

A wide-angle photograph of a dry, open landscape. A dirt road winds through the center of the frame, leading towards a distant horizon. The ground is reddish-brown and sparsely covered with low-lying, scrubby vegetation. The sky is a pale, clear blue with a few wispy clouds near the horizon. The overall scene conveys a sense of a vast, arid environment.

# The Australian Freshwater Environment & its fish fauna

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Iceland

Sweden

Norway

Finland

Baltic Sea

Estonia

Latvia

Moscow  
Москва

Lithuania

North Sea

United Kingdom

Denmark

Ireland

Netherlands

Poland

Belarus

London

Germany

Berlin

Belgium

Prague

Paris

Czechia

Slovakia

Ukraine

Vienna

France

Austria

Hungary

Moldova

Barcelona

Croatia

Romania

Black Sea

Portugal

Spain

Italy

Rome

Bulgaria

Serbia

Georgia

Azerbaijan

Tyrrhenian Sea

Greece

Istanbul

Turkey

Caspian

Morocco

Tunisia

Mediterranean Sea


Syria

Lebanon

Iraq

Algeria

Libya

 **Australia**  
 Total size in km2 (sq mi) 7,692,024 (2,969,907)

Israel

Jordan

Western Sahara

Riyadh  
الرياض

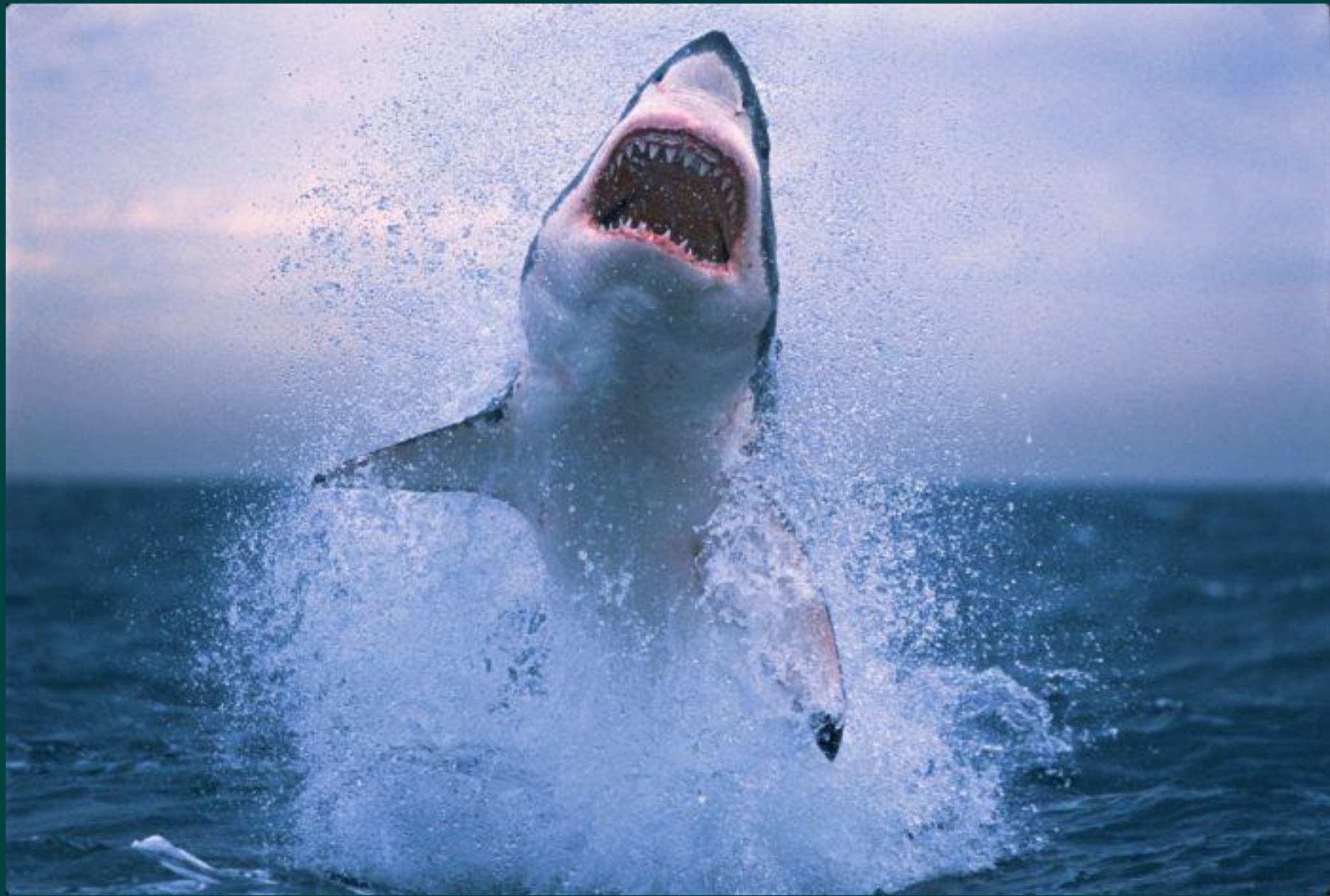
Mecca

Saudi Arabia

Persian

# The Murray-Darling Basin















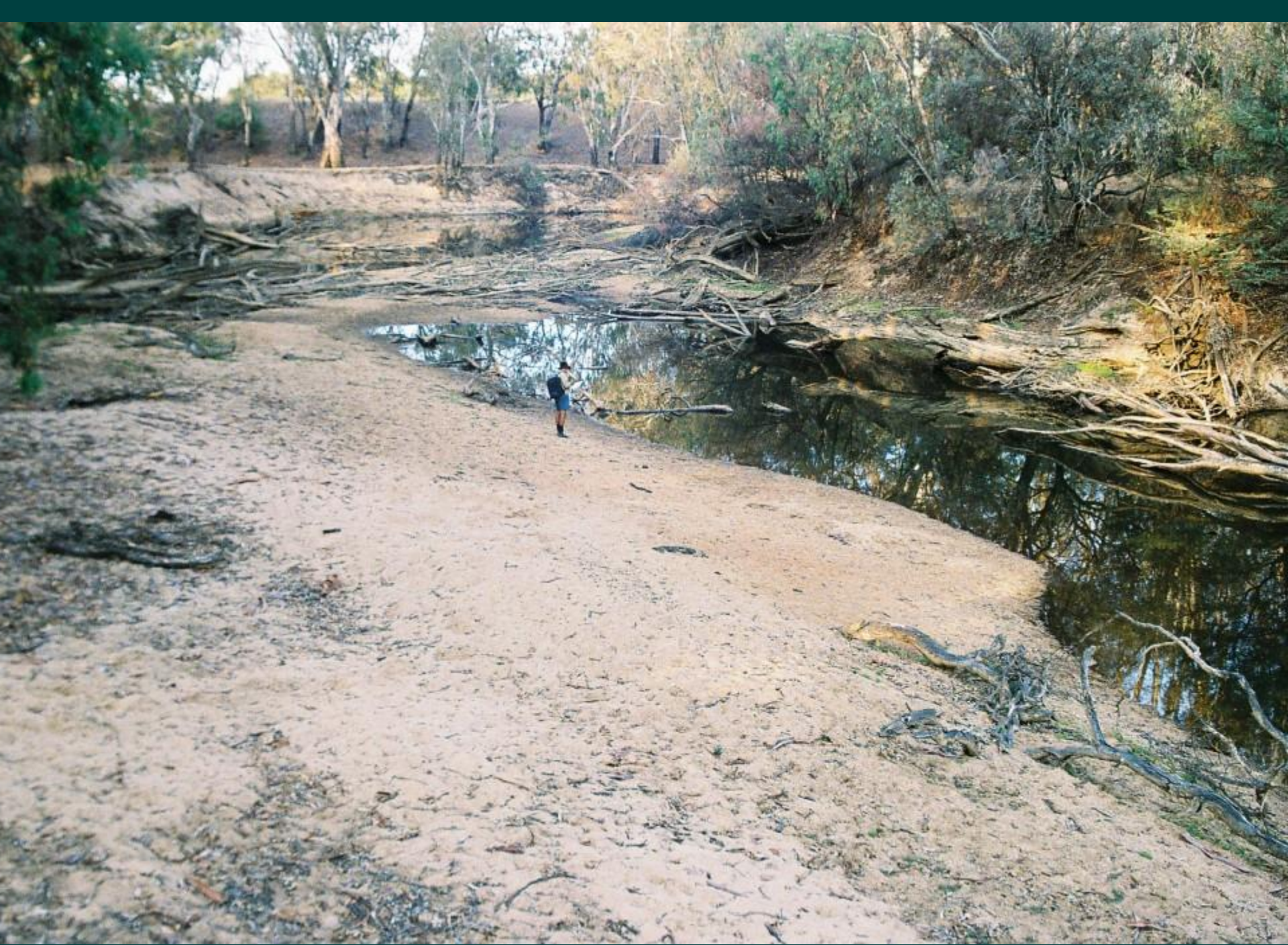


























National Archives





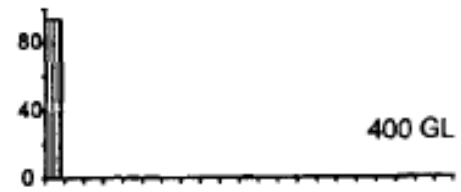
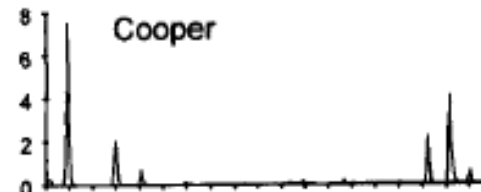
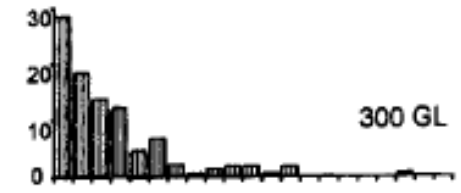
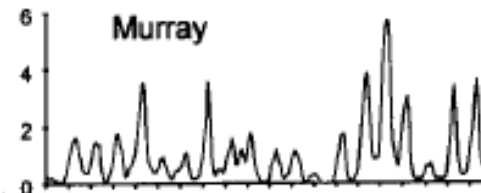
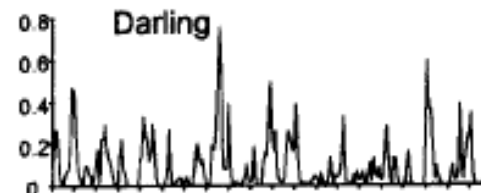
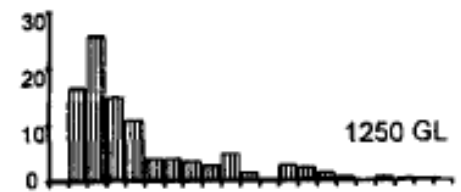
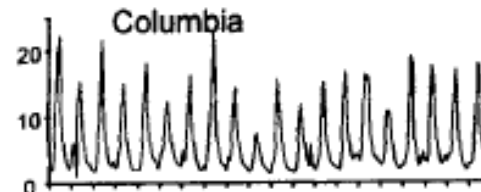
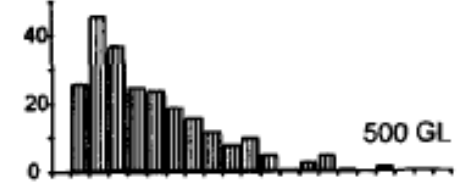
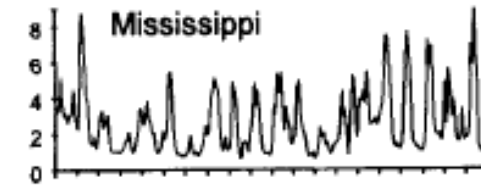
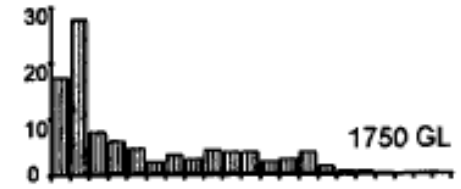
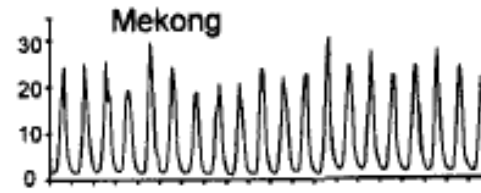




