



Rivers on Fire

Fran Sheldon

Australian Rivers Institute, Griffith University



Rivers on fire.... literally....



Condamine River 2016



Cleveland's Cuyahoga River ablaze, 1952



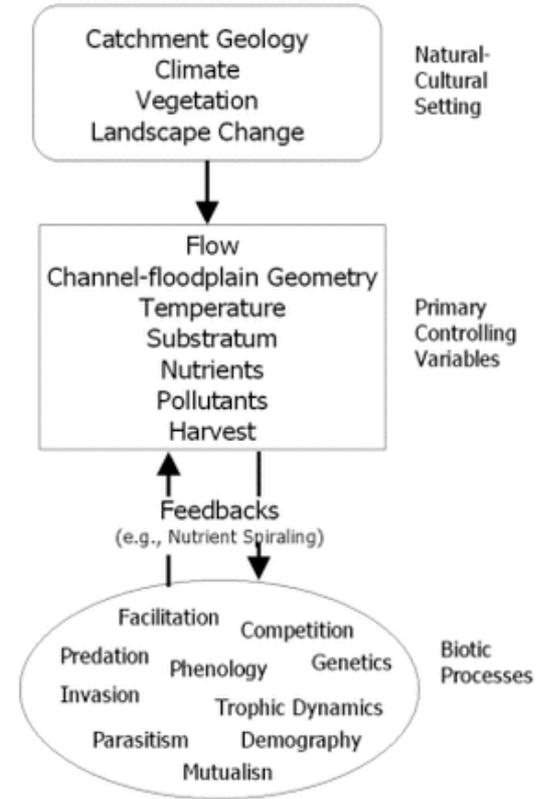
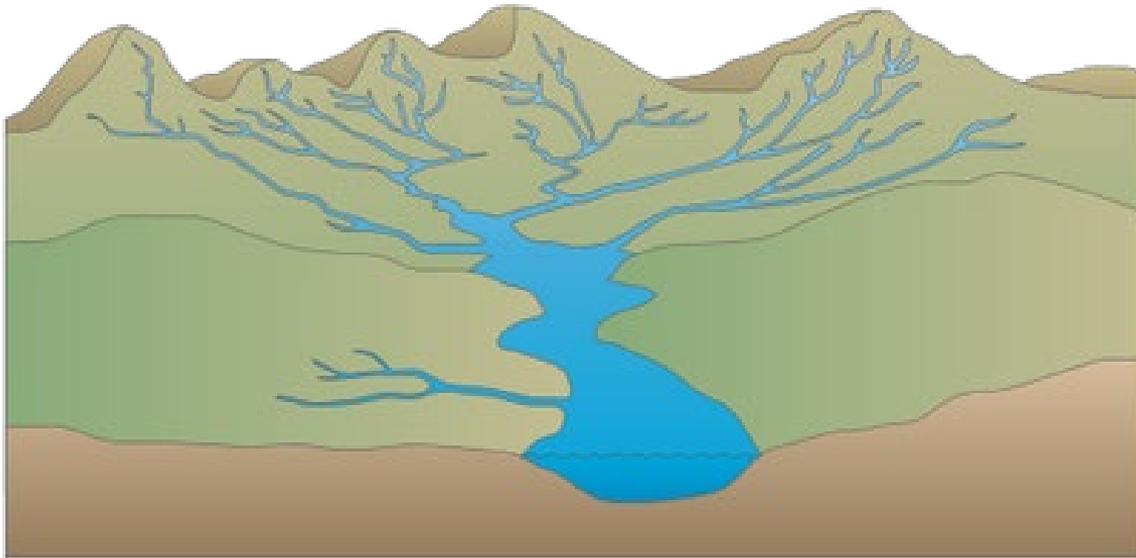
Outline

- Rivers, catchments, climate change and the role of **water quality** in river health
- Case Study 1:
 - Bushfires and impacts on water quality
- Case Study 2:
 - Droughts and impacts on water quality



