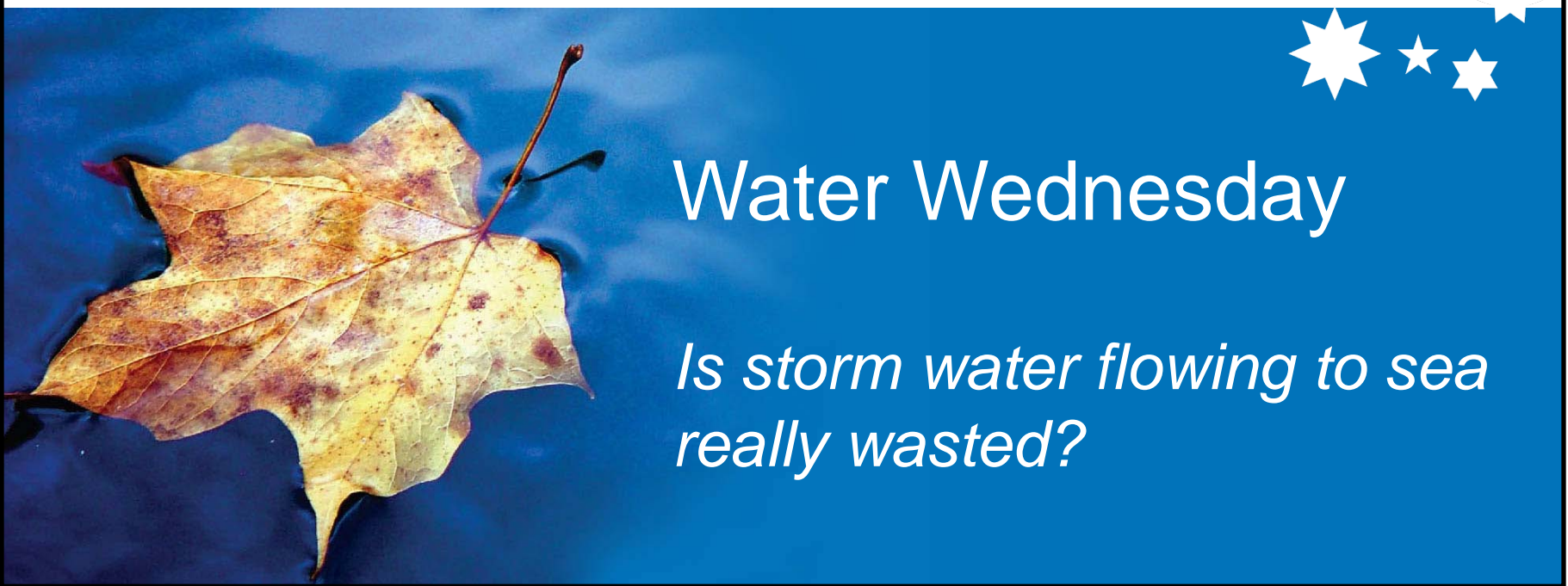


# The Environment Institute Water Research Centre



## Water Wednesday

*Is storm water flowing to sea  
really wasted?*

# Is storm water flowing to the sea really wasted?



## The environmental benefits of water flowing to the sea: A fish perspective

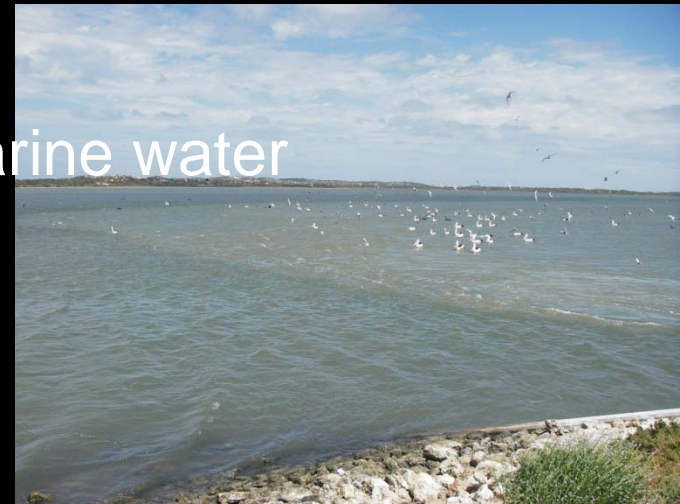
# The environmental benefits of water flowing to the sea: A fish perspective

- Freshwater flow to estuaries and the sea
- What does it do?
- Why is it important to fish?
- What species?
- The impacts of lack of flow
- What is happening locally and more broadly in SA
- The way forward



# What does freshwater do for the estuarine and coastal environment?

- Freshwater flow dictates the physical, chemical and biological nature of estuaries
- Forms a unique mixing zone with marine water
  - Gradient of salinity
  - Freshwater → brackish → marine
- Transport nutrients
  - Influencing primary and secondary productivity
- Provides hydraulic and biological connectivity between marine, estuarine and freshwater environments.



