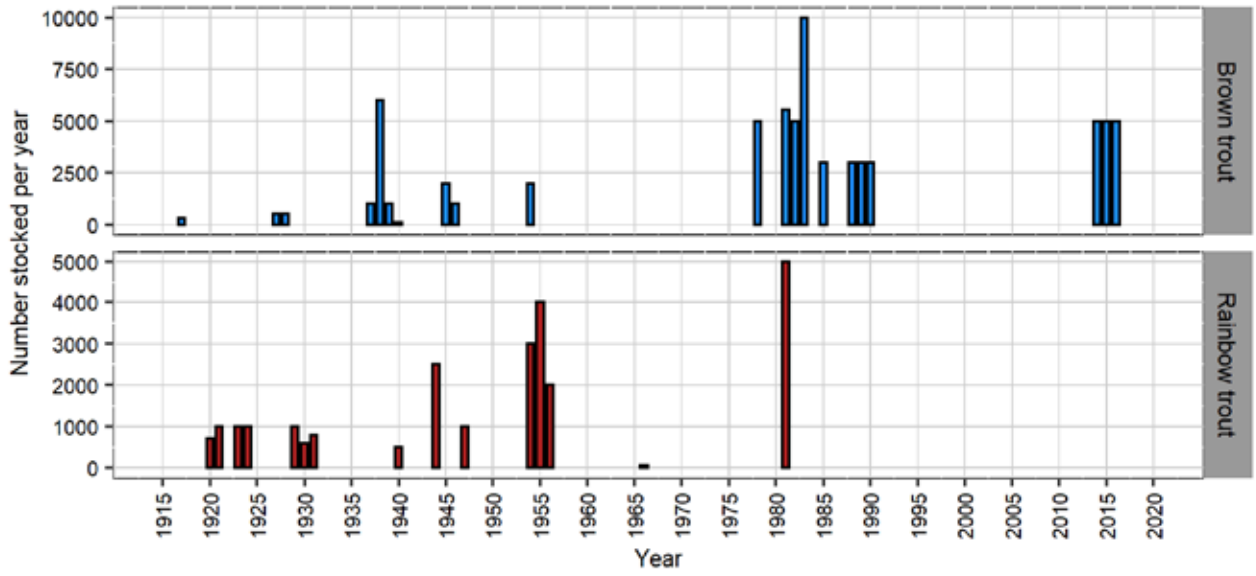


Figure 4. Stockings of brown trout (upper) and rainbow trout (lower) into the Howqua River since 1915.

Following concerns of poor fishing in the river, another trial stocking study commenced 2014 when 15,000 fin-clipped brown trout were released each year over three years (5,000 per year) as part of the Wild trout Program (Hunt *et al.* 2015) (Figure 4). However, few fin-clipped brown trout (only 16) were recaptured in three years of follow-up surveys, mimicking results of the stocking trial conducted in the late 1980s. These results again suggested that stockings did not significantly add to either the overall trout population or to angler catches (Douglas and Lieschke 2016, Ho 2017).

Recreational angling

The Howqua River has had a long history of being a recognised as a destination for good trout fishing, as indicated by extracts from various fishing articles dating back to the 1930s.

Image 2. Sargood's Hut on Howqua River [ca. 1945] (Source: Museums Victoria, https://trove.nla.gov.au).

1930s

In 1932 there were "…*plenty of young trout in the Jamieson, Howqua Upper Goulburn and Delatite*" ("Trace" 1932), and in 1933 there was a report a group of local anglers catching 84 trout in a couple of hours ("Trace" 1933). Although during this time some anglers considered that in the upper Goulburn country (Goulburn, Howqua, Delatite and Jamieson rivers), "…*easily the best water for sport was the Goulburn between Ten Mile and Knockfield*" ("Trace" 1934). In early 1935 there were plenty of trout in the Howqua River, the river was low and trout were taking grasshoppers ravenously with the best being a 6 lb rainbow trout ("Trace" 1935). But even then, the fishing was not always this good. In the same year one angler complained that after fishing the Delatite, Howqua, Jamieson and upper Goulburn for three weeks, "*I got about a dozen fish, not one over 1¼ lb*" (Old Angler 1935). He went on to say that, "*twenty years ago these rivers were teeming with fish*" and attributed the decline to "*destruction by legal and illegal fishing of immature fish*".

In the 1937 book "*Freshwater Angling*" by Jack Ryan (Ryan 1937), one of the best places in the Goulburn River to fish for trout was the junction of the Big River above Eildon Weir. Even then anglers recognised the impact of climate and temperature on trout. "*The state of the weather has a great influence on trout*". "*The water must not be too hot or the sun too bright, as, under these conditions, the trout do not move about very much*". "*They appear to know when the summer is coming, as they mostly all make out of the shallows to deep pools….*".

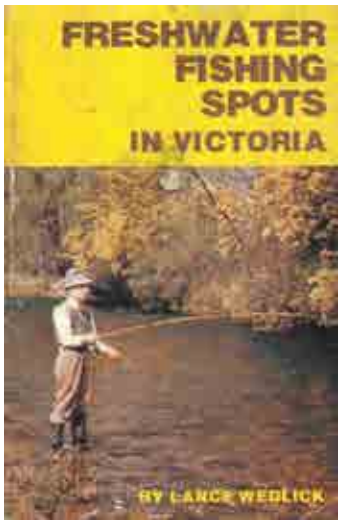
Image 3. Near Fryers on the Howqua River (Source: McCausland 1958).

1950s

In the 19050s, the Howqua River was recognised as one of the main trout fishing streams of Victoria. Dry and wet fly fishing was excellent from October to the end of the season, and it was suggested that many of the biggest fish drop back to the Eildon Weir when the water level falls after December (Wedlick 1955). However, "*The trout are not always plentiful by any means, but glorious scenery makes a visit to the waters worthwhile, whatever the fishing may be*" (McCausland 1958).

1970s and 1980s

During the late 1970s and early 1980s the river was rated as fair to excellent, and high value sport for trout while the upper section in particular was an excellent trout stream (Baxter 1986). Lance Wedlick (in Freshwater fishing spots in Victoria, undated) indicated that "*although big brown and rainbow trout have gone from the river, the Howqua River still provides for some of the best dry fly fishing in Victoria*".



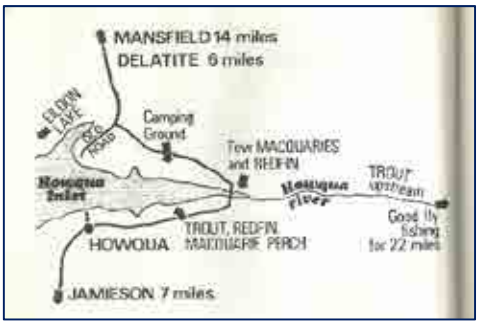


Image 4. Lance Wedlick's fishing map of the Howqua River [ca. 1970].

1990s

A guide to the inland angling waters of Victoria (Tunbridge et al. 1991) stated that the Howqua River "*Contains good numbers of brown and rainbow trout with the former slightly more abundant (from 100 g to 1.8 kg, mostly <350g).*"

2000s and 2010s

"*Howqua trout rise well, and typical freestone dries like the Humpy, Royal Wulff, Red Tag and Geehi Beetle often work, though be prepared for occasions when the trout are quite selective"* (Weigall 2003).