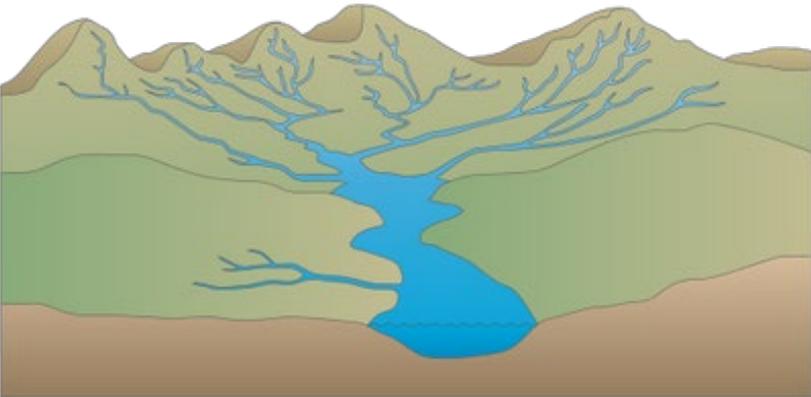
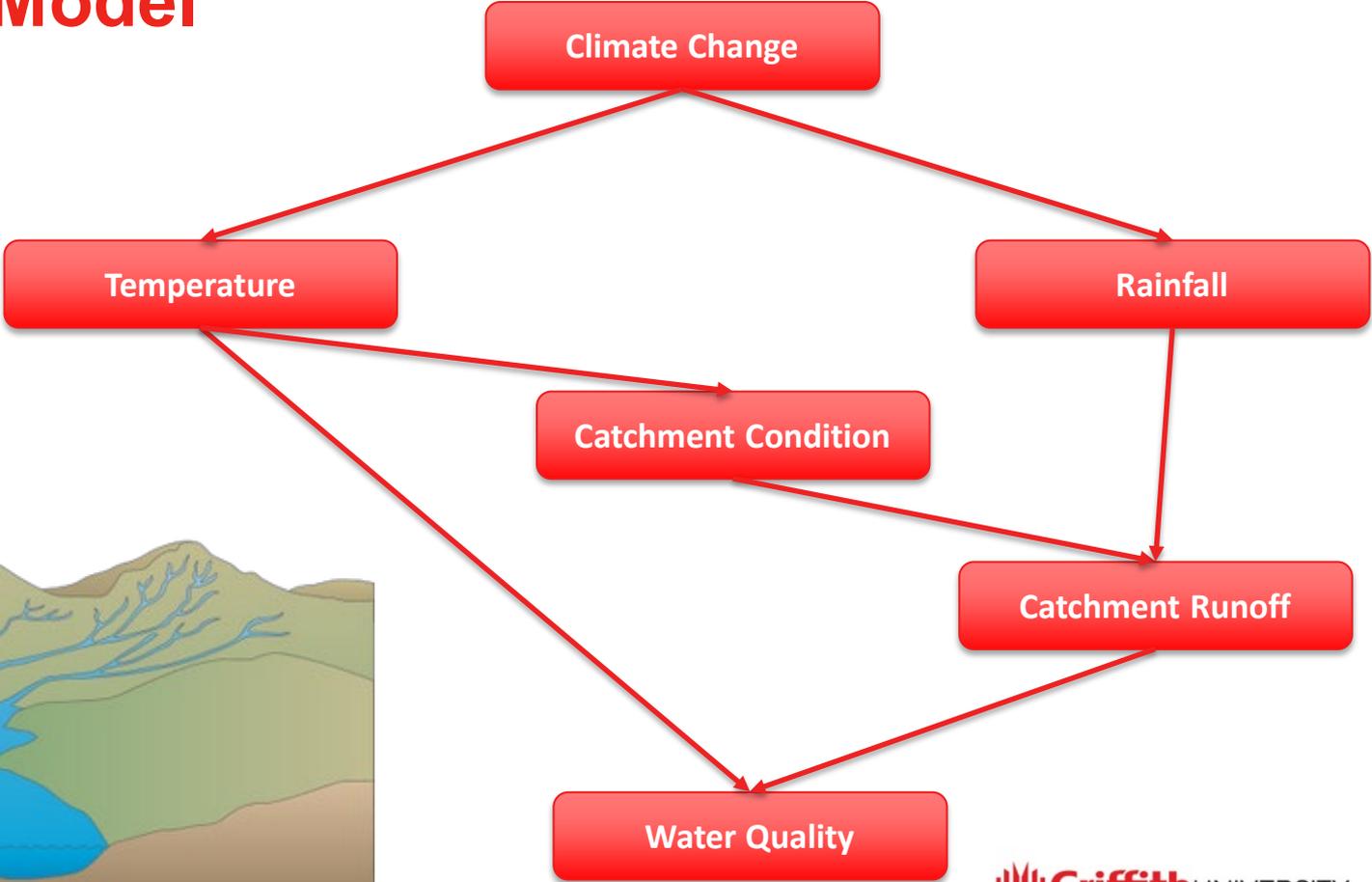
“Rivers are a manifestation of the landscapes that they drain...”