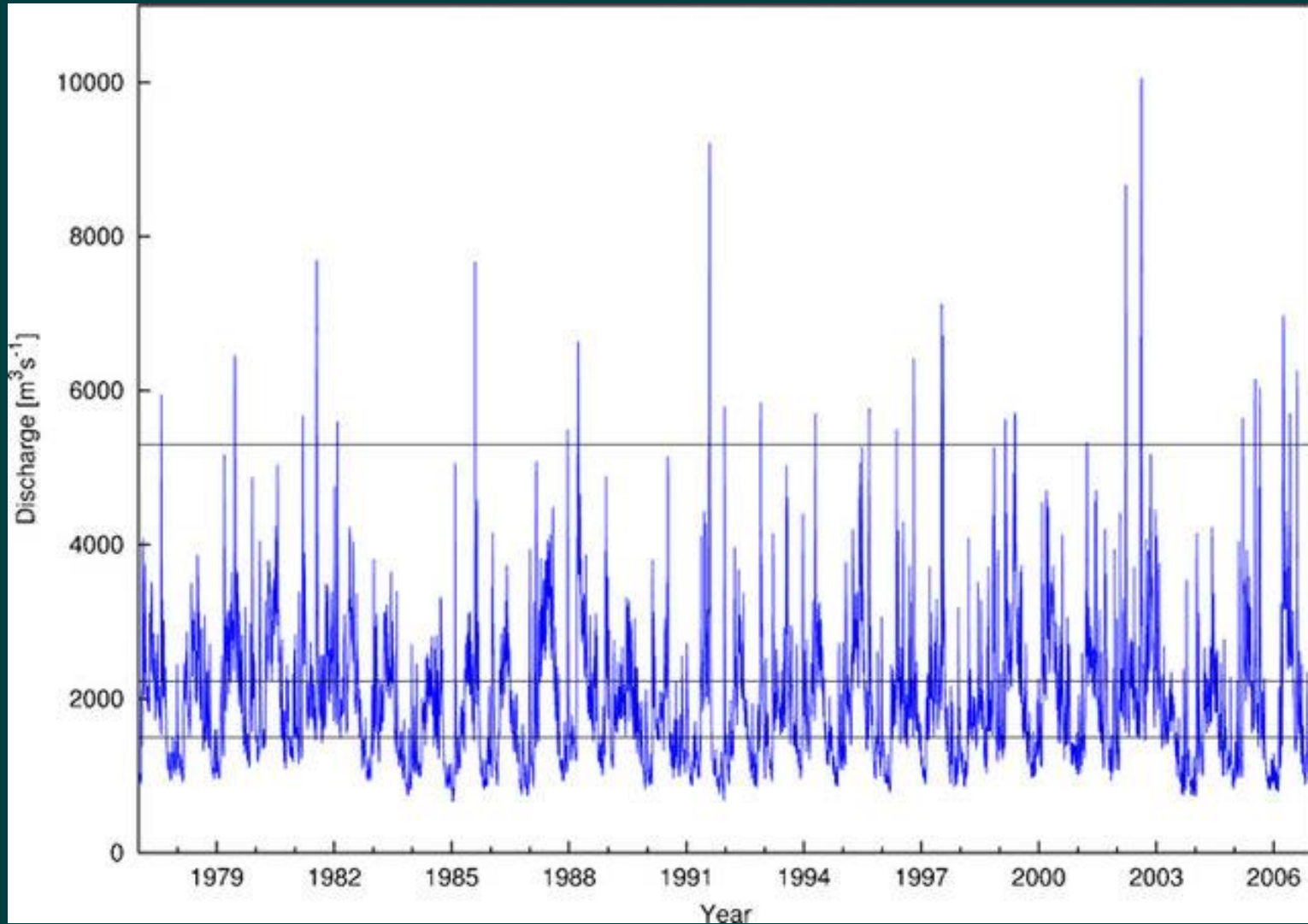




# River discharges: Australia vs the world!

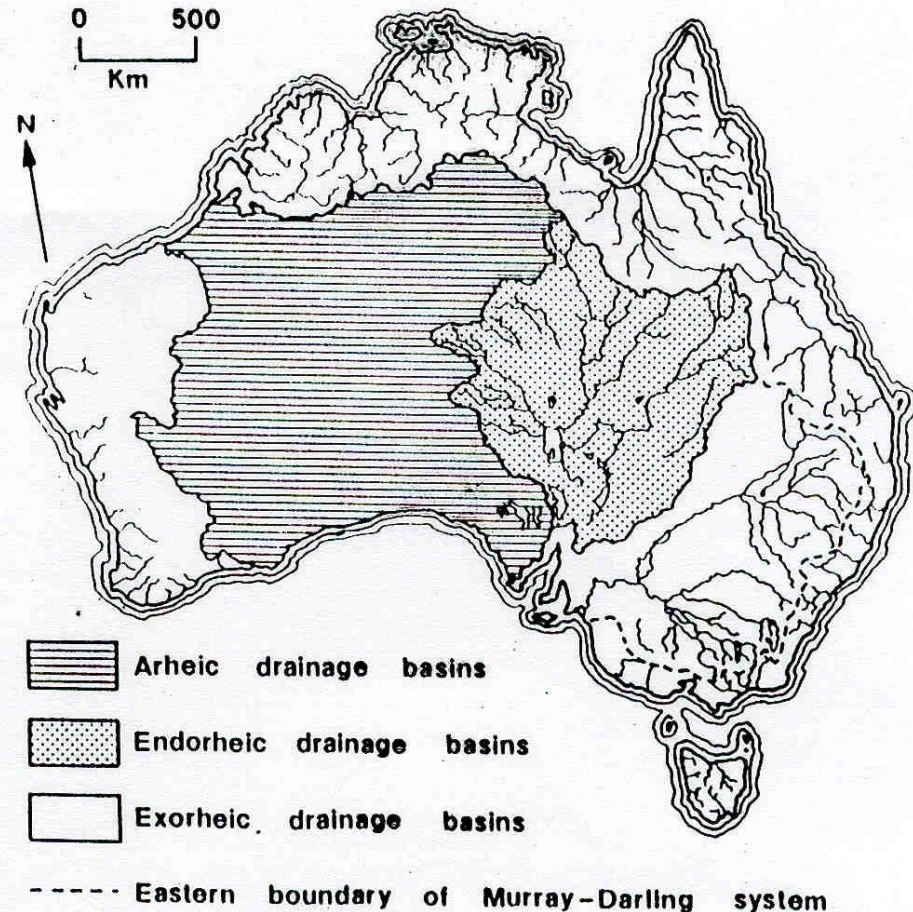


# River Danube (Welti et al. 2012)



# Drainage basin types in Australia

- **Exorheic** - rain discharges to sea
- **Endorheic** - drainage is internal
- **Arheic** - surface drainage patterns absent

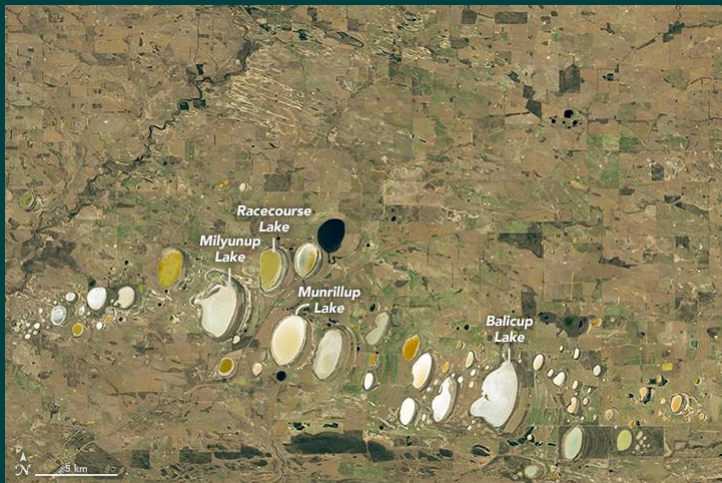


Source: Williams Australian Freshwater Life (1980)

# Australian still waters

## Freshwater lakes

Few large deep lakes on Australian mainland; most are in Tasmania



## Salt lakes

- Common in Australia
- Resident organisms have adapted to high salinities



Mountain-Lake  
National Park  
Mount Ossa

Lake Rowellian

Walls of Jerusalem  
National Park

Central Plateau  
Conservation Area

Great Western Tiers  
Conservation Area

A5

A5

A5

Great Lake

Lake St Clair

B11

Top Marshes  
Conservation Area

2 mi  
5 km

A10

# Australian still waters

## Billabongs

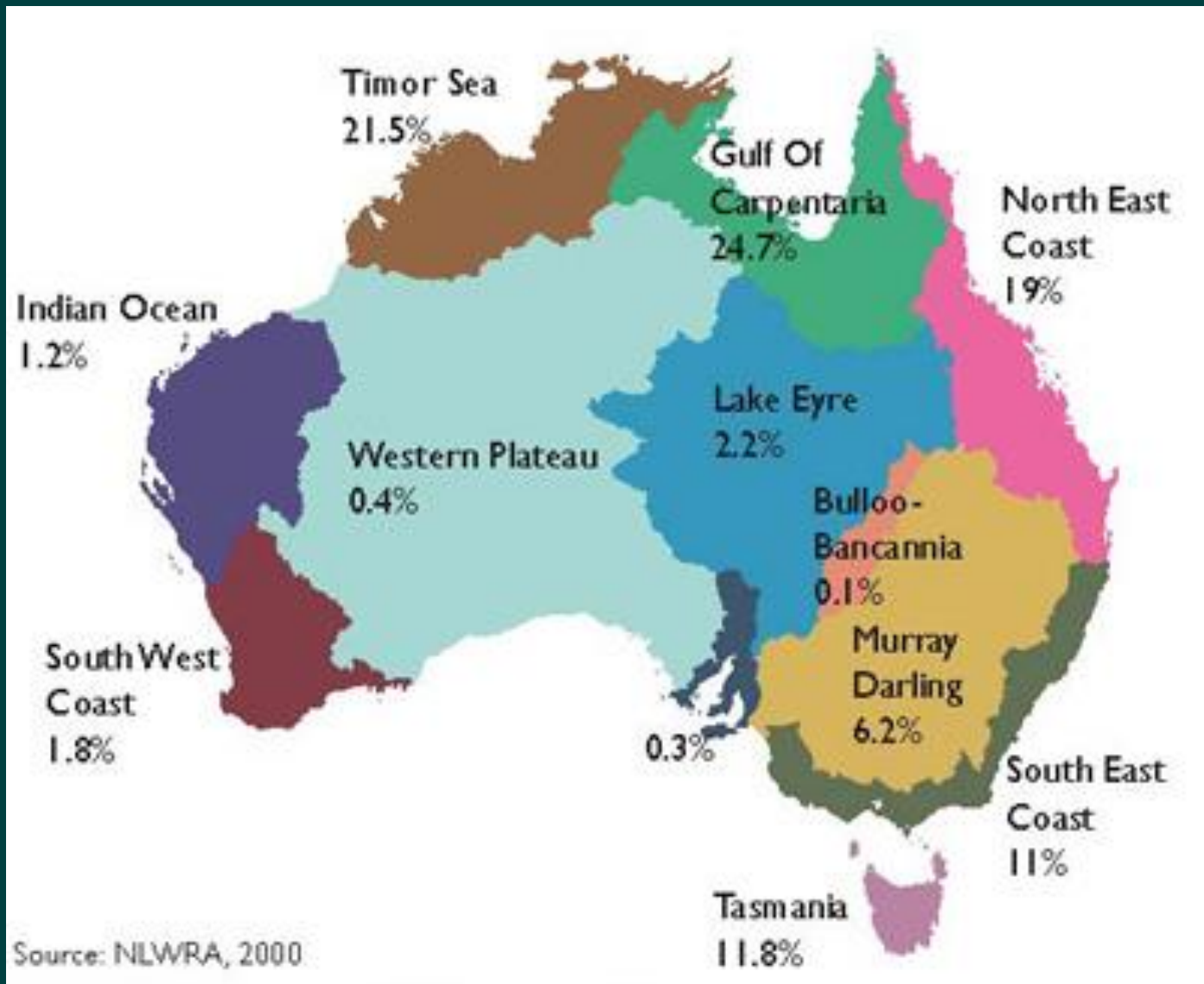
- Oxbow lakes
- Occur along most meandering rivers
- Link running & standing waters

## Swamps

- Shallow sheets of standing water
- Highly productive habitats
- Often drained or cleared