# Why is this important to fish?

- Salinity gradient (range of salinities) provides habitat diversity
  - Brackish salinities (below seawater levels) preferred by many estuarine dependent species
  - Drives habitat structure - aquatic vegetation
- Spawning cues
  - Several estuarine dependent spp spawn on inflows or at specific salinities
- Nutrient input = phytoplankton and zooplankton production
  - Fish food

# Why is this important to fish?

- Recruitment
  - Enhanced biological productivity
  - Better accessibility to nursery habitats
- Connectivity = free movement for migratory diadromous and estuarine species
- Freshwater signatures in coastal environment
  - Migratory/navigational cues



# What fish species are present in the region and benefit from freshwater inflows?

- Three divisions

1 - Species that may be benefited but are not dependent upon freshwater inflows (i.e. marine opportunists)



2 – Estuarine dependent species – rely on conditions provided by inflows for

- Spawning
- Recruitment
- Residence

Black bream



Mulloway



## Estuarine dependent species of the region

Mullet species



Goby species

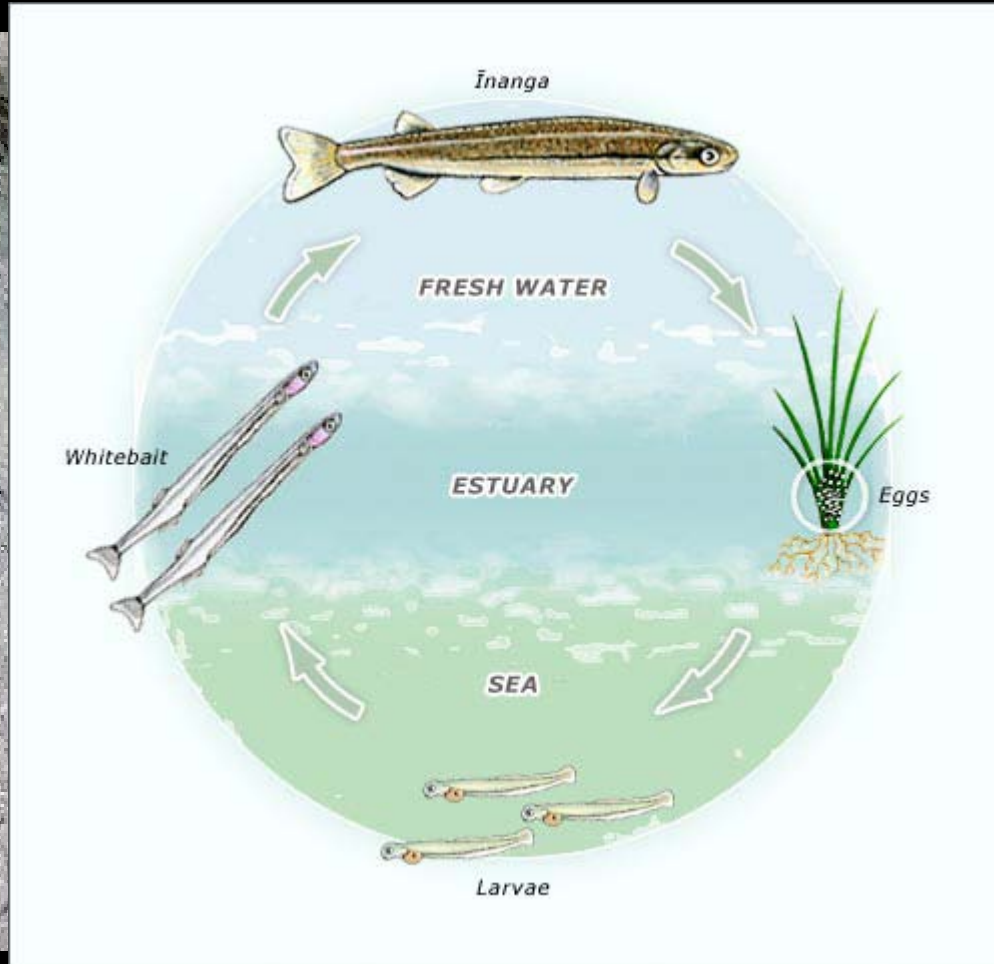
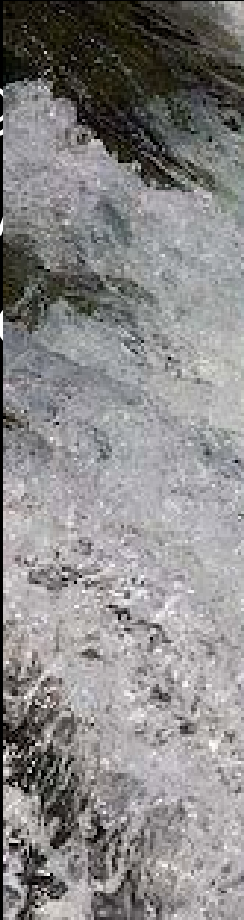