Hynes (1975) *The Stream and its Valley*

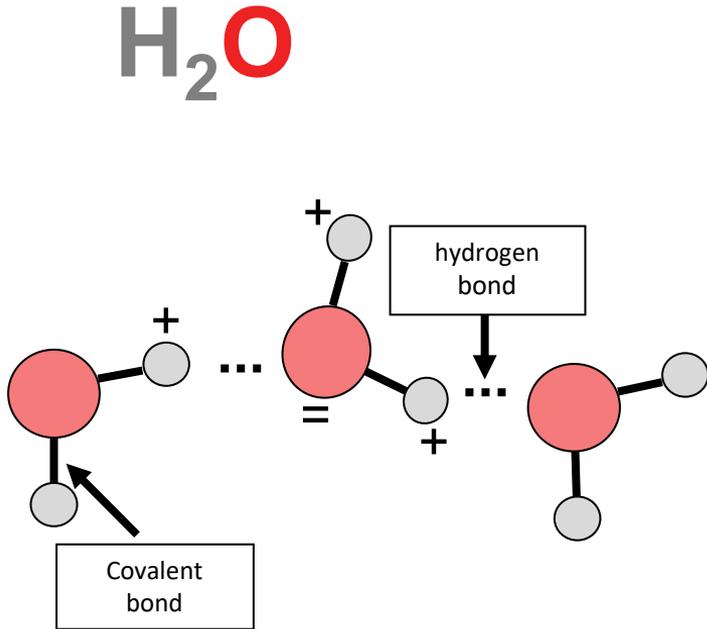


From: Stanford (1998) *Freshwater Biology* 40:402-406

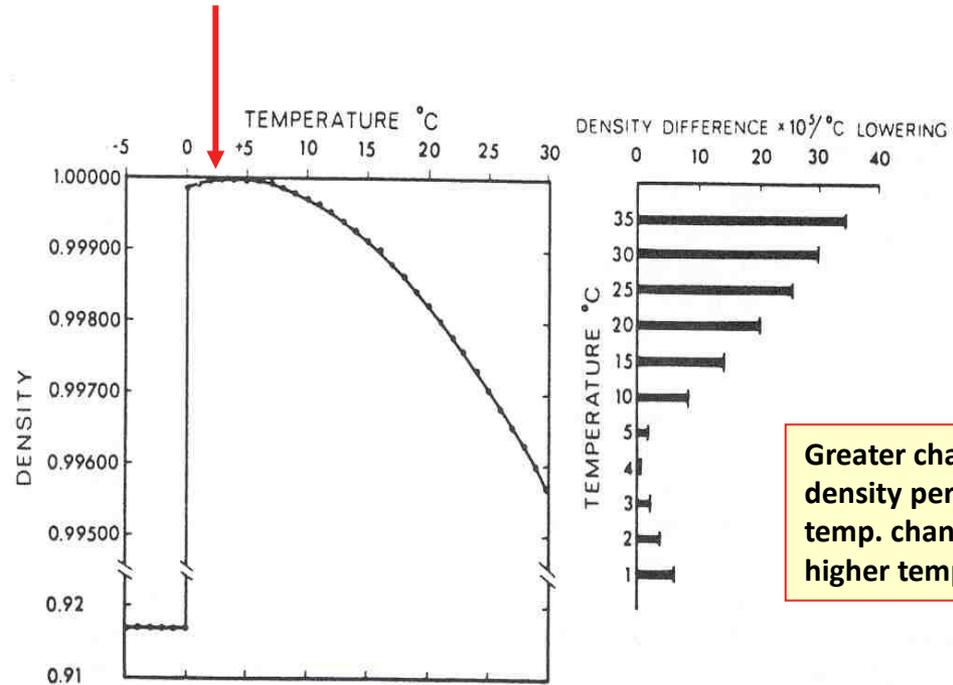
Conceptual Model



Water is weird...



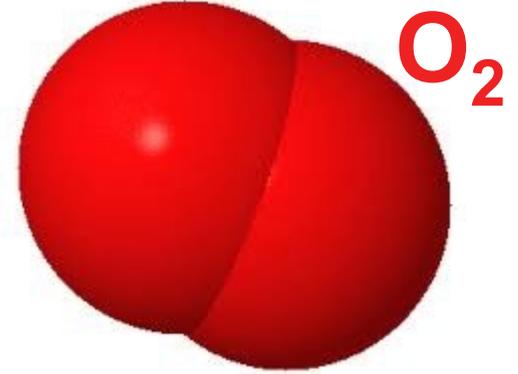
Maximum density around 4 C



Greater change in density per degree temp. change at higher temperatures

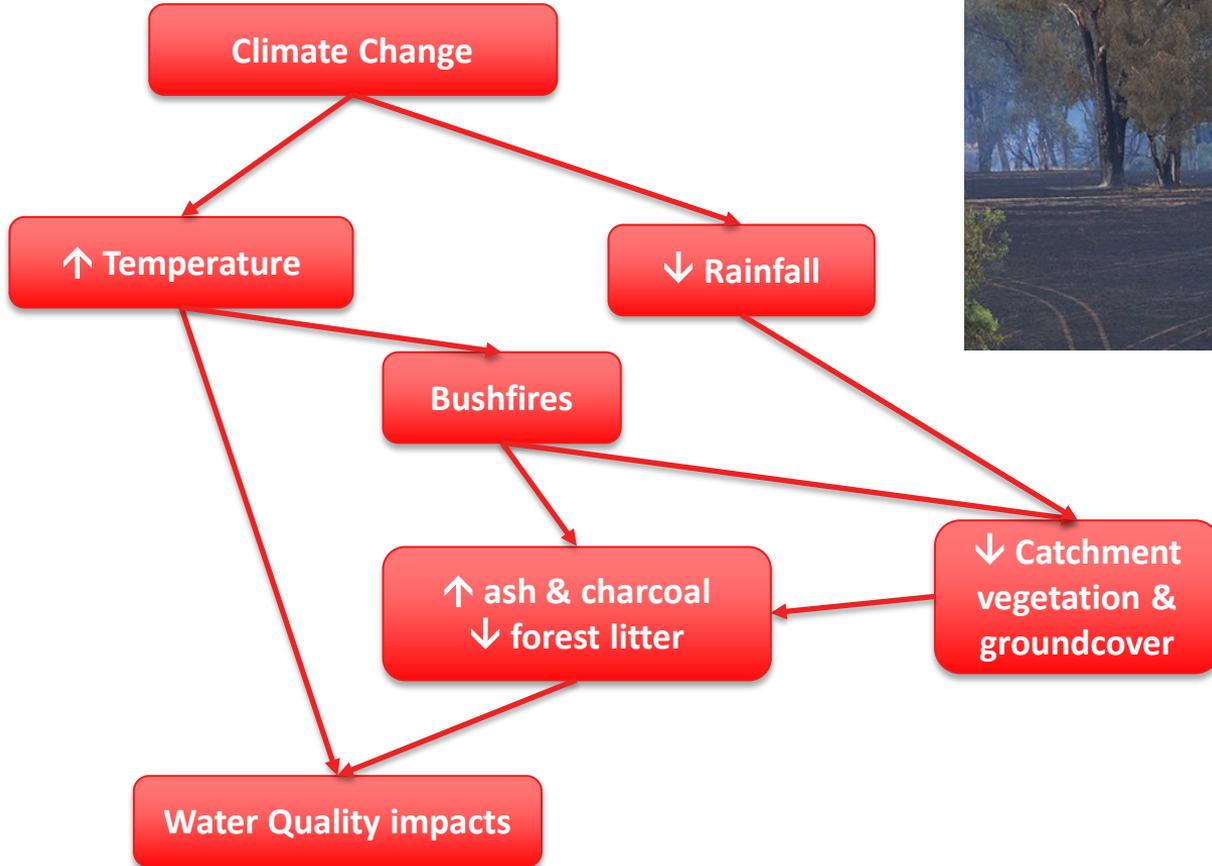
FIGURE 2-3 Density (g ml⁻¹) as a function of temperature for distilled water at 1 atm. The density difference per °C lowering is shown in the right-hand portion of the figure at various temperatures. (Modified from Valleryne, 1957.)