# Australian flowing waters

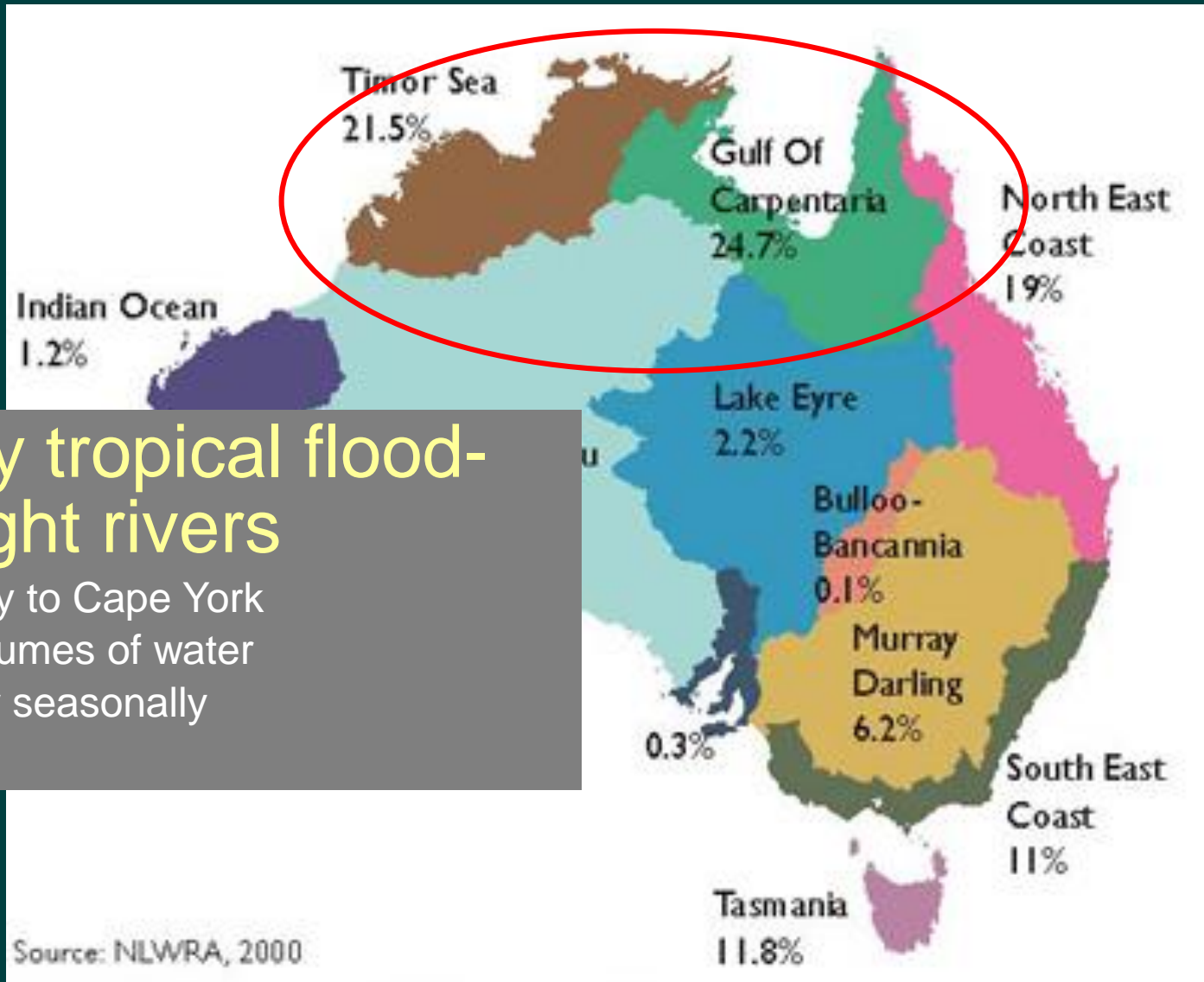




# Great Dividing Range



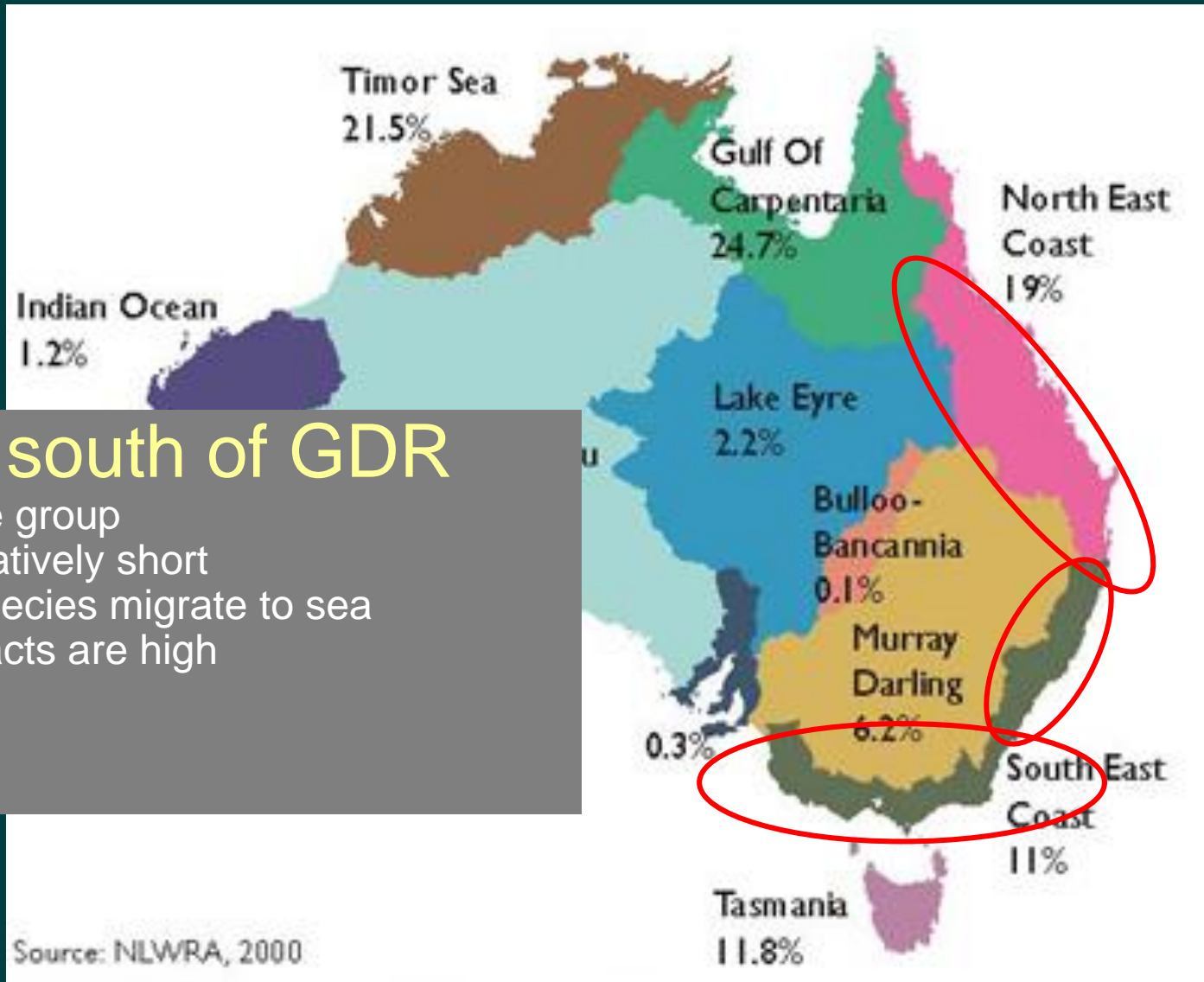
# Australian flowing waters



## Wet-dry tropical flood-drought rivers

- Kimberley to Cape York
- Huge volumes of water
- Often dry seasonally

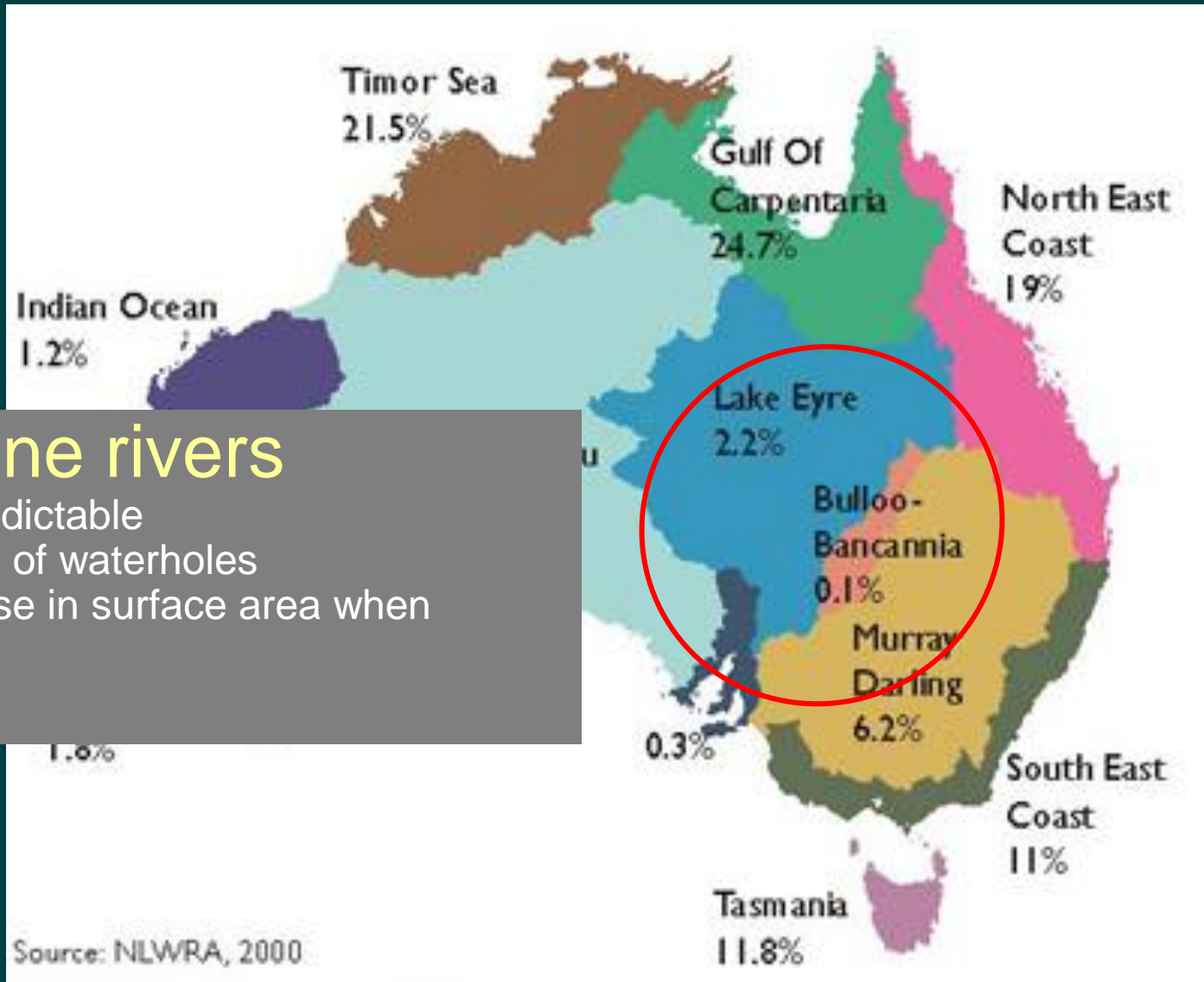
# Australian flowing waters



## East & south of GDR

- Most diverse group
- Most are relatively short
- Many fish species migrate to sea
- Human impacts are high