The Millennium drought (2000-2011) of the first decade of the 2000s, said by some to be the worst drought recorded since European settlement (https://en.wikipedia.org/wiki/2000s_Australian_drought), affected many of Victoria's rivers, including the Howqua River. Although fishery surveys had reported low catches of trout during the drought (see section *Fishery Surveys*), some good trout were still being taken by anglers. In May 2010, a party of four anglers caught 82 trout between 20-40 cm during a day (8 hours) of fishing between Tunnel Bend and Seven Mile Camp, and an experienced fly fisherman caught 2 trout (18-19 cm) in 30 minutes below the Mansfield-Jamieson Road Bridge and 5 trout (18-30 cm) at Sheepyard Flat in under than 2 hours (Hunt 2010).

Following emergence of La Niña weather conditions in 2010 the drought ended and the trout population in the Howqua River appeared to recover. The book *Atlas for Victorian Inland Waters* (Cray and Dyason 2015) indicated that angling in the Howqua River was "….*very good with brown trout to 2.2 kg (average 300 g) and rainbow trout to 1.5 kg (average 250 g)*."

The Angler Diary Program managed by the Victorian Fisheries Authority has been running since 1997 with most participants fishing coastal waters (Conron and Oliveiro 2016). This program provides valuable information used to assess and manage important recreational fisheries in Victoria. Data for anglers targeting trout in the Howqua River is patchy, covering just 25 trips over eight years between 1998 and 2012 (Figure 5). The average annual catch rate ranged from 0.7 to 2.7 trout per angler hour (long-term average = 1.4 trout/angler hour). Although the annual catch rate has varied from one year to the next, importantly during the 14-year period the catch rate was relatively stable and not declining.

The usefulness of the Angler Diary Program for monitoring and managing trout fisheries can be improved greatly by increasing participation of trout anglers in the program. Anglers interested in becoming and diarist can contain the Victorian Fisheries Authority.

The Howqua River is thought to be very good in the upper reaches and fair to good in the lower reaches with best fishing times being between November and April (Weigall 2014). "*Nymphing is superb on the river…..and is a good fallback dries aren't working*" (Weigall 2014).

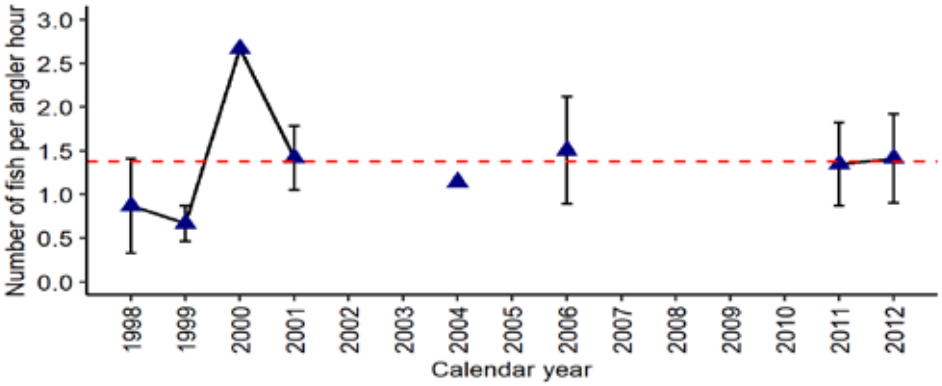


Figure 5. Annual average catch rate for anglers targeting trout in the Howqua River. (Black line = annual average and standard error. Red line = long-term average) (Data source: Angler Diary Program).

Recent major events affecting the Howqua catchment

There have been several major environmental events that have impacted the Howqua catchment and its trout in recent decades. The 2000-2011 Millennium drought of south-eastern Australia was initiated by patchy rainfall and the El Niño weather pattern that was followed by extended hot and dry conditions which was evenly broken by a wet La Niño pattern in 2010. Reduced river discharge caused by the drought can be seen in Figure 1, and some of the lowest catch rates of trout observed during electrofishing surveys of the Howqua River occurred towards the end of the drought (Figure 7b).

Victorian trout populations, including that of the Howqua River, have been affected by significant bushfires (Gavine *et al.* 2010). Between December 2006 and March 2007 the Eastern Victoria Great Divide bushfires burnt 1.2 million hectares of land in the Victorian alpine areas including some of the Upper Goulburn Catchment. The impacts of this bushfire may have been exasperated by the Millennium Drought. Gavine *et al.* (2010) found that brown trout populations in the Howqua River declined following the bushfire events, possibly due to disrupted recruitment in the year immediately post-fire, but suggested they would likely recover within 1—2 years due to re-colonisation from Lake Eildon and other refugia. Indeed a survey conducted in May 2010 found that self-sustaining populations of brown and rainbow trout were present in the Howqua River and that populations had survived environmental events/disasters including bushfire and drought (Hunt 2010).

On a more positive note, however, recent activities by the Australian Trout Foundation, with funding from the Victorian government's Recreational Fishing Licence funding grant and support from Parks Victoria and DELWP, and the Goulburn-Broken Catchment Management Authority have worked towards improving the health the trout population in the Howqua river. These included improvement works and maintenance to riparian zone through planting trees to provide future shading and in-streams works (boulder seeding) (Figure 6).

Figure 6. Boulder seeding in the lower Howqua River undertaken by the Goulburn-Broken Catchment Management Authority.

Fishery surveys

Fishery surveys of the Howqua River conducted by the state government spans four decades, back to 1978 (Figure 7). In the early years (1978-1994) surveys were undertaken by the then Trout Management Group as part of regular annual monitoring of trout population across the state (e.g. see Baxter 1986), while later surveys were undertaken for specific studies (e.g. Gavine *et al.* 2010, Hunt 2010). Since 2015 surveys of the Howqua River have been conducted as part of the *Wild Trout Wild Trout Fisheries Management Program* (see Hunt and Lieschke 2015, Hunt and Lieschke 2016, Ingram *et al.* 2017, Ingram and Lieschke 2018, Ingram and Lieschke 2019, this proceedings).

Two types of fishery surveys have been conducted in the Howqua river. Between 1978 and 1991 surveys used rotenone (a chemical that kills fish), but since 1996 all surveys have used the non-destructive method of electrofishing (Figure 7). It should be stressed that results from these two methods are not comparable due to differences in sampling efficiency (ability to catch fish under different conditions and the size of fish caught). However survey results do show that abundance trout varies considerably from one year to the next; from 4 trout/100m (1984) to 79 trout/100m (1986) for rotenone surveys, and from 0.3 trout/100m (2011) to 27 trout/100m (2016) for electrofishing surveys (Figure 7). These fluctuations are normal for fish populations and trout are particularly good at responding to their environment so streams that fished poorly last year may fish well the next season, or vice versa.

Trout fishery surveys conducted as part of *Wild Trout Wild Trout Fisheries Management Program* (2015-2019) have rated the Howqua River trout fishery as *Very good* in 2015, *Excellent* 2016, 2017 to 2018 and *Good* in 2019 (see Ingram and Lieschke 2019, this proceedings).