# What fish species are present in the Adelaide region and benefit from freshwater inflows?

- Three divisions
  - 1 - Species that may be benefited but are not dependent upon freshwater inflows (i.e. marine opportunists)
  - 2 – Estuarine dependent species – rely on conditions provided by inflows for
    - Spawning
    - Recruitment
    - Residence
  - 3 – Diadromous species – rely on connectivity and conditions provided by inflows for
    - Migration
    - Spawning
    - Recruitment

# What is a diadromous fish

- Mig



nts





Lamprey species



Short-finned eel

## Diadromous fishes of the Adelaide region



Common galaxias



Congolli



Climbing galaxias

Photo M. Hammer

# What is happening in catchments around Adelaide and more broadly in South Australia?

- Most coastal streams are heavily degraded
  - Urbanisation
    - Vegetation clearance
  - Regulation (human & agricultural use) – altered flow regimes
    - Decreased volume of water
    - Changed frequency and duration of flows (shorter duration)
    - Timing of flows different to natural timing
    - Increased rate of change in flows
  - Onkaparinga
    - Mt Bold, Clarendon and > 2,700 farm dams!!!!
    - Total discharge significantly diminished
    - Decreased frequency of low and high flow events (<25% natural)
    - Decreased mean duration
    - Summer low flow period most affected



# What is happening in catchments around Adelaide and more broadly in South Australia?

- Barriers to movement
  - Weirs, dams, culverts, etc
  - i.e. Breakout Creek Weir, City Weir (Torrens), Clarendon Dam wall (Onkaparinga)
  - Fishways
    - But they need flow.....



Photos J. Fredberg

# What is happening in catchments around Adelaide and more broadly in South Australia?

- Stormwater comprises a major component of freshwater flowing into our estuaries and coastal environment
- Almost, the only water
  - providing estuarine conditions
  - facilitating spawning and recruitment
  - facilitating fish movement



# Status of the fishes of WMLR

- Very little historic data
  - Reliance on anecdotal evidence
- Lamprey species formerly common now rare
- Short-finned eel and climbing galaxias rare
- Common galaxias and congolli reasonably common in most coastal streams
- Black bream and mulloway are reasonably common, particularly in the Onkaparinga
  - Likely much more abundant historically

# Freshwater deprivation: The fishy impacts

- Flow regime dictates patterns and processes in river systems – including estuaries
- Limited local information on impact of freshwater deprivation on estuaries
- Many examples of impacts of freshwater deprivation from estuaries worldwide
  - Particularly South Africa
  - Decrease in fish species diversity
  - Decrease in abundance of
    - Estuarine dependent species &
    - Diadromous species

# Local examples: The Lower Lakes and Coorong

- ‘Coorong fish movement and recruitment project’
  - Sampled fish assemblages below the Murray Barrages annually since 2006/07
  - Low-volume flows in 2006/2007
  - Zero flow in 2007/08, 2008/09 and 2009/10

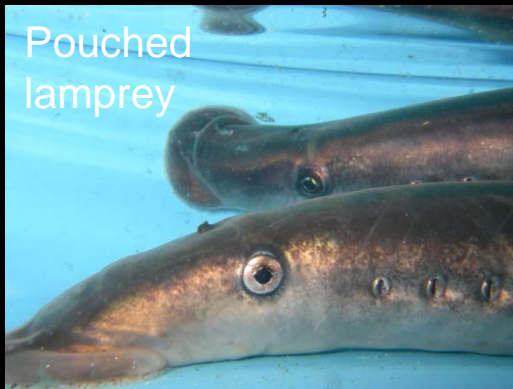


# The Lower Lakes and Coorong: 'with flow' vs 'no flow'

- Increased Coorong salinity (marine/hypermartine)
- Loss of connectivity
- Decrease in species richness
- Assemblage changed
  - With flow (2006/07): diverse, characterised by a range of freshwater, diadromous, estuarine and opportunistic marine species
  - No flow (2007-2010): characterised by tolerant estuarine and marine species
- Drastic declines in diadromous species