Water quality & the story of oxygen



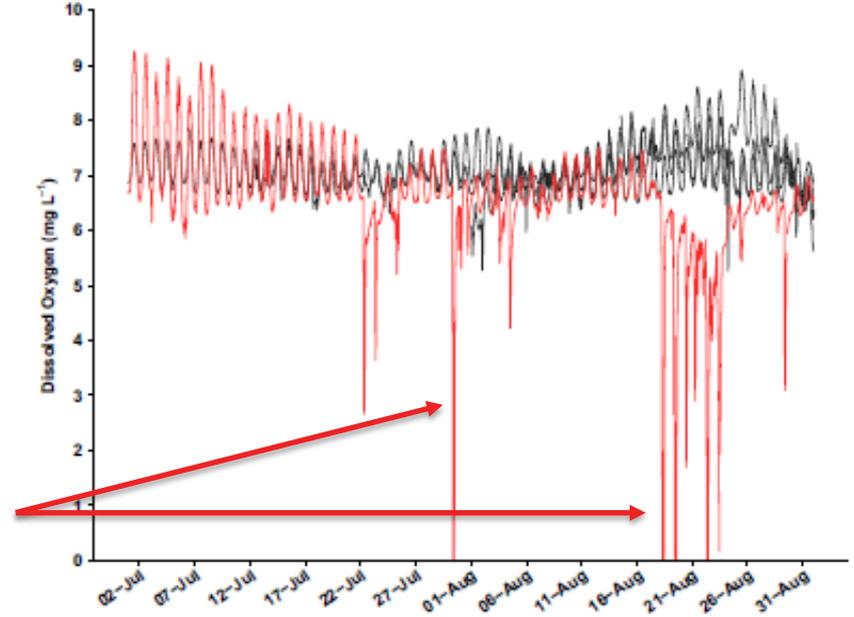
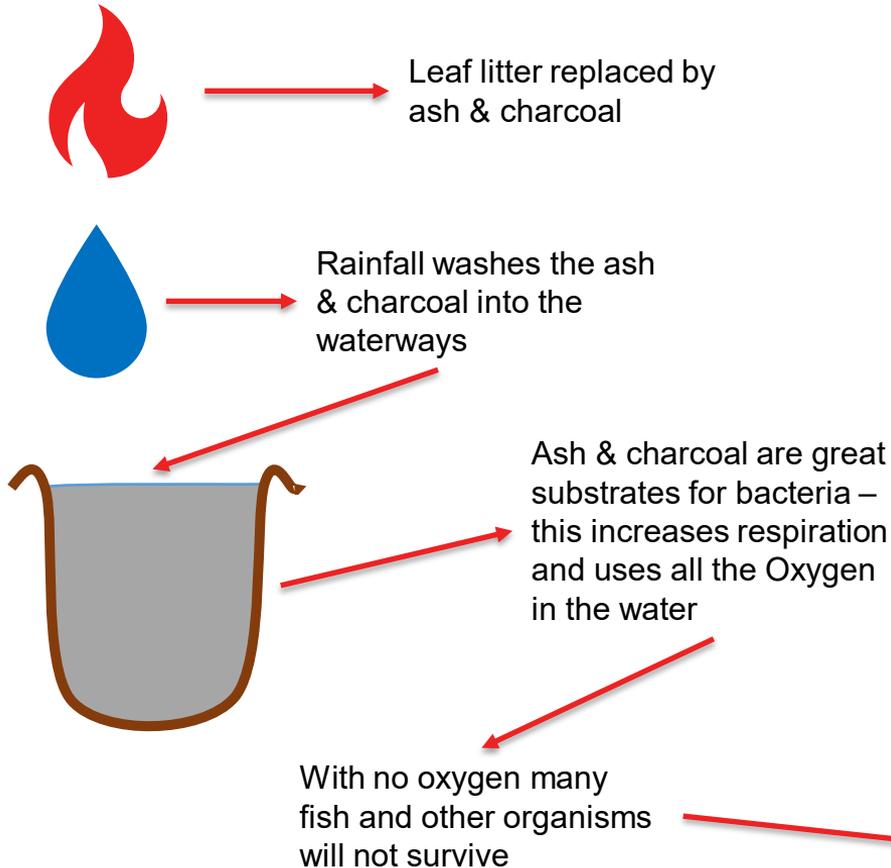
- Oxygen is required for most aquatic life, but
- Oxygen doesn't readily dissolved in water
 - At 20°C water saturated with oxygen has about 9 mg/L of oxygen – which is 0.9% compared with ~21% O_2 in the atmosphere
- What drives oxygen in water?
 - Photosynthesis (plants and algae) – increase O_2 in water
 - Respiration (bacteria) – decrease O_2 in water