Overall, about 59% of trout caught in fishery surveys were brown trout and, in most years (16 of 26 years), more brown trout were caught rainbow trout.

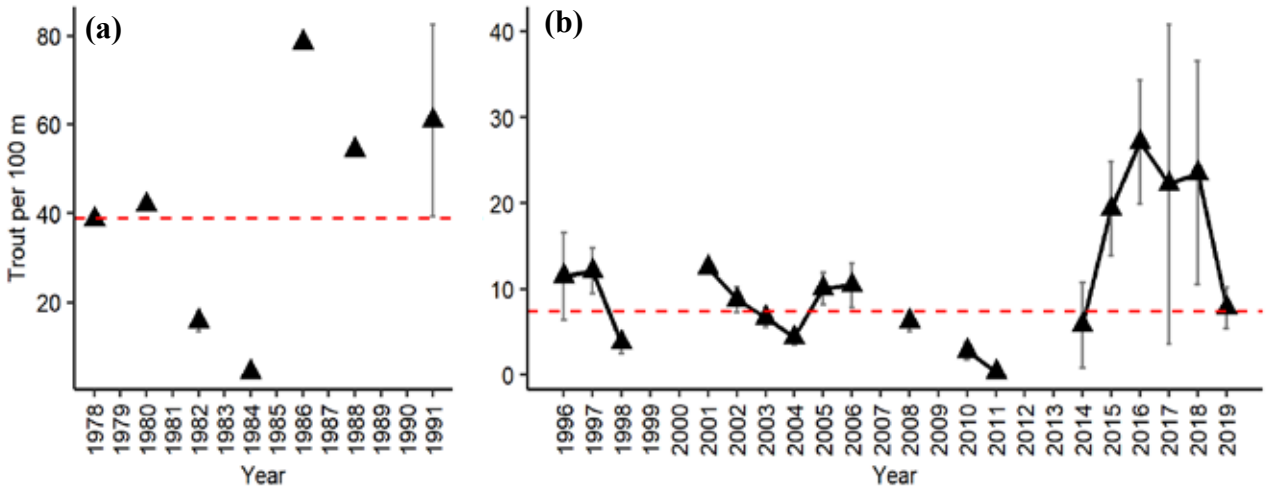


Figure 7. Abundance of trout in the Howqua River. (a) Rotenone surveys between 1978 and 1991. (b) Electrofishing surveys between 1996 and 2019. Black symbols and line = average with standard error bar. Dashed red line = long term average

Size of trout

"*Howqua trout are seldom large, but fight with a vigour that matches their environment*" (Philip Weigall) (in Various authors 1996). In the words of Philip Weigall, "*Expect the browns and rainbows to be 'pannies'*" (Weigall 2003). Over the 41 years of fishery surveys the average length of brown trout and rainbow trout was 18 cm and 15 cm, respectively. The largest brown trout was 59 cm (1.84 kg), which was caught at Frys Flat in 2002 while the largest rainbow trout was 48 cm (0.84 kg), which was caught below Running Creek in 1982.

Some anglers have suggested that the size of trout in the Howqua River has declined. However, this view is not supported by fishery survey records. Apart from some variation from year to year, both the average size and maximum size of brown trout has been fairly stable over the last 4 decades (Figure 8). The average size of rainbow trout has also been relatively stable over time, but has declined noticeably in the last five years (Figure 9). This, however has been due to the presence of large numbers of juveniles from very successful annual natural recruitment in recent years, as indicated in length frequency distribution data (Appendix I).

Image 5. Howqua River rainbow trout.

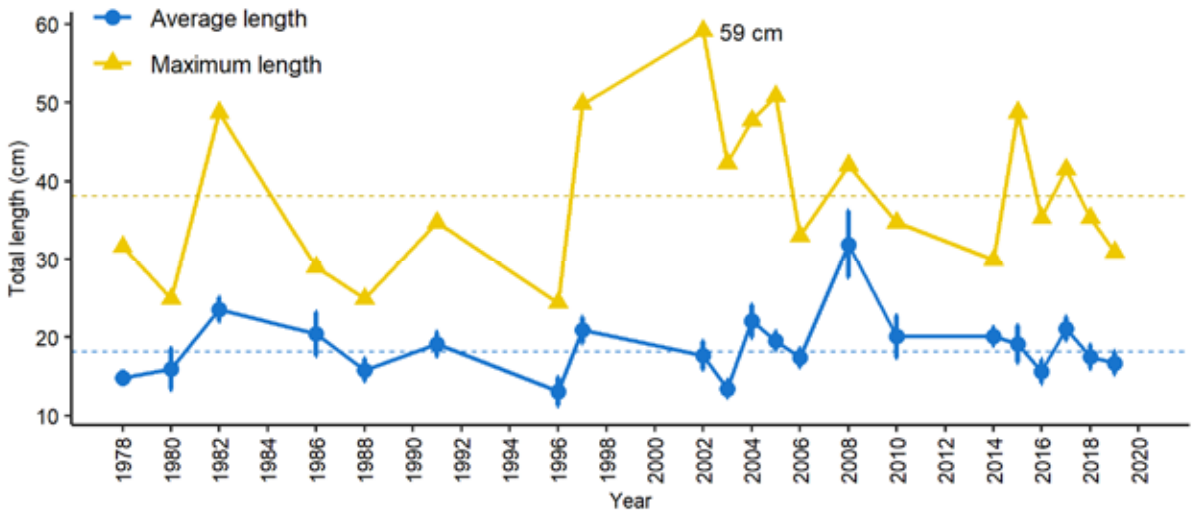


Figure 8. Average and maximum length of brown trout collected during fishery surveys of the Howqua River since 1978 (dashed lines = average. Error bar = confidence interval. Sample size = 1,556 fish).

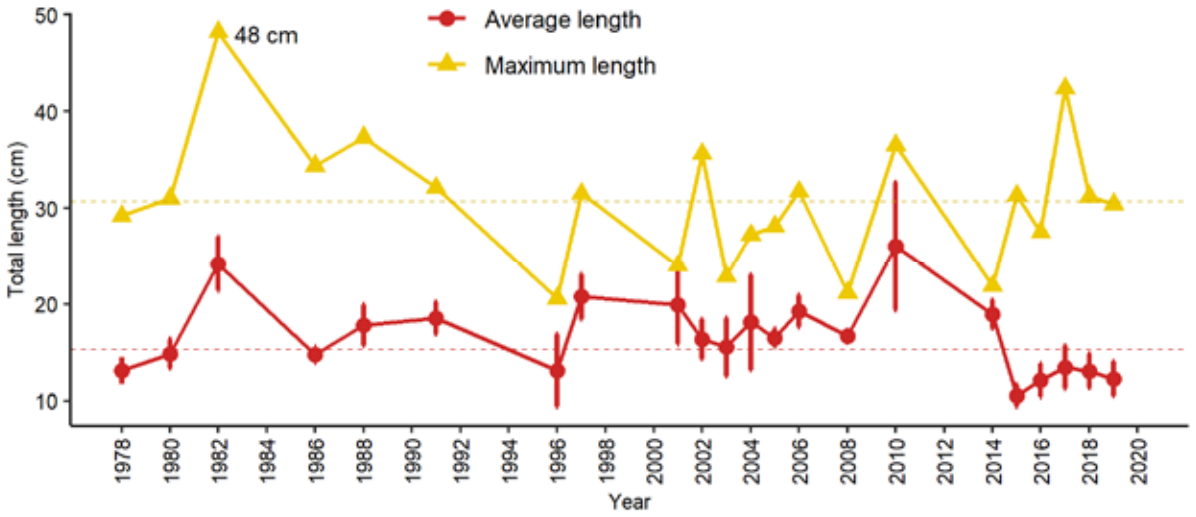


Figure 9. Average and maximum length of rainbow trout collected during fishery surveys of the Howqua River since 1978 (dashed lines = average. Error bar = confidence interval. Sample size = 1,018 fish).