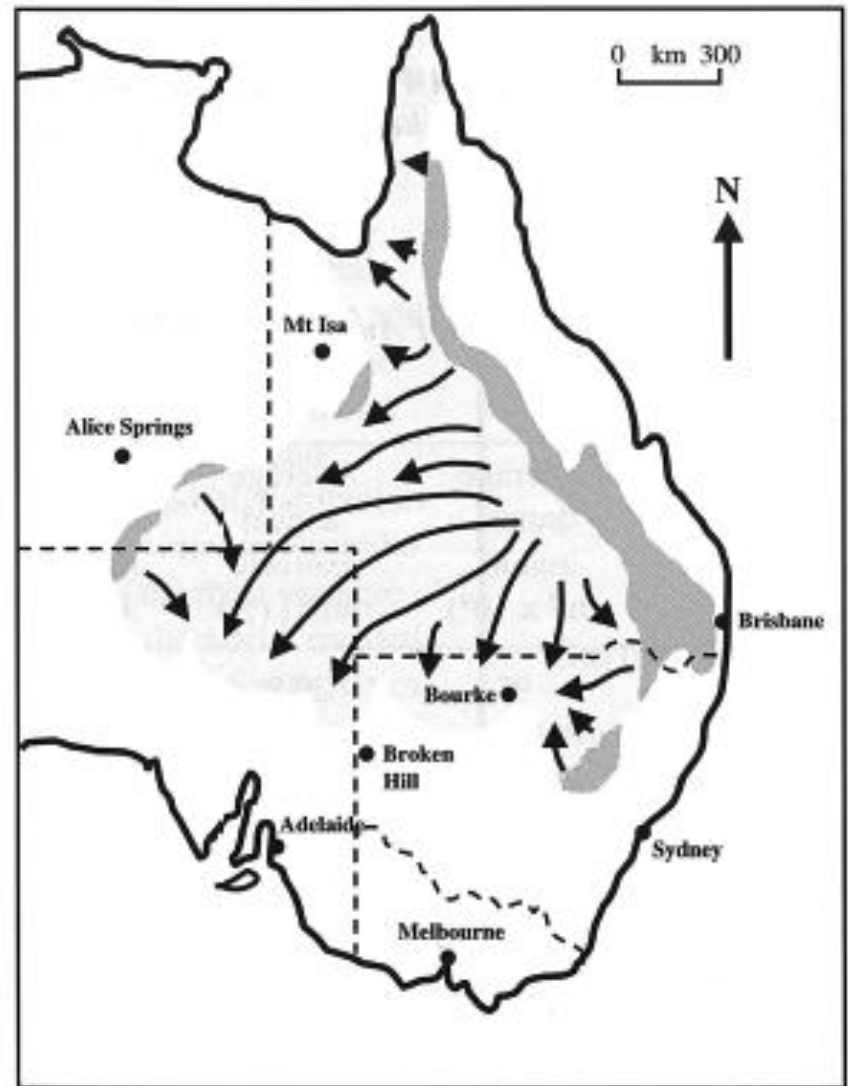
# Australian flowing waters



## Arid-zone rivers

Highly unpredictable  
Dry to series of waterholes  
Huge increase in surface area when flooding

# Groundwater-dependent ecosystems



*Fig. 2.8 The Great Artesian Basin. Dark shading represents recharge areas. Natural springs abound along the south-western, south-eastern, and north-eastern margins. From Aplin (1998).*

# Australia's freshwater fish fauna

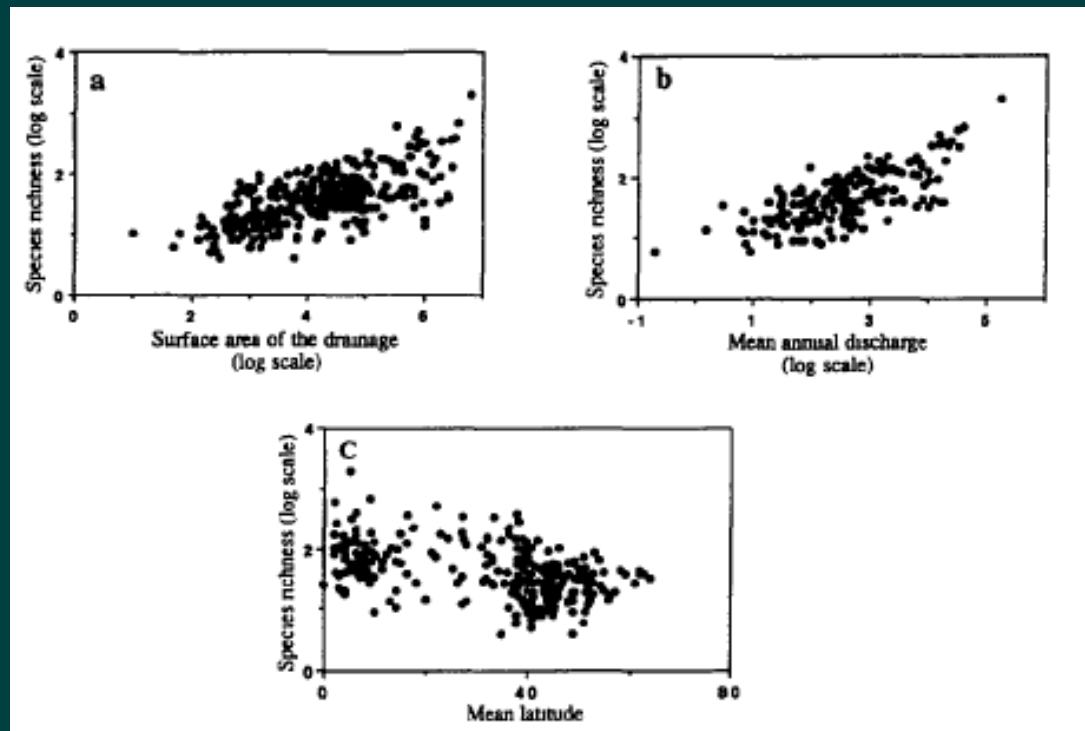
Its diversity and its peculiarities

# Number of species by country

Country	Total	Native	Alien	Extinct
Brazil	2298	2281	17	0
USA	883	821	61	25
India	678	659	19	0
Cameroon	490	487	2	0
Europe	400	368	32	?
<b>Australia</b>	<b>325</b>	<b>297</b>	<b>28</b>	<b>0</b>
Guatemala	151	143	8	0
Vanuatu	30	29	1	0

# Best predictors of number of species

- Number of species related best to mean annual discharge
- Then surface area

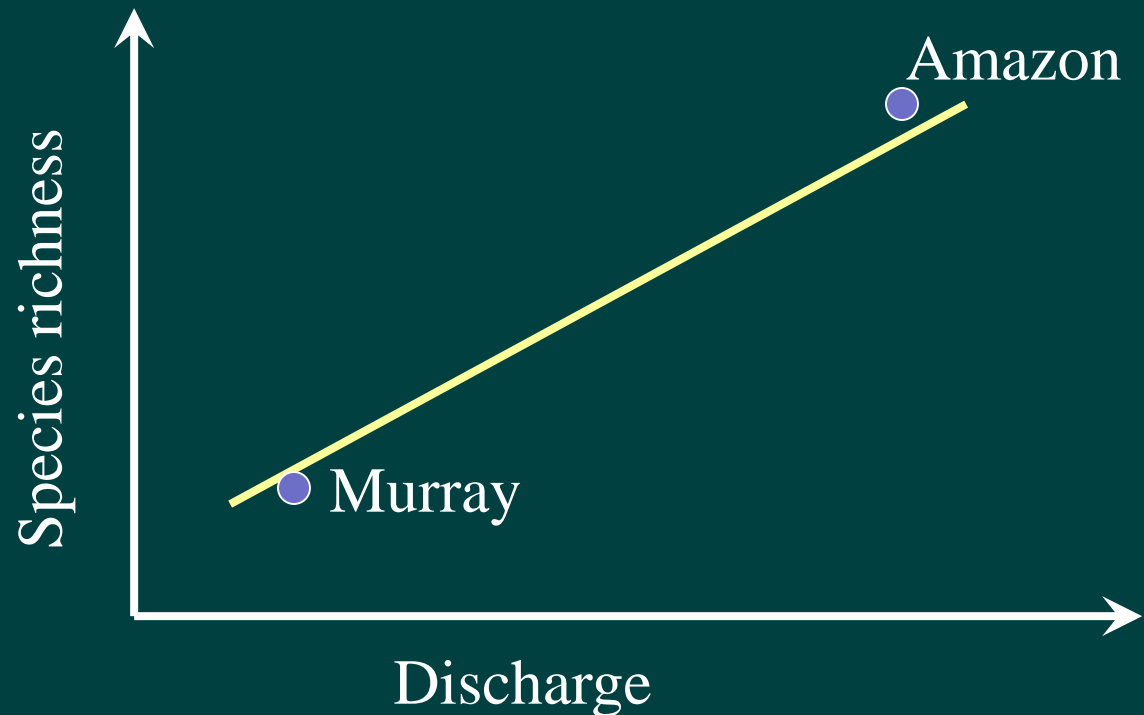


Oberdorff et al., 1995



# A depauperate fauna?

- In total, yes.
- In relation to discharge....no!
- But species have to contend with much variability



# Australian freshwater fish fauna

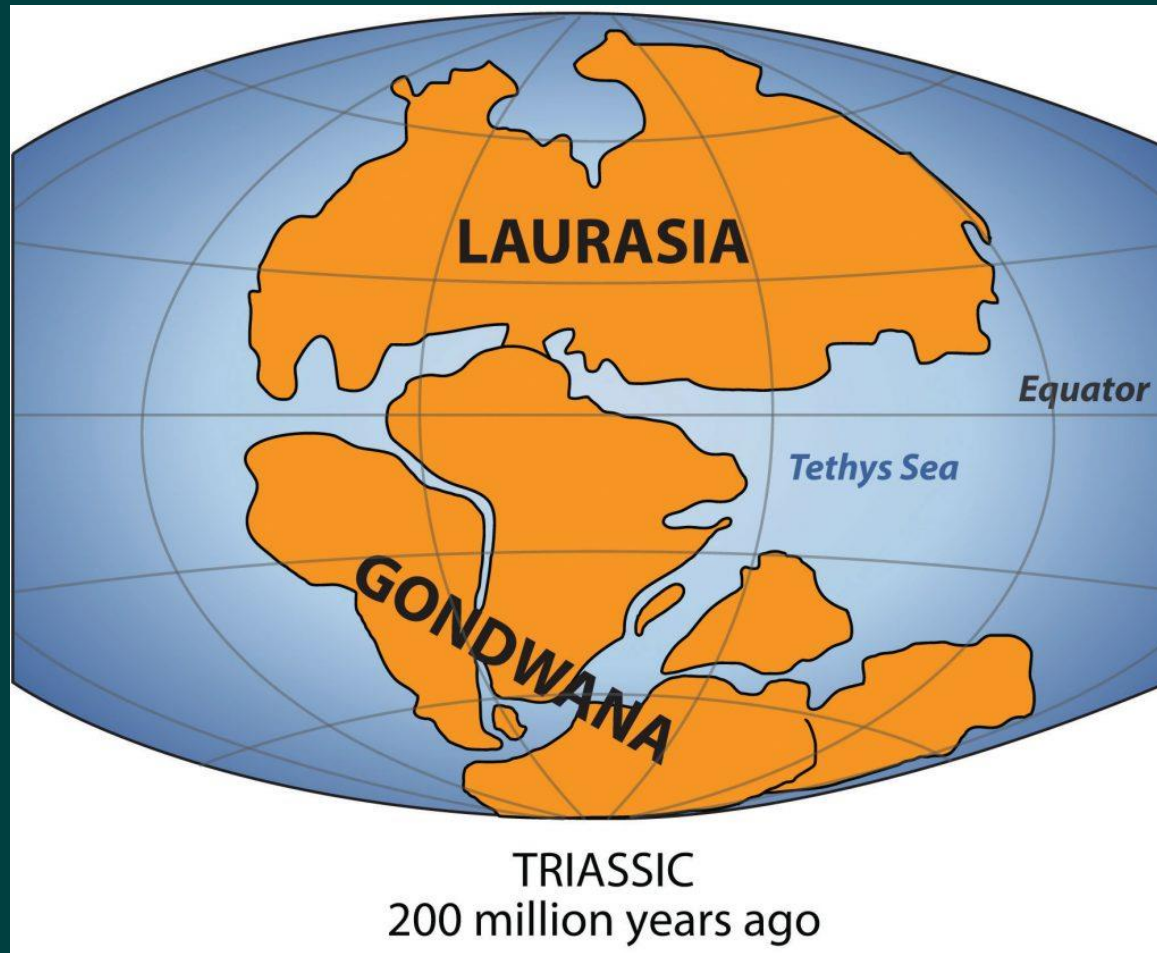
- Approx. 256 native freshwater species in Australia
  - >60% endemic
- Gondwanan origins likely for:
  - Retropinnidae (smelt and grayling)
  - Galaxiidae (galaxiids)
  - Percichthyidae (cods and basses)
  - Ceratodidae (lungfish)
  - Osteoglossidae (bony tongues)