1. Rivers on fire.... bushfire



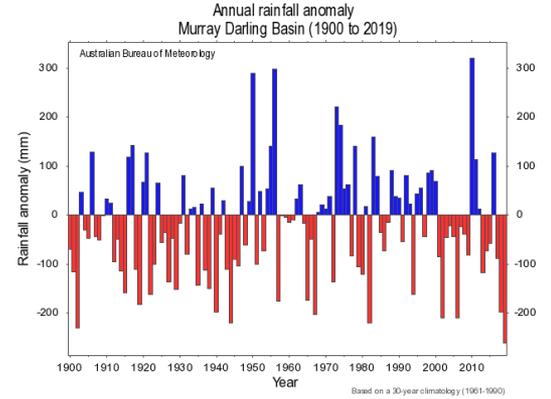
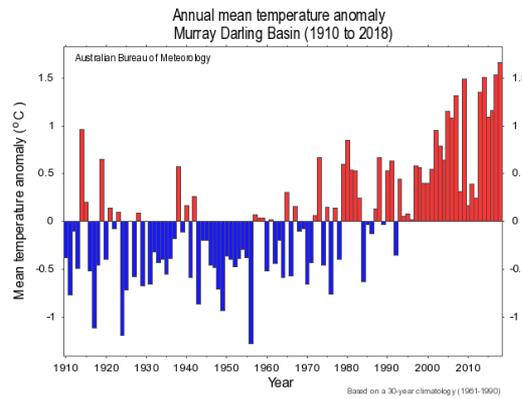
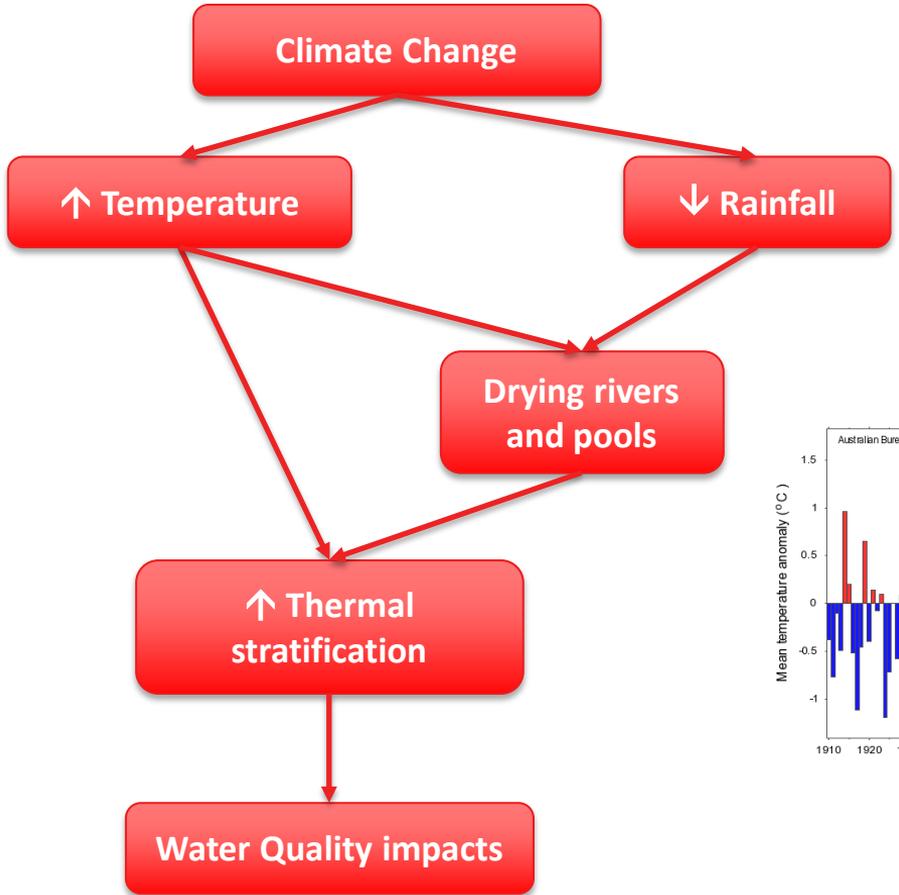
From: www.mdba.gov.au