Factors affecting abundance of trout

The factors that affect trout populations in streams, such as the Howqua River, are many and varied (e.g. see Bottom *et al.* 1985, Crisp 1993, Baglinière and Maisse 1999, Crisp 2000, Ernesto and Budy 2005) (Figure 10). To complicate matters, the impact of these factors may be subtle to dramatic and localised to regional. Factors may influence different parts of the trout lifecycle and may occur over different time scales.

Factors may occur at difference scales of area, for example:

- Localised - Bank erosion from cattle grazing affects a small section of stream
- Catchment – Bushfires (Gavine *et al.* 2010).
- Regional – Drought (Matthews and Marsh-Matthews 2003).

Factors may occur at difference time scales, for example:

- Days – Mass mortality following an oil spill (Lund *et al.* 1996)
- Years – Drought (Matthews and Marsh-Matthews 2003)

Factors may affect different parts of the trout lifecyle, for example:

- Sedimentation smothers eggs whereas adults are unaffected (Scheurer *et al.* 2009).
- Predators consume smaller fish (fry and juveniles) while larger fish are less affected (Baxter *et al.* 1985).
- Angling targets larger fish more than smaller fish (Brana *et al.* 1992).

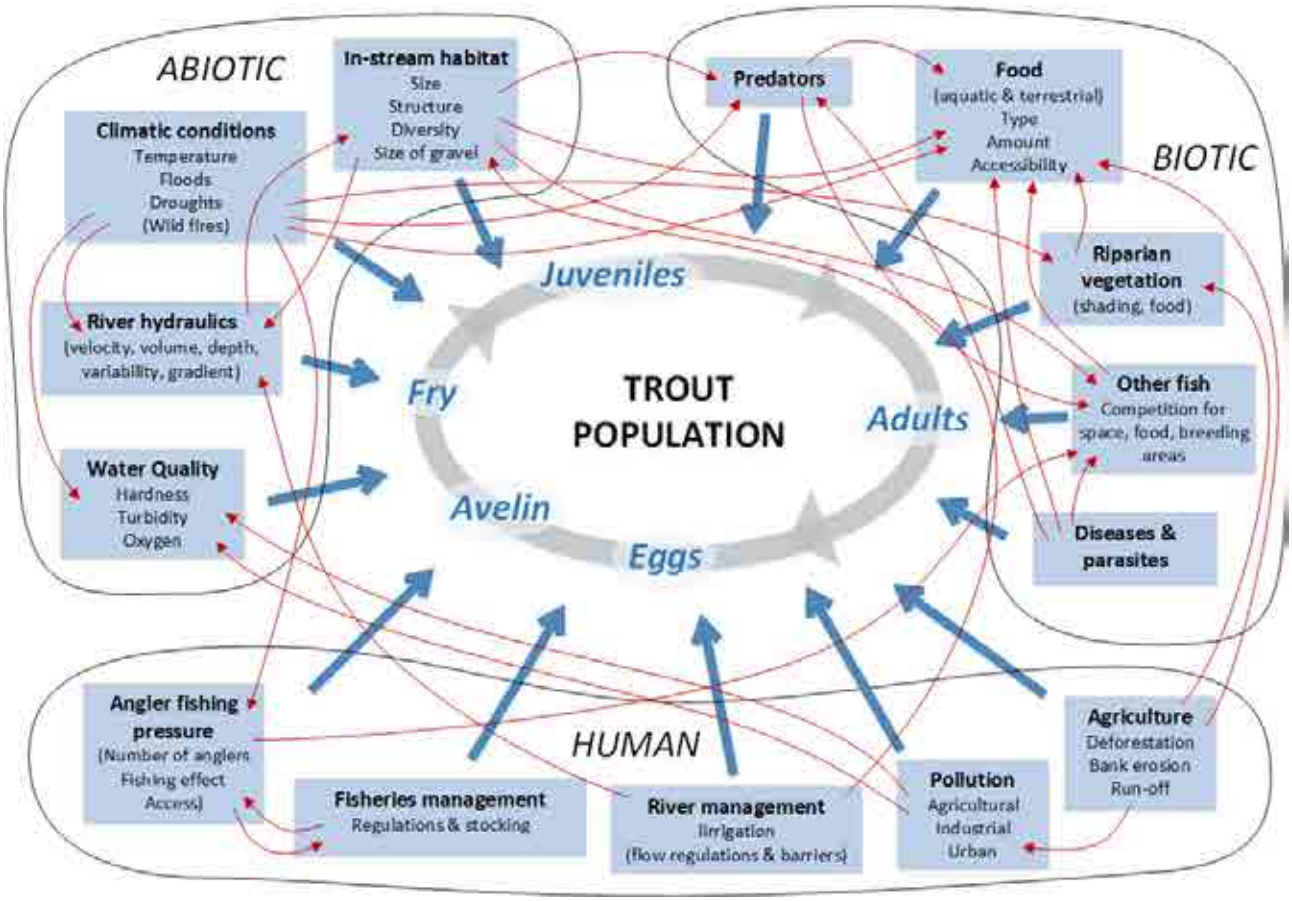


Figure 10. Abiotic, biotic and human factors affecting trout (Blue arrow = direct effect. Red arrow = indirect effect).

Many factors may interact to compound impacts on trout, such as a wild fire during drought conditions. While many may affect trout directly, such as availability of food (aquatic and terrestrial), other factors may have indirect effects (Figure 10). For example, the amount and type of terrestrial insects available to trout may be affected by the amount and type of riparian vegetation (Allan *et al.* 2003, Fausch *et al.* 2010).

Overfishing by recreational anglers can reduce fish stocks (Post *et al.* 2002, Almodóvar and Nicola 2004). However, angling pressure is apparently having minimal effect on trout in the Howqua River. Firstly, despite the Howqua River valley being a popular destination for outdoor activities, recent surveys indicated that fishing was not the primary reason for visiting the area and those that were fishing were generally satisfied (Hall and Giri 2017). Secondly, much of the river is protected from angling due to it being inaccessible. Indeed, these inaccessible areas may not only provide a refuge from angling but also secure spawning areas providing recruits that eventually move into the fishable sections of the river.