# Lungfish & saratoga

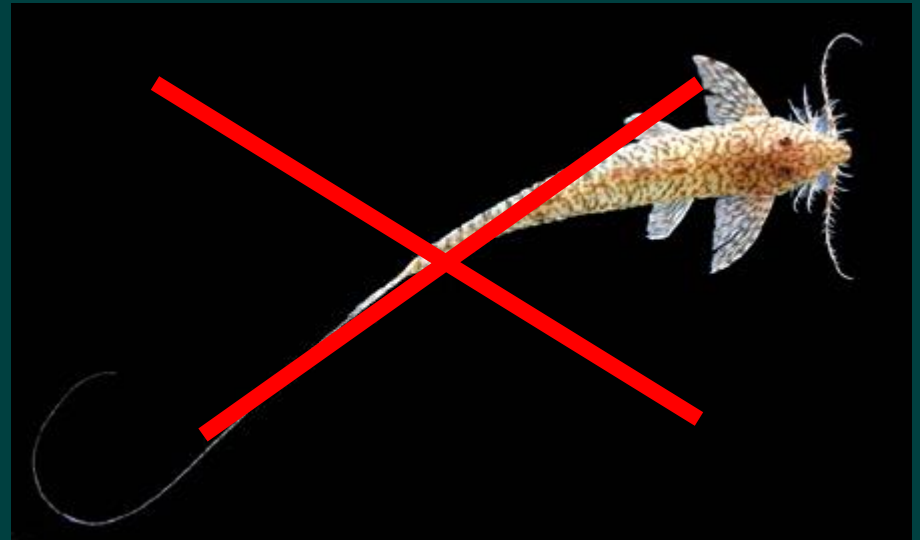


# The world 200 million years ago

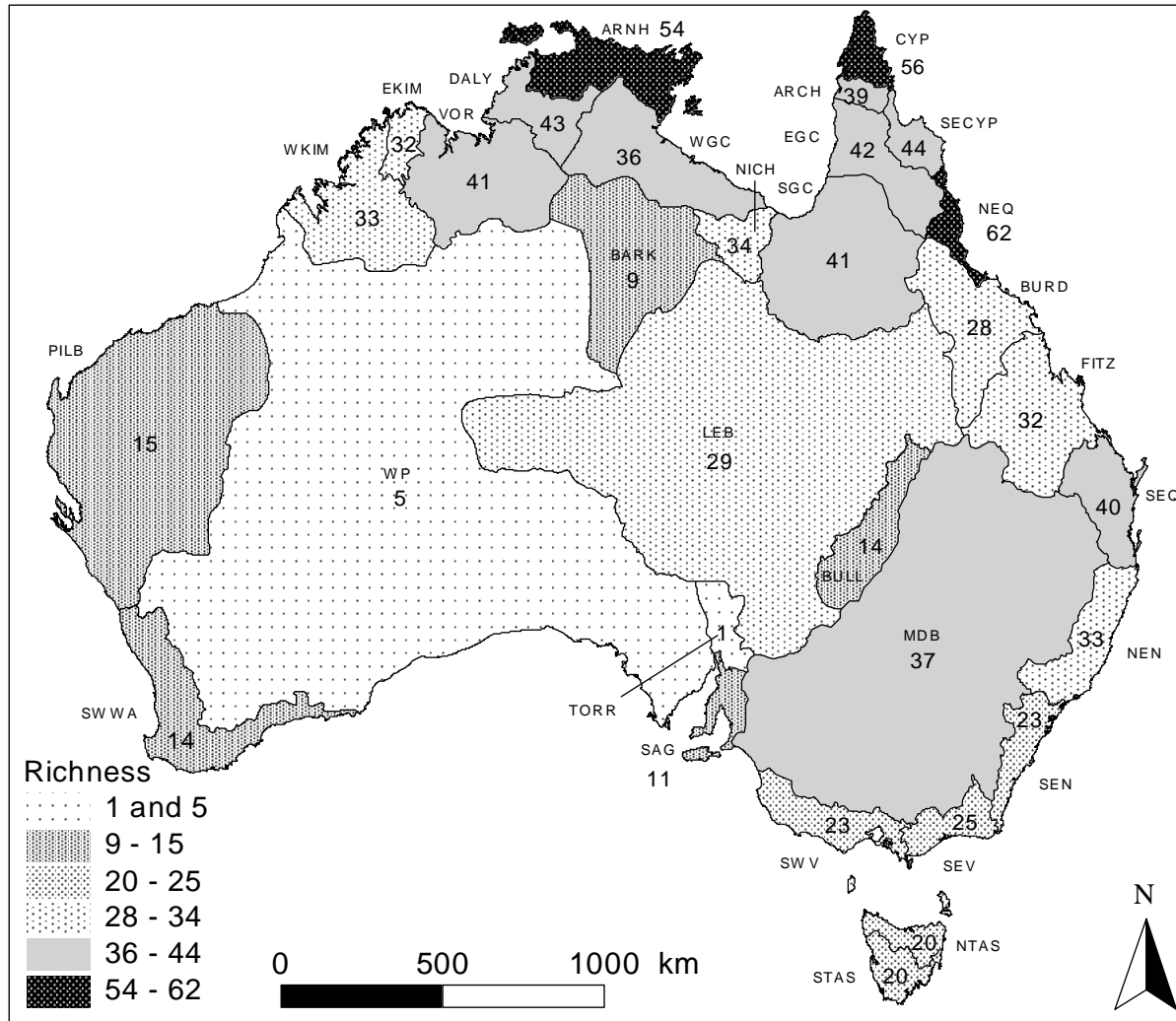


# Australian freshwater fish fauna

- Deep oceanic barrier between eastern Indonesia and Australia/New Guinea region probably prevented dispersal of:
  - Cypriniforms (carps, loaches, suckers)
  - Siluriforms (catfishes, knifefishes)



# Freshwater fish species richness by drainage basin



# Murray-Darling Basin species and endemism

River	No. of species	Endemism
Murray-Darling	~34	~75%
Danube	62	5%
Zaire	690+	84%
Niger	134+	5%
Nile	115+	20%

# Eleotridae (gudgeons) 31 spp





# Galaxiidae (native trout/minnows) 22



McDowall



Photographics



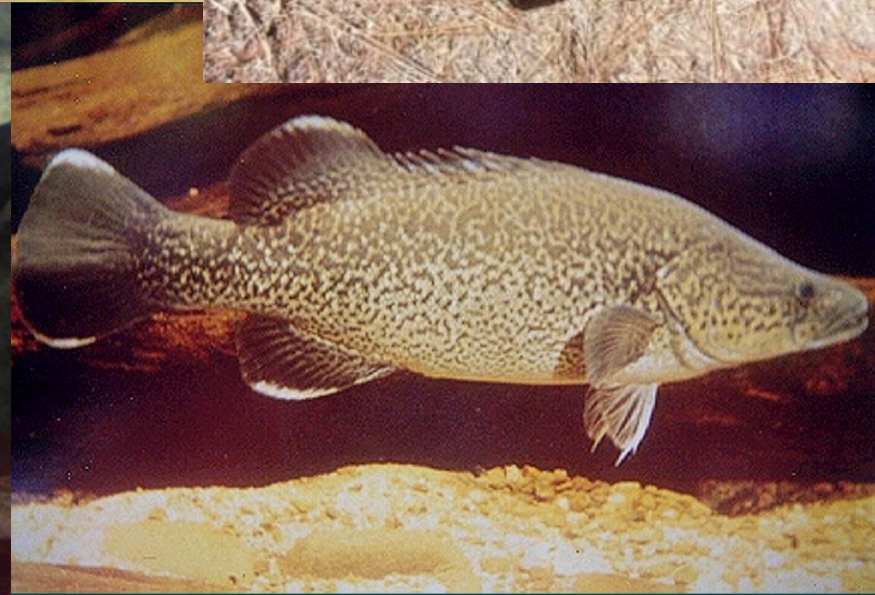
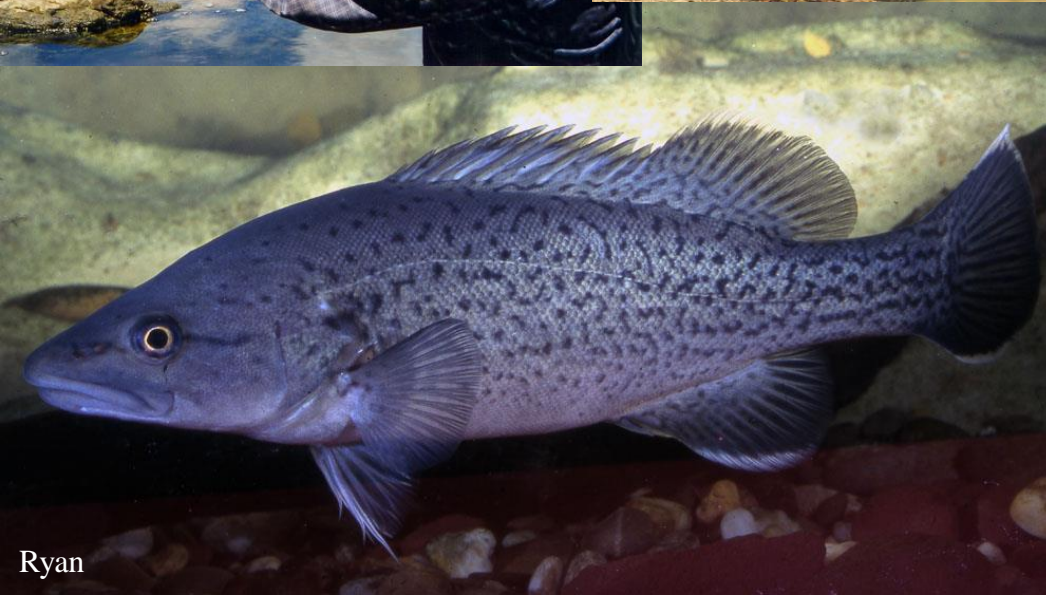
Nelson



McDowall



# Percichthyidae (cods and basses) 20 spp



# Includes: pygmy perches (8 spp)



Includes: blackfish (2 spp)