Fire and reduced oxygen levels in rivers and streams

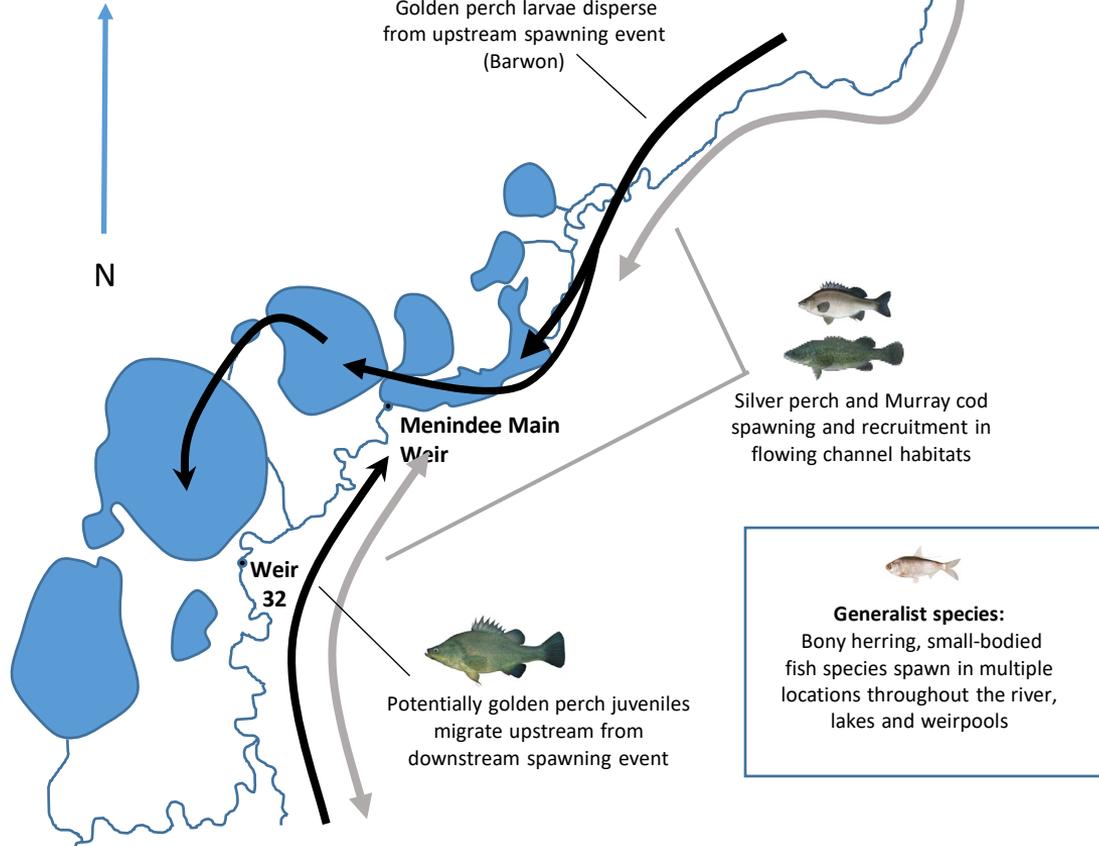


Dahm, C., et al. (2015). "Extreme water quality degradation following a catastrophic forest fire." *Freshwater Biology* 60(12): 2584-2599.