Modelling results for the Howqua River

More than 30 models were fit to the available data to investigate which factors influenced trout abundance. The "best" models indicated that both brown trout and rainbow trout became more abundant the farther upstream from Lake Eildon. In other words, the abundance of both species increased by around 0.05% for every km upstream. This trend may be associated with, for example:

- Water temperature (cooler upstream)
- Riparian habitat (more forested upstream)
- Fishing pressure (less accessible to anglers upstream)
- Interacting combinations of the above factors

However, other factors may also be influencing this trend including instream habitat complexity and structure, stream flow, population structure, food availability, competition with other trout and other species.

Modelling also suggested that brown trout abundance declined when SOI over the past 12 months was more positive, but this was not the case for rainbow trout. Sustained positive SOI values above about +8 indicate a La Niña event which are associated with increased rainfall, floods and cooler days (http://www.bom.gov.au/climate/). This trend, however, seems counter intuitive to the general perception that abundance of trout would increase under these conditions, particularly decreased temperature.

Other factors analysed, including temperature, river discharge and stocking, could not be fit to a model.

These results suggest that there is no simple answer to the question of what affects trout abundance in the Howqua River and that identifying key factors is complex, even when there is a reasonable amount of data available. There are a multitude of factors that affect trout abundance (Figure 10), many of which may interact in complex ways that we do not fully understand. Unfortunately, detailed information on many of these factors is lacking for the Howqua River.

Conclusion

Results from this review clearly demonstrate that brown trout and rainbow trout populations in Howqua River trout are quite resilient over time. Although fluctuations in abundance have occurred from time to time, and major environment events such as bushfires and droughts have reduced abundance, the population responds to favourable conditions through natural recruitment to sustain stocks. With good management and support from stakeholders, the river should continue to support good trout fishing into the future.

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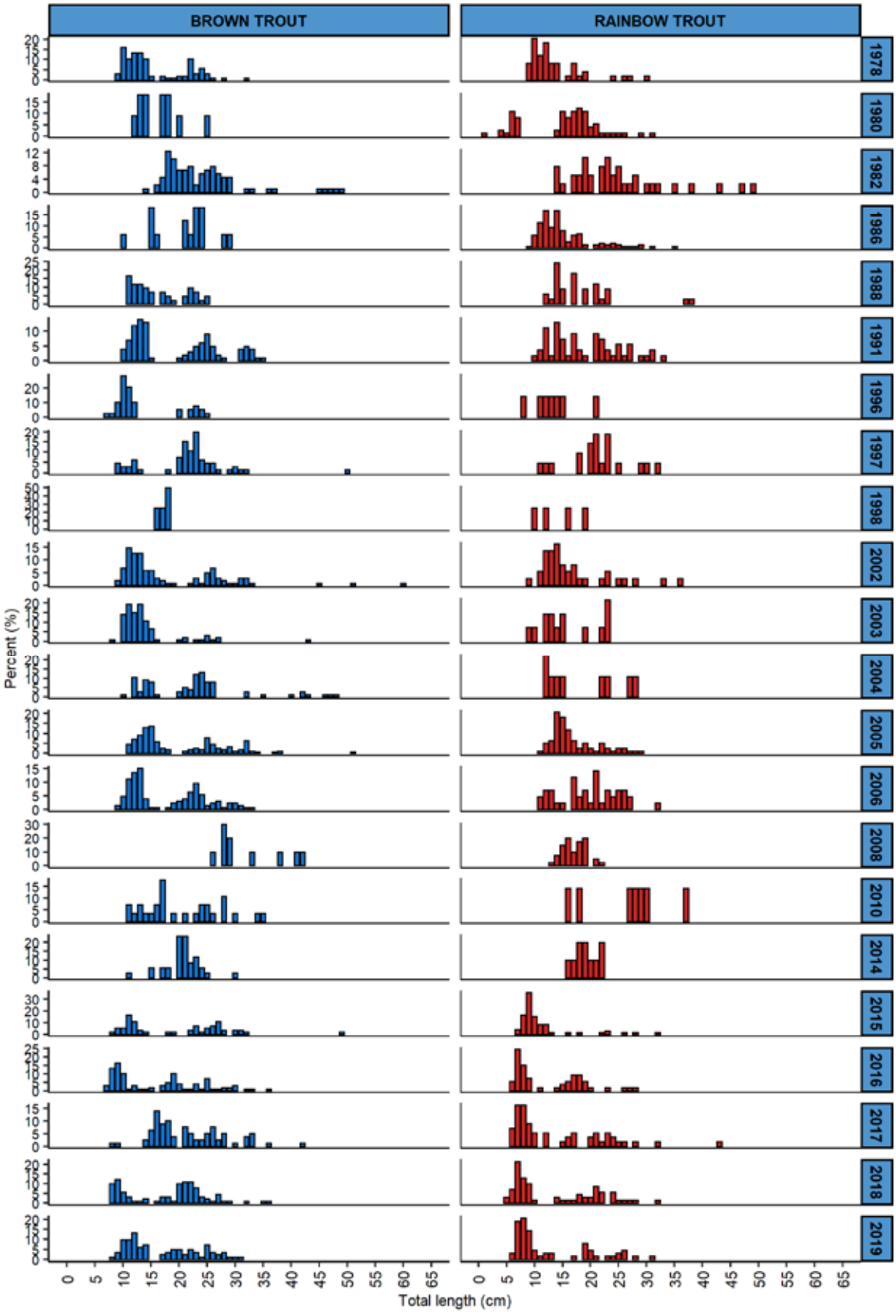
Appendix I. Size distribution of Howqua River trout, 1978 - 2019



Trees for Fish: Angler Riparian Partnerships Program

Renae Ayres
Arthur Rylah Institute, DELWP, ATF

The Angler Riparian Partnerships Program

Healthy waterways mean healthy fish and better fishing, but what actions can we take to extend and improve the health of our streams?

One of the easiest things that anglers can do for fish is plant a native tree!

Trees, shrubs and grasses that grow along the banks of waterways play an important role in helping to:

- maintain water quality
- provide shade to lower, and buffer, water temperatures from extremes
- reduce nutrients getting to the stream, that can lead to excessive growth of algae and instream vegetation
- filter out sediments from entering the waterway, to prevent them filling up pools and smothering habitat where aquatic organisms live
- stabilise stream banks and reduce erosion
- contribute timber and branches that fall into the waterway, provide habitat for fish, and help create other micro-habitats such as deeper holes and areas of slower flow
- support the food web by dropping leaves and organic material into the waterway. These grow biofilm, which is eaten by plankton and aquatic insects, which in turn are food for small fish, which are eaten by larger fish.

Healthy riparian vegetation offers huge habitat benefits to wild trout fisheries and other fish.
Photo: Kristina Royter

The quality of the waterway environment affects the survival, growth and breeding of fish, and the broader distribution and abundance of fish populations. Streamside vegetation is an important factor to support trout fisheries and to mitigate the effects of degraded aquatic habitats and a warming climate.

Dr John Morrongiello's presentations at Talk Wild Trout 2015 and 2016 rang alarm bells about the trajectory of wild trout fisheries given habitat degradation and climate change. Trout are a cold-water species, vulnerable to warm water. Increased water temperature can impact their distribution, feeding, growth, reproduction and catchability by fishers, and ultimately their survival. Improving riparian vegetation is a tangible way that anglers can help protect wild trout fisheries.

How can you help?