# Terapontidae (grunters) 25 spp



# Melanotaeniidae (rainbowfishes) 15 spp



# Clupeidae (herrings) 3 spp



# Lepidogalaxiidae (salamanderfish) 1 sp





# Pseudaphritidae (tupong/sandy) 1 sp

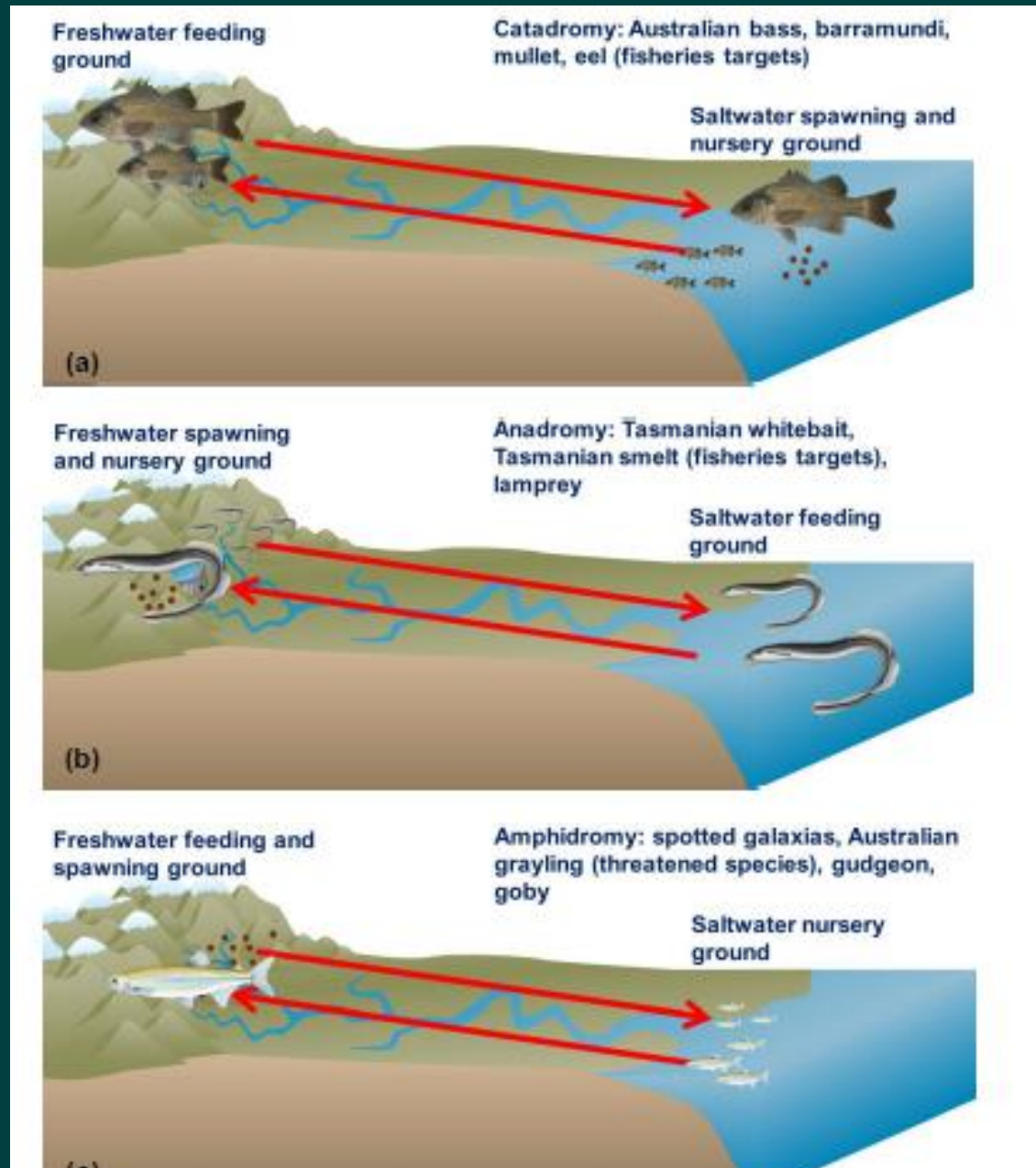


**SO, HOW DO AUSTRALIAN  
FISH SURVIVE SUCH A HARSH  
ENVIRONMENT?**

# Aestivate = summer hibernate



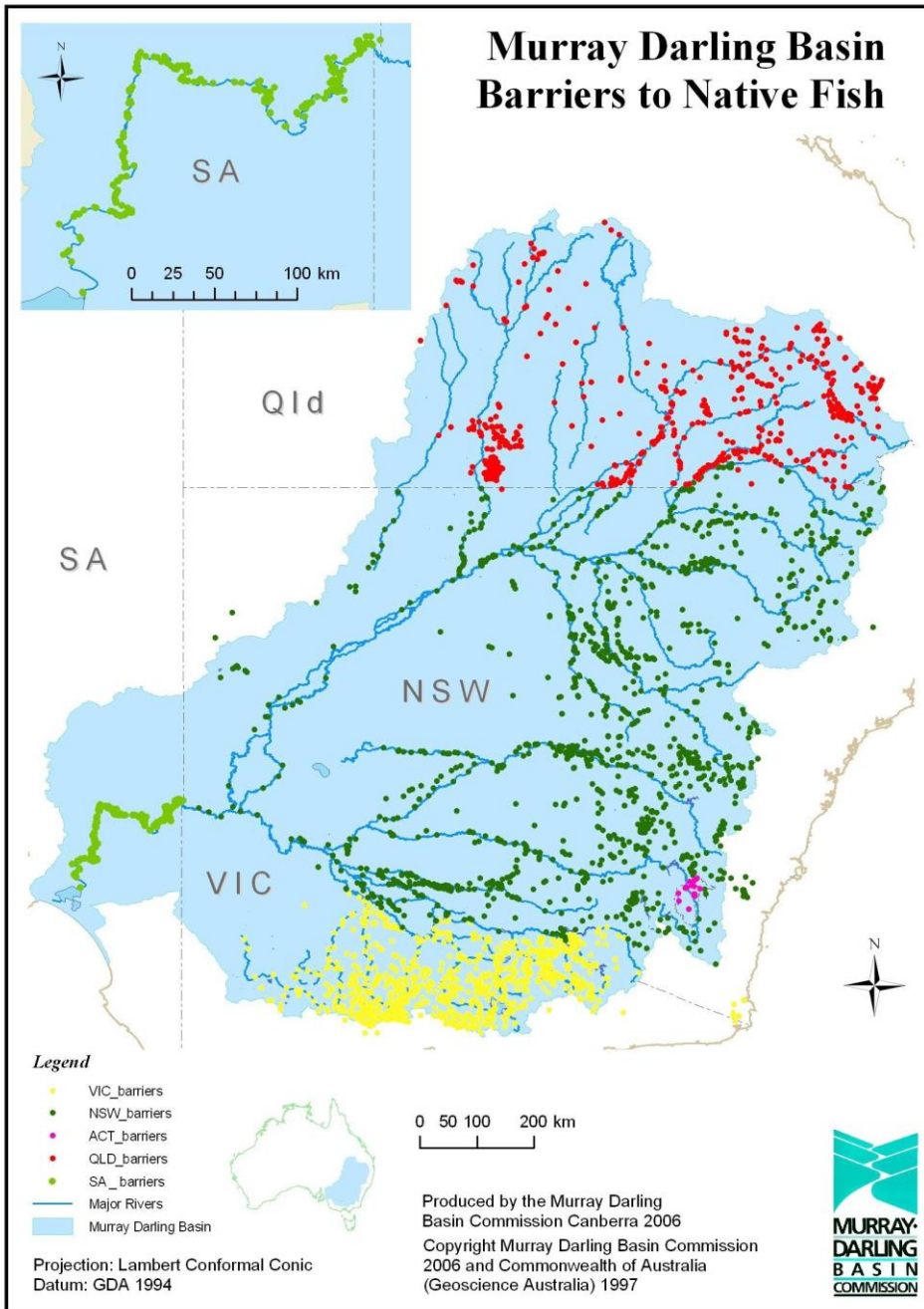
# Diadromy: move between f/water & sea



Hsien-Yung Lin,  
2016

# Environmental disturbance to Murray-Darling Basin rivers

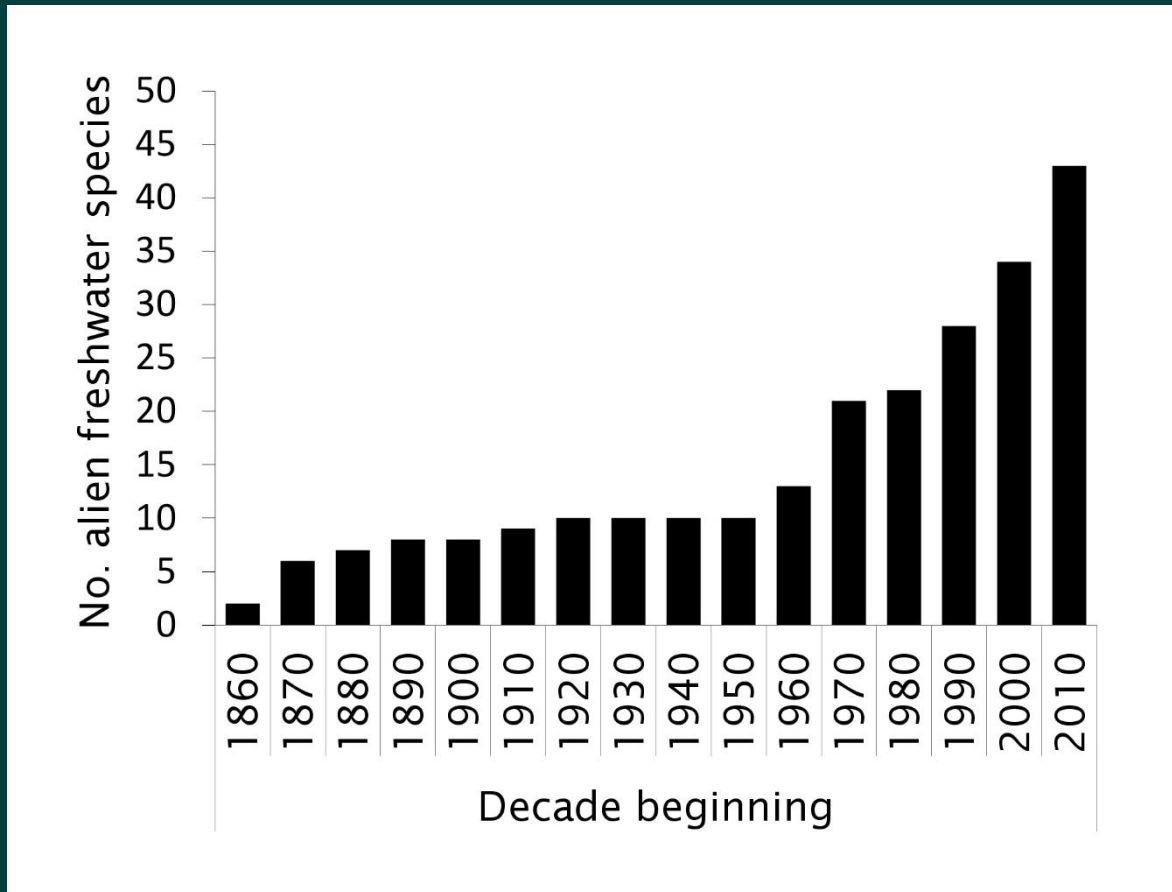
# B



# Introduced species

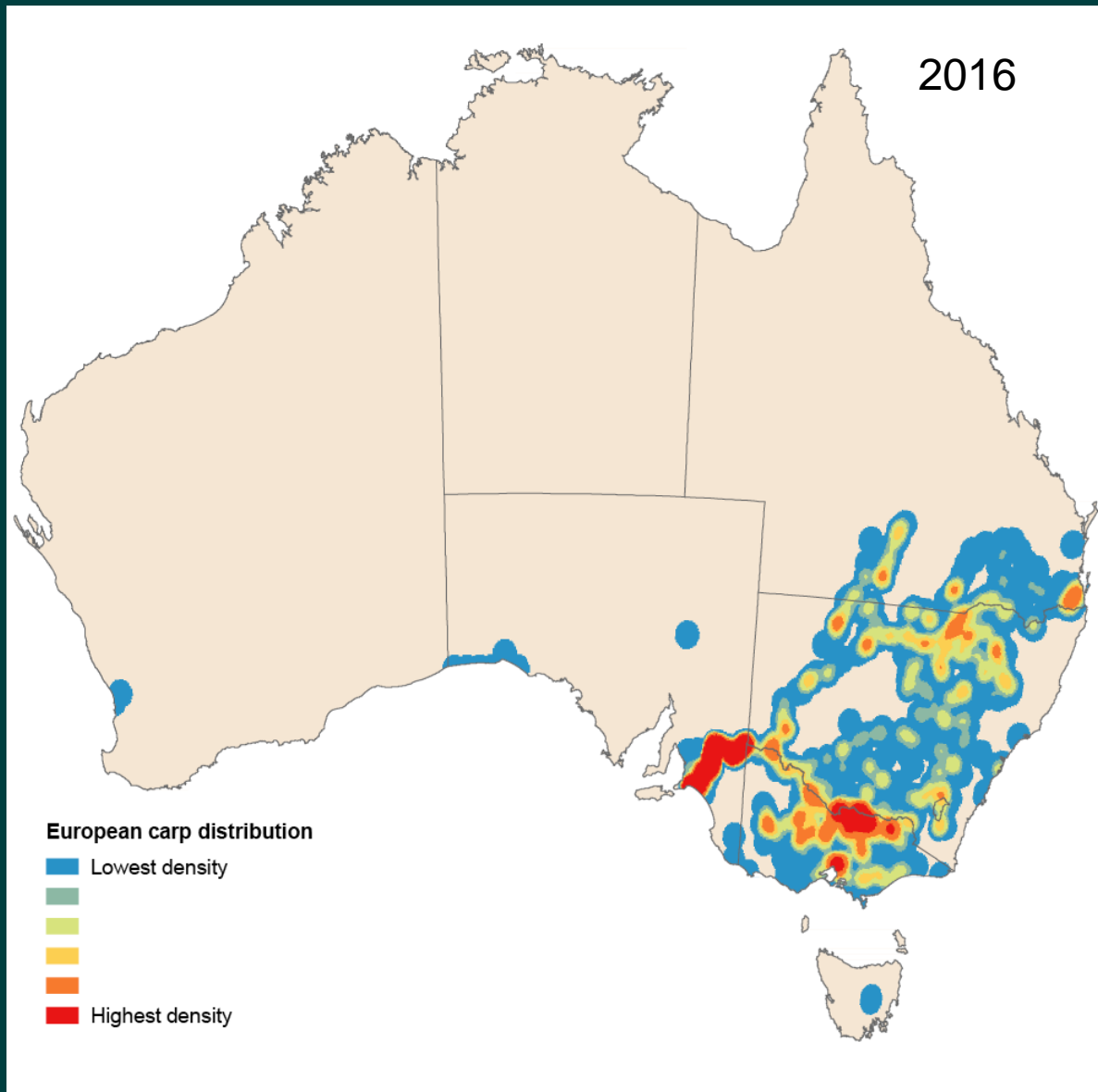


# Chronology of freshwater fish introductions to Australia





# Common carp

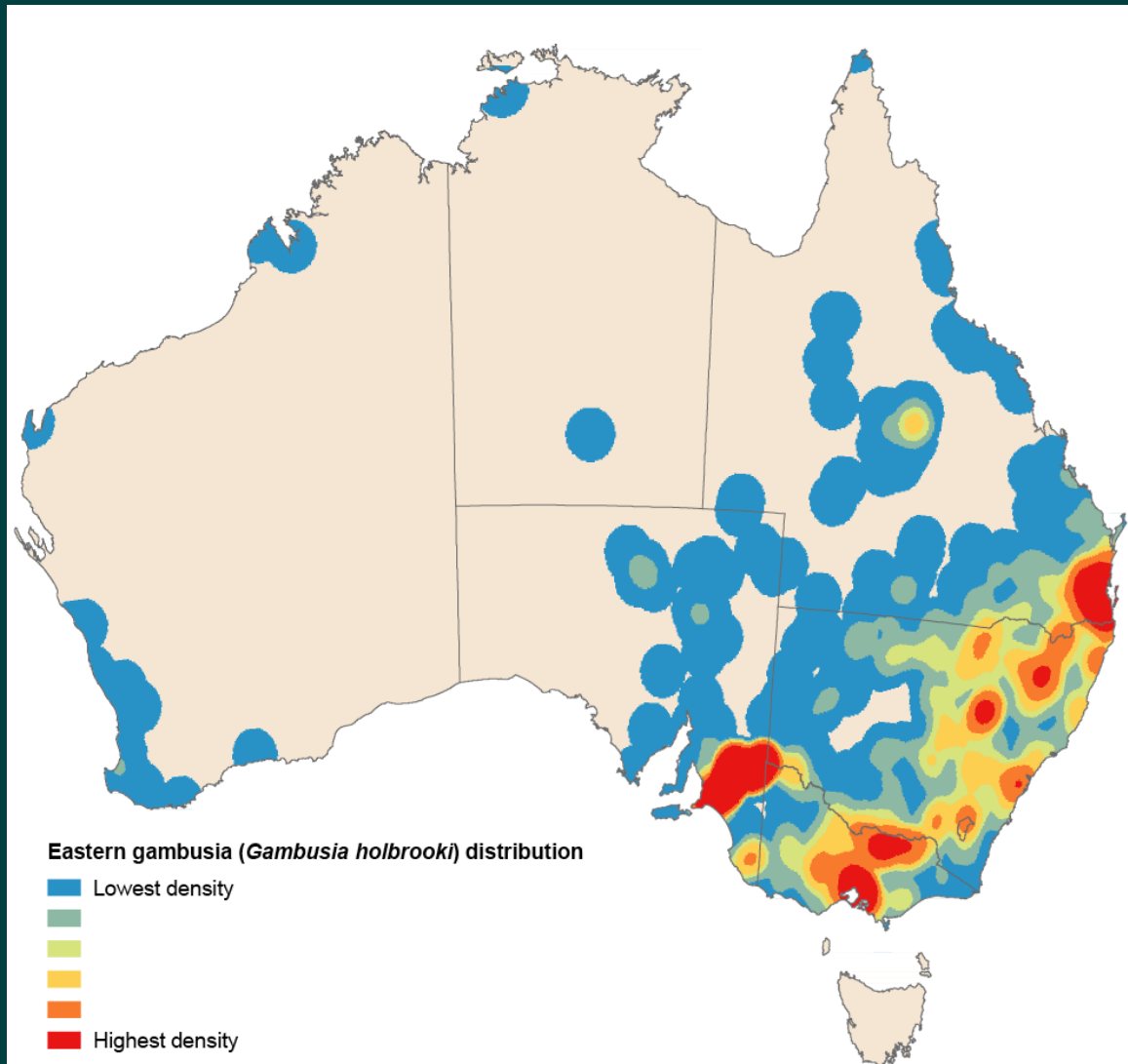


# Methods for controlling carp

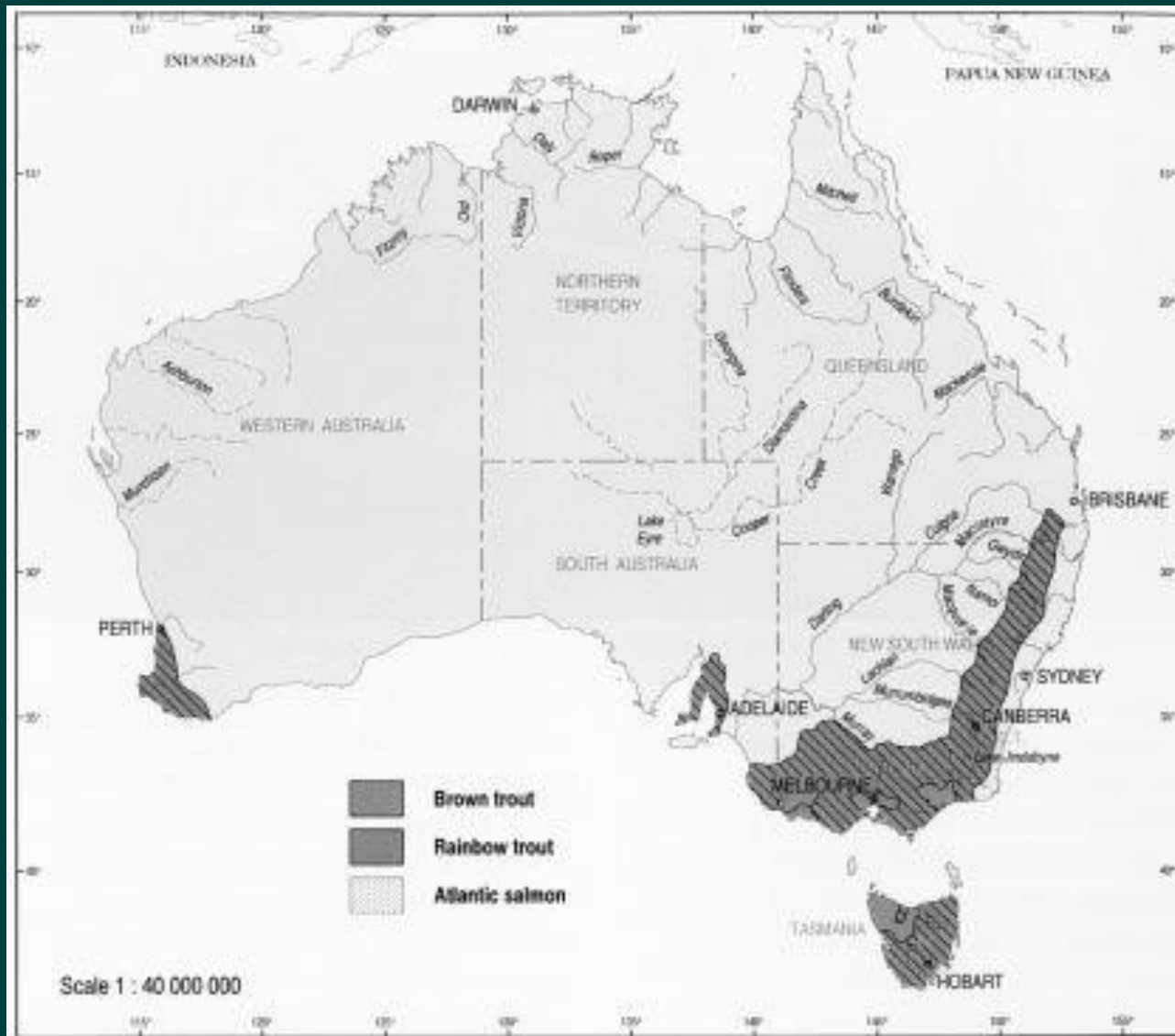