2. Rivers on fire.... drought

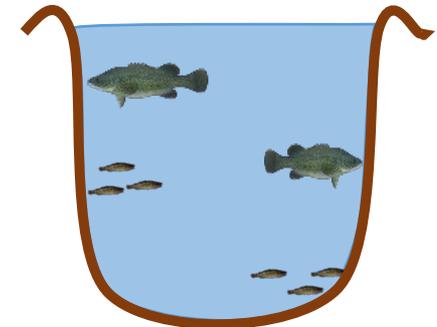


August 2016 – Flows



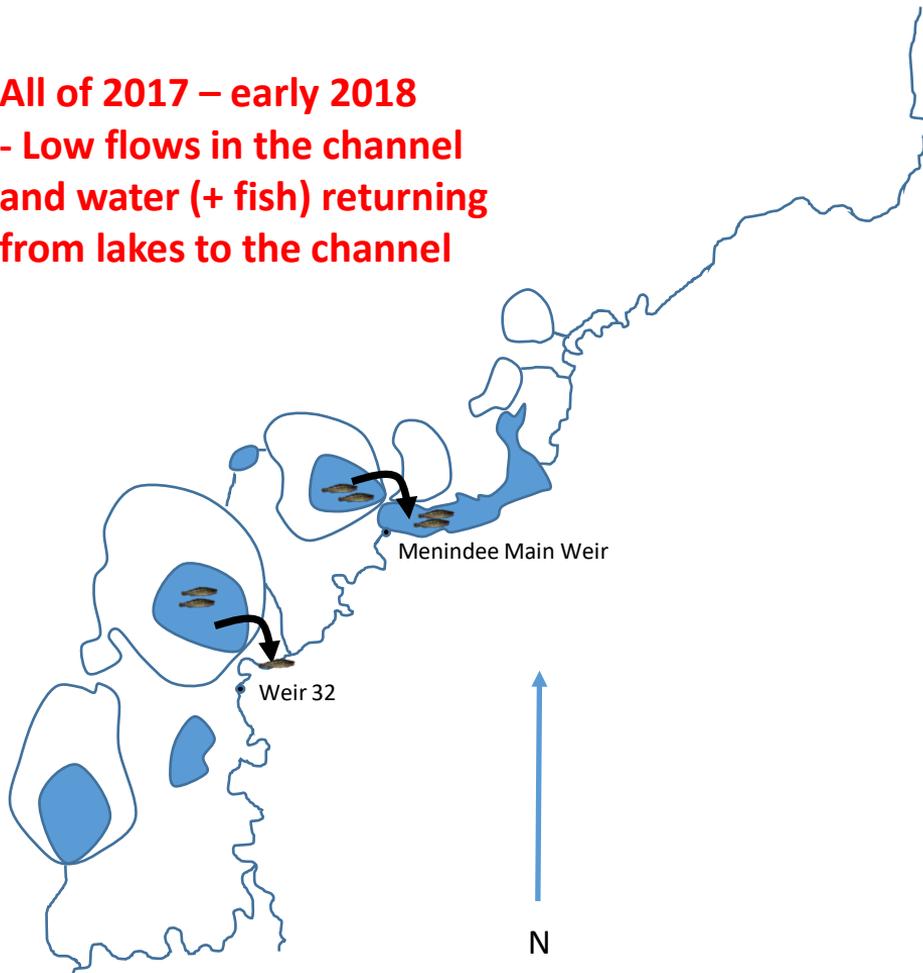
Background Fish Ecology – the role of Menindee Lakes in the Darling River

- Connected system with main channel flowing promotes recruitment (survival of young)
- Under natural conditions, when lakes fill, fish dispersing from upstream have high recruitment.
- E-watering takes place in August 2016 to increase connectivity and promote recruitment in Menindee Lakes; data shows this is successful.



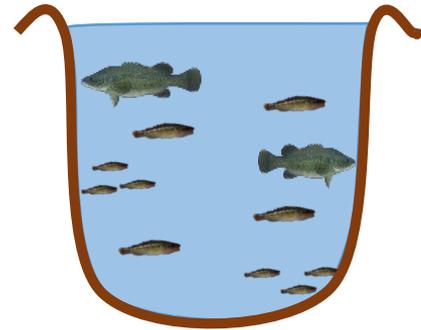
Weir 32 weirpool

All of 2017 – early 2018
- Low flows in the channel
and water (+ fish) returning
from lakes to the channel



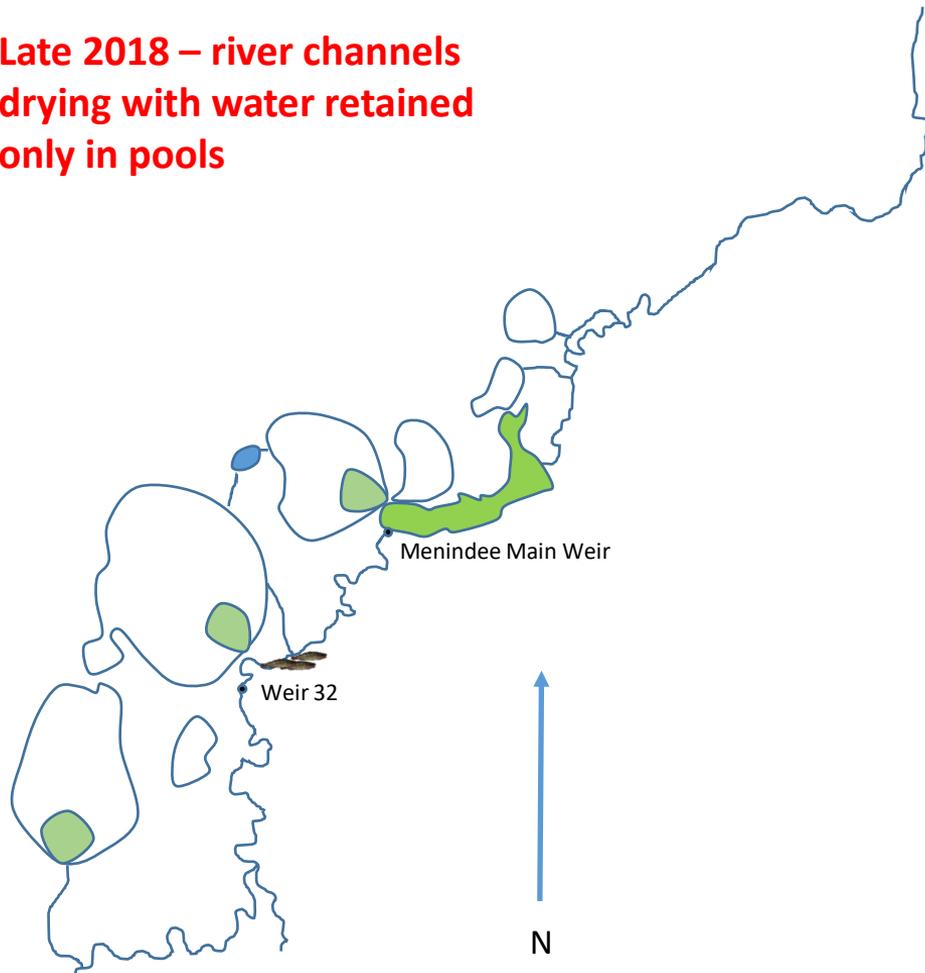
Beginning of conditions that increased risk of fish kills