Anglers concerned about the condition of streams, and who want to help in restoring habitat, can get involved in the Angler Riparian Partnerships Program. This is a four-year program (2016/17 to 2019/20) that funds projects which improve riparian land at locations along waterways important to anglers – it's a great way to help the fish and fishery in your favourite fishing streams. It allows recreational fishers to partner directly with regional catchment management authorities (CMAs), landholders and local communities to carry out works on riparian land, such as weed control, revegetation, fencing and rubbish removal.

The $1 million Angler Riparian Partnerships Program is part of the Victorian Government's $222 million commitment, announced in Water for Victoria, to improve the health of waterways and catchments across regional Victoria. Fittingly, the Angler Riparian Partnerships Program was launched at Talk Wild Trout 2016.

Many projects in the Angler Riparian Partnerships Program leverage extra funding: for example, from Victorian Recreational Fishing Licence Fees and other state-funded programs. This allows the delivery of bigger projects and broader activities, such as instream habitat rehabilitation (e.g. installing logs and boulders), extra riparian habitat works, and improvements to angler access. These result in greater outcomes for waterways, fish and fishers!

Approach—how it works

Anglers and regional CMAs connect to initiate and develop local projects under the Angler Riparian Partnerships Program. Together they plan activities, order resources (such as plants, stakes and tree guards), engage contractors (e.g. to undertake fencing or weed control) and organise and promote volunteer tree planting days and events. A few keen anglers and CMA staff often drive the project planning and a broader army of volunteers join in with its delivery.

Statewide achievements

The Angler Riparian Partnerships Program is making a difference. It's now entering Year 4, its final year (2019/20) and we're currently collating information about state-wide achievements in Year 3 of the program.

The statewide achievements in Years 1 and 2 include:

- 51 angling clubs and community groups involved
- over 330 people participated in activities
- 17 projects completed on 14 waterways across Victoria
- 21 km of riparian land improved
- 16,000 native trees, shrubs and grasses planted
- 7 km of fencing installed
- 60 ha of weeds controlled
- 2 truckloads of rubbish cleaned-up

Every partnership on every local project contributes to improving riparian land, waterways and fisheries, and deserves individual recognition of achievement - well done.

The Angler Riparian Partnerships Program started slowly and has been growing each year. Increases in the number of partnerships (new and continued), the number of projects completed, the number of people volunteering their time, and the scale of outputs (e.g. number of trees planted) all demonstrate the passion of anglers to improve habitat for fish. Camaraderie, enthusiasm and adequate resourcing are key to the success of this program.

Acknowledgements

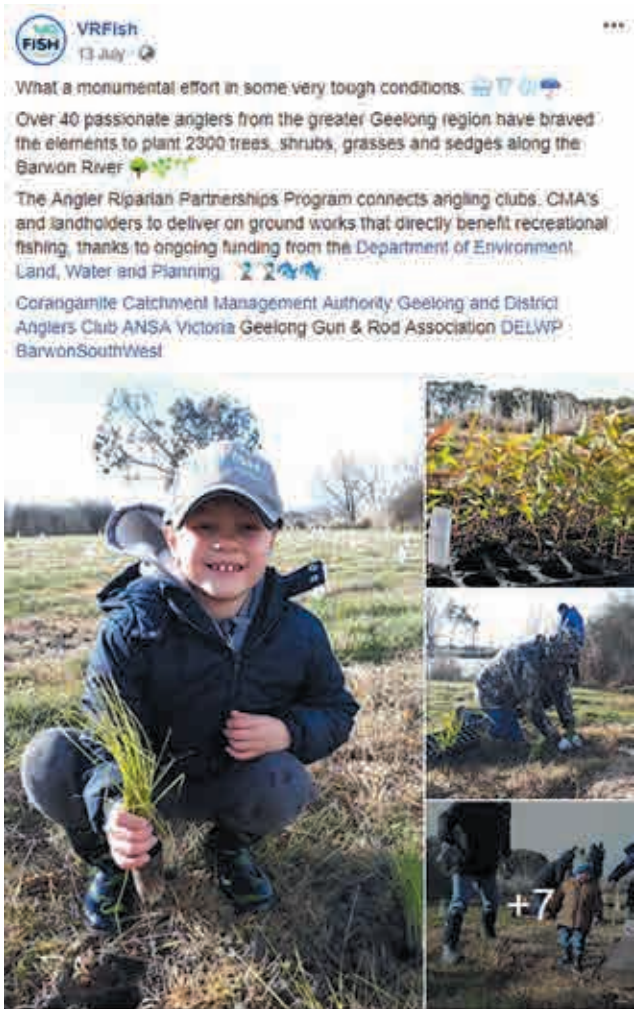
The DELWP and regional CMAs take this opportunity to sincerely thank the many angling clubs, Landcare groups, other community groups, families and individuals who have volunteered hundreds of hours and travelled from near and far to support and participate in Angler Riparian Partnerships Program projects. The Australian Trout Foundation, VRFish and other angling clubs have demonstrated great leadership by organising multiple projects and rallying local teams. The vast network of habitat champions underpins this program. United together we have stepped up to the challenge and are supporting fisheries and waterways into the future.

The Australian Trout Foundation and North East CMA led a team of angler and Landcare volunteers who planted 500 native trees and shrubs near new instream habitat in the Buckland River.
Photo: David Anderson

Native Fish Australia and Goulburn Broken CMA have held planting days on Hughes Creek each year.
Photo: Goulburn Broken CMA

Pre-planting brief at the Macalister River.
Photo: Lyndon Webb

The Curdies River received some riparian TLC - fencing to manage stock, spot spraying of weeds and thousands of new native plants. Photo: Renae Ayres



Sharing information about local events and achievements is a great way to raise awareness, encourage involvement and build social licence. Courtesy of VRFish.

Dare to be wild

Greg French

What is a 'wild' fish?

The simplest definition of *wild* is *river-born*.

The gold standard is:
Founding stock derived from river-born fish rather than hatchery-reared fish, and all subsequent generations river-born.

Why does 'wild' matter?

Truly wild fish are beautiful to look at. They are robust and live for a long time. Most importantly, Wild fish exhibit diverse and thrilling behaviour. Wild fish smash baitfish, tail on scud and leap high out of the water for spinners and other insects. They also, swim open-mouthed like basking sharks through clouds of water fleas, charge about in the shallows after mudeyes, cruise offshore in windlanes.

Many of the behaviours we see in wild fish are highly influenced by genetics, which is why monocultured hatchery fish don't behave like wild fish.

Anglers dream of wild fish, not tame fish

Wild fish are steeped in mystique and allure.

Who hasn't dreamed of travelling to:

- Tasmania's Western Lakes
- NZ's backcountry streams
- Mongolia's taimen rivers
- Yellowstone's cutthroat fisheries
- Alaska's salmon rivers

Who here dreams of travelling abroad to fish for someone else's hatchery-reared rainbows?

No one? It's hardly surprising: hatchery fish are often ugly (soft bodied and dull coloured, with eroded fins and facial deformities). They are weak, and most don't live long in the wild. They are often all the same size.

Being drab, easy to catch and all alike, domestic fish quickly become humdrum. Beginners may enjoy the relative ease of capture, but only for a while. They are soon looking to find something more challenging and diverse.