- Commercial fishing
- Recreational fishing
- Active netting/electrofishing
- Carp cages at fishways
- Daughterless carp
- Koi herpesvirus



# Eastern gambusia



# Brown trout

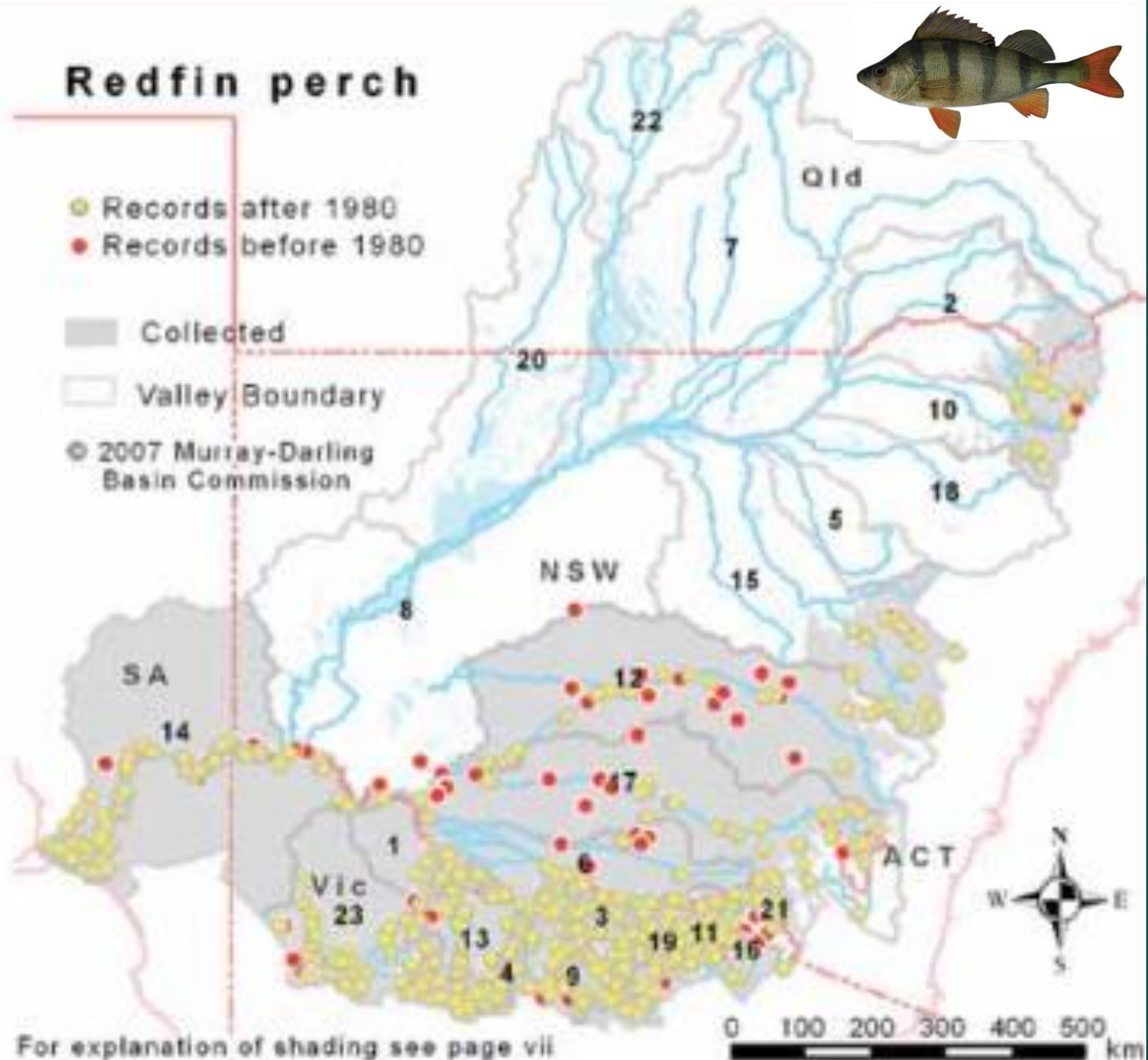


- | ID | VALLEY         |
|----|----------------|
| 1  | Avoca          |
| 2  | Border Rivers  |
| 3  | Broken         |
| 4  | Campaspe       |
| 5  | Castlereagh    |
| 6  | Central Murray |
| 7  | Condamine      |
| 8  | Darling        |
| 9  | Goulburn       |
| 10 | Gwydir         |
| 11 | Kiewa          |
| 12 | Lachlan        |
| 13 | Loddon         |
| 14 | Lower Murray   |
| 15 | Macquarie      |
| 16 | Mitta Mitta    |
| 17 | Murrumbidgee   |
| 18 | Namoi          |
| 19 | Ovens          |
| 20 | Paroo          |
| 21 | Upper Murray   |
| 22 | Warrego        |
| 23 | Wimmera        |