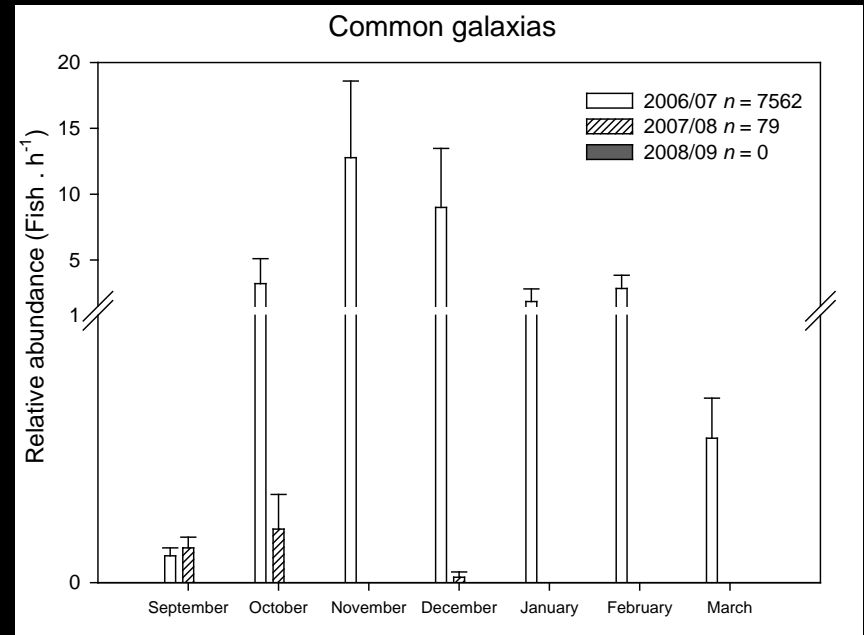
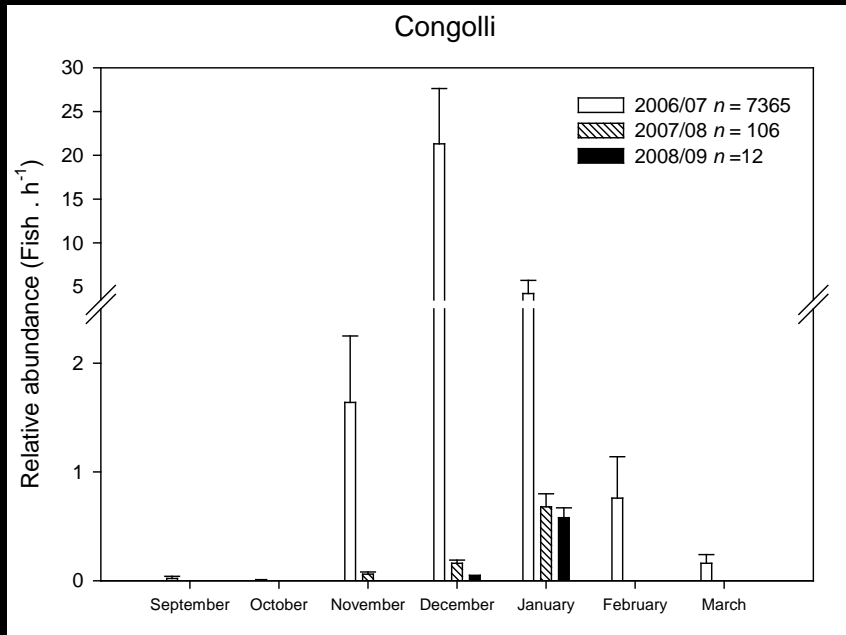
# The Lower Lakes and Coorong: 'with flow' vs 'no flow' – Diadromous species declines

- Absence of both lamprey species (short-headed and pouched) in no flow years



Photos M. Hammer

- > 90% declines in abundance of upstream migrating juvenile common galaxiids and congolli



Decline in abundance of congolli and common galaxias below  
Tauwichee barrage between 2006/07 and 2008/09