Wild fish fill that void because they provide a meaningful challenge to the angler.

I should emphasise here that Gondwanan landscapes are unique. I find that wild trout in the Victorian high country provide some of the most enjoyable fly fishing in the world.

Why do managers stock at all?

In waters that don't have natural recruitment, hatchery-reared fish are a lot better than nothing. Sometimes after an ecological disaster – pollution, major drought, that sort of thing – reseeding is genuinely needed.

Sometimes, however, stocking is done just so that managers can to be seen to doing something. This is despite the fact that domestic fish are ridiculously expensive to produce, especially when reared to catchable size and that cartage alone can be cost prohibitive.

Despite the fact that, when hatchery-reared fish are placed into rivers which already boast self-sustaining stocks of wild fish, the fishing goes downhill. The domestics are quickly depleted – nature kills many more than anglers do – and the wild fish are disrupted, making them harder to catch. Natural recruitment can be adversely affected too, often severely.

In the 2000s, Tasmania became re-addicted to hatchery fish. Given that the wild fishery was performing so well, many old-hands found this 'new' direction hard to fathom. But the Commercial salmon and 'ocean-trout' farmers were offering surplus stock (runts and old brood fish) to the IFS for free, and the IFS found itself under political pressure to modernise. Why maintain a quaint historic hatchery at Salmon Ponds when you could have a state-of-the-art recirculating factory in suburbia?

It became a classic case of 'tail wags dog'. Instead of asking questions like *What waters actually need stocking? or Would it be cheaper to transfer wild fish from overpopulated highland lakes?*, the burning question became *What the hell do we do with all these hatchery fish?* This led to the dumping of domestic stock into robust wild fisheries like the Bradys chain of lakes. Predictably, this led to reduced catch rates and an exodus of anglers to waters that weren't being stocked. (I say *predictably* because the global scientific evidence is decades old and gets stronger by the year. Tasmania actually pioneered this work in the 1950s.)

Sometimes stocking seems sensible, but still proves to be counterproductive. Consider cormorant invasions. When a plague of birds depletes stock, calls go out to replenish the rivers. But if you replenish a river while the cormorants are still there, the stocked fish become easy cormorant food – *expensive* cormorant food – and the cormorants have an incentive to linger. If you wait until after the cormorants move on, the wild fish tend to quickly replenish themselves. There might be fewer fish for a year or two, but during this time the average size increases, providing a different set of rewards. For many anglers, the dynamics of a wild fishery is the main attraction.

I am pleased to be able to say that Tasmania's fisheries managers have learnt – or relearnt – the lessons of the past and are once again extolling the benefits of wild fish. We are back on track.

Wild fish do better than domestics

In native habitats, trout evolved to fill every possible niche in a river or lake, and these populations are often so behaviourally different and genetically distinct that many populations can be said to comprise different races or subspecies.

In Europe this diversity can still be seen in Ireland's Lough Melvin and Iceland's Lake Thingvallavatn, and it hangs on, precariously, in Italy's Lake Garda.

But almost everywhere else, introduced hatchery fish have hybridised many native races to extinction. The remaining stock is often a single generic fish that is widespread, but not particularly efficient in any one habitat. The result is that the lakes support many fewer fish than they used to.

The story in rivers is even more dramatic.

Here in Australia our founding stock came from many different subspecies and races, and once introduced they quickly adapted to fill multiple niches. While our discrete populations are not as ancient as the ones in their homelands, they still risk being swamped by hatchery fish. Once swamping occurs you notice less diverse behaviours and less fish, and this can take many generations to recover, if it ever does.

How quickly can wild fish become domesticated?

The answer is, *Less than one generation*. Think about that for a moment.

The sea-run rainbows in many rivers on Vancouver Island have been destroyed by logging. Over recent decades there were many attempts to reseed rivers with hatchery fish. These attempts didn't work. The next idea was to strip eggs from the few remaining wild fish, take them to a hatchery where survival would be greater than in the wild, and return the smolts to where the eggs were collected. It still didn't work.

It turned out that the hatchery environment was selecting fish that did well in hatchery environments. The river was selecting fish that did well in the wild environments. There was a *genetic* difference between the two. The genes that differentiate hatchery fish from river-born ones probably relate to their ability to withstand crowding, or to tolerate artificial feeding.

Looking after the environment

Essential to wild fish are wild waters and wild landscapes. Protecting wild environments is becoming harder, with ever more pressure for water extraction and land clearing, not to mention climate change. Looking after wild waterways can be very difficult indeed, especially when, as happens from time to time, the minister for fisheries is also the minister for agriculture or logging.

Looking after wild waterways goes well beyond looking after specific lakes and rivers. Since I started fishing in Europe the flying insect population has crashed 80 per cent. This is largely due to the increased use of pesticides. You need a certain critical mass of insects to maintain their viability. Then, too, insects migrate long distances. What happens on farmland hundreds of kilometres away from a wild river can dramatically affect the viability of fishing in that river. The same thing is now happening in Australia.

Major wild-trout foods that are heavily affected by pesticides include:

- Grasshoppers
- Ants
- Gum Beetles
- Jassids
- Cicadas

Looking after a wild fishery is a complex business that requires scientific research and tremendous powers of political persuasion. This costs money, and unlike stocking, it can sometimes be hard to see where the money and effort goes.

But If you want a fishery that is affordable, diverse, productive and fun – one that inspires enough enthusiasm and wonder to maintain your passion for a lifetime – this is where your licence money needs to be spent.

By hosting this event, the VFA has demonstrated that it understands the truth: looking after wild fish is the best way to look after anglers. I urge you all to support the VFA's scientific research, rehabilitation programs and political manoeuvrings.

Theme 2 – Trout fishing

The fun of wild trout: Victorian context

Robbie Alexander

I caught my first trout in the mid 1980's when I was 12 years old and have been addicted to trout fishing ever since.

Every year I make dozens of trips into the streams of North East Victoria fishing for trout and I document my adventures in places such as magazines and YouTube.

It's no secret that the trout fishing has become harder in recent years thanks to the ever-changing landscape. Climate change, global warming, call it what you will has made an impact but whatever the reason, the environment has changed, and the trout fishing has changed with it.

BUT it's not all bad. There is still some really great trout fishing to be found in North East Victoria, and my tips, pointers and suggestions may help you and your kids catch some.

My information about trout movement as various times of the year and the best baits at certain times of the year, will be arm you with information to ensure that your catch rate increases when you go trout fishing in the streams of North East Victoria.