- Lakes drawn down to less than 50%,
- Fish move into main channel,
- Darling River fish biomass increases,
- No inflows,
- Main channel at minimum releases



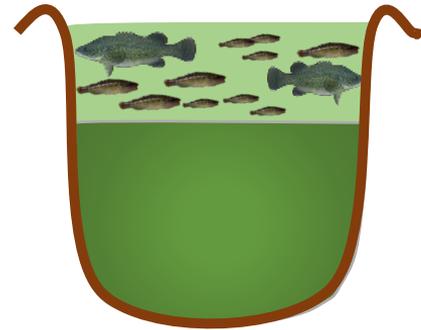
Weir 32 weirpool

**Late 2018 – river channels
drying with water retained
only in pools**



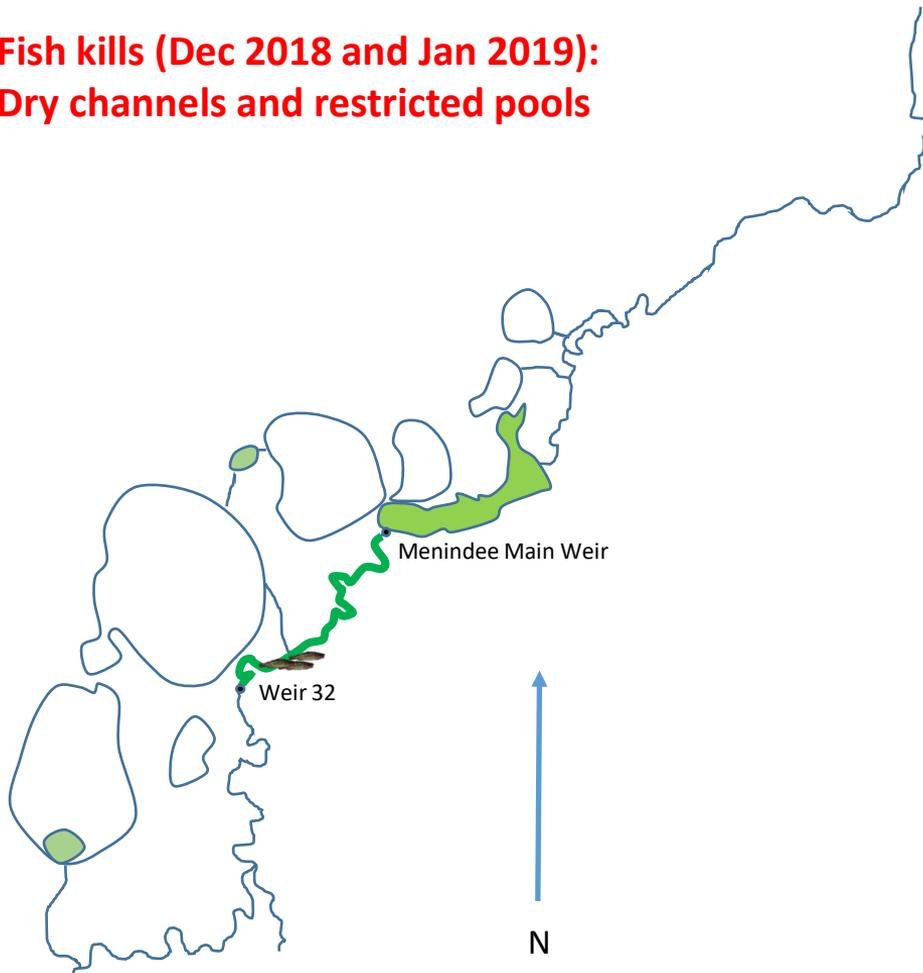
**Conditions develop that further increase
risk of fish kills**

- Lakes drawn down to less than 10%,
- Fish all in main channel,
- No inflows,
- Blue green algae develops,
- Weir 32 stratifies,
- Fish concentrated at surface and become stressed often seen gulping for air,
- Cold water with zero oxygen at bottom



Weir 32 weirpool

**Fish kills (Dec 2018 and Jan 2019):
Dry channels and restricted pools**



Conditions unsuitable for fish - fish kills occur

- Lakes drawn down to minimum level,
- Fish all in main channel, no inflows,
- Blue green algae persists,
- Weir 32 weirpool flips,
- Hypoxic water mixes with surface water,
- Fish basically suffocate



Weir 32 weirpool

Summary



- Rivers reflect the condition of their catchments
- Climate change, through increases in temperature and changes in rainfall, will have (and is having) significant impacts on catchments and therefore rivers; this includes
 - Increased drought and frequencies of bushfires
 - Associated changes in water quality with poor outcomes for rivers and streams

THANK YOU