# How much water is needed and when?

- Very difficult to determine volume
- Estuaries are naturally highly variable
- Timing - diadromous fishes
  - Connectivity in winter for downstream spawning migrations
  - Extended flows and connectivity in spring/summer for upstream migration of,
    - juvenile congolli and common galaxias
    - adult lamprey
- But is there any issues with the water.....
  - Quantity vs quality

# Potential impacts of freshwater releases

- Urbanisation has increased,
  - Sediment and nutrient loads
  - Toxicant
    - Heavy metals
    - Herbicides
    - Petrochemicals



Photo M. Thiel

- Suggested stormwater runoff is partly responsible for seagrass loss on metropolitan coastline
- Increased sediment and nutrient loads result in increased turbidity
  - Limit light availability – impact photosynthesis

# A complex problem

- Riverine and stormwater inputs are largely seasonal
- Wastewater treatment plant outfalls – constant pressure
- River systems and their estuaries and associated biota require freshwater to flow to the sea

# Conclusion – water flowing to the sea is not wasted

- Estuarine dependent and diadromous species evolved with and are dependent upon estuarine/brackish conditions
- Stormwater is potentially facilitating ecological processes in the absence of natural flows
  - What happens if we harvest this water?
  - More water for the environment?
  - Broader management of river flow and stormwater discharge?
- Delicate balance between providing water for environmental needs and insuring poor quality water does not impact the marine environment

Thank you

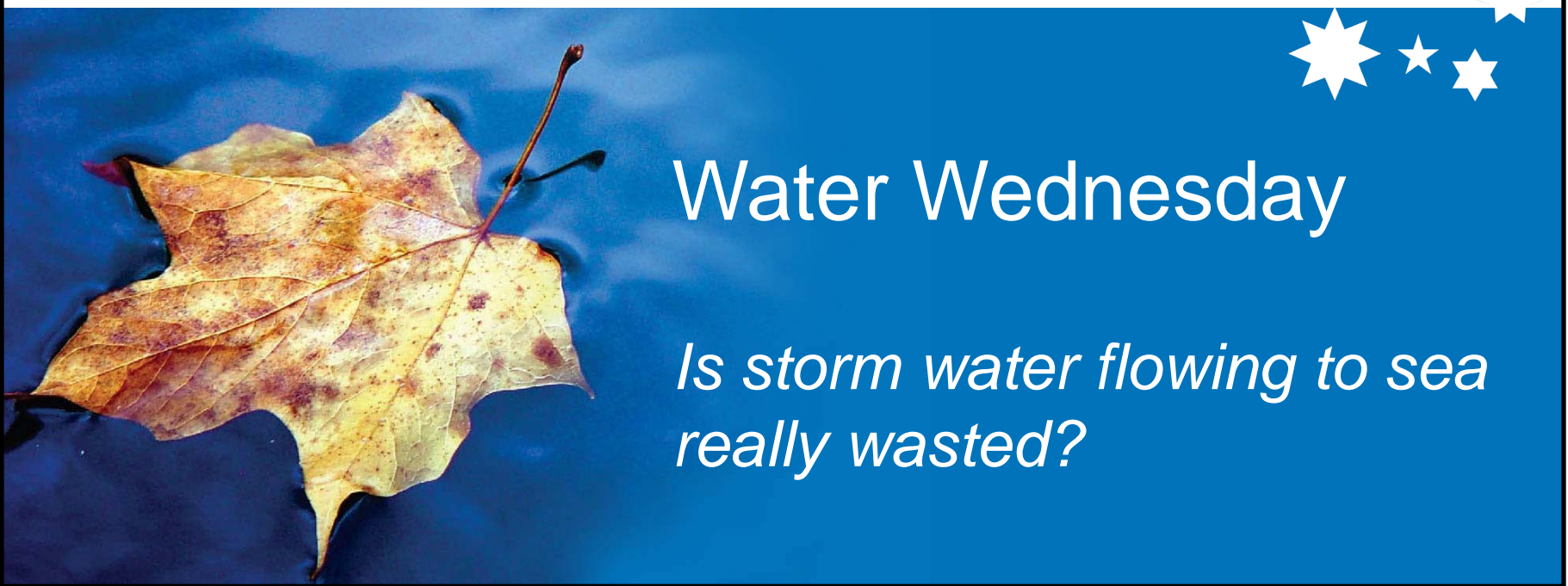


Government  
of South Australia

Chris Bice  
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