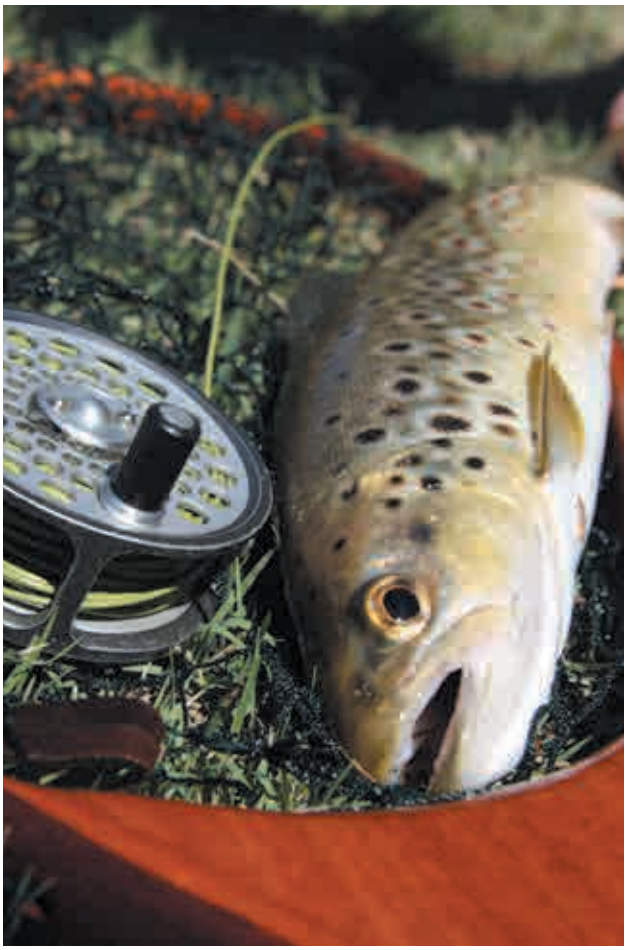
Trout fishing in Victoria is accessible and fun for the whole family. Get out and give it a go.

Off the beaten track: Time to find new water?

Martin Auldist

OK, I admit it. Sometimes I tire of trout.

It's not that I tire of catching them, it's just that sometimes trout fishing can become a bit repetitive. Fishing the same rivers over and over in the same fashion for the same species can leave me a little uninspired.



I first became trout-weary after returning from seven years in New Zealand. Based in the North Island, I taught myself to fly fish because all the best fishing spots were designated fly only zones. As my fly-casting skills improved, I became accustomed to catching thumping rainbow trout on luminous smelt flies in the river mouths of Lake Taupo, or on heavy bug-eyed nymphs and Glo-bugs in the Tongariro River. I'm talking 5 to 8-pound trout, just good average fish for Lake Taupo. Clearly, I was spoilt.

Fast forward a few years and my family had relocated to Warragul in Gippsland, from where I tried my best to re-adapt to Victorian trout fishing. I made trips to famous trout rivers like the Mitta Mitta, Cobungra and Goulburn. Likewise, I frequently targeted better-known local waters like the Latrobe and Tarago rivers. None of it was really doing it for me, and the trout were tiny. After a while my trout fishing obsession went into recess.

Happily, I have recently fallen back in love with Victorian trout. For that I have my three sons to thank…and my youngest son, Billy, in particular. Let me explain.

We have a small public dam close to our house; maybe 500 m as the crow flies. After much nagging from Billy, we finally went to fish it. To our delight, we found the dam full of big redfin and trout. Billy was especially stoked because this was a place he could fish without me. Since that day, Billy has spent countless hours fishing that dam and has caught countless fish there, both reddies and trout, and he has released 99% of them. He has honed his skills, his casting, his knowledge of the water and of lures, and his love of fishing has grown and grown.

Then, one day, Billy outgrew that dam. I knew the feeling. Billy reckoned it was time to look for new waters and I knew exactly what he meant. I was happy to help.

Over the next year or two, I followed Billy on his trout fishing adventures. Being only 14 he is highly adept at social media and the internet. He is also a very sociable young bloke and is more than happy to chat to local experts either on-line or in person. Via these channels he frequently identified new stretches of local rivers that looked promising and together we went to fish them. Unlike me, Billy was unencumbered by preconceived expectations and I shared his joy when a plan came together and he caught trout in a new location.

Some spots we visited were quite close to places I had fished previously but the fact they were not exactly the same was refreshing. Maybe we turned left from the car and not right. Maybe we walked downstream and not upstream. Maybe we pushed that little bit further, through thicker scrub or across deeper streams. Other spots were completely new rivers for us that took us on entirely new adventures. We found was some great fishing, off the beaten track, and it really was a rewarding experience to land trout in places we'd never thought of before. Yet other spots were ridiculously close to civilisation…so close that I doubt other anglers would even bother to cast a line there!

Taking our quest for new waters a step further, the boys started accompanying me on my back pack hunting trips after deer and bringing their trout gear along with them. These trips led us to remote rivers that were often choc-a-block full of wild brown trout. Not only that, these pristine places are invariably breath-taking in their beauty, so that even when the trout don't oblige it is still a pleasure to be there.

Almost the entire eastern half of the state is covered in mountains, and that almost every stream in there contains trout. Many of 4WD tracks are closed to vehicles from June until November…so for two months of the year it is a great option to walk in behind the gates (perfectly legal). It may still be a long walk, but the going is much easier than hard-core bush bashing, and you are still almost certain to have the water to yourself. Clearly bush bashing is still a great opportunity for those so inclined.

So, if you're trout fishing has become a little stale, I encourage you to look somewhere different. Somewhere others may have over looked, away from the crowds. Make trout the excuse to get out and explore new waterways whether they be at the end of your street or the end of a remote 4WD track. I'm pretty sure you won't be disappointed because there are some awesome spots out there that you don't even know exist…it's just a matter of looking.

Forging new paths: Increasing angler access

Anthony McGrath
Victorian Fisheries Authority

If the first four years of Target One Million were about getting more Victorians fishing more often, then Phase two is about giving us more places to fish.

'Phase two' has a strong intention to improve access to Victorian waters with two key commitments setting out clear objectives to be achieved throughout the current term of government.

They are to:

- Mandate access for fishing and camping through opening up hundreds of kilometres of crown land river frontages, many covered by grazing licences; and
- Allow anglers to use boats and kayaks with electric motors on some lakes and reservoirs including Tullaroop, Lauriston, Hepburn, Barkers Creek, Upper Coliban and Malmsbury, with later consideration to be given to Tarago and Devilbend.

One of the key issues facing recreational fishers throughout Australia is good quality access to lakes and rivers and Victoria is no different. Many anglers are under the impression that "the Queens chain" provides an invisible access corridor along our rivers and streams, but this is not the case. Two hundred years of legislation and regulation changes have left us with many different types of land status and a myriad land and waterway managers including government agencies, water authorities, CMA's, local councils, committees of management and adjoining landholders. For the most part, river frontage land parcels still belong to the Crown and therefor to all Victorians. Yet much of it has been licenced to adjoining landholders over the decades, with many of them unsure of the terms of their agreements and the responsibilities in regards to public access. The commitment to open up these river frontages will require legislations changes and this work is currently underway.

On-water boat access has always been a contentious issue for fishers and boaters. Despite having similar uses for the water, some reservoirs are open to all types of boating use, whilst at others have stringent rules around no water entry being permitted. Working with Goulburn Murray Water and Coliban Water to unpack the operational and management requirements, we managed to improve access to each of the six listed reservoirs, with better access to come over the next 12 months.

'Working together to build community awareness, understanding and action that will enrich our fisheries into the future.'

Anthony Forster

Victorian Fisheries Authority

Target One Million
More Victorians fishing, more often

Your fishing licence fees at work

Arthur Rylah Institute for environmental research

VFFA