## Redfin perch

- Records after 1980
- Records before 1980
- Collected
- Valley Boundary
- © 2007 Murray-Darling Basin Commission

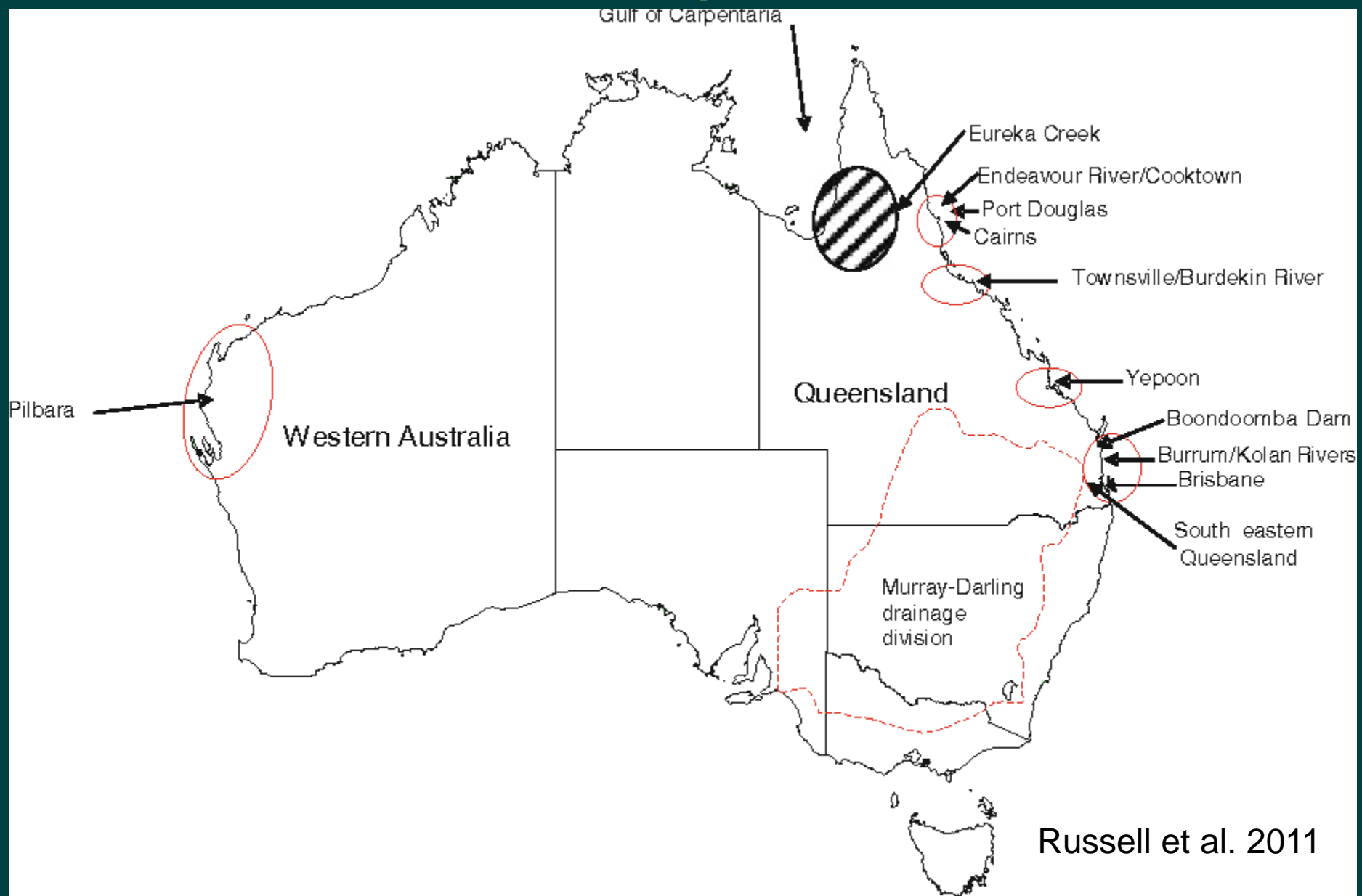


For explanation of shading see page vii

AUSTRALIA  
MDB

0 100 200 300 400 500 km

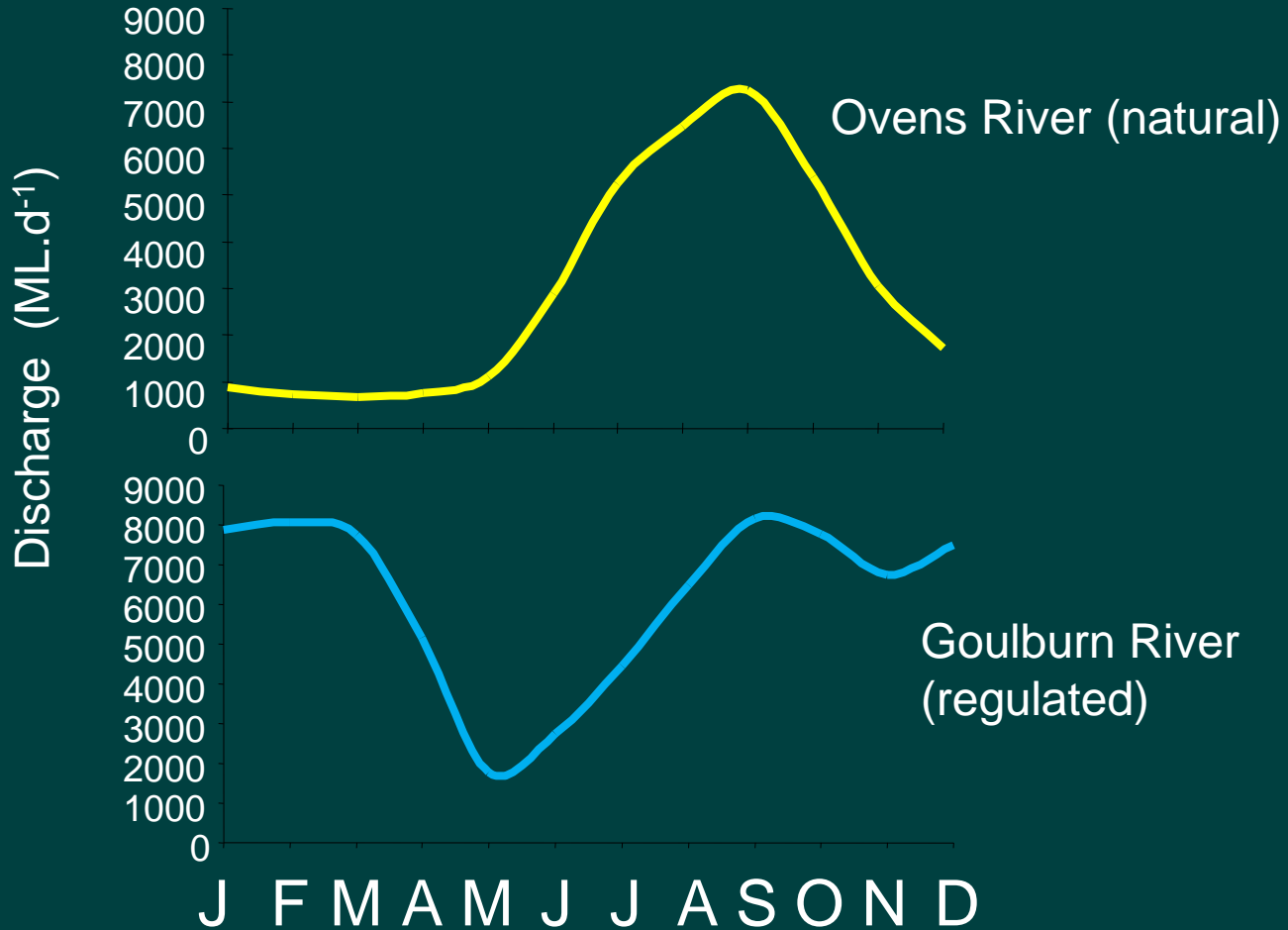
# Tilapia



# Algal blooms

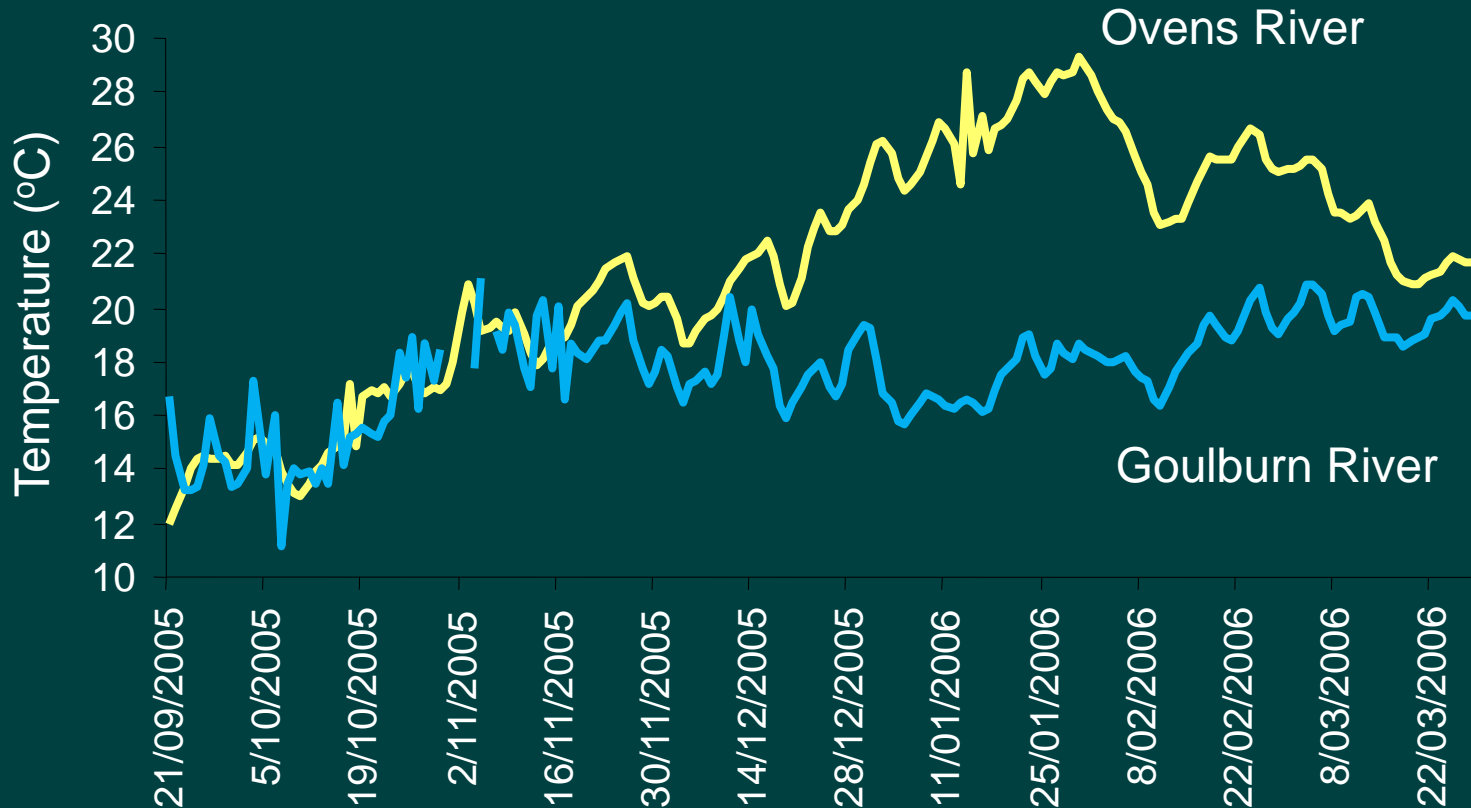


# Flow alteration





# Temperature depression



# Over-fishing



Murray cod:  
the biggest fish in the river





Thank you

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Rheophilia: [interviews in  
freshwater science](#)

[River Ecology Blog](#)